

**NATURAL RESOURCES CONSERVATION SERVICE**  
**CONSERVATION PRACTICE GENERAL SPECIFICATION**  
**FOREST STAND IMPROVEMENT**

(Ac.)

**CODE 666**

## **GENERAL SPECIFICATIONS**

Procedures, technical detail, and other information listed below provide additional guidance for carrying out selected components of the named practice. This material is referenced from the conservation practice standard for the named practice and supplements the requirements and considerations listed therein.

## **PRECOMMERCIAL THINNINGS**

Precommercial thinning is often performed on young over-crowded timber stands to ensure an optimum growth rate in the residual stand by manipulating the stocking rate before the trees reach merchantability.

Precommercial thinning may be needed in dense, natural pine stands and in plantations where the number of planted trees has been supplemented with natural regeneration from surrounding stands. Precommercial thinning is justified if the stand contains 1,500 or more pine seedlings per acre. The stocking rate should be reduced to 450-700 stems per acre.

This type of thinning will be performed when the natural seedlings are well established but before they reach 3-4 inches in diameter at breast height. The most effective results are achieved between ages two and five years. Delaying precommercial thinning can sharply reduce growth and increase future thinning costs.

In precommercial thinnings, trees to be cut are not marketable. Therefore, it is not necessary or cost effective to remove the cut or deadened trees from the site. Leaving them in the stand will contribute to nutrient recycling, buildup of soil, and provide cover and perching sites for wildlife. The construction and maintenance of firebreaks is strongly recommended, however, due to high fuel levels and wildfire potential following the thinning. Refer to the Oklahoma NRCS Firebreak (394) standard for guidance.

Precommercial thinning methods include:

- Mechanical release
- Chemical release
- Prescribed burning

### **Mechanical Release**

Pine trees may be removed mechanically by use of a rotary mower, bulldozer, skid steer with cutter, disk, roller chopper or by use of hand tools such as machete, axe, brush hook or chain saw. Equipment used will depend upon the size of the trees, the size of the area to be treated, site conditions, and the economic limitations of the landowner.

Strips of trees 6 to 10 feet wide will be removed from the stand to leave strips of young trees 1 to 3

feet wide as growing stock. These strips may then be cross-thinned in a checkerboard pattern to further reduce the number of trees per acre when the original stocking is extremely high. The residual clumps of trees will be 1 to 3 feet square in area. The clumps can be thinned with hand tools so that one dominant tree per clump remains. The residual stocking will be 450 to 700 trees per acre for pine.

Precommercial thinning will be done from mid-October through March when soil moisture conditions permit use of the selected equipment. This timing will reduce the danger of insects and disease.

Repeat treatments may be necessary in shortleaf pine stands due to the sprouting potential.

Mechanical precommercial thinning in hardwood stands shall be accompanied with herbicide use. Mechanical removal of unwanted hardwood trees alone will cause sprouting instead of death of the trees and will result in a thicker stand after treatment.

### **Chemical Release**

Chemical herbicides may be applied to a forest stand to remove undesirable trees. The advantages of using chemical methods of release are that chemicals control vegetation with little soil disturbance; they can be used on steeply sloping land where equipment limitations are severe; they may be applied over large acreages quickly; landowners with small tracts can treat their property themselves; selectivity of the chemicals allows targeting specific types of problem vegetation; and chemical treatments may be used when mechanical methods are impractical or are not cost-effective.

Guidance for selection of the proper herbicide, rates, and timing of the application will be obtained from recommendations by the Oklahoma Cooperative Extension Service. Landowners will be advised to read and follow the product label directions carefully to avoid unsafe use of the chemical. Be aware of leaching, runoff potential, setback requirements, persistence, and toxicity ratings.

Timing of the chemical application is often critical. There are differences in the susceptibility of the various target species to different herbicides which influence the proper timing of application. Most hardwood species are least susceptible to chemical action during sap flow (bud swell to full leaf expansion) in the early summer, therefore should be treated at other times, as dictated by the herbicide label.

