

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

FOREST STAND IMPROVEMENT

(Acre)

CODE 666

DEFINITION

The manipulation of species composition, stand structure, and stocking by cutting or killing selected trees and understory vegetation.

PURPOSES

- To increase the quantity and quality of forest products, e.g., sawtimber, veneer, wood fiber, poles, pilings, maple syrup, naval stores, nuts and fruits.
- To harvest forest products.
- To initiate forest stand regeneration.
- To reduce the potential of damage from wildfire, pests, and moisture stress.
- To restore natural plant communities.
- To achieve a desired understory plant community.
- To improve aesthetic, recreation, and open space values.
- To improve wildlife habitat.
- To improve water conservation and yield.
- To achieve a desired level of crop tree stocking and density.
- To increase carbon storage in selected crop trees.

CONDITIONS WHERE PRACTICE APPLIES

All forestland where competing vegetation hinders development and stocking of preferred tree and understory species or where some or all of the stand will be cut or killed for intended purposes.

CRITERIA

General Criteria Applicable To All Purposes

The harvest-regeneration strategy will be identified for all planned forest improvement harvesting:

- Uneven-aged management systems (single-tree selection, group selection, coppice selection)
- Even-aged management (clear-cut, seed-tree, shelterwood, coppice)

The tree species chosen for future management will be compatible with the species' site adaptation, the site's potential, and the landowner's objectives. Refer to Section II of the Field Office Technical Guide (FOTG), the published soil survey, National Soil Information System (NASIS) or the suggested species listing in the Tree and Shrub Establishment Standard, Code 612.

Spacing, density, size class, number, and amounts of trees and understory species to be retained will follow established guidelines for the intended purposes and the silvicultural system chosen.

The method, felling direction and timing of tree cutting for harvesting shall facilitate efficient and safe tree removal and protect sensitive areas such as riparian zones, cultural resources, sensitive areas and structures.

Forest stand improvement activities shall be performed to minimize soil erosion, compaction, rutting, damage to remaining vegetation and hydrologic conditions.

Slash and debris left on the site after treatment will not present an unacceptable fire, safety,

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resource Conservation Service.

NHCP, NRCS-TX
September 2001

environmental, or pest hazard. Such remaining material will not interfere with the intended purpose or other management activities.

Harvesting/Silvicultural Systems

Planning a silvicultural method will consider

1. the age, size and condition of the stand
2. the current stocking level of desired species
3. the erosion potential of the site
4. the landowners' objectives, financial limitations and concern for aesthetics and wildlife

Harvesting will be planned in such a way as to minimize excessive soil disturbance, particularly on erodible sites. Landowner will abide by the Texas Forestry Best Management Practices. Also, refer to the Standard for Forest Harvest Trails and Landings, Code 655, and Riparian Forest Buffer, Code 391.

When using natural regeneration, only high quality trees (high form class, favorable conformation and good growth rate) of the desired species will be retained as seed trees. Choose methods and timing of harvesting in preparation natural regeneration that will not harm the remaining trees.

When natural regeneration methods are used in pine stands, adequate reproduction will be:

500-700 seedlings per acre within the first 2 years.

If reproduction exceeds 1500 seedlings per acre after 3-5 years, it may be necessary to use precommercial thinning (see below).

A. Clearcut

Hardwood. Clearcut is applicable in hardwood stands when:

- 1) There are at least 200-500 large, well-developed seedlings of desirable species and form per acre OR
- 2) Planting or direct seeding is planned OR
- 3) The site is to be managed for light seeded species and there is suitable seed source nearby OR

- 4) Regeneration from coppice and root sprouts can be achieved.

Where natural regeneration is planned, limit the size of the clearcut ≤ 40 acres. All trees ≥ 2 " DBH will either be harvested or deadened.

Pine. Clearcutting pine stands is applicable when:

- 1) Planting or direct seeding is planned OR
- 2) An adequate seed source is available OR
- 3) There are at least 300-500 viable pine seedlings per acre present.

When natural regeneration is planned and advanced reproduction is not present, the clearcut will be $\leq 400'$ wide for loblolly, shortleaf and slash. Whenever possible, orient the clearcut perpendicular to the prevailing fall winds. Planting following clearcutting will be planned for longleaf pine.

