

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
TREE/SHRUB ESTABLISHMENT**

(Ac.)

CODE 612

DEFINITION

Establishing woody plants by planting seedlings or cuttings, direct seeding, or natural regeneration.

PURPOSE

This practice is used to establish woody plants for one or more of the following purpose(s):

- Forest products such as timber, pulpwood, and energy biomass.
- Wildlife habitat.
- Long term erosion control and improvement of water quality.
- Treating waste.
- Storing carbon in biomass.
- Reduced energy use.
- Develop renewable energy systems.
- Improving or restoring natural diversity.
- Enhancing aesthetics.

CONDITIONS WHERE PRACTICE APPLIES

Tree/shrub establishment applies on any appropriately prepared site where woody plants can be grown.

Utilize other practices for specialized tree/shrub establishment situations, e.g., Riparian Forest Buffer-391; Alley Cropping-311; Windbreak/Shelterbelt Establishment-380; Critical Area Planting-342; Hedgerow Planting-422.

CRITERIA

Use the following criteria in planning and applying this practice. The general criteria apply to all Tree/Shrub Establishment.

Additional criteria apply based on the intended purpose(s) of the practice.

General Criteria Applicable to All Purposes

Selecting Plant Species

Selected species or composition of species must be adapted to soil, site and climatic conditions. Refer to WOODLAND SUITABILITY – North Carolina (NC), Field Office Technical Guide (FOTG) Section II.

Selected species shall be suited for the planned purpose(s).

No plants on the federal or state noxious weeds list shall be planted.

See *Table 1: Conifer* and *Table 2: Hardwood* for a list of suggested species to plant in North Carolina.

Density and Spacing

Planting or seeding rates will be adequate to accomplish the planned purpose. See *Table 1: Conifer* and *Table 2: Hardwood* for recommended minimum and maximum spacing between plants. Use the table and formula below to convert planted spacing to a stocking rate (trees per acre).

Convert Plant Spacing to Stocking Rate

¹ Plant Spacing (L X R)	² Stocking Rate (trees per acre)
6 X 10	726
7 X 10	622
8 X 10	545
8 X 12	454
10 X 10	435
12 X 12	302

$$\begin{array}{l}
 \text{}^1 R = \text{row width (ft.)} \\
 \text{}^2 \text{Stocking Rate} = \frac{43560 \text{ ft}^2}{R \times L} \\
 \text{L} = \text{in-row distance} \\
 \text{between plants (ft.)}
 \end{array}$$

Site Preparation and Planting

A precondition for tree/shrub establishment is appropriate site preparation, which shall be sufficient for establishment and growth of

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

**NRCS, NC
December 2011**

selected species. Refer to FOREST SITE PREPARATION – NC Practice Standard 490.

See *Table 1* for planting information specific to conifers and *Table 2* for planting information specific to hardwoods.

Only viable, high-quality and adapted planting stock or seed will be used.

Planting dates, and care in handling/planting of seed, cuttings or seedlings will ensure that planted materials have an acceptable rate of survival. Seedlings, when used, will be properly protected and stored from the nursery until planting.

Planting technique and timing will be appropriate for the site and soil conditions.

Protect planting from unacceptable adverse impacts from plant and animal pests, and fire. If pesticides are used evaluate pest control risks and possible mitigation strategies.

Time to Plant - Plant bare root seedlings during the dormant season. (The planting season can be extended 2 to 4 weeks by properly handling and keeping dormant seedling in cold storage). Containerized plants may be planted over wider time window. Avoid planting when the ground is frozen, excessively wet and sticky, or excessively dry.

Planting Methods – Seedlings may be planted by hand or with a machine transplanter.

Machine transplanters can be used where site conditions (logging debris, steep slopes, wetness, etc.) do not prohibit operation.

Machine prepared slits or furrows should be free of plant stems, leaves or other litter.

Hand planting with bars, dibbles and mattocks is effective on most soils. Hand planting equipment must be able to prepare a hole with adequate depth for the stock being planted. Mattocks are usually required on steep or eroded areas. Shovels are generally used to plant large containerized plants. Rocky conditions or heavy soils may require a special heavy duty bar (ex. KBC planting bar).

