SPECIFICATIONS
FOREST STAND IMPROVEMENT
CODE 666

I. Timber Stand Maintenance (Release)

Practices are often performed on young stands to manipulate the stocking rate or control undesirable vegetation before the trees reach merchantability. Release components may include herbicide suppression, precommercial thinning and prescribed burning.

A. Herbicide Treatments (Competing Vegetation Suppression)

Herbicides may be applied to a forest stand to remove undesirable trees. Advantages of herbicide competing vegetation suppression are can minimize soil disturbance; can be used on steep slopes; can be applied over large acreage quickly; can be applied by landowners; can be used selectivity on specific problem vegetation; and can be used when mechanical methods are impractical or are not cost-effective. The following application methods are available:

1. Aerial or ground-mobile broadcast herbicide applications are used widely for woody brush suppression in sapling and maturing stands to increase timber growth and improve wildlife habitat.

2. Ground-mobile, banded applications are used for herbaceous weed suppression in newly regenerated stands.

3. Single stem treatments that include injection basal spray and hack and squirt can be used to create small wildlife openings on areas where systemic herbicide could damage crop trees. Ground mobile equipment can be used to create small wildlife openings

Successful forestry herbicide application depends on the following factors.
a. Species to be controlled
b. Soils
c. Environmental impact
d. Herbicide selection
e. Rates
f. Timing

Herbicides must be labeled for forestry use and all labeled directions for proper application and safety should be followed. Herbicides should be used in accordance with all limitations of EPA, the manufacturer, and state and federal regulations,

B. Pre-Commercial Thin

This practice should be applied to young overstocked stands up to about 4 inches DBH (Figures 1 and 2) and can include one of the following:

1. Rotary Mower: Trees are generally less than one-half inch DBH, mow strips 8-10 feet wide leaving residual strips 1-3 feet wide. These strips may be left or they may be cross mowed or cross checked Resulting clumps should be 1-3 feet wide.

2. Rolling Chopper, Disk or Bulldozer: Seedling to small sapling size trees may be chopped, disked or pushed down in strips 8 feet apart. Residual strips should be 1-3 feet wide.

3. Hand Tools: Seedlings or saplings may be thinned by machete, axe, brush hook or gas engine circular saw.

C. Prescribed Burning

Prescribed burning may be used in pine stands to remove hardwood species and other ground vegetation for wildlife habitat improvement. Fire should not be planned for maintenance of hardwood stands. Refer to the practice standard for Prescribed Burning (338) for specifications.

II. Merchantable Stand Maintenance (Commercial Harvests)

Commercial harvesting in merchantable forest stands is done periodically to concentrate growth on crop trees, reduce susceptibility to diseases and insects, remove suppressed and dying trees, remove low-quality trees, improve growth of herbaceous plant material beneficial for livestock and/or wildlife forage, adjust species composition, regenerate the stand, and/or increase economic gain for the landowner. The harvesting practices to improve forest conditions may include intermediate, regeneration salvage, and sanitation harvests.

A. Intermediate Harvests

Intermediate harvests manipulate stand conditions during the time between regeneration establishment and final harvest.. These harvests are generally done to control the spacing, quality, and species composition of the stand to attain management objectives and should be an integral part of the management plan to ensure the health and productivity of the forest.

Tree selection during harvest should be based on:

1. Management objectives
2. Adaptability of species to soil
3. Form and vigor of individual trees

The following are guidelines to use when planning intermediate harvests:

1. Favor trees adapted to the site
2. Remove merchantable suppressed trees
3. Remove high risk and diseased trees
4. Remove forked, short bole trees
5. Remove crooked and low vigor trees
6. Space desirable trees to allow room for growth and development

Determine Residual Spacing

Intermediate harvests should provide sufficient space for growth of the desirable trees for a given number of years. 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 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 southern 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.

Example: D + 6 spacing of a l0-inch tree would be 10 + 6 or 16 feet. In application of this method, trees should be considered in groups of three or more arranged in compact geometric figures with the outside trees spaced approximately D + 6 feet apart.

A normal rule of thumb for intermediate cutting in stands is to thin to a basal area of 60 square feet per acre. 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. Several options are available to landowners when regenerating southern pine and hardwood (Tables 1, 2 and 3).