Chemical herbicides can be applied by various methods including:

- Stem injection
- Frill
- Girdling
- Basal spray
- Stump cut
- Foliar spraying
- Soil application

(Refer to the Oklahoma NRCS Brush Management (314) standard for additional guidance)

**Stem Injection.** Herbicide injection can be used to select individual medium-to-large size trees for treatment. Tree Injectors or Hypo-Hatchets are used to inject the appropriate dosage of herbicide through cuts in the bark of the tree. Calibrate the injection device according to herbicide label dosage instructions. Make injections at intervals dictated by the herbicide label, completely around the tree. Injections should be done during the active growing season, after sap flow. Refer to herbicide label for application recommendations.

Difficult to control species such as hickory and dogwood may need a continuous cut rather than spaced cuts.

**Frill.** Use a hand axe, hatchet, machete, or similar device to make a series of single overlapping hacks (frills) or cuts, at a downward angle, completely around the tree stem as close to the ground as feasible. Cuts should penetrate through the bark into the living cambium tissue and produce a cupping effect to hold the herbicide. Spray or paint the injured surface with herbicide using enough volume to wet the treated areas. This method can be used year round, except during period of heavy sap flow in the spring.

**Girdling.** Girdling involves using a chainsaw to “ring” the tree by making a continuous one inch deep cut all the way around the tree at waist height. This method is generally used to control trees larger than 5 inches in diameter. Apply herbicide within 30 minutes to the fresh cut. Cutting two rings approximately 6” apart is also effective, without herbicide. However, young fast growing trees can callus over the girdles and recover, so timing is important when herbicide is not applied. Girdling in this manner is more effective after full leaf out.

**Basal Spray.** Basal spray, or sometimes referred to as basal bark application, is a technique used to deaden small trees less than 6" in diameter. A herbicide mixture is applied, with a backpack sprayer, to the lower 12" to 18" of the tree trunk, thoroughly wetting the stem on all sides to the ground line (root collar). Spray until there is runoff noticeable at the ground line, but not to the point of runoff into the surrounding soil. This method is most effective during the late summer, fall and winter when trees are moving food reserves to the roots.

**Stump Cut.** Spray the sides and cut surface of freshly cut stumps with the herbicide, within 30 minutes of cutting. The cambium (outer wood next to the bark) area is the most vital area to wet. This method can be done during any season.

**Foliar Spraying.** Spraying herbicides can be done aerially (fixed-wing aircraft, helicopter) or by ground broadcast application (sprayers attached to backpacks, ATV's, tractors, skidders, or other ground equipment). This is one of the fastest methods of hardwood brush control in pine stands.

Foliar herbicide application is generally made during the early summer, after foliage has fully developed. Exercise extreme caution to avoid offsite drift.

**Soil Applications.** Herbicide treatment to individual stems can also be accomplished through soil application of chemical formulations. Herbicide rates should be calibrated depending on soil texture and herbicide recommendations. This type of application is generally performed in the early growing season (mid-March to early May).

The chemicals percolate into the soil during rainfall events and are absorbed by the tree's root system. Surrounding trees may also be damaged by this treatment due to this washing action. The landowner will be informed of this potential damage when soil application of herbicides is planned.

Soil applied herbicides will not be used near streams and other water bodies where there is the potential for runoff of the chemicals into the water during rain storm events.

### **Prescribed Burning**

Prescribed burning is often used in pine stands to remove undesirable hardwood species and other ground vegetation that compete with the crop trees.

Fire can be used for regeneration purposes in hardwood stands, but it should not be used in stands containing high-quality crop trees unless the primary objective is wildlife management.

Prescribed burning is an excellent tool used to promote the development of historical plant communities in oak/hickory or oak/pine savannah forests, by mimicking the natural fire regimes as closely as possible.

Refer to the Oklahoma NRCS Prescribed Burning (338) standard for additional information and guidance.