Other General Criteria

For Natural Regeneration - Adequate seed or advanced reproduction need to be present, or provided for, when using natural regeneration to establish a stand. Natural Regeneration from seed applies to light-seeded intolerant

species with wind disseminated seed. Example species include native pines, cottonwood, and yellow poplar. Refer to FOREST STAND IMPROVEMENT – NC Practice Standard 666 for information on managing an existing stand for natural regeneration. Heavy-seeded, tolerant hardwoods can reproduce satisfactorily from coppice (existing root stock/stumps). Example species include oak and hickory. The acceptability and timing of coppice regeneration shall be based on species, age, and diameter.

For Interplanting young stands – Interplanting is usually done by hand with dibbles, mattocks or spades. Interplanting should be done within the first year following failure of the original planting. The objective of interplanting young stands is to attain at least the minimum desired average stocking (spacing) of the species planted. Release of interplanted trees may be required, generally in the spring after planting (see FOREST STAND IMPROVEMENT – NC Practice Standard 666).

For Planting Patches or Openings – Openings within established stands of trees should only be planted if they are large enough to permit direct sunlight to reach the ground for several hours every day. Minimum opening width or diameter should be at least twice the height of surrounding trees.

For Direct Seeding – Seed should be ordered from a reliable commercial seed dealer. A local adapted seed source is crucial. Lots should contain no more than: 10% empties (by number), 10% moisture (by weight), and 2% impurities (by weight). For broadcast seeding, the site must be prepared sufficiently to insure direct soil-seed contact. Hand or machine planting should prepare an 8-12 inch spot or width where the seeds are planted. Do not direct seed steep eroded slopes or deep sandy soils unless the seed can be covered with ½ inch of soil --- a very time consuming operation. Release of direct seeded plants may be required after seeds have sprouted. Seed Treatment including stratification and repellent coating are essential for all pines except longleaf. Stratification hastens germination. Coatings include chemicals to repel birds and rodents; and, a lubricant to help seed flow through a seeding machine.

Timing of planting seeds should generally be about the time of the last killing frost.

November or February are the preferred seeding times for longleaf pines.

Planting rates for broadcast seeding should be 10,000 to 15,000 seed per acre. For hand planting use the planned spacing for the selected species and drop six seeds on exposed soil in a prepared one foot square area.

Each site will be evaluated to determine if mulching, supplemental water or other cultural treatments will be needed to assure adequate survival and growth.

Comply with applicable federal, state, and local laws and regulations during the installation, operation and maintenance of this practice.

Note: Specific pesticide recommendations will be obtained from personnel who are licensed by the NC Department of Agriculture and Consumer Services in specialty area Agricultural Pest Plant Category G (forest) or - O (agricultural, plant) in accordance with North Carolina Pesticide Laws and Regulations. All pesticides must be registered for use by North Carolina and approved for use by the U. S. Environmental Protection Agency (EPA). Refer to the current issue of "North Carolina Agricultural Chemicals Manual" for guidelines, rules and regulations regarding use of pesticides. Users must **always** follow instructions and safety precautions on the container label when handling, applying, or storing pesticides.

Additional Criteria for Forest Products such as Timber, Pulpwood, etc.

For Timber/Pulpwood – Select a variety and spacing based on projected markets and rotation period that meets landowner requirements. Input from a professional forester is recommended.

For Energy Biomass – Select a variety that grows quickly (short rotation for biomass), has a locally available market, and is easily chipped, chopped or pelletized to burn as fuel. Consult a professional for variety selection and planting recommendations. See Additional Criteria for Developing Renewable Energy Systems.

For Christmas Trees – Christmas tree production requires land of suitable quality and adequate area. The table below summarizes some species that can be grown for Christmas trees in North Carolina.

Trees for Christmas Tree Production

Species	NC Region		
	Coastal Plain	Piedmont	Mountains
Red Cedar	x ¹	x ¹	
Virginia Pine	x	x	x ²
Eastern White Pine	x	x	X
Leyland Cypress	x	x	
Fraser Fir			X

¹ Local Sales ² Not generally used in commercial operations

Red cedar has been a traditional natural Christmas tree in NC – (prickly foliage, poor form and color).