Harvest by clearcut requires strict adherence to any limitations of the soil or site that exist. Careful planning is essential to avoid long-term site degradation and infraction of the National Clean Water Act.

B. Group Selection/Patch Clearcuts

Hardwood. Hardwood stands are suitable for group selection when:

- 1) There are at least 200-500 large, well-developed, viable seedlings of desirable species and form present per acre. OR
- 2) The site is to be managed for light-seeded species and there is suitable seed source available.

The size of the harvest area will be 1-5 acres in size. All trees ≥ 2 "DBH will be harvested or deadened.

Pine. Pine stands are suitable for group selection when:

- 1) An adequate seed source is available OR
- 2) There are at least 300-500 viable pine seedlings present per acre.

The minimum width and size of a group selection harvest will be 100' to 120' or 0.25 to 0.33 acre.

C. Seed Tree

Hardwood. Hardwood stands lend themselves to seed tree management when: the desirable species are light-seeded and/or shade tolerant. This does not include oaks, hickories and other heavy-seeded species.

Retain 8-15 well formed, superior trees per acre on a 50' to 70' spacing.

Pine. Pine stands are suitable for seed tree management when:

- 1) An adequate seed source is available on the site AND
- 2) The species to be managed is loblolly, shortleaf or slash.

Longleaf pine is suitable for natural regeneration but requires protection from free-ranging hogs and frequent prescribed burning to reduce the threat of brownspot needle blight. Prescribed fire also serves to bring the longleaf seedlings out of their "grass stage" more quickly.

The seeds should fall on bare mineral soil for successful germination and early survival. See Standard for Forest Site Preparation, Code 490.

Minimum stocking and spacing is dependent upon the average size of the seed source trees as shown in the following table.

Seed Source Trees	10" DBH	12" DBH	14" DBH	16+ DBH
Loblolly Slash	12/ac	10/ac	6/ac	4/ac
Spacing	60'x60'	66'x66'	85'x85'	105'x105'
Shortleaf	20/ac	14/ac	12/ac	12/ac
Spacing	45'x45'	55'x55'	60'x60'	60'X60'

D. Shelterwood

Hardwood. Shelterwood management is applicable in hardwood stands when heavy seeded species are desired.

This method will generally involve 3 cuts. The first is to remove the lower crown class trees (midstory and understory). The second will reduce the stocking to 25 to 50 trees per acre to encourage the development of desirable seedlings by root sprout or coppice. The third cut removes the overstory once the seedlings are well established.

Pine. This method is applicable when there are adequate pine seed source available on the site.

This method will involve 2 to 3 cuts. If the seed trees to be left have well-developed crowns, the first cut is a harvest to the seed tree number listed below. Three to five years afterwards the final harvest will occur.

If, on the other hand, the seed trees do not have well-developed crowns, the first cut will be an improvement cut to release the seed trees. Once the crowns of the seed trees have developed, reduce the stand to the desired number of trees.

The number of seed source trees depends on their DBH and species as shown in the following table.

Avg. DBH	Min. Trees/Ac*	Max. Trees/Ac
10	55	110
12	40	75
14	30	55
16	20	45
18+	15	30
* Use the minimum number for longleaf pine.		

Intermediate Cuttings/Thinnings

Harvesting operations will be carried out to minimize soil disturbance and compaction. Harvest in compliance with Texas Forestry Best Management Practices. The method and timing of tree harvest will not damage the residual stand beyond an acceptable level. Riparian forest buffers, code 391, or SMZs and any unique or sensitive areas will be protected during all harvest operations.

Slash Treatment. Normally removal of slash is not necessary. However, if it poses a potential wildfire threat, the slash should be removed. Felled trees should not remain lodged in standing trees.

A. Precommercial Thinnings in Pine Stands

Spacing, density and stocking of preferred trees.

When young pine seedlings exceed 1500 stems per acre at age 2 to 5 years, if the residual stand is to grow at an optimum rate. Stands should be thinned as soon as the overstocking is recognized. Reduce the number to 450-700 stems per acre.