## **COMMERCIAL THINNING/CUTTING**

Cutting in merchantable forest stands is periodically done to concentrate growth onto crop trees, to reduce susceptibility to disease and insects, to salvage low quality or suppressed and dying trees, or to improve growth of ground cover for grazing by livestock or wildlife. These measures include:

- Intermediate thinning
- Harvest/regeneration cuts
- Salvage cuts/Sanitation cuts

It is important to plan harvest treatments and proceed with practice installation carefully to avoid damage to the site. It may take years for the forest to recover from improper harvesting practices.

### **Intermediate thinning**

Commercial harvesting in merchantable forest stands is done periodically to increase growth on crop trees. Cuts which manipulate conditions in a merchantable stand during the time period between regeneration/establishment and final harvest of the trees are called intermediate thinnings. This type of thinning is generally done to improve the spacing, quality, and species composition of the stand to attain the intended purpose of the practice. Intermediate treatments should be an integral part of the management plan to ensure the health and productivity of the forest.

Trees to be targeted for removal during improvement thinnings include:

- Suppressed trees of low vigor
- Trees with injuries resulting from fire, ice, insects, lightning, disease, etc.
- Poorly formed trees (forked, crooked, etc.) that have a low value
- Trees which are not well adapted to the site and have a resultant low growth rate
- Mature trees which have begun to decline in vigor
- Tree species which do not supplement the objectives of the landowner.

Intermediate thinnings should provide the high quality dominant and co-dominant trees left in the stand with sufficient growing space for a given number of years.

The timing of the first thinning will depend upon merchantability of the products, site productivity, and size of the trees. First thinnings should be made just prior to overcrowding and reduction of diameter growth, and before the live crown ratio of the trees in the stand is reduced to below 35 percent of total height. This will generally be between 13 and 15 years of age on productive pine sites and 17 to 25 years on hardwood sites.

Residual stocking rates are based on the following guides to indicate the space required by a tree to maintain growth and vigor between cuttings:

- Tree spacing
- Basal area
- Cutting cycle

**Tree Spacing.** In pine stands, the D + X method for thinning is a good rule to use when expressing the growing space required by a tree for normal growth over a given number of years. "D" represents the DBH (diameter breast height) of the average residual tree and "X" is an added constant to allow normal growing space to a leave tree. In most cases "X" will be "6" for pine. The DBH of a tree in

inches is added to the constant "6" and the total is the average distance in feet that trees of this size should be spaced. "X" varies with the average stand diameter for hardwoods.

**Table 1: Tree Spacing**

Ave DBH	Pine (D+6)	Mixed Hardwoods
6"	12'	13'
8"	14'	16'
10"	16'	19'
12"	18'	22'
14"	20'	25'
16"	22'	28'
18"	24'	31'
20"	26'	34'

**Basal Area.** Stand density is a measure of the stocking of a stand of trees. Basal area is the common method used by foresters to measure stand density. Proper stocking is the number of trees per acre that fully utilizes the site's potential to grow trees.

Basal area is the cross-sectional area of tree trunks per acre, expressed in square feet. Stands should be thinned to the desired basal area or spacing according to the species and DBH.

A normal rule of thumb for intermediate thinning in pine stands is to thin to a basal area of 60-80. This will vary on those stands that will be intensively managed. Adjustments should be made to compensate for natural mortality due to fire, insects, disease, natural disasters and stand composition.

**Table 2: Basal Area 60 Residual Spacing Guide for Pine**

DBH (In)	Ave. Spacing BA 60	# Trees per acre	Spacing By D+X
4	8	680	D+4
6	12	302	D+6
8	16	170	D+8
10	20	108	D+10
12	24	75	D+12
14	28	55	D+14
16	32	45	D+16
18	36	33	D+18
20	40	27	D+20

**Table 2a: Basal Area 80 Residual Spacing Guide for Pine**

DBH (In)	Ave. Spacing BA 80	# Trees per acre	Spacing By D+X
4	7	888	D+3
6	11	380	D+5
8	14	222	D+6
10	18	135	D+8
12	21	99	D+9
14	25	70	D+11
16	28	55	D+12
18	32	42	D+14
20	35	36	D+15