Virginia Pine is being genetically improved for better Christmas tree characteristics – (rapid growth, 4-6 yr. rotations possible).

Eastern White Pine is susceptible to root diseases, so avoid piedmont soils where plastic clay is within 1 foot of the surface – (7-10 years required to grow a 7-8 foot merchantable tree from a 2 yr. old seedling)

Leyland Cypress is a relatively new variety used for Christmas tree production – (potential bag worm problems, fast growing, 5-7 year rotations possible)

Fraser Fir sells for the highest price of any Christmas tree grown in NC – (7-12 years to grow a 7-8 foot tree from a 4-5 yr. old transplant)

For Nuts and Berries – Select an appropriate nut or berry producing variety for site conditions. Consult a professional horticulturalist for variety selection and planting recommendations.

For Pine Straw (mulch) – Where adapted, longleaf pine is the species of choice for pine straw production in North Carolina. Loblolly pine is a secondary choice.

For Mulch (chips) - Select a variety that grows quickly, has a locally available market, and is easily chipped or chopped. Consult a professional for variety selection and planting recommendations.

Additional Criteria for Wildlife Habitat

Tree/shrub selection and stocking (spacing) shall benefit targeted wildlife species. Consult a professional biologist for woody plant selection and planting recommendations for specific wildlife species management.

General Guidelines For Wildlife that Require Grasses or Early Successional Vegetation - plant trees at lower stocking levels (wider spacing) to allow for more grass, weed, forb and brush habitat.

General Guidelines For Small Game and Non-Game Species – establish hardwood and mixed pine-hardwood trees, especially in riparian areas. This habitat type is known to be important for many neo-tropical migratory birds.

Additional Criteria for Long Term Erosion Control and Improvement of Water Quality

Long term erosion control and/or improved water quality is a general consequence for most tree/shrub planting. Where erosion control and improved water quality is a primary purpose be sure to select a tree/shrub species (or mixture) that has a high growth rate and is adapted to the soil/site conditions.

Additional Criteria for Treating Waste

Treatment of wastes with trees/shrubs is very site specific and requires high levels of management. Species used to treat waste should exhibit fast growth characteristics, have extensive root systems capable of high nutrient uptake, and produce wood/fiber products in short rotations. Treating waste with trees is

often done as part of a CONSTRUCTED WETLAND – NC Practice Standard 656.

A professional consultant is recommended to advise and evaluate the whole waste treatment system. State and local government regulatory agency approval may be required.

Additional Criteria for Storing Carbon Storage in Biomass

For optimal carbon sequestration, select plants (or mixtures of plants) that have a high growth rate and are adapted to the site. Plant the appropriate FULL stocking rate and manage for fast growth. Some plants may fix carbon in biomass and soils more efficiently than others. Consult a professional for current research on adapted plants that sequester carbon more efficiently.

Carbon sequestration benefits increase when trees are managed for durable, lumber products over a longer rotation. Calculate predicted carbon sequestration rates using current, approved carbon sequestration modeling technology.

Additional Criteria to Reduce Energy Use

To conserve energy, plant and orient trees strategically provide shade to a building or structure and reduce solar heat gain during the summer. The first priority is placement on the building's west side where the greatest daily heat gain occurs. Second priority is the building's east side. Deciduous trees are usually used for this purpose.

Select plants with a potential height that will be taller than the structure/facility protected.

Use plant densities that optimize shade and meet energy reduction needs.

Trees planted within 30-50 feet of a building generally provide effective shade to windows and walls depending on tree height.

Keep trees at least 10 feet or further from structures depending on mature crown spread, to avoid damage to foundations and restricted maintenance access to walls and windows.

Additional Criteria for Developing Renewable Energy Systems

Select plants that can provide adequate kinds and amounts of plant biomass to supply identified bioenergy needs.

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

The harvesting of energy biomass shall be accomplished in a manner that will not compromise the other intended purpose(s) and functions.