Methods. Thinning these young stands may be done by hand or mechanically. When thinning by hand, leave desirable trees 8 to 10 years apart.

Mechanical methods include the use of bush hogs, hydro-axes, other rotary type cutters, drum choppers and bulldozers. These machines can be run in strips or in "checkerboard" patterns. Take care to minimize damage in the residual strips or blocks. Cleared strips should be 7 to 10 feet wide with the residual strips as narrow as possible (1-3 feet wide). Checkerboard blocks should be 8-10 feet wide. Hand thinning within the strips or blocks may be needed, as well.

B. Commercial Thinning

Spacing, density and amount of preferred trees.

Determine the desired level of stocking that meets the landowners' objectives and the stand's management needs. Use **Table 1** or **Table 2** to establish the stand's present condition in relation to the desired stocking level.) The charts contain benchmark lines showing the stocking levels where stands are understocked, fully (or adequately) stocked, and overstocked. The "understocked" line represents minimum stocking - the site is not fully occupied by trees. Within the fully or adequately stocked levels, the site is fully dedicated to growing trees. Individual trees here have enough space to maximize growth, but the site is still fully occupied by trees. As the stand develops and approaches the "overstocked" line, the canopy begins to close as tree crowns expand, and competition and subsequent reduced growth rates begin to affect the productivity of the stand. In many management situations, particularly where an uneven-aged structure is the goal, long-term objectives are best served by maintaining stocking between the fully (or

adequately) stocked levels. These charts are developed as guides and are usually applied in a "rule-of-thumb" manner.

When a thinning is needed, the thinning level will be expressed in terms of D+spacing, trees per acre removed or retained, basal area, or percent of stocking (trees per acre OR basal area per acre) to be removed.

Stands that are maintained in an overstocked condition or those that have been thinned to an understocked condition will not be planned. Exceptions may be made for thinnings delayed for market or other reasons, or harvest cuttings made for regeneration efforts. In addition, **removing trees in a change of landuse is not to be planned or reported under this practice.**

Methods of reaching the desired level of stocking.

The purpose of intermediate cuttings or thinnings is to improve the stand's overall vigor and quality. The means used to reach the desired stocking level will be consistent with this purpose. The maximum response to thinning usually is found among the remaining co-dominant trees once they are relieved from competition with equals.

The following general guidelines will be followed no matter which method of thinning is used.

- Remove all merchantable trees that are suppressed
- Salvage high-risk damaged or diseased trees
- Space the "keep" trees at allow for room for growth and development
- Favor high quality dominant and codominant trees for retention

Correct spacing of leave trees will be accomplished by the application of a recommended system of thinning. These systems include D+, crown friction, row thinning in plantations, and thinning from below (removing weak co-dominants and suppressed trees).

Timber Stand Improvement (TSI)/Release

Species Selection. An inventory that identifies both the species to be controlled and retained will be needed in order to plan appropriate methods of control. This inventory will also include information

on the stocking and consideration of the desired trees as well as the undesirable plants.

Amounts of Desired Species for Release. For release to be effective and economically feasible there must be at least **300 released pine seedlings per acre or 500 released desirable hardwood seedlings per acre**. The seedlings must be fairly evenly distributed throughout the stand and of good form and condition.

Amounts of Desired Species for TSI. Timber Stand Improvement should result in stocking levels of desired species that will meet the landowner's objectives. Minimal stocking, by diameter class, for pine and hardwood management is listed below. Adjustments may be made for pine/hardwood mixes, wildlife, aesthetics, etc. to meet landowner's objectives.

Avg. DBH	Pine (minimal)	Hardwood (minimal)
4	300	500
6	200	300
8	145	175
10	100	125
12	75	80
14	55	70
16	45	60

Best Management Practices. All methods of control will comply with Texas Forestry Best Management Practices.

Use of Herbicides. Use only approved chemicals and comply with all relevant state laws, label instructions and Texas BMP's.

Methods. Selection of appropriate control methods will be based on effectiveness, economic considerations and landowner's objectives and concerns.

- a) **Release of seedlings from herbaceous weeds, grasses and vines.** Mowing and shredding can be effective on sites that have a good plant-soil moisture relationship and where follow-up mowing is possible if needed.

