

## Chemical Stabilization (CHS)



Photo courtesy of Sunshine Supplies, Inc.

### Practice Description

Chemical Stabilization erosion control involves the use of products, including soil binders that help to hold the soil in place, thereby reducing soil particle detachment and short-term erosion caused by water and wind. Water-soluble polyacrylamide (PAM) is often used for this purpose. Other products may also provide this benefit. The products are typically applied with temporary seeding and or mulching on areas where the timely establishment of temporary erosion control is so critical that seeding and mulching need additional reinforcement.

### Planning Considerations

Chemical Stabilization products for surface stabilization are available in different formulations should be used in combination with other Best Management Practices. The use of seed and mulch should be considered for providing erosion protection beyond the life of the chemical or soil binder. If the area where Chemical Stabilization products have been applied is disturbed, the application will need to be repeated.

Following are additional considerations to enhance the use of or avoid problems:

- Use recommended setbacks (Buffer Zone) when applying near natural water bodies.

- Application delays between product mixing and application as well as ultraviolet light exposure may decrease the performance of some products.
- Products are generally not effective in concentrated flow areas.
- Seeded areas will also need mulch.
- It is important to closely follow manufacturer's recommendations on application procedures.
- Do not use products in a way that will be toxic to aquatic organisms.
- Requests to use products not approved for Chemical Stabilization on permitted sites should be made to the state environmental agency.

## Design Criteria

Application rates shall conform to manufacturer's guidelines for application.

The following specific criteria shall be followed:

- Chemical mixtures shall be environmentally benign, harmless to fish, wildlife, and plants, and shall be non-combustible.
- Users of chemical stabilization products shall follow all Material Safety Data Sheet requirements and manufacturer's recommendations. In the case of PAM, the use of a specific product should be based on the jar test with soil from the site and there should be appropriate measures at the site to ensure that PAM is not carried in stormwater emptying directly into natural waterbodies. This means that runoff should be flowing to settling sites such as sediment basins or sediment traps or be flowing over sites such as filter strips, straw or matting that serves as a collection site for the sediments.
- Additives such as fertilizers, solubility promoters or inhibitors, etc. to chemical stabilization products shall be non-toxic.
- The manufacturer or supplier shall provide written application methods. The application method shall ensure uniform coverage to the target and avoid drift to non-target areas including waters of the state. The manufacturer or supplier shall also provide written instructions to ensure proper safety, storage, and mixing of the product.

## Dune Sand Fence (DSF)



Photo courtesy of Alabama Department of Environmental Management

### Practice Description

A dune sand fence is a temporary barrier consisting of wooden slots installed across a dune landscape perpendicular to the prevailing wind. Dune sand fence reduces wind velocity at the ground surface and traps blowing sand. Sand fencing and appropriate planting materials can be used to build frontal ocean dunes to control beach erosion and flooding behind frontal dunes from wave overwash. Sand fence is applicable where sand can be trapped to enhance dune vegetation.

### Planning Considerations

Coastal beaches are subject to regulations from a variety of Federal, State, and local agencies including the requirements of the state Coastal Nonpoint Pollution Control Program and Coastal Zone Management Programs. Permits or other approval procedures must be requested and granted by all appropriate jurisdictions before work is performed.

Coastal areas are affected by many dynamic systems. Detailed studies are often required to determine the possible effects that may result from dune modifications. Environmental assessments are generally required including public review and comment.

Plans should include details to install an additional set of fences over the existing fence until the barrier dune has reached a protective height. Dune sand fences must be constructed in such a manner that impacts to nesting endangered sea turtles are minimized.

Dune sand fences are components of dune erosion control systems and are most effective when used with other practices including Dune Walkover and Dune Vegetation Planting.

The specific location of a sand fence is based on professional knowledge and experience considering the factors that relate to natural dune establishment and sustainability.

## **Design Criteria**

### *Scheduling*

Attempt to install sand fencing during the recommended planting periods for the associated dune vegetation plantings that are planned.

### *Site Preparation*

Plan to determine if underground utilities exist on the site, mark their location and locate fence lines and stakes to not damage the utilities.

Obstacles that will prevent installation of the sand fence will need to be removed before any work begins.

### *Installing the Dune Sand Fence*

Erect the sand fences a minimum of 100 feet (horizontal distance) from the Mean High Tide (MHT) line with two parallel lines or rows of fence approximately 30 feet apart. The rows should be roughly parallel to the water line and be as close as possible to a right angle to the prevailing winds. See Figure DSF-1 for a plan view of a conceptual erosion and sediment control system.

As the fences fill with sand, an additional set of fences should be planned to be placed over those that are filled until the barrier dune has reached a protective height. To widen an old dune, fencing should be set seaward at a distance of 15 feet from its current base.

### *Materials*

Use standard commercial 4-foot sand fences that consist of wooden slats wired together with spaces between the slats. The distance between slats is 1¼" or approximately equal to the slat width. The fence should be sound and free of decay, broken wire, and missing or broken slats.

The fence should be made from Grade A or better spruce with slats 1¼" wide and about 1¼" of space between laths or pickets. The 4-foot high fence should be woven between 5 two-wire cables of copper bearing, galvanized wire. The laths or pickets should be hot dipped in a red oxide weather resistant stain.

Wooden posts for fence support may be of pressure treated yellow pine or untreated black locust, red cedar, white cedar or other wood of equal life and

strength. Use standard fence posts at least 7 feet long with a diameter of 3” to 4”. Posts should be set at least 3 feet deep no further than 10 feet apart and not concreted in place. Four wire ties should be used to fasten the fence to the wood posts. Weave the fence between posts so that every other post will have fencing on the ocean side of posts. Tie wires should be no smaller than 12 gauge galvanized wire.

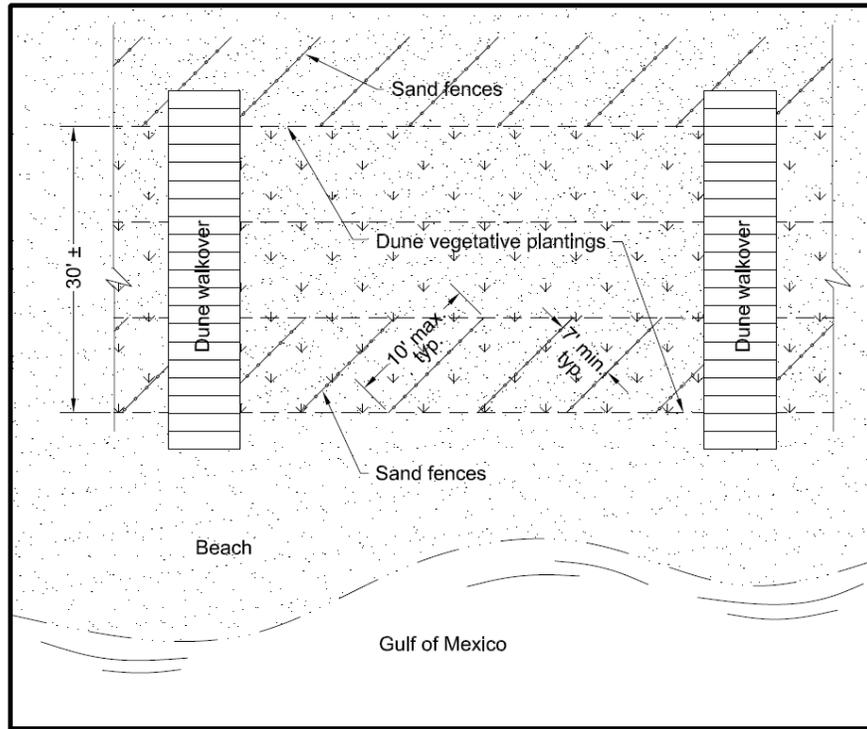


Figure DSF-1 Typical Dune Erosion Control System with Sand Fence

*Construction Verification*

Conduct inspections to determine that materials and installation meet plan specifications.

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## Dune Vegetation Planting (DVP)



Photo courtesy of Alabama Department of Environmental Management

### Practice Description

Dune vegetation planting is the establishment of perennial vegetation on dunes from seed or vegetative material. Perennial dune vegetation provides economical long-term erosion control and helps prevent sediment from leaving the site. This practice is used where vegetation is desired and appropriate to permanently stabilize the dune. Additional measures, such as crosswalks and barriers, are often needed to develop successful establishment of the vegetation.

### Planning Considerations

Coastal beaches are subject to regulations from a variety of Federal, State and local agencies. Permits must be requested and granted by all appropriate jurisdictions before work is performed.

Protection of dunes from human and vehicular traffic is essential if vegetation is to succeed.

There are only a few plant species that are tolerant of the stresses of the beach environment. Plants must be able to survive burial by blowing sand, sand blasting, salt spray, saltwater flooding, drought, heat, and low nutrient supply.

Mulch usually used with other seedings (straw, hay, netting, peg and twine, and asphalt) is not recommended due to the difficulty in applying and anchoring the mulch and its untidy appearance.

Supplemental water (irrigation) is usually required during the first growing season to obtain good plant survival.

## Design Criteria

### *Plant Materials*

Use commercially available plant materials/varieties that are adapted in Alabama for coastal dune stabilization. See the section Protecting the Coastal Dunes in Chapter 2, Table DVP-1 and the planting guides at the end of this practice for information to use in selecting plants.

Planting stock is available from commercial nurseries. Plants from 2-4" pots are generally adequate for most stabilization and building work. Smaller plants may be used on sites under ideal planting conditions or irrigation. Plants from pots larger than 4" are desirable only where aesthetics or traffic control is important, or erosion is extreme. Bare root stock dug from vigorous stands and planted when fresh gives survival and growth rates equal to potted materials. Unrooted stolons of bitter panicum may be cut after seed is mature and planted at 3 vertical cuttings per planting space or uncut stems in 3" to 4" deep furrows 12-18" apart. 'Atlantic' coastal panicgrass may be direct seeded at 15 pounds per acre, drilled or sowed in 2" deep furrows.

Table DVP-1 Commonly Used Plants for Dune Stabilization

Species	Plant Spacing	Preferred Planting Period*	Method
Sea Oats ( <i>Uniola paniculata</i> )	12 – 36"	March 1-June 1	Potted plants
Atlantic Coastal Panicgrass ( <i>Panicum amarum var-amarulum</i> )	12 – 36"	March 1- June 1	Seed or sprigs
Flageo Marshhay Cordgrass ( <i>Spartina patens</i> )	12 – 24"	March 1- June 1	Sprigs
Sharpe Marshhay Cordgrass ( <i>Spartina patens</i> )	12 – 24"	March 1- June 1	Sprigs
North PA Bitter Panicum ( <i>Panicum amarum</i> )	24 – 36"	March 1- June 1	Potted plants or bare root plugs
South PA Bitter Panicum ( <i>Panicum amarum</i> )	24 – 36"	March 1- June 1	Potted plants or bare root plugs

\* See planting guide for each species for more details on planting dates.

### *Site Preparation*

Tillage or liming is not required for planting on beach sand. Install the dune crossover structures, sand fences and the irrigation system prior to planting.

### *Planting Date*

Plant vegetative material from fall until early spring. See plant guides for more detailed information on each species. Plantings should be made from late winter to early spring.

### *Planting Depth*

Plants for the dunes should be planted at least 6-8" or deep enough to have adequate soil moisture at the time of planting.

Use freshly dug bare root tillers, rooted stem cuttings or nursery grown potted vegetative material.

Use a tree dibble, or spade to plant the vegetative material.

### *Spacing*

Plantings must consist of at least 10 feet (strips) of dune building vegetation. Wider areas may be considered based on the severity of the site. Herbaceous plant spacing ranges from 1-3 feet, but is typically 18" for 1-4" potted stock or bare root plugs of the same diameter.