Additional Criteria for Improving or Restoring Natural Diversity

Composition of species selected for planting or favored for natural regeneration will be indigenous or native to the site and create a successional stage or state that can progress to the desired natural community. Consult a professional biologist for variety selection and planting recommendations.

Longleaf pine – Longleaf pine habitat is considered an ‘endangered ecosystem’ in the Southeast United States. Suitable sites that occur within the former longleaf pine community range are candidates for longleaf restoration.

Wetland and Bottomland Hardwood - Tree/shrub establishment is an important component of wetland and bottomland hardwood restoration. On-site evaluation and site specific recommendations are required to restore these ecosystems. Consult a professional biologist or forester.

Additional Criteria for Enhancing Aesthetics

Select species with features such as showy flowers, brilliant fall foliage, persistent colorful fruits or noteworthy growth forms and shapes (see table below for a partial listing of North Carolina trees). Use these species along edges, along access roads, and/or walkways to create an elegant and appropriate appearance. Aesthetic considerations for tree/shrub planting are often secondary to other criteria.

NC Species with Aesthetic Features (partial list)

Species	Flowering	Foliage
Black gum		X
Dogwood	X	
Holly		X
Live Oak		X
Magnolia	X	X
Red Maple		X
Redbud	X	
Red cedar		X
Sassafras		X
Sourwood	X	X
Sweet gum		X
Wild Plum	X	
Yellow Poplar		X

Table 1: CONIFERS – Recommended Species and Spacing

Species & Spacing *	Coastal Plain	Sandhills	Lower Piedmont	Upper Piedmont	Mountains
Atlantic White Cedar ¹¹ minimum/Ac. 12'x12' maximum/Ac. 8'x10'	X				
Loblolly Pine ¹ minimum/Ac. 12'x12' maximum/Ac. 7'x10'	X	X	X	X	X ²
Longleaf Pine ^{3,10} minimum/Ac. 12'x12' maximum/Ac. 6'x10'	X	X	X		
Shortleaf Pine ⁴ minimum/Ac. 12'x12' maximum/Ac. 6'x10'			X	X	X ⁵
Virginia Pine (improved) ^{6,9} minimum/Ac. 10'x 10' maximum/Ac. 6'x10'				X	X ⁷
Eastern Redcedar 5'x10'	X	X	X	X	
Eastern White Pine minimum/Ac. 12'x12' maximum/Ac. 7'x10'				X	X
Fraser Fir ⁹ 5'x5'					X ⁸
<p>* Other conifer species may be used if reviewed and approved by NRCS-NC-ECS staff or professional biologist/forester. * Minimum/maximum spacing in this table are recommendations for commercial timber production; spacing can be varied to meet landowner objectives, level of management and potential for commercial thinning. Spacing for environmental, restoration, aesthetics or wildlife can generally be wider (fewer plants per acre) than the indicated minimum.</p>					
<p>¹ Not recommended on sands over 30" in depth. ² Cherokee, Clay, and Macon only up to 1,500 elevation. ³ Best species for sands over 30" in depth and within former longleaf pine community range. ⁴ Do not plant on severely eroded soil. Adapted to dry, infertile soils. ⁵ Recommended up to 2,500 ft. elevation. ⁶ Adapted to severely eroded soil. For erosion control. ⁷ Recommended to 2,500 ft. elevation. ⁸ Above 2,000 ft. elevation. ⁹ For Christmas tree production. ¹⁰ Containerized stock advocated over bare-root. ¹¹ Generally planted for environmental purposes and timber production secondarily X = recommended</p>					
<p>Planting Conifer Seedlings</p> <p><u>Seedling Quality</u> – Seedlings should exhibit the following characteristics: disease-free; root collar diameter no less than one-eighth inch; stiff and woody, with secondary needles present; maximum top length 14 inches; and, root system not less than five inches nor more than 9 inches long.</p> <p><u>Care of Seedlings</u> - Successful plantations depend on the care of planting stock. Every effort should be made to keep seedlings in good condition. Planting stock can generally be better kept in better in bales/bags/boxes - as it comes from the nursery - than in field heel-in beds. This is particularly true where the stock will be planted within two to three weeks. Seedling roots must be kept moist at all times. Seedlings (especially the roots) should not be exposed to the sun, wind, heating, drying, or freezing at any time from lifting at the nursery plantbeds until planted. Roots should not be exposed to sun or wind for more than 10 minutes. If cold storage is not available, keep seedlings packed in bales after delivery. They should not be stored in bales longer than 2 weeks.</p> <p>The following additional precautions should be taken in storing bales/bags/boxes:</p> <ul style="list-style-type: none"> • Keep in a cool place. Avoid heated rooms. • Protect bales/bags from freezing. • Water at least once each week to keep roots and packing moss moist. • Stack bales/bags on sloping racks to insure air circulation, easy watering, and drainage of excess water. <p>Stock must be kept cool (34 - 38 degrees F) and protected from "heating". Stock which is well watered, protected from direct sunlight, and properly aerated usually will not heat. Seedlings subjected to heating should be discarded and not planted. The sooner seedlings are planted after being lifted from nursery beds, the better the chances for survival and normal growth. Loose seedlings should be "heeled in" immediately upon arrival. Steps to follow are</p> <ul style="list-style-type: none"> • Select a well-drained and slightly sloping spot with some shade. • Dig the trench 2 to 4 inches deeper than the seedlings' roots are long. One side of the trench should be smooth and slightly sloping. 					