Table 1. Residual spacing guide for southern pines

	D + SPACING GUIDE			**BASAL AREA SPACING GUIDE**		
DBH[1] (Inches)	D[2]+6 Average Spacing (feet)	Trees /Acre	Basal Area[3] /Acre	Average Spacing (feet) for BA 60 D x 2.00	Trees /Acre	Spacing By D+x
4	10	436	38	8	680	D+4
6	12	303	59	12	302	D+6
8	14	222	78	16	170	D+8
10	16	170	93	20	108	D+10
12	18	135	105	24	75	D+12
14	20	109	116	28	55	D+14
16	22	90	126	32	45	D+16
18	24	76	134	36	33	D+18
20	26	65	142	40	27	D+20

[1]DBH is diameter at least height (41/2 ft. from ground level).
[2]D is DBH
[3]Basal Area (BA) is the cross-sectional area of tree trunks per acre.

For BA guides other 80 use the following:
BA 50 = D x 2.20; BA 70 = D x 1.85; BA 80 = D x 1.75, BA 90 = D x 1.65; BA 100 = D x 1.55; BA 110 = D x 1.45; and BA 120 = D x 1.140.

Table 2. Residual spacing for mixed hardwoods

DBH (Inches)	D + SPACING GUIDE			BASAL AREA SPACING GUIDE		
	D+8 Average Spacing (feet)	Trees / Acre	Basal Area / Acre	Average Spacing (feet) for BA 60 D x 2.00	Trees / Acre	Spacing bvD+x
8	16	170	59	16	170	D+8
10	18	135	73	20	108	D+10
12	20	109	86	24	75	D+12
14	22	90	96	28	55	D+14
16	24	76	105	32	45	D+16
18	26	65	115	36	33	D+18
20	28	55	120	40	27	D+20

Table 3. Residual spacing guide for cottonwood

DBH (Inches)	D + SPACING GUIDE			BASAL AREA SPACING GUIDE		
	D+11 Average Spacing (feet)	Trees / Acre	Basal Area / Acre	Average Spacing (feet) for BA 70 D x 1.85	Trees / Acre	Spacing bvD+x
6	17	151	30	11	360	D+5
10	21	99	54	19	121	D+9
14	25	70	75	26	65	D+12
18	29	51	90	33	40	D+15
22	33	40	106	41	26	D+19

Cutting Cycle A cutting cycle is the length of time between cuts in the same area. This time varies with species, stocking, and site index. For well-stocked vigorous stands the following table will serve as a guide for determining cutting cycles.

Table 4. Approximate cutting cycles for various forest types

Site Index	50	60	70	80	90	100	110	120
	PINE							
Cutting Cycle (years)	9	8	7	6	5	5	5	4
	SWEETGUM AND MIXED HARDWOOD							

Cutting Cycle (years)	--	--	14	12	10	9	8	
	COTTONWOOD							
Cutting Cycle (years)	--	--	--	--	7	6	5	4

B. Regeneration Harvests

Regeneration harvests are made when forest stands reached economic and/or physiological maturity. The timing depends not only on forest conditions but also on landowner objectives and economic considerations. The harvesting method will determine the landowner's regeneration options available for establishing a new stand (refer to Tree/Shrub Establishment, code 612). It is more feasible for the landowner to determine the preferred regeneration method and use an appropriate harvest system to facilitate that method. Harvest methods fall into two general categories: those which allow regeneration of even-aged forest stands and those which result in uneven-aged stands. Even-aged stands are created through use of clearcut harvests, seed tree harvests, and shelterwood harvest. Uneven-aged stands result from selection harvesting.

1. Hardwood Regeneration Harvests

a. Uneven-Age System

This management system may be accomplished by using the following harvests:

1) Diameter Limit Harvest: Trees are selected for harvest by cutting to a diameter limit. This is the least desirable method.

2) Single Tree Harvest: This harvest is often recommended for landowners with small tracts. Single trees from all merchantable diameter classes are periodically selected for removal. If done in the proper manner, there is temporary disturbance to the forest environment. This is not an effective method of regenerating desirable shade intolerant species because openings created by harvesting are too small to allow sufficient sunlight.

b. Even-Age System

3. Clearcut Harvest: This harvest is an efficient method to regenerate stands of shade-intolerant hardwoods. All merchantable timber in a stand or portion of a stand is removed in a single harvest. Harvest options include entire stand removal in single harvest or partial stand removal in strips or blocks with several harvests. Harvest option is determined by site conditions and the landowner's economic situation

Entire stand removal can be used for oak reforestation when seed crop or natural seedling stocking is sufficient for regeneration or when artificial regeneration is planned. Strip or block harvest sites should be oriented perpendicular to the prevailing wind so that adjacent seed sources can be used for light-seeded hardwood regeneration. All harvest options should be followed by a site preparation treatment (Refer to Forest Site Preparation 490).