### *1st Year Fertilization*

Initial fertilization is best done at planting with slow release complete fertilizer, such as 14-14-14, at a rate of 1 ounce per plant placed under the plant. Initial fertilization may also be provided with 200-300 pounds of mineral 13-13-13 per acre broadcast 6 weeks after planting.

### *2nd Year Fertilization*

Maintenance fertilization should be provided with 400 pounds of 13-13-13 per acre per year split in two applications during the growing season before September 1. Fertilization is recommended until the plants spread to provide complete cover and after storms damage stands.

### *Irrigation*

Supplemental water (irrigation) is usually needed on dune plantings to provide adequate moisture during the initial establishment period.



## PLANTING GUIDE

'Atlantic' Coastal panicgrass (*Panicum amarum* var. *amarulum*)

Description: A tall, robust, warm-season, perennial grass. Growth habit is upright and the plant looks like a bunch grass, although it produces short rhizomes that may result in lateral spread of 4 to 8 inches annually. Plants are 3 to 7 feet in height with multi-stemmed bluish-green leaves  $\frac{3}{4}$  to 1 inch wide by 12 to 20 inches long. Seed heads 4 to 8 feet in height are produced in late July through August or September and produce viable seed with strong seedling vigor.

- Native Habitat and Range: Coastal dunes throughout the North Atlantic and Gulf regions.
- Conservation Use: The principal use is in coastal dune erosion control. It is suitable for revegetating disturbed areas such as borrow and gravel pits and other areas with droughty and infertile conditions.
- Plant Materials: Seed and freshly dug root tillers (sprigs) are normally commercially available.
- Time of Planting: Plantings should be made from late winter until early spring and sprigs should be planted from November until March.
- Site Preparation and Seeding: Prepare a seedbed with tillage or drill seed and plant seed 2 inches deep. Surface seeding on sand dunes will likely not produce a successful stand. Use 10-15 pounds of seed per acre if planting and 20 pounds per acre if broadcasting.
- Planting Sprigs: Tillers (sprigs) should be planted in rows 6 to 8 feet apart and spaced about 18 inches apart in the rows. Tillers should be planted deep enough to be in moist soil (normally 4 to 10 inches) with the crown covered with  $\frac{1}{2}$  to 1 inch of soil packed firmly around each tiller. This type of planting requires about 5,000 tillers per acre. Closer spacing of rows will significantly increase the time of coverage.
- Fertilizer: Fertilize at the time of planting with 200 to 300 pounds of 10-10-10 per acre or equivalent a few weeks after planting. Top dress with similar applications in late June and late summer until the stand is established.
- Protect from damage by foot and vehicular traffic and remove debris.

## PLANTING GUIDE

'NORTHPA' and 'SOUTHPA' Bitter panicum (*Panicum amarum*)

**Description:** Perennial, warm season grass growing to a height of 7 feet with a growth habit ranging from erect to prostrate. The leaves are 1/4- to 1/2-inch wide, 7 to 20 inches long, smooth without hair, and bluish in color. This robust grass spreads slowly from short, strong rhizomes, forming open clumps. Small quantities of poor quality seed are produced on compact panicles 6 to 12 inches long and 2 to 4 inches wide.



*Bitter panicum*

- **Native Habitat and Range:** Coastal dunes and sandy shores from New Jersey to Florida and Texas.

- **Conservation Use:** The principal use is in coastal dune erosion control and it may have a role in stabilizing other dry, sterile areas such as roadsides and minespoils.

- **Site Preparation:** Generally none required.

- **Plant Material:** Potted and bare root plants are available commercially. Freshly dug bare root tillers, rooted stem cuttings, and unrooted stem cuttings can also be obtained from vigorous stands.

- **Time of Planting:** Late fall with stem cuttings; late winter or early spring with potted plants; late spring with young tillers (when it coincides with the rainy season).

- **Spacing:** Plant potted and bare root material in a grid pattern 2 feet apart in 2 to 3 foot staggered rows. Plant stem cuttings three to a hole 2 feet apart in 2 to 3 foot staggered rows.

- **Depth:** Place plants 4 to 10 inches, or deeper, in moist soil. Plant stem cuttings at a 45-degree angle, deep enough to bury several nodes and leaving the top 6 to 10 inches of stem exposed.

- **Fertilizer:** Place one ounce of slow release fertilizer such as \*Osmocote in each hole as material is planted, or apply 200 to 300 pounds of 10-10-10 per acre 3 to 4 weeks after planting. Apply this same rate annually in June and repeat in August, until the stand fills in the spacing.

- **Maintenance:** Restrict traffic and livestock. Overgrazing and high palatability were responsible for the decrease of this plant in the 19th century.

## PLANTING GUIDE

**'FLAGEO' Marshhay cordgrass** (*Spartina patens*)

**Description:** Perennial, warm season grass with erect stems, mostly less than 40 inches tall. It spreads by long slender rhizomes. Leaves are less than 1/8-inch wide and are sometimes flat, but usually roll inward from the edges with the upper surface inside. There are 2 to 7 spikes on the seedhead. These 3/4- to 2-inch spikes are born against or away from the stem.

**- Native Habitat and Range:** Salt marshes and sandy meadows from Quebec, Canada to Florida and Texas, and saline marshes inland from New York to Michigan.

**- Conservation Use:** Saltmeadow cordgrass is used for coastal erosion control in backdune areas, along tidal river banks, and on salt marshes above the high tide line. Inland uses include stabilizing waterways, gullies, roadsides, and minespoil and saline oil seep areas. The 'salt hay' is used as a mulch and fed to cattle.

**- Site Preparation:** None required, but removal of trash on tidal areas will prevent burial of plants.

**- Plant Material:** Potted plants or bare root stock are available commercially and from vigorous stands. Use transplants that have 5 to 10 stems each.

**- Time of Planting:** Late winter and early spring, and at the beginning of the rainy season in Florida.

**- Spacing:** Place plants 12 to 24 inches apart, depending on severity of site.

**- Depth:** Plant 4 to 8 inches, or deeper, in moist soil.

**- Fertilizer:** On critical area plantings, place one ounce of slow release fertilizer such as \*Osmocote per plant at planting, or apply 200 to 300 pounds of 10-10-10 per acre several weeks after planting. Apply 200 to 300 pounds of 10-10-10 per acre annually in June until the stand fills in the spacing. Do not fertilize rangeland plantings.

**- Maintenance:** Minimize foot traffic and remove debris from planting.



*Marshhay cordgrass*

PLANTING GUIDE

**Sea oats (*Uniola paniculata*)**

**Description:** Perennial, erect, strong, rhizomatous, colonizing grasses native to the coastal sands and dunes of Florida and the southeastern United States. This grass forms in dense, rather stiff bunches 40 to 60 inches tall and 30 to 120 inches in diameter. Leaves are less than 1/2-inch in width, 16 to 28 inches long, and are usually flat. Leaves are rolled or involute on drying. Panicles of the seedhead are 8 to 12 inches long with numerous spikelets less than 1-inch long, each having 8 to 15 florets. Very little to no seed is produced by most seedheads and is readily eaten by birds. Only rarely is reproduction by natural germination of seed observed. Lateral spread and colony increase is accomplished by moderate to strong rhizome development.



*Sea oats*

- **Native Habitat and Range:** Sand dunes from southern Virginia to Florida and Texas.

- **Conservation Use:** Critical area stabilization of saline coastal sands and sand dunes.

- **Site Preparation:** Generally none required.

- **Plant Material:** Potted plants and bare root stock are available commercially and from vigorous stands. Use transplants with a minimum 30-inch stem height.

- **Time of Planting:** Late winter to early spring, and at the beginning of the rainy season in Florida.

- **Spacing:** Place plants 12 to 36 inches apart, depending on the pot size and severity of the site. Use 18-inch spacing for an average site using 2- to 4-inch pots.

- **Depth:** Place plants 8 to 12 inches, or deeper, in moist soil.

- **Fertilizer:** Place one ounce of slow release fertilizer such as \**Osmocote* in each hole as material is planted, or apply 200 to 300 pounds of 10-10-10 per acre 3 to 4 weeks after planting. To maintain and/or develop the stand, apply 200 to 300 pounds of 10-10-10 (or equivalent) per acre annually June 1 to June 15 and repeated August 1 to August 15.

- **Maintenance:** Minimize foot traffic and remove debris from planting.

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## Dune Walkover (DW)



Photo courtesy of Alabama Department of Environmental Management

### Practice Description

A dune walkover is a measure consisting of elevated walks that are constructed across the dune system. It provides pedestrian access to the beach area and protects the dunes from erosion. It is applicable on sparsely vegetated dunes where pedestrian access adversely impacts the vegetation and on dunes with adequate vegetation where pedestrian access is planned and vegetation is needed to protect the dunes from erosion.

### Planning Considerations

Coastal beaches are subject to regulations from a variety of Federal, State, and local agencies. Permits must be requested and granted by all appropriate jurisdictions before work is performed.

Coastal areas are affected by many dynamic systems. Detailed studies are often required to determine the possible effects that may result from dune modifications. Environmental assessments are generally required including public review and comment.

Dune walkovers are components of dune erosion control systems and are most effective when used with other practices including Dune Vegetation Planting and Dune Sand Fence.

## Design Criteria

### *Scheduling*

Attempt to construct dune walkovers during the recommended planting periods for the associated dune vegetation plantings that are planned.

### *Site Preparation*

Ensure that all necessary materials are on the site before any work begins.

### *Construction*

Develop construction plans based on sound building concepts that meet the requirements of the Coastal Nonpoint Pollution Control Program. Plans for Dune walkovers should consider the following guidance.

- Locate cross-over structures at sites that consider both people and site protection concerns.
- All load-bearing connections to the post should be made by bolts or lag screws.
- Utilize appropriate standard drawings developed specifically for the coastal zone if they are available.

### *Materials*

All lumber materials should be pressure treated no.2 yellow pine in accordance with American Wood Preservers Association standard C-2. Treatment should be to 0.40 lbs. CCA per cubic foot, or greater or other copper-based preservatives with treatment rates recommended for ground contact applications.

All nuts, bolts, washers, nails, and other hardware should be hot dipped galvanized metal or other corrosion resistant fasteners.

### *Erosion Control*

Plan to minimize the size of all disturbed areas and vegetate as soon as each phase of construction is complete.

Develop a planting plan that utilizes adapted species. See Figure DCW-1 and Dune Vegetation Planting practice for details to incorporate into the planting plan.

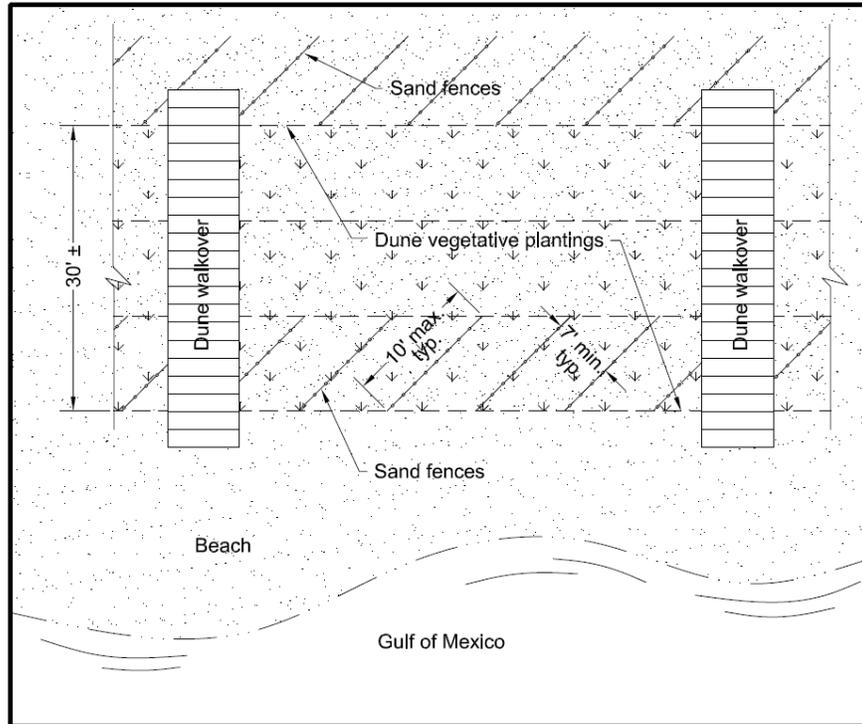


Figure DCW-1 Typical Dune Walkover System

*Safety*

Specify that equipment used in construction should be free of leaks of fuel and hydraulic fluids.