Table 1: CONIFERS – continued

Table 2: Hardwoods – Major Species by Region and Soil Characteristics

Species ¹	Plant Spacing ²	Coastal Plain Soil Characteristics				
		Well drained Deep, Rich (River Terrace)	Heavy, Somewhat Wet Soils (Mineral Soils)	Very Poorly Drained Permanently Wet Soils w/ Clay Base- Muck or Peat	Deep Sands	Shallow, Sandy Loamy Soils Over Clay Base (> 6" Topsoil)
Cottonwood	12' x 12'	X				
Cottonwood cuttings are easily and quickly planted using a pointed steel rod, approximately 3/4" in diameter and 36"-42" long. The rod is used to create a hole in the soil at least 12" deep. A cottonwood cutting 20" or longer is placed in the hole, leaving 4-5" of cutting above ground. Soil is then firmed around the cutting. Cottonwood cuttings of lengths up to 40" may be planted.						
Green Ash	12' x 12'	X	X			X
Red Maple	12' x 12'		X	X		
Red Oaks (Cherrybark)	12' x 12'	X	X			
Swamp Chestnut Oak	12' x 12'	X	X			
Sweetgum	12' x 12'	X	X			X
Sycamore	12' x 12'	X				X
Tupelo Gum	12' x 12'		X	X		
Water-Willow Oak	12' x 12'	X	X			X
Yellow Poplar	12' x 12'	X	X			
		Piedmont Soil Characteristics				
Species ¹	Plant Spacing ²	Loamy, Clayey, Red, Droughty (Eroded)	Upland Slopes & Ridges; Deep, Loamy Soil (Little Erosion)	Small Stream Bottom (Variable)	Major River Bottoms (River Terraces)	
Green Ash	12' x 12'			X	X	
Red Oaks	12' x 12'		X		X	
Sweetgum	12' x 12'		X	X	X	
Sycamore	12' x 12'		X	X	X	
Water-Willow Oak	12' x 12'			X	X	
White Ash	12' x 12'			X	X	
Yellow Poplar	12' x 12'		X	X		

Table 1: HARDWOODS – continued

		High Piedmont & Lower Mountains Soil Characteristics			
Species ¹	Plant Spacing ²	Upland Ridges Rocky, Eroded (Less than 3" Topsoil)	Upland Ridges, Deep Soil (less than 50 % Rocks)	Coves, Valleys	High Plateau
Black Walnut	20 'x 20'			X	
Cherry	12' x 12'		X	X	
Northern Red Oak	12' x 12'		X	X	
White Ash	12' x 12'			X	
Yellow Poplar	12' x 12'		X	X	

¹ Selected hardwood species must be adapted to the site and seedlings must be of correct geographic source. Other species may be used if reviewed and approved by NRCS-NC-ECS staff or professional biologist or forester.