Whenever grasses, weeds and vines pose a competition problem (moisture usually) for seedlings or young trees, control using chemicals is an alternative. Consider the potential for runoff and leaching with all chemical use. See Table 3.

- b) **Release of seedlings and young trees from overtopping trees and brush.**

Consider harvesting the overtopping trees when the volume and quality of these trees makes this feasible. Otherwise, the use of herbicides will be considered. See Table 4. Chemicals can be used in single stem treatments, such as basal spray or injection, or in ground or aerial broadcast applications. Chemicals applied by broadcast can be foliar or soil activated. Give consideration to the potential for runoff and leaching with all chemical use.

- c) **Control of undesirable trees within a stand of desirable trees.** Control of undesirable trees such as unwanted species and suppressed, cull diseased, "wolf", or overmature trees must result in an adequately stocked stand of good quality, desirable trees. Methods include cutting and harvesting, prescribed burning (Code 338), application of herbicides and mechanical means of control.

Mechanical methods include shredding, shearing and bulldozing. Care must be taken to minimize damage to desirable trees during the release operation. Potential hazards such as wildfire, disease and insect infestation from slash and debris left after the release operation must also be considered.

Consider harvesting the unwanted trees when the volume and quality of these trees makes this feasible. Minimize damage to the desirable trees left in the residual stand.

Chemical methods can include broadcast application or foliar or soil activated herbicides, soil activated spot treatments and individual stem treatments. See Table 3 and Table 4.

CONSIDERATIONS

Silvicultural During the planning and implementing processes, consideration should be given to factors such as site index, soil

limitations, and to existing conditions. If only a part of the tract is harvested for regeneration, it must be done so as not to adversely affect future management operations of the rest of the tract.

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, e.g., prescribed burning, site preparation, tree and shrub establishment, prescribed grazing and use exclusion.

The extent, timing, size of treatment area, or the intensity of the practice should be adjusted to minimize cumulative effects (onsite and offsite), e.g., hydrologic and stream alteration, habitat fragmentation, nutrient cycling, biodiversity and visual resources.

Potential landowner and operator liability should be assessed before forest stand improvement activities begin.

Wildlife Forest management plan should include consideration for wildlife habitat. Creek bottoms, steep slopes, wet areas and other sites should remain in food and shelter trees suitable to endemic wild species. The plan should include corridors, unharvested strips or stringers, and riparian forest buffers, Code 391, or SMZs that will be used as travel ways for wildlife, will enhance the value of the forest for wildlife species and will limit habitat fragmentation.

From 5% to 20% of the area should be left in mast-producing trees when wildlife is a consideration. Leave these trees in motts or strips whenever possible. The principles of timber stand improvement can be applied within these areas to improve the mast bearing capabilities within the motts or strips.

The practice should be timed to minimize disturbance of seasonal wildlife activities.

Consider retention of selected dead and dying trees, including down material, to enhance wildlife habitat values. Standing snags can provide roost sites for raptors that will reduce the rodent population in a forested stand.

Other. Landowners should secure a written contract with any service provider that specifically describes the extent of activity, duration of

activity, responsibilities of each party and amount and timing of payments for services provided.

When aesthetics is an important consideration in planning a forest management practice, the preferred species and density may be altered to address this concern. Aesthetically desirable species include dogwood, redbud, white fringetree, rusty blackhaw, and others should be left around roads, trails and home sites when this agrees with the objectives of the landowner.

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan, or other acceptable documentation.

OPERATION AND MAINTENANCE

Periodic inspections during treatment activities are necessary to ensure that objectives are achieved and resource damage is minimized. Follow-up and ongoing management activities will be needed to obtain desired results.

REFERENCES

American Hardwood Council Forest World.
Silvicultural Studies and Stocking Charts.

Boyd, John. Forestry Herbicide Use in Arkansas
from Arkansas Forest Owners Handbook.
University of Arkansas Cooperative Extension
Service.

Miller, James H. 1990. Directed Foliar Sprays of
Forestry Herbicides for Loblolly Pine Release.
Southern Journal of Applied Forestry 14:199-206.

Mitchell, Robert J. Herbaceous Weed Control in
Young Pine Plantations. Alabama Cooperative
Extension Service.