Plan for fencing and warning signs if trespassing is likely during construction.

*Construction Verification*

Plan for construction inspections to determine that materials and construction meet plan specifications.

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## Dust Control (DC)



### Practice Description

Dust control includes a wide range of techniques that prevent or reduce movement of wind-borne soil particles (dust) during land disturbing activities. This practice applies to construction routes and other disturbed areas where on-site and off-site damage or hazards may occur if dust is not controlled.

### Planning Considerations

Construction activities that disturb soil can be a significant source of air pollution. Large quantities of dust can be generated, especially in “heavy” construction activities such as land grading for road construction and commercial, industrial or subdivision development.

The scheduling of construction operations so that the least amount of area is disturbed at one time is important in planning for dust control.

The greatest dust problems occur during dry periods. Therefore, to the extent practicable do not expose large areas of bare soil during drought conditions.

Where wind erosion is a potential cause of dust problems, preserving vegetation should be considered as a passive measure. Leave undisturbed buffer areas between graded areas wherever possible.

Installing temporary or permanent surface stabilization measures immediately after completing land grading will minimize dust problems.

## Design Criteria

### *Permanent Methods*

#### *Vegetative Cover*

For disturbed areas not subject to traffic, vegetation provides the most practical method of dust control. Establish vegetative cover according to the Permanent Seeding or Temporary Seeding practice.

#### *Topsoiling*

This entails covering the surface with less erosive soil material. See Topsoiling practice for guidance.

#### *Stone*

Stone used to stabilize construction roads can also be effective for dust control. Stone should be spread a minimum of 6" thick over construction roads in the disturbed area. For heavily traveled roads or roads subjected to heavy loads the stone thickness should be 8" to 10". A non-woven geotextile meeting the minimum requirements of ASSHTO M288 should be used under the stone.

### *Temporary Methods*

#### *Mulches*

Mulch offers a fast, effective means of controlling dust when properly applied. See Mulching practice for guidelines for planning and installing the practice.

#### *Temporary Vegetative Cover*

For disturbed areas where no activity is anticipated for 14 days or longer, temporary seeding can effectively control dust. Establish vegetative cover according to Temporary Seeding practice guidelines.

#### *Calcium Chloride*

Calcium chloride may be applied by mechanical spreader as loose, dry granules or flakes at a rate that keeps the surface moist but not so high as to cause water pollution or plant damage. Sites may need to be retreated because the product degrades over time.

*Spray-on Adhesives*

Spray-on adhesives may be used on mineral soils for dust control. Traffic must be kept off treated areas to prevent the product from becoming ineffective. Examples of spray-on adhesives for use in dust control are listed in Table DC-1.

Table DC-1 Spray-on Adhesives for Dust Control on Mineral Soil

<b>Material</b>	<b>Water Dilution</b>	<b>Type of Nozzle</b>	<b>Apply Gal/Ac</b>
<b>Anionic Asphalt Emulsion</b>	7:1	Coarse Spray	1,200
<b>Latex Emulsion</b>	12.5:1	Fine Spray	235
<b>Resin In Water</b>	4:1	Fine Spray	300

*Chemical Stabilization (CHS)*

Chemical products are available for use on mineral soils for dust control. Traffic must be often kept off treated areas to prevent the product from becoming ineffective. The manufacturer or supplier shall provide written application methods. The application method shall ensure uniform coverage to the target and avoid drift to non-target areas including waters of the State. The manufacturer or supplier shall also provide written instructions to ensure proper safety, storage, and mixing of the product. Refer to the Planning Considerations for the Chemical Stabilization practice for planning consideration before deciding to use these type products.

*Sprinkling or Irrigation*

Sprinkling is especially effective for dust control on haul roads and other traffic routes. Sprinkle the site until the surface is wet. Repeat as needed. Also bare areas may be kept wet with irrigation to control dust as an emergency treatment.

*Tillage*

Tillage is used to roughen the site and bring clods and moist soil to the surface. This is a temporary emergency measure that can be used on large open disturbed areas as soon as soil blowing starts. Begin tilling on the windward edge of the site. The depth of tillage is determined by the depth to moist soil and the amount of moist soil desired at the surface. In sandy soils, the depth to moist soil may make tillage impractical.

*Barriers*

A board fence, wind fence, sediment fence, hay bales, or similar barriers can control air currents and blowing soil. Place barriers perpendicular to prevailing air currents at intervals about 15 times the barrier height.

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## Erosion Control Blanket (ECB)



Photo courtesy of Environmental Plans and Review Section, Development Department, DeKalb County, GA.

### Practice Description

To aid in controlling erosion on critical areas by providing a protective cover made of straw, jute, wood or other plant fibers; plastic, nylon, paper or cotton. This practice is best utilized on slopes and channels where the erosion hazard is high, and plant growth is likely to be too slow to provide adequate protective cover. Erosion control blankets are typically used as an alternative to mulching but can also be used to provide structural erosion protection. Some important factors in the choice of a blanket are: soil conditions, steepness of slope, length of slope, type and duration of protection required to establish desired vegetation, and probable shear stress.

### Planning Considerations

Care must be taken to choose the type of blanket that is most appropriate for the specific project needs. Fourteen classes of erosion control blankets are included in this practice and are from the list developed by the Erosion Control Technology Council (ECTC). Manufacturer's instructions and recommendations, as well as a site visit by the qualified design professional and site plan reviewer are highly recommended to determine a product's appropriateness.

Note: The Alabama Department of Transportation (ALDOT) identifies Rolled and Hydraulic Erosion Control Products based on performance. Description of ALDOT types can be found in Section 659 of their Standard Specifications for Highway

Construction. ALDOT recognizes some Hydraulic Erosion Control Products equal in performance to Rolled Products.

### *Temporary Erosion Control Blankets*

Benefits of using temporary erosion control blankets include the following:

- Protection of the seed and soil from raindrop impact and subsequent displacement.
- Thermal consistency and moisture retention for the seedbed area.
- Stronger and faster germination of grasses and legumes.
- Spreading stormwater runoff to prevent rill erosion of slopes.
- Prevention of sloughing of topsoil added to steeper slopes.

Because temporary blankets will deteriorate in a short period of time, they provide no enduring reduction in erosion potential.

### *Permanent Erosion Control Blankets*

Permanent erosion control blankets are also known as permanent soil reinforcing mats or turf reinforcement mats. Roots penetrate and become entangled in the matrix, forming a continuous anchorage for surface growth and promoting enhanced energy dissipation.

Benefits of using permanent erosion control blankets, in addition to the benefits gained from using a temporary blanket include the following:

- Sediment from stormwater flows is deposited in the matrix providing a fine soil growth medium for the development of roots.
- In stormwater channels, blankets and the vegetative root system form an erosion resistant cover which resists hydraulic uplift and shear forces of channel flows.

Tables ECB-1 and ECB-2 give typical applications of the different classes of erosion control blankets.

## **Design Criteria**

### *General*

All blankets shall be nontoxic to vegetation and to the germination of seed and shall not be injurious to the unprotected skin of humans. Erosion control products shall be of sufficient strength to hold the prepared ground and, if applicable, cover material (mulch, sod, etc.) in place until an acceptable growth of natural or planted material is established.

Erosion control products shall be identified by a classification designation (Class 1.A, 1.B, 1.C, etc.) where the classification is based on the physical properties of the product.

Table ECB-1 Temporary Erosion Control Blanket Classes and Applications

Class	Application
1.A	Designed for use on geotechnically stable slopes with gradients up to 5:1 and channels with shear stresses up to .25 pounds per square foot.
1.B	Designed for use on geotechnically stable slopes with gradients up to 4:1 and channels with shear stresses up to .5 pounds per square foot.
1.C	Designed for use on geotechnically stable slopes with gradients up to 3:1 and channels with shear stresses up to 1.5 pounds per square foot.
1.D	Designed for use on geotechnically stable slopes with gradients up to 2:1 and channels with shear stresses up to 1.75 pounds per square foot.
2.A	Designed for use on geotechnically stable slopes with gradients up to 5:1 and channels with shear stresses up to .25 pounds per square foot.
2.B	Designed for use on geotechnically stable slopes with gradients up to 4:1 and channels with shear stresses up to .5 pounds per square foot.
2.C	Designed for use on geotechnically stable slopes with gradients up to 3:1 and channels with shear stresses up to 1.5 pounds per square foot.
2.D	Designed for use on geotechnically stable slopes with gradients up to 2:1 and channels with shear stresses up to 1.75 pounds per square foot.
3.A	Designed for use on geotechnically stable slopes with gradients up to 5:1 and channels with shear stresses up to .25 pounds per square foot.
3.B	Designed for use on geotechnically stable slopes with gradients up to 1.5:1 and channels with shear stresses up to 2 pounds per square foot.
4	Designed for use on geotechnically stable slopes with gradients up to 1:1 and channels with shear stresses up to 2.25 pounds per square foot.

Table ECB-2 Permanent Erosion Control Blanket Classes and Applications

Class	Application
5.A	Designed for use on geotechnically stable slopes with gradients up to 0.5:1 and channels with shear stresses up to 6 pounds per square foot.
5.B	Designed for use on geotechnically stable slopes with gradients up to 0.5:1 and channels with shear stresses up to 8 pounds per square foot.
5.C	Designed for use on geotechnically stable slopes with gradients up to 0.5:1 and channels with shear stresses up to 10 pounds per square foot.

*Class Designations and Durability*

Erosion control products shall have the configurations and durability as shown in Tables ECB-3 and ECB-4.