For basal area (BA) guides other than 60 and 80, use the following:

- BA 50 = D X 2.20
- BA 70 = D X 1.85
- BA 90 = D X 1.65
- BA 100 = D X 1.55
- BA 110 = D X 1.45
- BA 120 = D X 1.40

**Cutting Cycle.** A cutting cycle is the length of time between cuts on the same area. This length of time varies between intermediate thinning depending on the species being managed, the site index of the soil, and the volume necessary for an economically feasible harvest operation. In general, this cycle is the time it takes the average tree diameter to increase by 2 inches for pine and 4 inches for hardwoods. For well-stocked vigorous stands the following table will serve as a guide for determining cutting cycles.

**Table 3: Cutting Cycle for fully stocked stands**

Site Index	Pine	Upland Oaks
50	9 yrs	9 yrs
60	8 yrs	8 yrs
70	7 yrs	7 yrs
80	6 yrs	6 yrs
90	5 yrs	5 yrs
100	5 yrs	5 yrs

**Harvest/Regeneration Cuts**

Harvest and regeneration cuts are made when the forest stand has reached economic and/or physiological maturity. The harvest method used will determine the regeneration option available to the landowner to establish a new stand. It is more feasible for the landowner to determine the preferred regeneration method and use an appropriate harvest system to facilitate that method.

Management to achieve all aged stands (uneven-aged management) is desirable for woodland owners with combined stands of pine and hardwoods. This allows for sustained harvests over time and is beneficial when managing for wildlife.

There are four basic harvesting/regeneration systems which include:

- Seed Tree Cuts
- Shelterwood Cuts
- Clear Cuts
- Selection Cuts

Harvest methods fall into two general categories: those encouraging regeneration of even-aged forest stands, and those resulting in uneven-aged stands. Even-aged stands are created through use of seed tree cuts, shelterwood cuts and clear cuts. Uneven aged stands result from selection cuts.

**Seed Tree Cuts.** Seed tree cuts are the most frequently used method of natural regeneration for southern pines. This method consists of leaving enough seed-producing trees scattered over the area to ensure adequate stocking. The seed trees are later removed to eliminate shading effects when the seedlings are 2 to 3 years old.

The area should be prescribed burned prior to the seed tree cut to prepare a seedbed and control competing vegetation. Refer to the Oklahoma NRCS Prescribed Burning (338) standard. The regeneration cut will be timed so that seeds will be dispersed on a site freshly scarified by logging.

Residual basal area will be 15 square feet per acre or less. Seed trees should be dominant trees of good form and quality with seed-producing capabilities, which are at least 9 to 10 inches in diameter. They shall be well-distributed over the area to be regenerated.

The seed trees will be susceptible to lightning strikes and wind throw when the cut is complete. They should not be left in place longer than 2 to 3 years.

Areas lacking suitable seed trees and stands not naturally regenerated within two years should be planted to the most suitable species.

Newly established seedlings, natural or planted, should be released from undesirable competition within two years after establishment, preferably the first year following establishment.

**Table 4: The minimum number of recommended seed trees per acre necessary for satisfactory regeneration of pine**

DBH (In)	Loblolly Pine	Shortleaf Pine
10	12	20
12	10	14
14	8	12
16+	4	12

**Shelterwood Cuts.** Shelterwood cuts are similar to seed tree cuts, but more trees are left to regenerate the stand and to serve as a canopy shelter for the germinating seedlings. This method is well suited for naturally regenerated southern pines.

Leaving more trees after the initial harvest helps suppress the development of competing vegetation, and it also reduces the risks associated with poor seed crops during regeneration efforts.

This method will involve 2 to 3 cuttings. If the seed trees to be left have well-developed crowns, the first cut is a harvest to the seed tree number listed below. Two to five years afterward the remaining seed source trees will be harvested.

If the seed trees do not have well-developed crowns, the first harvest will be an improvement cutting to release the seed trees. Once the crowns of the seed trees have developed reduce the stand to the desired number of trees listed below.