² On productive sites with good expected survival 12'x12' spacing can be increased to 12'x15' or even 15'x15' for commercial timber production. Spacing for environmental, restoration, aesthetics or wildlife will generally be wider (fewer plants per acre) than 12'x12'. Where tree tubes and/or weed mats are used at planting, plant spacing may be reduced to 100-200 trees per acre.

Planting Hardwood Seedlings

As a general guide, a site should have a pine site index of 90 feet or more at 50 years if hardwood plantations are to be considered as a satisfactory crop. Don't plant sites that have been damaged (erosion, compaction, rutting) by site preparation or logging.

Newly planted seedlings need to grow without severe competition. This requires intensive site preparation and proper aftercare to control competing vegetation. Plantings must be carefully protected - hardwoods are killed or injured by light fires; they can be destroyed by grazing cattle and deer; and, they are sensitive to herbicides

Seedling Quality – Seedlings must be large (at least 3/8" root collar diameter) and healthy. Cull and discard small or weak seedlings.

Care of Seedlings - Care of hardwood seedlings is similar to care of conifer seedlings.

Planting – Planting hardwood seedlings is similar to planting conifer seedlings. Some hardwood seedlings are larger, requiring a deeper hole or trench and more care to keep roots straight down.

CONSIDERATIONS

Use locally adapted seed, seedlings or cuttings. Priority will be given to plant materials that have been selected and tested in tree/shrub improvement programs. All plant materials should comply with a minimum standard, such as the American Nursery and Landscape Association, Forest Service, or state-approved nursery.

Plant community restoration requires extensive planning and management to approximate native conditions. Have realistic expectations, and be prepared to apply management/ improvement activities over an extended period of time.

Some cost share programs will only reimburse costs for planting up to a set stocking level or density.

For pines, planting fewer than 300 trees per acre can create limby trees that may require pruning to grow clean, clear wood. Refer to TREE SHRUB PRUNING – NC Practice Standard 660.

Plans for landscape and beautification plantings should consider foliage color, season and color of flowering, and mature plant height.

Internal emotional feelings involved with passing something of intrinsic value--a legacy--to the next generation can be an important motivator for tree planting.

Consider using diverse species combinations which best meet local wildlife and pollinator needs.

Tree/shrub arrangement and spacing should allow for and anticipate the need for future access lanes for purposes of stand management.

Natural regeneration from seed generally increases genetic diversity while sprouting (asexual reproduction) perpetuates existing genotypes.

When underplanting, trees should be planted sufficiently in advance of overstory removal to ensure full establishment.

Residual chemical carryover should be evaluated prior to planting

Consider weed barrier/moisture conservation fabric (at least 4 feet wide) and/or tree tubes where needed to improve establishment success of plant materials and help reduce rodent damage. Where tree tubes and/or weed mats are used, plant stocking rates can be reduced to 150-200 plants per acre depending on landowner objectives and planned level of management.

Soil tests may be needed on sites with expected phosphorus deficiency (such as poorly drained savannas-flatwoods-organics of the NC Coastal Plain). Fertilize as part of site preparation to improve phosphorus levels where soil tests indicate. Soil testing should be considered where significant capital outlays for the customer are involved.

Consider invasive potential when selecting plant species.

Considerations for Insects and Disease

- a. Pales weevil is the most serious insect pest for pine seedlings on recently cutover pine lands. In susceptible areas, purchase treated seedlings if available. Another preventive measure is to delay planting for one season following harvest cutting. Pales weevil population is directly proportional to volume of slash and stumps (more slash and stumps = more pales weevil).
- b. Fusiform rust is the most important disease of loblolly pines. In locations where the incidence of fusiform rust is high, consider planting rust resistant stock or species less susceptible to rust (longleaf, shortleaf, and white pine.)
- c. Brown spot on planted longleaf pine may be controlled or prevented by prescribed burning. Application of this practice will ensure better survival and increase early height growth at a reasonable cost. Refer to PRESCRIBED BURNING – Practice Standard 338.