Table ECB-3 Typical Configuration and Durability of Temporary Erosion Control Blankets

Class Designation	Usual Configuration	Typical Durability
1.A Ultra-short term mulch control netting	Mulch control netting consisting of rapidly degrading photodegradable synthetic mesh or woven biodegradable natural fiber netting.	3 months
1.B Ultra-short term netless erosion control blanket	An erosion control blanket composed of processed rapidly degrading natural and/or polymer fibers mechanically interlocked or chemically adhered together to form a continuous matrix.	3 months
1.C Ultra-short term single net erosion control blanket or open weave textile	An erosion control blanket composed of processed degradable natural and/or polymer fibers mechanically bound together by a single rapidly degrading, synthetic or natural fiber netting to form a continuous matrix. Or an open weave textile composed of processed rapidly degrading natural or polymer yarns or twines woven into a continuous matrix.	3 months
1.D Ultra-short term double net erosion control blankets	An erosion control blanket composed of processed natural or polymer fibers mechanically bound between 2 rapidly degrading, synthetic or natural fiber nettings to form a continuous matrix.	3 months
2.A Short-term mulch control netting	Mulch control netting consisting of photodegradable synthetic mesh or woven biodegradable natural fiber netting.	12 months
2.B Short-term netless erosion control blanket	An erosion control blanket composed of processed degradable natural and/or polymer fibers mechanically interlocked or chemically adhered together to form a continuous matrix.	12 months
2.C Short-term single net erosion control blanket or open weave textile	An erosion control blanket composed of processed degradable natural and/or polymer fibers mechanically bound together by a single degradable, synthetic or natural fiber netting to form a continuous matrix. Or an open weave textile composed of processed degradable natural or polymer yarns or twines woven into a continuous matrix.	12 months
2.D Short-term double net erosion control blanket	An erosion control blanket composed of processed natural or polymer fibers mechanically bound between 2 synthetic or natural fiber nettings to form a continuous matrix.	12 months
3.A Extended-term mulch control netting	Mulch control netting consisting of a slow degrading synthetic mesh or woven natural fiber netting.	24 months
3.B Extended-term erosion control blanket or open weave textile	An erosion control blanket composed of processed slow degrading natural and/or polymer fibers mechanically bound together between 2 slow degrading synthetic or natural fiber nettings to form a continuous matrix. Or an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix.	24 months
4 Long-term erosion control blanket or open weave textile	An erosion control blanket composed of processed slow degrading natural and/or polymer fibers mechanically bound together between 2 slow degrading synthetic or natural fiber nettings to form a continuous matrix. Or an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix.	36 months

Table ECB-4 Typical Configuration and Durability of Permanent Erosion Control Blankets

Class Designation	Usual Configuration	Typical Durability
5.A Permanent turf reinforcement mat	A non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and vegetation reinforcement.	Permanent
5.B Permanent turf reinforcement mat	A non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and vegetation reinforcement.	Permanent
5.C Permanent turf reinforcement mat	A non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and vegetation reinforcement.	Permanent

### *Materials Physical Requirements*

A properly designed erosion control blanket installation requires selection of a product manufactured with physical properties to withstand the stresses the product will be subjected to for the design life of the product. Table ECB-5 gives the minimum physical requirements for each class of blanket.

### *Product Placement*

The erosion control product should be placed immediately after completion of the preparation of the area where the product will be placed.

Follow the manufacturer's recommendations for installation or use the following instructions. If there is a conflict, follow the manufacturer's recommendations. Strips shall be rolled out parallel to the direction of flow, in flumes and ditches. On steep slopes, strips shall be rolled out in the direction of flow to reduce rill erosion. When 2 or more strips are required to cover an area, they shall overlap at least 3" (75 mm); however, some type blankets will not require lapping but are to be butted together and stapled with half of each staple located in each of the adjoining blankets. Ends of strips shall overlap at least 6" (150 mm) with the upgrade section on top. The upslope end (anchor slot) of each strip shall be buried in 6" (150 mm) vertical slots, and soil tamped firmly against it. When, in the opinion of the qualified design professional, that conditions warrant, any other edge exposed to excessive flow shall be buried as noted above. The erosion control product shall be spread evenly and smoothly, and most importantly, shall be in contact with the soil at all points. The product should not be stretched tight in such a manner that the material "tents" over the soil surface. If the manufacturer's recommendations for installation of the erosion control product are different than those given here, the Contractor will be required to follow the more stringent of the two.

Table ECB-5 Minimum Physical Requirements For Erosion Control Blankets

Class	Property				
	Minimum Tensile Strength (pounds/ft.) (ASTM D 4595) <sup>1</sup>	Minimum Permissible Shear Stress (pounds/sq. ft.) (ASTM D 6460) <sup>2, 5</sup>	Maximum "C" Factor for Temporary Products (ASTM D 6459) <sup>3, 5</sup>	UV Stability (Minimum % tensile retention) for Permanent Products (ASTM D 4355) (500 hour exp.)	Minimum Thickness (inches) For Permanent Products (ASTM D 6525) <sup>4</sup>
1.A <sup>6</sup>	5	0.25	0.10 @ 5:1	N/A	N/A
1.B	5	0.50	0.10 @ 4:1	N/A	N/A
1.C	50	1.50	0.15 @ 3:1	N/A	N/A
1.D	75	1.75	0.20 @ 2:1	N/A	N/A
2.A <sup>6</sup>	5	0.25	0.10 @ 5:1	N/A	N/A
2.B	5	0.50	0.10 @ 4:1	N/A	N/A
2.C	50	1.50	0.15 @ 3:1	N/A	N/A
2.D	75	1.75	0.20 @ 2:1	N/A	N/A
3.A <sup>6</sup>	25	0.25	0.10 @ 5:1	N/A	N/A
3.B	100	2.00	0.25 @ 1.5:1	N/A	N/A
4	125	2.25	0.25 @ 1:1	N/A	N/A
5.A <sup>7</sup>	125	6.00	N/A	80	0.25
5.B <sup>7</sup>	150	8.00	N/A	80	0.25
5.C <sup>7</sup>	175	10.00	N/A	80	0.25

- 1 Minimum average roll values, machine direction. For turf reinforcement mats used in field conditions with high loading and/or high survivability requirements tensile strengths of 3000 pounds/ft or greater.
- 2 Minimum shear stress the rolled erosion control products or turf reinforcement mats can sustain without physical damage or excess erosion (>.5" of soil loss) during a 30 minute flow event in large scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using Erosion Control Technology Council Test Method no.3. For temporary products the permissible shear stress levels were established for each class based on historical experience with products characterized by Manning's roughness coefficients in the range of 0.03 to 0.05.
- 3 "C" factor calculated as ratio of soil loss from rolled erosion control product protected slope (tested at the specified gradient) to soil loss from unprotected (control) plot in large scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using Erosion Control Technology Council Test Method no.2.
- 4 Minimum average roll values.
- 5 Other large scale test methods may be determined acceptable.
- 6 Obtain maximum "C" factor and allowable shear stress for mulch control nettings with the netting used in conjunction with pre-applied mulch material.
- 7 For turf reinforcement mats containing degradable components, all property values must be obtained on the non-degradable portion of the matting alone.

Check slots shall be placed so that one check slot, junction slot, or anchor slot of the erosion control product occurs every 50 feet (15 m) of slope. Check slots shall be made by burying a tight fold of the product vertically in the soil a minimum of 6" (150 mm) deep, and tamping and stapling the fold in place. If the manufacturer's recommendations for the installation of check slots are different than those given here, the Contractor will be required to follow the more stringent of the two.

Each strip shall be stapled in 3 rows, at each edge and the center, with staples spaced not more than 3 feet (900 mm) longitudinally. Check slots and ends of strips shall be stapled at 9" (225 mm) intervals across their width.

For temporary blankets, staples should be U-shaped wire with an 11 gauge thickness or greater. Staples should be of sufficient thickness for soil penetration without undue distortion. The legs of the staples shall be at least 6" long with a crown of 1". Appropriate biodegradable staples can be used in lieu of wire staples.

Permanent blankets shall be anchored in one of two ways. Blankets can be anchored using sound wood stakes, 1" by 3" stock sawn in a triangular shape. The length of the stakes shall be from 12" to 18" depending upon the soil compaction at the site. Stakes shall be installed on 4 feet centers along each edge of the blanket. Blankets can also be anchored using U shaped staples of 11 gauge steel or greater with a minimum leg length of 8" and a 2" crown.

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## Groundskeeping (GK)



### Practice Description

Groundskeeping, or “good housekeeping”, describes the various activities and measures, in addition to the specific practices used for erosion and sediment control that are essential during construction for the protection of environmental quality. Groundskeeping is applicable at all construction sites.

### Planning Considerations

In addition to the sediment and erosion control practices included in the Handbook that deal directly with sediment and erosion control, some general groundskeeping practices are essential to the pollution prevention aspect of a Stormwater Pollution Prevention Plan. Groundskeeping addresses these practices. Included in the practice are the following different areas:

- Inspection and Maintenance Procedures
- Materials Inventory
- Spill Prevention and Material Management Practices
- Spill Controls
- Hazardous Products
- Air Emissions (excessive odor)
- Other Good Groundskeeping Practices (i.e. fugitive spray, excessive noise and aesthetics)

## Design Criteria

### *Inspection and Maintenance Procedures*

The following inspection and maintenance procedures need to be followed to maintain adequate sediment and erosion controls:

- All control measures need to be inspected at least once per week and following any accumulation of rainfall of 3/4" or more within a 24-hour period. A more frequent inspection interval may be required by either a permitting agency or a permittee.
- All measures need to be maintained in good working order. If a repair is necessary, it should be initiated within 24 hours of report.
- Silt fence and straw bales need to be inspected weekly for proper anchorage and leakage underneath. Silt fencing should also be inspected for tears.
- Built-up sediment needs to be removed from silt barriers when it has reached 1/2 of the height of the barrier. Sediment needs to be placed in a stabilized site to prevent re-entry into the same site or another entrapment area.
- Sediment basins need to be inspected for depth of sediment on a monthly basis and built up sediment needs to be removed when 1/2 of the basin volume is filled.
- Temporary and permanent seeding and plantings need to be inspected for bare spots, washouts and unhealthy growth. A person should be designated to be responsible for maintaining planted areas until there is a uniform stand with 85% ground cover and growth has reached 1" in height.

### *Materials Inventory*

A materials list should be compiled for items that will be stored outside on the site during construction. For example:

- \_\_\_\_\_ Pipe, fittings and joint compounds for underground utility piping
- \_\_\_\_\_ Gravel and stone bedding material
- \_\_\_\_\_ Concrete forming materials
- \_\_\_\_\_ Other (specify) \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

*Note: Fuels, oils and other petroleum products; forming oils and compounds; fertilizers; pesticides; strippers; detergents; cleaners; or any other hazardous or toxic compounds should not be stored outside on the site unless specifically agreed upon by all responsible parties, including those persons responsible for enforcing local ordinances and policies. On-site storage should meet all local, state and federal rules regarding secondary containment. Additionally, local ordinances may require fencing and security measures for storage of these products.*

## *Spill Prevention and Material Management Practices*

### *Petroleum Products*

All vehicles kept on the site need to be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage. A Spill Prevention Control and Countermeasures (SPCC) plan should be developed for the facility to address the safe storage, handling and clean-up of petroleum products and other chemicals. Petroleum products should be stored in tightly sealed containers, which are clearly labeled. If petroleum products are stored on site, a secondary containment facility will be required if the cumulative storage capacity of all tanks, greater than 55 gallons, at the site exceeds 1,320 gallons. Any asphalt substances used on-site should be applied according to the manufacturer's recommendations.

### *Fueling & Servicing*

No fueling, servicing, maintenance, or repair of equipment or machinery should be done within 50 feet of a stream, or within 100 feet of a stream classified for public water supply (PWS) or Outstanding Alabama Water (OAW), or designated as an Outstanding National Resource Water (ONRW), or a sinkhole.

### *Mud Tracking*

A stabilized construction entrance needs to be designated on the plan. The practice Construction Exit Pad provides design details for planning such an entrance.

Only designated entrances should be used for construction access to the site. The General Contractor should be responsible for keeping mud cleaned from adjoining streets on a daily basis if needed.

### *Concrete Trucks*

Concrete trucks should be allowed to wash only in locations where discharge is appropriately treated to meet applicable regulatory requirements. It is not permissible to discharge concrete wash directly to streams or storm drains. Concrete wash can contain sediment, as well as, alkalinity and chemical additives that could be harmful to fish, stream bottom macroinvertebrates and wildlife.

### *Disposal of Oil*

No fuels, oils, lubricants, solvents, or other hazardous materials can be disposed of on the site. All hazardous material must be properly disposed of in accordance with State law.

### *Trash/Solid Waste*

The General Contractor is responsible for disposing of all solid waste from the site in accordance with State law. Dumpsters or other collection facilities must be provided as needed. Solid waste may not be buried on the site.

### *Sanitary Waste*

The General Contractor is responsible for providing sanitary facilities on the site. Sanitary waste may be disposed only in locations having a State permit. Portable toilets should be located so that accidental spills will not discharge into a storm sewer or concentrated flow area.

### *Other Discharges*

Water for pressure testing sanitary sewers, flushing water lines, sand blasting, concrete cleansing, etc., may be discharged only in approved areas. Discharge of hydrostatic test water may require additional permitting, particularly if chlorinated public water is used.