4. Group Selection Harvest: This harvest periodically removes groups of selected tress to create canopy openings for regenerating shade-tolerant species. It improves wildlife habitat by creating openings for ground cover establishment and increasing tree species, age and size diversity in the stand.

5. Shelterwood Harvest: This method has been recommended as one that may work in the south when the objective is to increase the oak component in the future stand. Oaks must be present in the understory as advanced regeneration (1 inch diameter at the root collar and 4 ½ feet tall) prior to harvest.

2. Pine Regeneration Harvests

a. Uneven-Age System

1) Selection Method: This method is the removal of mature timber, usually the oldest or largest trees, either as single scattered individuals or in small groups at relatively short intervals. This harvest would be repeated indefinitely, to promote continuous regeneration while maintaining an uneven-age stand.

b. Even-Age System

1) Clearcut method: Removal of the entire stand in one cutting with regeneration obtained naturally by seed from adjacent stands or from trees cut in the harvesting operation, or artificially by planted seedlings or direct seeding (See Tree/Shrub Establishment, Code 612).

2) Seed Tree method: Removal of the mature timber in one cutting, except for a small number of residual seed trees individually spaced over the area or in small groups.

3) Shelterwood method: Removal of the mature timber in a series of cuttings, which extend over a relatively short portion of the rotation. Usually accomplished in two harvests with the second harvest being a seed tree harvest, where the establishment of essentially even- age regeneration under the partial shelter of seed trees is encouraged.

Table 5. Pine regeneration harvest options

Method	Seed Source Trees Per Acre	Advantages	Disadvantages
Seed Tree	DBH Loblolly Shortleaf 10" 12 20 12" 10 14 14" 8 12 16" 4 12	1) Possible high volume first cut. 2) Less expensive than planting 3) Seed source left in place. 4) Aesthetically pleasing	1) Seedlings are not genetically improved. 2) Remaining volume may not be sufficient for harvest. 3) High risk to seed trees form lightning, wind, *etc*. 4) Hard to control seedling density.
Shelterwood	DBH Upper[a] Lower 10" 110 55 12" 75 40 14" 55 30 16" 45 20 18" 35 15 20" 30 15 [a] Trees /acre in stands with basal area of 30 - 60 sq. ft.	1) Remaining trees help suppress competition and continuous growth. 2) Less expensive than planting. 3) Aesthetically pleasing 4) Offer more options.	1) Seedling are not genetically improved. 2) Cannot control seedling density. 3) Remaining trees may be subject to logging damage. 4) Less volume in first cutting.
Clearcutting	The trees bordering the clearcut serve as a seed source. Size - Maximum width is 400 feet. Location - oriented perpendicular to the prevailing wind.	1) Larger timber sale. 2) All harvesting done at the same time. 3) Marking and supervision of harvest in minimal.	1) Seedlings are not genetically improved. 2) Cannot control seedling density. 3) The only remedy for failure in planting. 4) Not aesthetically pleasing.

C. Improvement Harvest

This harvest maintains the health and productivity of the stand by removing damaged, dying and dead trees. Generally, the tree removal includes oldest and largest size class and is incorporated into a planned intermediate harvest. Damaged unmarketable trees resulting from weather or fire can be left for wildlife nesting and roosting habitats

1. Salvage Harvest
Salvage harvests remove trees damaged by insects, disease, ice, tornadoes, fire, and other disasters to obtain economic gain before tree value is lost.

2. Sanitation Harvest
Sanitation harvest removes trees attacked by insect or disease. The removal is done to stop insect and disease infestations. Since this is an emergency operation, no economic benefit is expected for the landowner.