USDA, Natural Resources Conservation Service
Texas Conservation Practice Standards, Code
666, TSI, dated July 1996; Code 666, Intermediate
Cuttings/Thinnings dated January 1997; and Code
666, Harvesting/Silvicultural Systems dated
October 1997.

Yeiser, Dr. Jimmie. 2001. Stephen F. Austin
State University School of Forestry. Personal
communications.

TABLE 1. PINE STOCKING CHART

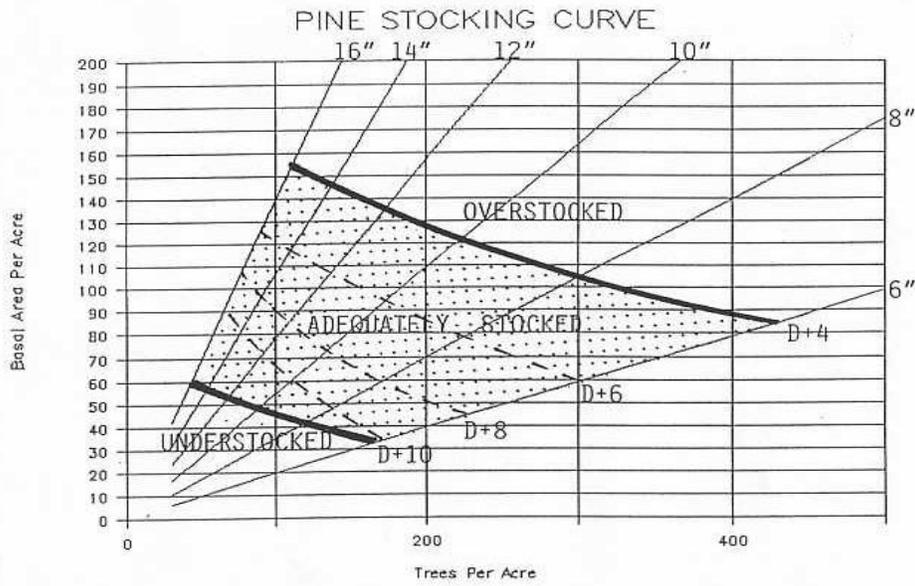


TABLE 2. BOTTOMLAND HARDWOOD STOCKING CHART

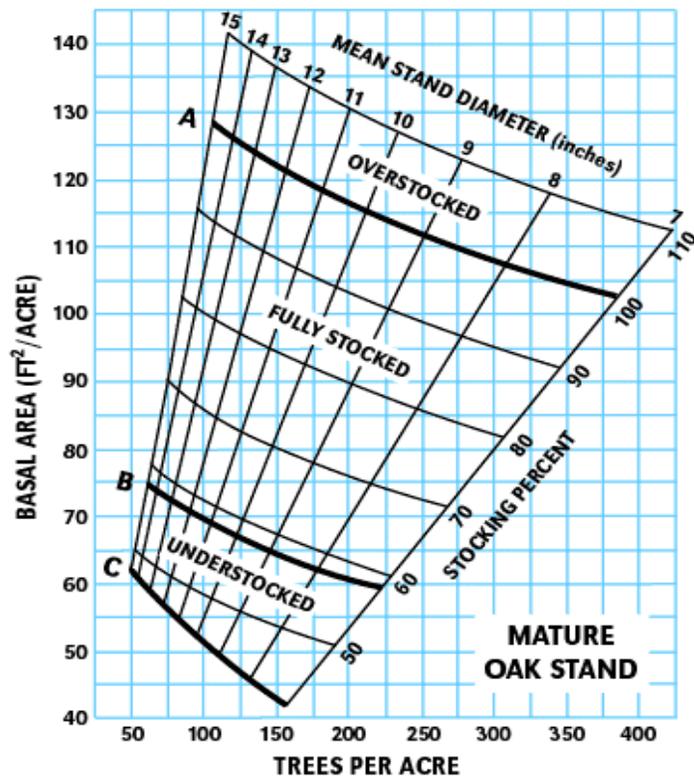


Table 4 - Weed Response Ratings for Pine Release Herbicides
S = Susceptible, M = Marginal, R = Resistant, blank cell = Unknown response