## *Spill Controls*

In addition to the good housekeeping practices and material management practices listed previously, the following procedures need to be followed for spill prevention and clean-up:

- Manufacturer's recommended methods for spill cleanup needs to be clearly posted and site personnel need to be made aware of the procedures and the location of the information and cleanup supplies. Refer to material safety data sheets (Material Safety Data Sheet).
- Material and equipment necessary for spill cleanup needs to be kept in the material storage area on-site. Equipment and materials include, but are not be limited to; brooms, dust pans, mops, rags, gloves, goggles, absorbent clay (kitty litter), sand, sawdust, absorbent mats, and plastic and metal trash containers specifically for this purpose.
- All spills need to be cleaned up immediately after discovery and properly containerized for proper disposal. Burial is not acceptable.
- The spill area must be kept well ventilated and personnel need to wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
- Spills of toxic or hazardous material must be reported immediately to the appropriate state or local government agency, regardless of the size.

- The spill prevention plan needs to be adjusted to include measures to prevent this type of spill from being repeated, and the plan needs to show how to clean up the spill if another one does occur.

### *Contaminated Soils*

Removal of contaminated soils and underground storage tanks should be based on information provided by the Alabama Department of Environmental Management following a proper site assessment.

### *Hazardous Products*

- Products must be kept in original containers unless they are not resealable. If product is transferred to a new container, it must be properly marked and labeled.
- Original labels and material safety data sheets should be retained.
- If surplus product must be disposed, disposal must be done in accordance with Alabama Department of Environmental Management regulations.

### *Air Emissions*

#### *Burning*

Burning on the site may require a permit from the Alabama Forestry Commission. County or city ordinances may also apply. Starting disposal fires with diesel fuel or old tires is not a recommended practice. The use of burn pits with fans to generate hot disposal fires decreases the fire disposal time and minimizes smoke.

#### *Dust Control*

Apply measures that minimize dust. Stabilizing areas with mulch as soon as possible can minimize dust. Watering should be provided in unstabilized areas.

### *Other Good Groundskeeping Practices*

The following good housekeeping practices also need to be followed during the construction of the project:

- An effort should be made to store only enough products to do the job.
- All materials stored on-site should be stored in a neat, orderly manner in their appropriate containers and, if possible, under a roof or other enclosure.
- Products should be kept in their original containers with the original manufacturer's label.

- Whenever possible, all of a product should be used up before disposing of the container.
- Manufacturer's recommendations for proper use and disposal must be followed (see Material Safety Data Sheet).
- The site superintendent should inspect daily to ensure proper usage, storage and disposal of materials.
- Fertilizers need to be applied only in the minimum amounts recommended by the manufacturer.
- All paint containers need to be tightly sealed and stored when not required for use. Excess paint shall not be dumped into the storm sewer system but should be properly disposed of according to manufacturer's instructions (see Material Safety Data Sheet) and State regulations.
- The site should be kept clean and well groomed (trash picked up regularly, weeds mowed and signs maintained).
- Offsite fugitive spray from dust control, sand blasting and pressure washing must be minimized to the extent possible.
- Locate activities that generate odors and noise as far from surrounding properties as possible (this item includes portable toilets burn sites, fueling areas, equipment repair areas and dumpsters).

## Mulching (MU)



### Practice Description

Mulching is the application of plant residues such as straw or other suitable fibrous materials to the soil surface. Mulch protects the soil surface from the erosive force of raindrop impact and reduces the velocity of overland flow. It helps seedlings germinate and grow by conserving moisture, protecting against temperature extremes and controlling weeds. Mulch also maintains the infiltration capacity of the soil. Mulch can be applied to seeded areas to help establish plant cover. It can also be used in unseeded areas to protect against erosion over the winter or until final grading and shaping can be accomplished except in areas with concentrated flow.

### Planning Considerations

Surface mulch is the most effective, practical means of controlling runoff and erosion on disturbed land prior to vegetation establishment. Mulch absorbs the energy associated with raindrops and thereby minimizes soil particle detachment, which is the initiation step of erosion.

Mulch also reduces soil moisture loss by evaporation, prevents crusting and sealing of the soil surface, moderates soil temperatures, and provides a suitable microclimate for seed germination.

Organic mulches such as straw, wood chips and shredded bark have been found to be very effective mulch materials. Materials containing weed and grass seeds which may compete with establishing vegetation should not be used. Also, decomposition of some wood products can tie up significant amounts of soil nitrogen, making it necessary to modify fertilization rates or add fertilizer with the mulch.

Hydraulic Erosion Control Products (HECPs) as defined by the Erosion Control Technology Council (ECTC) can also be used as effective mulch applications. HECPs are designated as 5 different types based on product characteristics and performance. Information from the ECTC table dated August 2010 is provided as Table MU-1. To ensure that you use the most valid information refer to the latest HECP specifications provided by the ECTC or the manufacturer's recommendation. The Alabama Department of Transportation (ALDOT) characterizes mulches based on performance levels identified in Sections 656 and 659 of their Standard Specifications for Highway Construction.

The choice of materials for mulching should be based on soil conditions, season, type of vegetation to establish, and size of the area. Properly applied and tacked mulch is always beneficial. Mulching is especially important when conditions of germination are not optimum, such as midsummer and early winter, and on difficult sites such as cut slopes, fill slopes and droughty soils.

Straw has traditionally been the most commonly used mulching material in conjunction with seeding. Wheat straw is the mostly commonly used straw, and can be spread by hand or with a mulch blower. If the site is susceptible to blowing wind, the straw should be tacked down with a tackifier, or a crimper to prevent loss.

Wood chips are suitable for areas that will not be closely mowed, and around ornamental plantings. Chips do not require tacking. Because they decompose slowly they must be treated with 12 pounds of nitrogen per ton to prevent nutrient deficiency in plants. They can be an inexpensive mulch if the chips are obtained from trees cleared on the site.

Compost, peanut hulls, and pine straw are organic materials that potentially make excellent mulches but may only be available locally or seasonally. Creative use of these materials may reduce costs.

Jute mesh or the various types of netting is very effective in holding mulch in place on waterways and slopes before grasses become established.

Erosion control blankets promote seedling growth in the same way as organic mulches and are suited for use in areas with concentrated flows (see Erosion Control Blanket practice).

Table MU-1 Hydraulic Erosion Control Products (HECP) Specification Chart <sup>1</sup>

Hydraulic Erosion Control							
Type HECP <sup>2</sup>	Term	Functional Longevity <sup>3</sup>	Typical Application Rates Lbs/acre (kg/ha)	Typical Maximum Slope Gradient (H:V)	Maximum Uninterrupted Slope Length (ft)	Maximum C Factor <sup>4, 5</sup> (3:1 test)	Minimum Vegetation Establishment <sup>6</sup>
1	Ultra Short	1 month	1500—2500 (1700—2800)	≤ 4:1	20	0.75	150 %
2	Short Term	2 month	2000—3000 (2250—3400)	≤ 3:1	25	0.5	150 %
3	Moderate	3 month	2000—3500 (2250—3900)	≤ 2:1	50	0.15	200 %
4	Extended Term	6 month	2500—4000 (2800—4500)	≤ 1:1	75	0.1	300 %
5	Long Term	12 month	3000—4500 (3400—5100)	≤ 0.5:1	100	0.02	400 %

<sup>1</sup> This table is for general guidelines only. Refer to manufacturer for application rates, instructions, gradients, maximum continuous slope lengths and other site specific recommendations.

<sup>2</sup> These categories are independent of rolled erosion control products (RECPs) categories, despite the identical names.

<sup>3</sup> A manufacturer's estimated time period, based upon field observations, that a materials can be anticipated to provide erosion control as influenced by its composition and site-specific conditions.

<sup>4</sup> "C" Factor calculated as ratio of soil loss from HECP protected slope (tested at specified or greater gradient, h:v) to ratio of soil loss from unprotected (control) plot based on large-scale testing.

<sup>5</sup> Acceptable large-scale test methods may include ASTM D 6459, or other independent testing deemed acceptable by the engineer.

<sup>6</sup> Minimum vegetation establishment is calculated as outlined in ASTM D 7322 being a percentage by dividing the plant mass per area of the protected plot by the plant mass per area of the control plot.

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(Source: Erosion Control Technology Council, August 2010)

## Design Criteria

### *Site Preparation*

Before mulching, complete the required site preparation. Site preparation includes grading, if needed, and seedbed preparation and fertilizing, liming and seeding if a planting is being made by means other than hydroseeding.

### *Spreading the Mulch*

Select a mulch material based on the site and practice requirements, availability of material, and availability of labor and equipment. Table MU-2 lists commonly used mulches.

Table MU-2 Mulching Materials and Application Rates

<b>Material</b>	<b>Rate Per Acre and (Per 1000 ft.<sup>2</sup>)</b>	<b>Notes</b>
<b>Straw with Seed</b>	1 ½-2 tons (70 lbs-90 lbs)	Spread by hand or machine to attain 75% groundcover; anchor when subject to blowing.
<b>Straw Alone (no seed)</b>	2 ½-3 tons (115 lbs-160 lbs)	Spread by hand or machine; anchor when subject to blowing.
<b>Wood Chips</b>	5-6 tons (225 lbs-270 lbs)	Treat with 12 lbs. nitrogen/ton.
<b>Bark</b>	35 cubic yards (0.8 cubic yard)	Can apply with mulch blower.
<b>Pine Straw</b>	1-2 tons (45 lbs-90 lbs)	Spread by hand or machine; will not blow like straw.
<b>Peanut Hulls</b>	10-20 tons (450 lbs-900 lbs)	Will wash off slopes. Treat with 12 lbs. nitrogen/ton.
<b>HECPs</b>	0.75 – 2.25 tons (35 lbs – 103 lbs)	Refer to ECTC or Manufacturer's Specifications.

Uniformly spread organic mulches by hand or with a mulch blower at a rate which provides about 75% ground cover. Spread HECPs utilizing appropriate equipment and at rates as specified. When spreading straw mulch by hand, divide the area to be mulched into sections of approximately 1000 sq. ft. and place 70-90 pounds of straw (1 ½ to 2 bales) in each section to facilitate uniform distribution. Caution, an over-application of wheat straw will reduce stand success – do not over-apply wheat straw when mulching a seeding!

When straw mulch is subject to be blown away by wind, it must be anchored immediately after spreading. It is best anchored with a mulch anchoring tool.

Application of a commercial tackifier through a hydroseeder is often practical for steep slopes and can be effective on most sites. Binders (tackifiers) may be applied after mulch is spread or may be sprayed into the mulch as it is being

blown onto the soil. Applying straw and binder together is the most effective method. Liquid binders include an array of commercially available synthetic binders and organic tackifiers.

In high wind situations like roadways, crimping the mulch is the best alternative as the use of mulch binders may still result in the mulch being rolled up on the edge.

Straw mulch may also be anchored with lightweight plastic, cotton, jute, wire or paper netting which is stapled over the mulch. The manufacturer's recommendations on stapling netting should be followed.

### *Maintenance*

Inspect all mulches periodically, and after rainstorms to check for rill erosion, dislocation, or failure. Where erosion is observed, apply additional mulch or if washout has occurred, repair the slope grade, reseed, and reinstall mulch. Continue inspections until vegetation is firmly established.

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## Permanent Seeding (PS)



### Practice Description

Permanent seeding is the establishment of perennial vegetation on disturbed areas from seed. Permanent vegetation provides economical long-term erosion control and helps prevent sediment from leaving the site. This practice is used when vegetation is desired and appropriate to permanently stabilize the soil.

### Planning Considerations

The advantages of seeding over other means of establishing plants include the smaller initial cost, lower labor input, and greater flexibility of method.