**Table 5: The minimum number of recommended seed source trees per acre necessary for a satisfactory shelterwood cut in pine**

Ave. DBH (In)	Min. Trees/Ac	Max. Trees/Ac
10	55	110
12	40	75
14	30	55
16	20	45
18	15	35
20	15	30

**Clear Cuts.** Clearcutting removes all merchantable trees in the stand in one cut. This method is used when nearly all the desirable trees in the stand are mature and a new stand of shade-intolerant tree species such as pines or oaks can be established either through natural seeding/sprouting or through planting. This type of regeneration harvest is often followed by site preparation practices when seedling planting is used to establish the next stand.

The type of clearcut harvest made is determined by site conditions and the landowner's economic situation. Choices available include clearcutting an entire stand or clearcutting a stand in strips, blocks or patches over several cuts.

Clearcutting an entire stand at once may be done when sufficient desirable seed or seedlings are in place to regenerate the stand or when tree planting is planned.

A clearcut site is considered by some to be aesthetically less pleasing for a short period following the harvest. The initial negative impact will be lessened by planning the size, shape, and location of the clearcut to blend more naturally with the landscape.

Strip, block, or patch cutting is used when seed from adjacent stands will be utilized to restock the area or on steep slopes where soil erosion is a concern. Adjacent seed sources may be utilized when strips or blocks are cut perpendicular to prevailing winds so that the harvested areas are regenerated from blown seed. The cut areas should not be wider than 3 to 4 times the height of the trees to be used as a seed source. The area should be site prepared prior to seed fall. This method may be used for pine and light seeded hardwoods.

A patchwork of clearcuts resulting from harvests conducted at different times will provide a more diverse habitat for wildlife than one single large clearcut. Landowners with a wildlife management objective in addition to their timber management goals may wish to consider this alternative.

Successful clearcutting and regeneration in hardwood stands may be attained through seedlings in place plus naturally occurring root and stump sprouts. The seedlings in place (advance regeneration) must be at least 4.5 feet tall and 1 inch in root collar diameter prior to the cut.

**Selection Cuts.** Selection harvesting involves periodic cutting of selected trees from all merchantable diameter classes. This harvesting method maintains an uneven-aged stand.

Harvested volumes in fully stocked stands should generally approximate growth for the cutting cycle. In stands that are not fully stocked, only a portion of the growth is cut. The cutting cycle will approximate that discussed for intermediate thinnings.

**NRCS, OK**

**May 2012**

Slow-growing, poor quality, or undesirable trees will be cut, and the best trees will be left to improve quality and growth.

Harvest tree selection will be done either by targeting single individual trees or by removing a group of trees to create openings or gaps in the forest canopy. The openings provide freedom from competition for the natural establishment of shade-intolerant tree species. In this manner, a diversity of age and size class is maintained.

A group selection cut provides better regeneration opportunities for both pines and oaks than single tree selection because larger openings are created for these shade intolerant species.

Timber stands with a basal area of over 110 square feet per acre are considered overstocked and need to be thinned with a selection harvest. The desired basal area per acre is between 70 and 110 square feet.

**Table 6: Basal area residual spacing guide for mixed hardwoods:**

<b>Ave. DBH (Inches)</b>	<b>Average Spacing D+8</b>	<b># Trees per acre</b>	<b>Basal Area per acre</b>
8	16	170	59
10	18	135	73
12	20	109	86
14	22	90	96
16	24	76	105
18	26	65	115
20	28	55	120

### **Salvage/Sanitation Cuts**

Salvage cutting is the removal of trees damaged by insects, disease, ice, tornadoes, fire, and other disasters to obtain economic gain before tree value is lost.

Sanitation cutting is the removal of trees attacked by insect or disease. The cutting is done to stop the infestations and is usually not expected to bring high economic benefits to the owner due to the emergency considerations of the operation.

These cuts usually remove trees in the oldest and largest size category. This removal is important in maintaining the health and productivity of the stand.

Dead and dying trees may be left in the stand for wildlife nesting/roosting habitat when their retention does not endanger the health of the remaining trees.