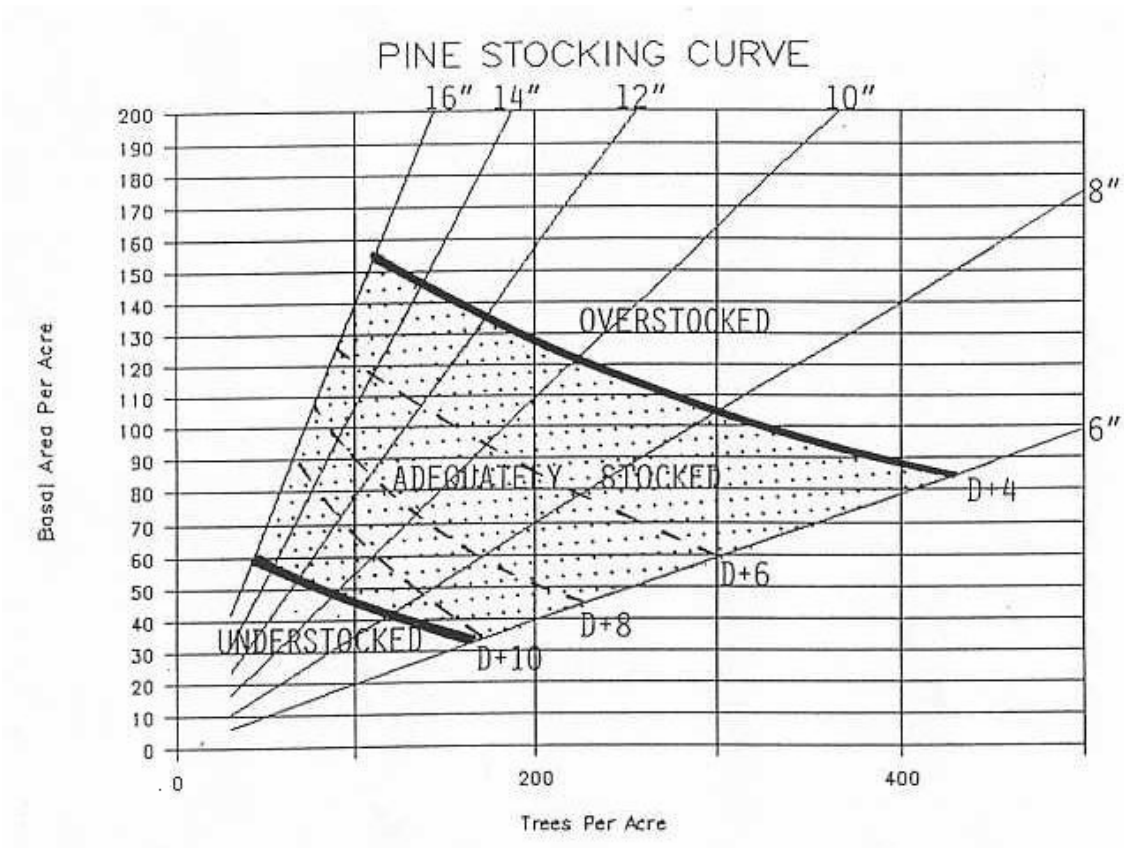

Figure 1. Pine Stocking Chart

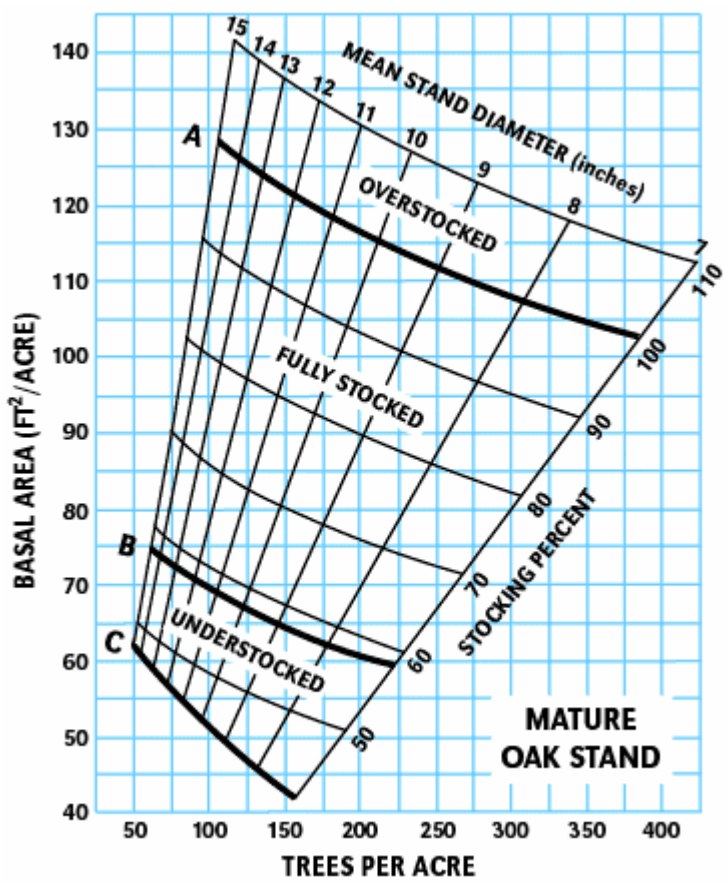

Figure 2. Bottomland Hardwood Stocking Chart