Disadvantages of seeding include potential for erosion during the establishment stage, seasonal limitations on suitable seeding dates, and weather-related problems such as droughts.

The probability of successful plant establishment can be maximized through good planning. The selection of plants for permanent vegetation must be site specific. Factors that should be considered are type of soils, climate, establishment rate, and management requirements of the vegetation. Other factors that may be important are wear, mowing tolerance, and salt tolerance of vegetation.

Plant selection for permanent vegetation should be based on plant characteristics, site and soil conditions, time of year of planting, method of planting, and the intended use of the vegetated area. Climate factors can vary widely in Alabama.

Important plant attributes are discussed in Vegetation Establishment for Erosion and Sediment Control in Chapter 2.

Plant selection may include companion plants to provide quick cover on difficult sites, late seedings, or where the desired permanent cover may be slow to establish. Annuals are usually used for companion plants and should be selected carefully to prevent using a species that provide so much competition that it prevents the establishment of the desired species.

Seeding properly carried out within the optimum dates has a higher probability of success. It is also possible to have satisfactory establishment when seeding outside these dates. However, as plantings are deviated from the optimum dates, the probability of failure increases rapidly. Seeding dates should be taken into account in scheduling land-disturbing activities.

Site quality impacts both short-term and long-term plant success. Sites that have compacted soils, soils that are shallow to rock or have textures that are too clayey or too sandy should be modified whenever practical to improve the potential for plant growth and long-term cover success.

The operation of equipment is restricted on slopes steeper than 3:1, severely limiting the quality of the seedbed that can be prepared. Provisions for establishment of vegetation on steep slopes can be made during final grading. In construction of fill slopes, for example, the last 4-6" might not be compacted. A loose, rough seedbed with irregularities that hold seeds and lime and fertilizer is essential for hydroseeding. Cut slopes should be roughened (see Land Grading practice).

Proper mulching is critical to protect against erosion on steep slopes. When using straw, anchor with netting or asphalt. On slopes steeper than 2:1, jute, excelsior, or synthetic matting may be required.

The use of irrigation (temporary or permanent) will greatly improve the success of vegetation establishment.

## **Design Criteria**

### *Plant Selection*

Select plants that can be expected to meet planting objectives. To simplify plant selection, use Figure PS-1 Geographical Areas for Species Adaptation and Seeding Dates and Table PS-1, Commonly Used Plants for Permanent Cover. Mixtures commonly specified by the Alabama Department of Transportation are an appropriate alternative for plantings on rights-of-ways. Additional information related to plants commonly used in Alabama is found in Chapter 2 under the section Vegetation for Erosion and Sediment Control.

The plants used for temporary vegetation may be used for companion plants provided the seeding rate of the annual species is reduced by one half. See the Temporary Seeding practice for additional information on establishing temporary

vegetation. **Ryegrass or other highly competitive plants should not be used as a companion plant.**

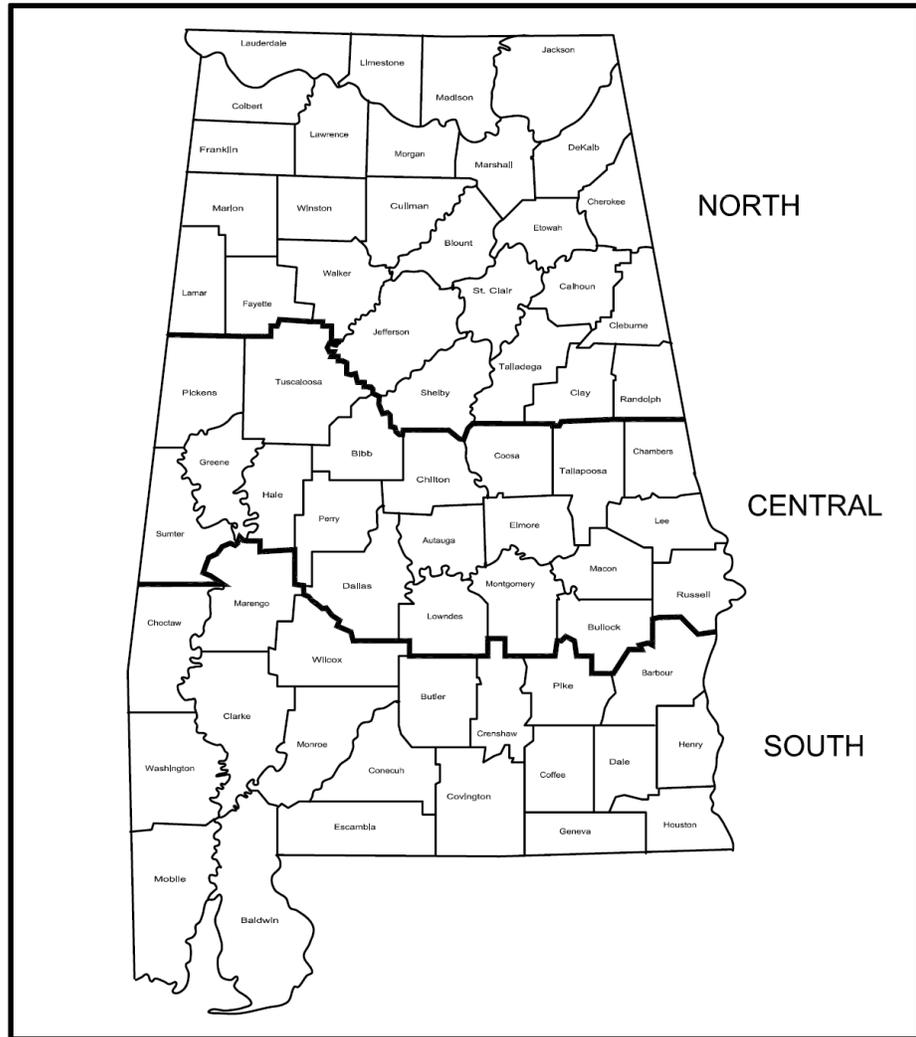


Figure PS-1 Geographical Areas for Species Adaptation and Seeding Dates

*Note: Site conditions related to soils and aspect in counties adjacent to or close to county boundaries may justify adjustments in planting dates by qualified design professionals.*

Table PS-1 Commonly Used Plants for Permanent Cover with Seeding Rates and Dates

Species	Seeding Rates/Ac PLS	Seeding Dates		
		North	Central	South
<b>Bahiagrass, Pensacola</b>	40 lbs	--	Mar 1-July 1	Feb 1-Nov 1
<b>Bermudagrass, Common</b>	10 lbs	Apr 1-July 1	Mar 15-July 15	Mar 1-July 15
<b>Bahiagrass, Pensacola Bermudagrass, Common</b>	30 lbs 5 lbs	--	Mar 1-July 1	Mar 1-July 15
<b>Bermudagrass, Hybrid (Lawn Types)</b>	Solid Sod	Anytime	Anytime	Anytime
<b>Bermudagrass, Hybrid (Lawn Types)</b>	Sprigs 1/sq ft	Mar 1-Aug 1	Mar 1-Aug 1	Feb 15-Sep 1
<b>Fescue, Tall</b>	40-50 lbs	Sep 1-Nov 1	Sep 1-Nov 1	--
<b>Sericea</b>	40-60 lbs	Mar 15-July 15	Mar 1-July 15	Feb 15-July 15
<b>Sericea &amp; Common Bermudagrass</b>	40lbs 10 lbs	Mar 15-July 15	Mar 1-July 15	Feb 15-July 15
<b>Switchgrass, Alamo</b>	4 Lbs	Apr 1-Jun 15	Mar 15-Jun 15	Mar 15-Jun15

PLS means pure live seed and is used to adjust seeding rates. For example, to plant 10 lbs PLS of a species with germination of 80% and purity of 90%,  $PLS = 0.8 \times 0.9 = 72\%$ .  $10 \text{ lbs PLS} = 10 / 0.72 = 13.9 \text{ lbs}$  of the species to be planted.

### Seedbed Requirements

Establishment of vegetation should not be attempted on sites that are unsuitable due to compaction or inappropriate soil texture, poor drainage, concentrated overland flow, or steepness of slope until measures have been completed to correct these problems. To maintain a good stand of vegetation, the soil must meet certain minimum requirements as a growth medium. A good growth medium should have these attributes:

- Sufficient pore space to permit root penetration.
- Enough fine-grained soil material (silt and clay) to maintain adequate moisture and nutrient supply.
- Sufficient depth of soil to provide an adequate root zone. The depth to rock or impermeable layers such as hardpans should be 12" or more, except on slopes steeper than 2:1 where topsoiling is not feasible.
- A favorable pH range for plant growth, usually 6.0-6.5.

- Sufficient nutrients (nitrogen, phosphorus and potassium) for initial plant establishment.
- Freedom from large roots, branches, stones, or large clods. Clods and stones may be left on slopes steeper than 3:1 if they are to be hydroseeded.

If any of the above attributes are not met: i.e., if the existing soil is too dense, coarse, shallow or acidic to foster vegetation – chiseling, topsoil, or special amendments should be used to improve soil conditions. The soil conditioners described below may be beneficial or topsoil may be applied (for guidance on topsoiling see Topsoiling practice). These amendments should only be necessary where soils have limitations that make them poor for plant growth or for turf establishment.

- Peat-appropriate types are sphagnum moss peat, reed-sedge peat, or peat humus, all from fresh-water sources. Peat should be shredded and conditioned in storage piles for at least 6 months after excavation.
- Sand-should be clean and free of toxic materials.
- Vermiculite-use horticultural grade.
- Rotted manure-use stable or cattle manure not containing undue amounts of straw or other bedding materials.
- Thoroughly rotted sawdust-should be free of stones and debris. Add 6 lbs of nitrogen to each cubic yard.

### *Soil Amendments*

#### *Liming Materials*

Lime (Agricultural limestone) should have a neutralizing value of not less than 90 percent calcium carbonate equivalent and 90 percent will pass through a 10 mesh sieve and 50 percent will pass through a 60 mesh sieve.

Selma chalk should have a neutralizing value of not less than 80 percent calcium carbonate equivalent and 90 percent will pass through a 10 mesh sieve.

Other liming materials that may be selected should be provided in amounts that provide equal value to the criteria listed for agricultural lime or be used in combination with agricultural limestone or Selma chalk to provide equivalent values to agricultural limestone.

#### *Plant Nutrients*

Commercial grade fertilizers that comply with current Alabama Fertilizer Laws should be used to supply nutrients required to establish vegetation.

Lime and fertilizer needs should be determined by soil tests. Soil testing is performed by the Auburn University Soil Testing Laboratory and provides recommendations based on field tests on Alabama soils. The local county Cooperative Extension Service can provide information on obtaining soil tests. Commercial laboratories that make recommendations based on soil analysis may be used.

When soil tests are not available, use the following rates for application of soil amendments.

Sandy soils: Use 1 ton/acre (exception on sandy soils – if the cover will be tall fescue and clover) use 2 tons/acre.

Clayey soils: 2 tons/acre.

(Do not apply lime to alkaline soils).

Grasses alone: Use 400 lbs/acre of 8-24-24 or the equivalent. Apply 30 lbs of additional nitrogen when grass has emerged and begun growth (approximately 0.8lbs/1000 ft<sup>2</sup>).

Grass-legume mixtures: Use 800 to 1200 lbs/acre of 5-10-10 or the equivalent.

Legumes Alone: Use 400 to 600 lbs/acre of 0-20-20 or the equivalent.

*Note: Fertilizer can be blended to meet exact fertilizer recommendations. Take soil test recommendations to local fertilizer dealer for bulk fertilizer blends. This may be more economical than bagged fertilizer.*

### *Application of Soil Amendments*

Apply lime and fertilizer evenly and incorporate into the top 6” of soil by disking, chiseling or other suitable means during seedbed preparation. Operate machinery on the contour. On sites too steep for seedbed preparation, fertilizer and lime can be applied with a hydroseeder.