This practice has the potential to affect National Register listed, or eligible, significant cultural resources (CULTURAL

RESOURCES INFORMATION - NC, FOTG Section II). Follow NRCS state policy for considering cultural resources during planning.

PLANS AND SPECIFICATIONS

Specifications for applying this practice and protection of the site shall be prepared and recorded using approved specification sheets, job sheets, technical notes, narrative statements in the conservation plan (including references to plans prepared by other agencies or consultants), or other acceptable documentation.

Plans and specifications for complex situations involving multiple planting methods and species for varied site conditions should be well documented. Separate specifications can be prepared for each planting method, species, site, etc.

Minimum documentation will include:

- map showing fields or areas where tree/planting will be done; additionally in forest land the map should delineate:
 - streams and water bodies
 - required filter strips/SMZ's
 - additional sensitive areas such as critical areas or cultural resources that need to be considered during site preparation activities
- plant material or species to be planted
- plant spacing and arrangement
- site preparation and planting method(s); and, equipment to be used
- site specific needs for soil amendments, cultural, pest management or other practices
- tree planting or forest management plan prepared by a registered forester when available.
- statement requiring compliance with all federal, state and local laws.
- required operation and maintenance instructions

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance).

- Planting Follow-Up - Seedling stocking can be determined a year after planting by taking 1/100 (radius of 11.75 ft.) acre randomly sampled plots. Sufficient plots are needed to get a good representation of the planted area. In general, 300 or more established seedlings is considered adequate. Hardwoods are harder to evaluate in the 1st year after planting. Additional time may be needed to fully evaluate hardwood survival.
- Replanting will be required when survival is inadequate. Generally, replacement or interplanting should be done within 2 years after the original planting.
- If needed, competing vegetation will be controlled until the woody plants are established. Noxious weeds will be controlled. Planted seedlings or cuttings should be released from any overtopping vegetation not later than 2 years after planting. Refer to FOREST STAND IMPROVEMENT – NC Practice Standard 666. Use extreme care if foliar spray herbicides are used on hardwood plantings.
- Inspect trees and shrubs periodically and protect from adverse impacts including insects, diseases, competing vegetation, fire (see FIREBREAK – NC Practice Standard 394) and damage from livestock or wildlife. Pine plantings should be protected from grazing until trees are at least 8-10 feet tall. Domestic livestock should be excluded from all hardwood and Christmas tree plantings.
- Access by vehicles or equipment during or after tree/shrub establishment shall be controlled to protect young plants and

minimize erosion, compaction and rutting. Refer to ACCESS CONTROL – NC Practice Standard 472, if vehicular or equipment traffic is a potential problem.

- Supplemental water will be provided as needed where possible and feasible.
- Periodic applications of nutrients may be needed to maintain plant vigor.
- After trees or shrubs are established, refer to FOREST STAND IMPROVEMENT – NC Practice Standard 666, and TREE/SHRUB PRUNING – NC Practice Standard 660 for subsequent management.

REFERENCES

McPherson, E. Gregory; Simpson, James R.; Perper, Paula J.; Maco, Scott E.; Gardner, Shelley L.; Cozad, Shauna K.; Xiao, Qingfu 2006. Midwest community tree guide: benefits, costs, and strategic planting. USDA Forest Service General Technical Report PSW-GTR-199, p. 1-99.

North Carolina Division of Forest Resources, 1998. Resources. Pocket Guide to Seedling Care and Planting Standards.

Noss, et al, "Endangered Ecosystems of the United States", 1995, USGS – Biological Resources

Sandhills Area Land Trust of Southern Pines, 1997. A Working Forest: A Landowner's Guide for Growing Longleaf Pine in the Carolina Sandhills.

Talbert, Cheryl 2008. Achieving Establishment Success the First Time. Tree Planters Notes, Vol. 52 No. 2 pages 31-3

Zobel, B. J. and C. B. Davey, "A Simplified Guide to Hardwood Management in the Southeast", College of Forest Resources, North Carolina State University, Raleigh, NC