Herbicide(s)	Arsenal	Arsenal	Arsenal	Arsenal	Pronone	VelparULW	Forestry	Arsenal	Weedar64A	Accord
		+		+	10G	or	Tordon 101	or	or	
		Escort		Accord		Velpar L		Chopper	2,4-D amine	
Formulated Material per acre	12 to 16	8-12 fl.oz.	1-3 oz.per	1 pt.	20 to 30	4.75 lb.	1 ml per cut, 1" apart			
	fl.oz.	+ 1 oz	gal. Water	+ 2 qts.	lbs.	or 1.5gal				
Application	Foliar Spray				Soil Treatment		Cut Surfaces			
Ash	S	S	S	S	S	S	S	S	S	S
Blackberry	R	S	R	S	S	S	S			
Blackgum	M	M	M	M	S	S	S	M	M	S
Dogwood	M	M	M	M	M	M	M	R	R	M
Eastern redcedar	R	R	R	R	R	R		R		
Elm	R	S	R	S	S	S	S	S	M	S
Hackberry	R	M	R	M	S	S	S		S	S
Hawthorn	S	S	S	S	S	S	S	S	S	S
Hollies	M	M	M	R	M	M	M		R	M
Hickories	R	M	R	M	R	R	S			
Honeysuckle	M	M	M	M	R	R				
Hornbeam	S	S	S	S	R	R	S	R		
Locust	R	S	R	S	R	R	S	S		
Maple, red	M	S	M	S	M	M	M	S	R	R
Oak, red	S	S	S	S	S	S	S		S	S
Oak, White	S	S	S	S	S	S	S	S	S	S
Peppervine	S	S	S	S				S		
Persimmon	S	S	S	S	R	R		S	S	S
Pine	R	S	R	R	R	R	S	R		S
Privet	S	M	S	M	M	M		S		
Redbud	R	M	R	M			S	R	S	S
Sassafras	R	S	R	S	R	R		S	R	M
Sumac	S	S	S	S	S	S		S	S	S
Sweetgum	S	S	S	S	S	S	S	S		S
Trumpetcreeper	R	M	R	M						
Waxmyrtle	R	M	R	M	M	M	S			
Willow	S	S	S	S	S	S		S	S	S

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resource Conservation Service.

TABLE 3. FOREST STAND IMPROVEMENT - HERBICIDE USAGE

Post-planting grass and weed control in pine plantings

<u>TRADE NAME</u>	<u>PLANTS CONTROLLED</u>
Arsenal*	Broadleaf weeds, vines and grasses
Fusilade DX*	Grasses
Oust*	Broadleaf weed and grasses
Pronone*	Some weeds and grasses
Velpar*	Some weeds and grasses
Accord**	Weeds, vines and some grasses
Garlon 3A**	Broadleaf weeds
Garlon 4**	Broadleaf weeds
<u>Roundup**</u>	<u>Weeds, vines and some grasses</u>

Several tank mixes of the above are possible. See labels.

* Can be applied as over-the-top or directed sprays

** Apply only as carefully directed spray

Post-planting grass and weed control in hardwood plantings

<u>TRADE NAME</u>	<u>PLANTS CONTROLLED</u>
Fusilade DX*	Grasses
Poast (Vantage)*	Grasses

Basal bark spraysTRADE NAME

Arsenal
Chopper
Garlon 4
Weedone CB

InjectionTRADE NAME

Accord
Arsenal
Banvel CST
Garlon 3A
Pathway
Roundup
Tordon
2,4-D

CONSERVATION PRACTICE STANDARD

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resource Conservation Service.

NHCP, NRCS-TX
September 2001

APPROVAL AND CERTIFICATION

FOREST STAND IMPROVEMENT

(ACRES)

CODE 666

PRACTICE STANDARD APPROVED:

_____/s Susan Baggett_____

(State Forester)

____September 28, 2001_____

(date)

This practice standard is needed in the _____Field Office
Technical Guide.

(NRM/DC)

(date)

Certification:

Reviewed and determined adequate without need of a revision.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resource Conservation Service.

**NHCP,NRCS-TX
September 2001**