### *Seedbed Preparation*

If needed, grade and shape to provide a surface on which equipment can safely and efficiently be used for seedbed preparation and seeding.

Install necessary sediment control practices before seedbed preparation and complete grading according to the approved plan.

Prepare a friable seedbed with tillage to a depth of at least 6”. Break up large clods, alleviate compaction, and smooth and firm the soil into a uniform surface. Fill in or level depressions that can collect water.

### *Planting Methods*

#### *Seeding*

Use certified seed for permanent seeding whenever possible. Certified seed is inspected by the Alabama Crop Improvement Association to meet high quality standards and will be tagged with a “Certified Seed” tag. (Note: all seed sold in

Alabama is required by law to be tagged to identify seed purity, germination, and presence of weed seeds. Seed must meet state standards for content of noxious weeds.)

Seeding dates are determined using Figure PS-1 and Table PS-1.

Inoculate legume seed with the Rhizobium bacteria appropriate to the species of legume. Details of legume inoculation are located in Chapter 2 in the part on Vegetation for Erosion and Sediment Control under Inoculation of Legumes.

Plant seed uniformly with a cyclone seeder, a drill seeder, a cultipacker seeder, or by hand on a fresh, firm, friable seedbed. If the seedbed has been sealed by rainfall, it should be disked so the seed will be sown into a freshly prepared seedbed.

When using broadcast-seeding methods, subdivide the area into workable sections and determine the amount of seed needed for each section. Apply one-half the seed while moving back and forth across the area, making a uniform pattern; then apply the second half in the same way, but moving at right angles to the first pass.

Cover broadcast seed by raking or chain dragging; then firm the surface with a roller or cultipacker to provide good seed contact. Small grains should be planted no more than 1" deep and grasses and legume seed no more than 1/2" deep.

### *Hydroseeding*

Surface roughening is particularly important when hydroseeding, as a roughened slope will provide some natural coverage for lime, fertilizer, and seed. The surface should not be compacted or smooth. Fine seedbed preparation is not necessary for hydroseeding operations; large clods, stones, and irregularities provide cavities in which seeds can lodge.

Mix seed, inoculant if required, and a seed carrier with water and apply as a slurry uniformly over the area to be treated. The seed carrier should be a cellulose fiber, natural wood fiber or other approved fiber mulch material which is dyed an appropriate color to facilitate uniform application of seed. Use the correct legume inoculant at 4 times the recommended rate when adding inoculant to a hydroseeder slurry. The mixture should be applied within one hour after mixing to reduce damage to seed.

Fertilizer should not be mixed with the seed-inoculant mixture because fertilizer salts may damage seed and reduce germination and seedling vigor.

Fertilizer may be applied with a hydroseeder as a separate operation after seedlings are established.

Lime is not normally applied with a hydraulic seeder because it is abrasive but if necessary it can be added to the seed slurry and applied at seeding or it may be applied with the fertilizer mixture. Also lime can be blown onto steeper slopes in dry form.

### *Sprigging*

Hybrid bermudagrass cannot be grown from seed and must be planted vegetatively. Vegetative methods of establishing common and hybrid bermudagrass, centipedegrass and zoysia include sodding, plugging and sprigging (see Sodding practice).

When sprigs are planted with a sprigging machine, furrows should be 4-6" deep and 2 feet apart. Place sprigs no farther than 2 feet apart in the row and so that at least one rooting node is in the furrow.

When broadcasting is used for sprig planting, broadcast sprigs at the specified rate (Table PS-1). Press into the top ½" to 2" of soil with a cultipacker or with a disk set nearly straight so that the sprigs are not brought back to the surface. A mulch tacking machine may be used to press sprigs into the soil.

### *Mulching*

The use of mulch provides instant cover and helps ensure establishment of vegetation under normal conditions and is essential to seeding success under harsh site conditions (see Mulching practice). Harsh site conditions include: slopes steeper than 3:1 and adverse soils (shallow, rocky, or high in clay or sand). Areas with concentrated flow should be treated differently and require sod, a hydromulch formulated for channels or an appropriate erosion control blanket.

### *Irrigation*

Moisture is essential for seed germination and vegetation establishment. Supplemental irrigation can be very helpful in assuring adequate stands in dry seasons or to speed development of full cover. It is a requirement for establishment of vegetation from sod and sprigs and should be used elsewhere when feasible. However, irrigation is rarely critical for low-maintenance vegetation planted at the appropriate time of the year.

Water application rates must be carefully controlled to prevent runoff. Inadequate or excessive amounts of water can be more harmful than no supplemental water.

### *Maintenance*

Generally, a stand of vegetation cannot be determined to be fully established until soil cover has been maintained for 1 full year from planting. Inspect vegetated areas for failure and make necessary repairs and vegetate as soon as possible.

If a stand has inadequate cover, reevaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand after seedbed preparation or over-seed the stand. Consider a temporary seeding if the time of year is not appropriate for establishment of permanent vegetation (see Temporary Seeding practice).

If vegetation fails to grow, a soil test should be made to determine if soil acidity or nutrient imbalance is responsible.

To attain complete establishment, fertilization is usually required in the second growing season. Turf grasses require annual maintenance fertilization. Use soil tests if possible or follow the guidelines given for the specific seeding mixtures.

Protect vegetation during its establishing period from traffic that will be harmful. If appropriate, use either temporary fences or barriers to protect areas that may be damaged by excessive traffic.

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## Preservation of Vegetation (PV)



### Practice Description

Preservation of vegetation is the avoidance of an area during land disturbing and construction activity to prevent mechanical and other injury to desirable plants in the planned landscape. The practice provides erosion and sediment control and is applicable where vegetative cover is desired and the existing plant community is compatible with the planned landscape.

### Planning Considerations

Preservation of vegetation requires good site management to minimize the impact of construction activities on existing vegetation.

Plants to save should be identified prior to any construction activity.

Proper maintenance, especially during construction, is important to ensure healthy vegetation that can control erosion.

Different species, soil types, and climatic conditions will require different maintenance activities.

## Design Criteria

### *Mark Plant Area for Retention*

Groups of plants and individual trees to be retained should be located on a plan map. Limits of clearing should be planned outside the drip line of groups or individual trees to be saved. The clearing should never be closer than 5 feet to the trunk of a tree.

Flagging or other appropriate means of marking the site of the groups of plants and individual trees to be retained should be required before construction begins. Individual trees to be retained should be marked with a highly visible paint or surveyor's ribbon in a band circling the tree at a height visible to equipment operators.

### *Plant Protection*

Restrict construction equipment, vehicular traffic, stockpiles of construction materials, topsoil etc., from the areas where plants are retained and restrict these activities from occurring within the drip line of any tree to be retained. Trees being removed shall not be pushed into trees to be retained. Equipment operators shall not clean any of their equipment by slamming it against trees to be retained.

Restrict burning of debris within 100 feet of the plants being preserved. Fires shall be limited in size to prevent damage to any nearby trees.

Toxic material shall not be stored any closer than 100 feet to the drip line of any trees to be retained. Toxic materials shall be managed and disposed of according to state laws.

### *Fencing and Armoring*

Groups of plants and trees should be protected by fencing or armoring where necessary (See Figure PV-1). The following types of fencing or armoring may be used:

- Board Fence-Board fence may be constructed with 4" square posts set securely in the ground and protruding at least 4 feet above the ground. A minimum of 2 horizontal boards should be placed between the posts. The fence should be placed at the limits of the clearing around the drip line of the tree. If it is not practical to erect a fence at the drip line, construct a triangular fence near the trunk. The limits of clearing will still be the drip line as the root zone within the drip line will still require protection.
- Cord Fence-Posts at least 2" square or 2" in diameter set securely in the ground and protruding at least 4 feet above the ground shall be placed at the limits of clearing with 2 rows of cord 1/4" or thicker at least 2 feet apart running between posts with strips of surveyor's tape tied securely to the string at intervals of 3 feet or less.

- Earth Berms-Temporary earth berms may be constructed. The base of the berm on the tree side should be located along the limits of clearing. Earth berms may not be used for this purpose if their presence will create drainage patterns that cause erosion.
- Additional Trees-Additional trees may be left standing as protection between the trees to be retained and the limits of clearing. However, in order for this alternative to be used, trees in the buffer must be no more than 6 feet apart to prevent passage of equipment and material through the buffer.
- Plan for these additional trees to be evaluated prior to the completion of construction and either given sufficient treatment to ensure survival or be removed.
- Trunk Armoring-As a last resort, a tree may be armored with burlap wrapping and 2” studs wired vertically no more than 2” apart to a height of 5 feet. The armoring should encircle the tree trunk. Nothing should ever be nailed to a tree. The root zone within the drip line will still require protection.
- Fencing and armoring devices should be in place before any construction work is done and should be kept in good condition for the duration of construction activities. Fencing and armoring should not be removed until the completion of the construction project.

### *Raising the Grade*

When the ground level must be raised around an existing tree or group of trees several methods may be used to insure survival.

A well may be created around a group of trees or an individual tree slightly beyond the drip line to retain the natural soil in the area of the feeder roots (see Figure PV-2).

When the well alternative is not practical or desirable, remove vegetation and organic matter from beneath the tree or trees for a distance of 3 feet beyond the drip line and loosen the surface soil to a depth of approximately 3” without damaging the roots.

Apply fertilizer in the root area of the tree to be retained. A soil test is the best way to determine what type of fertilizer to use. In the absence of a soil test, fertilizer should be applied at the rate of 1 to 2 pounds of 10-8-6 or 10-6-4 per inch of diameter at breast height (dbh) for trees under 6” dbh and at the rate of 2 to 4 pounds of 10-8-6 or 10-6-4 per inch of dbh for trees over 6” dbh.

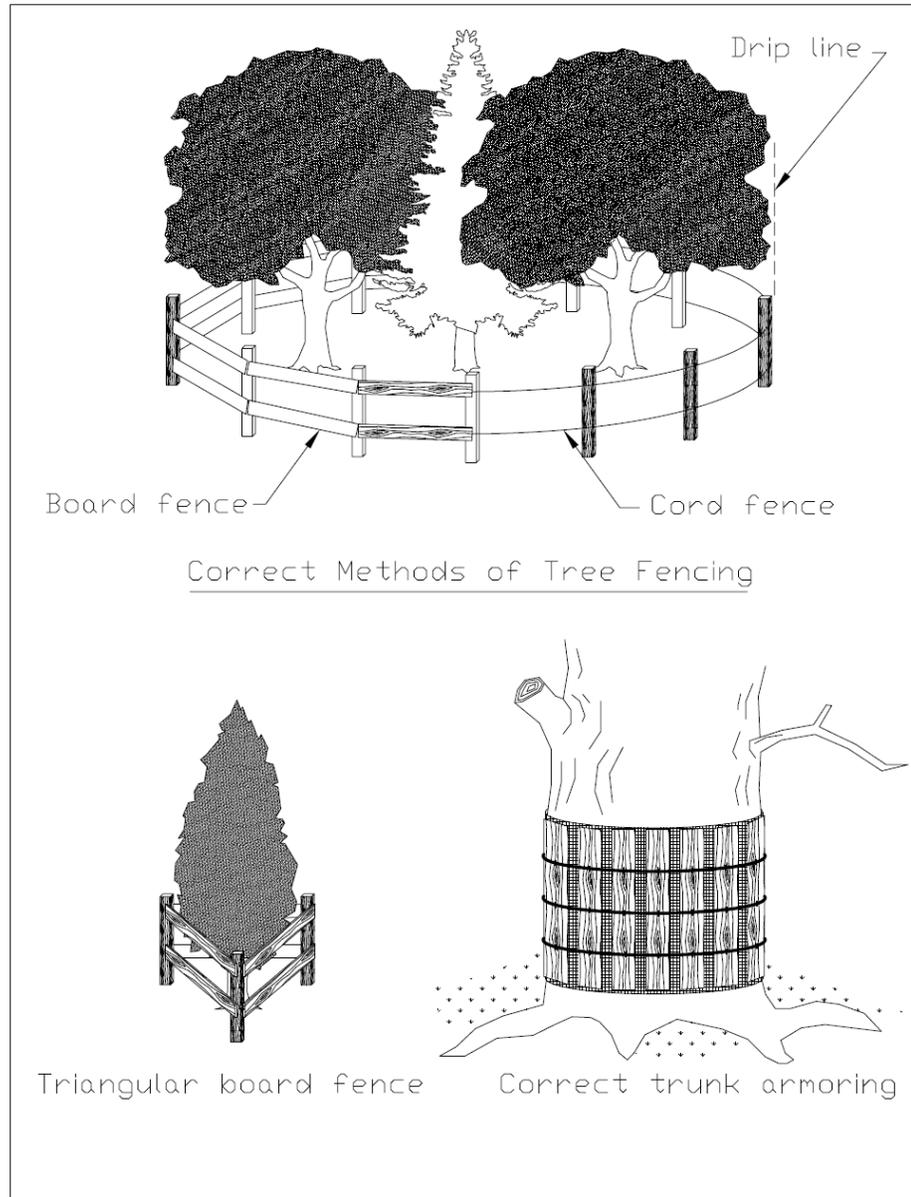


Figure PV-1 Fencing and Armoring

A dry well shall be constructed so as to allow for tree trunk diameter growth (see Figure PV-3). A space of at least 1 foot between the tree trunk and the well wall is adequate for old, slow growing trees. Clearance for younger trees shall be at least 2 feet. The well shall be high enough to bring the top just above the level of the proposed fill. The well wall shall taper slightly away from the tree trunk at a rate of 1" per foot of wall height.

The well wall shall be constructed of large stones, brick, building tile, concrete blocks, or cinder blocks. Openings should be left through the wall of the well to allow for free movement of air and water. Mortar shall only be used near the top of the well and only above the porous fill.

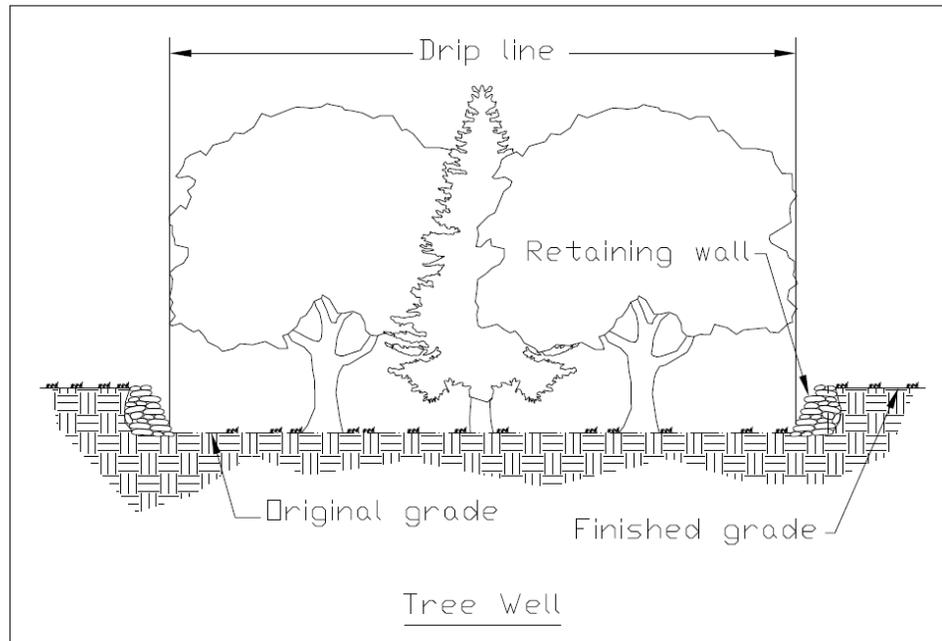


Figure PV-2 Tree Well

Drain lines composed of 4" high quality drain tiles shall begin at the lowest point inside the well and extend outward from the tree trunk in a wheel and spoke pattern with the trunk as the hub. Radial drain lines shall slope away from the well at a rate of  $\frac{1}{8}$ " per foot. The circumference line of tiles should be located beneath the drip line of the trees. Vertical tiles or pipes shall be placed over the intersections of the two tile systems if a fill of more than 2 feet is contemplated. Vertical tiles shall be held in place with stone fill. Tile joints shall be tight. A few radial tiles shall extend beyond each intersection and shall slope sharply downward to insure good drainage. Tar paper or its approved equivalent shall be placed over the tile and/or pipe joints to prevent clogging and large stone shall be placed around and over drain tiles and/or pipes for protection.

A layer of 2" to 6" of stone shall be placed over the entire area under the tree from the well outward at least as far as the drip line. For fills up to 2 feet deep, a layer of stone 8" to 12" thick should be adequate.

A thick layer of this stone not to exceed 30" will be needed for deeper fills. A layer of  $\frac{3}{4}$ " to 1" stone covered by straw, fiberglass mat or a manufactured filter fabric shall be used to prevent soil from clogging the space between stones. Cinders shall not be used as fill material. Filling shall be completed with porous soil such as topsoil until the desired grade is reached. This soil shall be suitable to sustain specified vegetation.

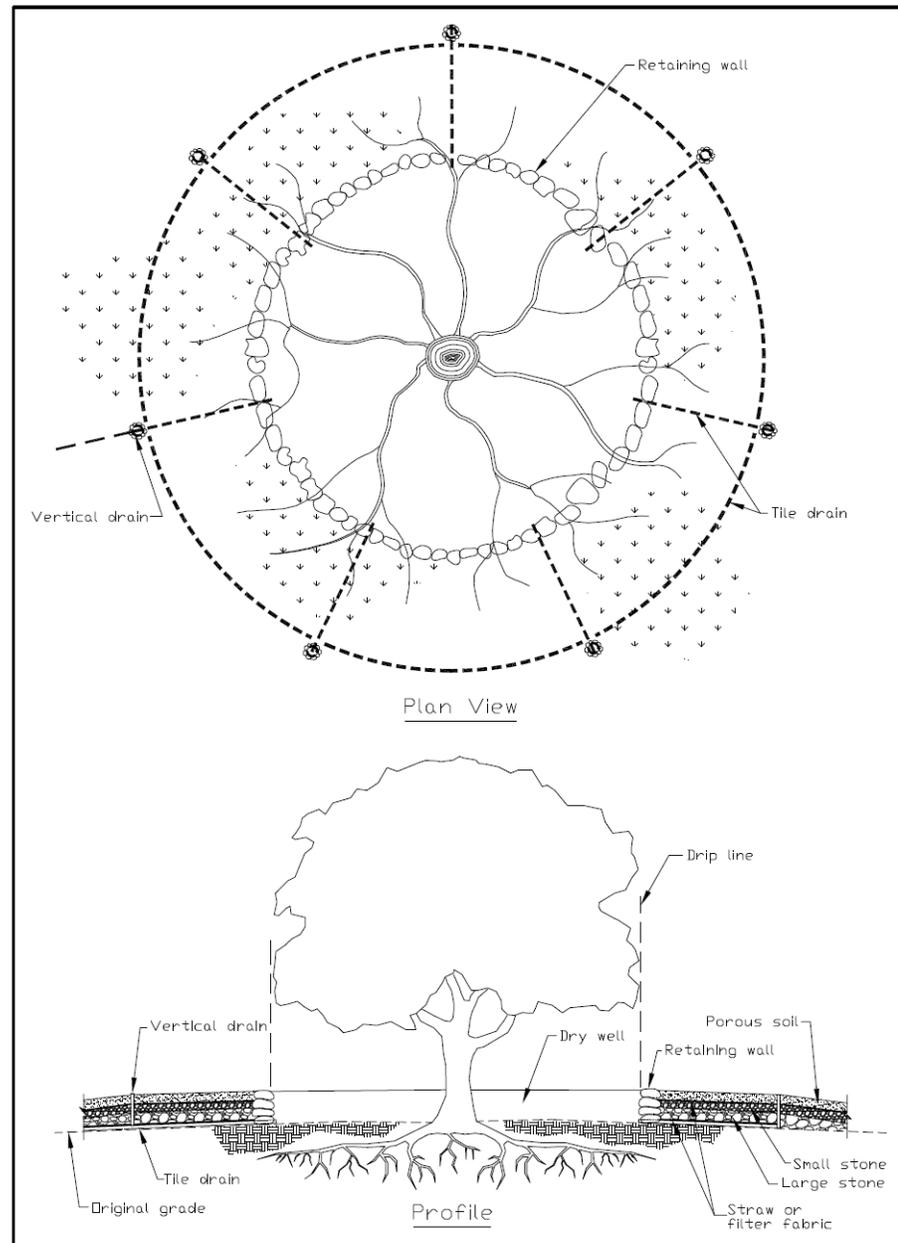


Figure PV-3 Tree Well Detail

Crushed stone shall be placed inside the dry well over the openings of the radial tiles to prevent clogging. The area between the trunk and the well wall shall either be covered by an iron grate or filled with a 50-50 mixture of crushed charcoal and sand to prevent anyone from falling into the dry well.

Where water drainage through the soil is not a problem, coarse gravel in the fill may be substituted for the tile. This material has sufficient porosity to ensure air drainage. Instead of the vertical tiles or pipes in the system, stones, crushed rock and gravel may be added so that the upper level of these porous materials slants toward the surface in the vicinity below the drip line.

Raising the grade on only one side of a tree or group of trees may be accomplished by constructing only half of one of these systems.

### *Lowering the Grade*

Shrubs and trees shall be protected from the harmful grade cuts by the construction of a tree wall (see Figure PV-4). Following excavation, all tree roots that are exposed and/or damaged shall be trimmed cleanly and covered with moist peat moss, burlap or other suitable material to keep them from drying out.

The wall shall be constructed of large stones, brick, building tile, concrete block or cinder block. The wall should be backfilled with topsoil, peat moss, or other organic matter to retain moisture and aid in root development. Apply fertilizer and water thoroughly. The tree plants should be pruned to reduce the leaf surface in proportion to the amount of root loss. Drainage should be provided through the wall so water will not accumulate behind the wall. Lowering the grade on one side of the tree or group of trees can be accomplished by constructing only half of this system.

### *Trenching and Tunneling*

Trenching should be done as far away from the trunks of trees as possible, preferably outside the branches or crown spreads of trees, to reduce the amount of root area damaged or killed by trenching activities. When possible trenches should avoid large roots or root concentrations. This can be accomplished by curving the trench or by tunneling under large roots and areas of heavy root concentration. Tunneling under a species that does not have a large tap root may be preferable to trenching beside it as it has less impact on root systems (see Figure PV-5).

Roots should not be left exposed to the air but should be covered with soil as soon as possible or protected and kept moist with burlap or peat moss until the trench or tunnel can be filled. The ends of damaged and cut roots shall be cut off smoothly and moist peat moss, burlap or topsoil should be placed over the exposed area.

Trenches and tunnels shall be filled as soon as possible. Care should be taken to ensure that air spaces are not left in the soil. Peat moss or other organic matter shall be added to the fill material as an aid to inducing and developing root growth. The tree should be fertilized and mulched to stimulate new root growth and enhance general tree vigor. If a large part of the root system has been damaged the crown leaf surface area should be reduced in proportion to the root damage. This may be accomplished by pruning 20-30 percent of the crown foliage. If the roots are damaged during the winter the crown should be pruned before the next growing season. If roots are cut during the growing season, pruning should be done immediately.

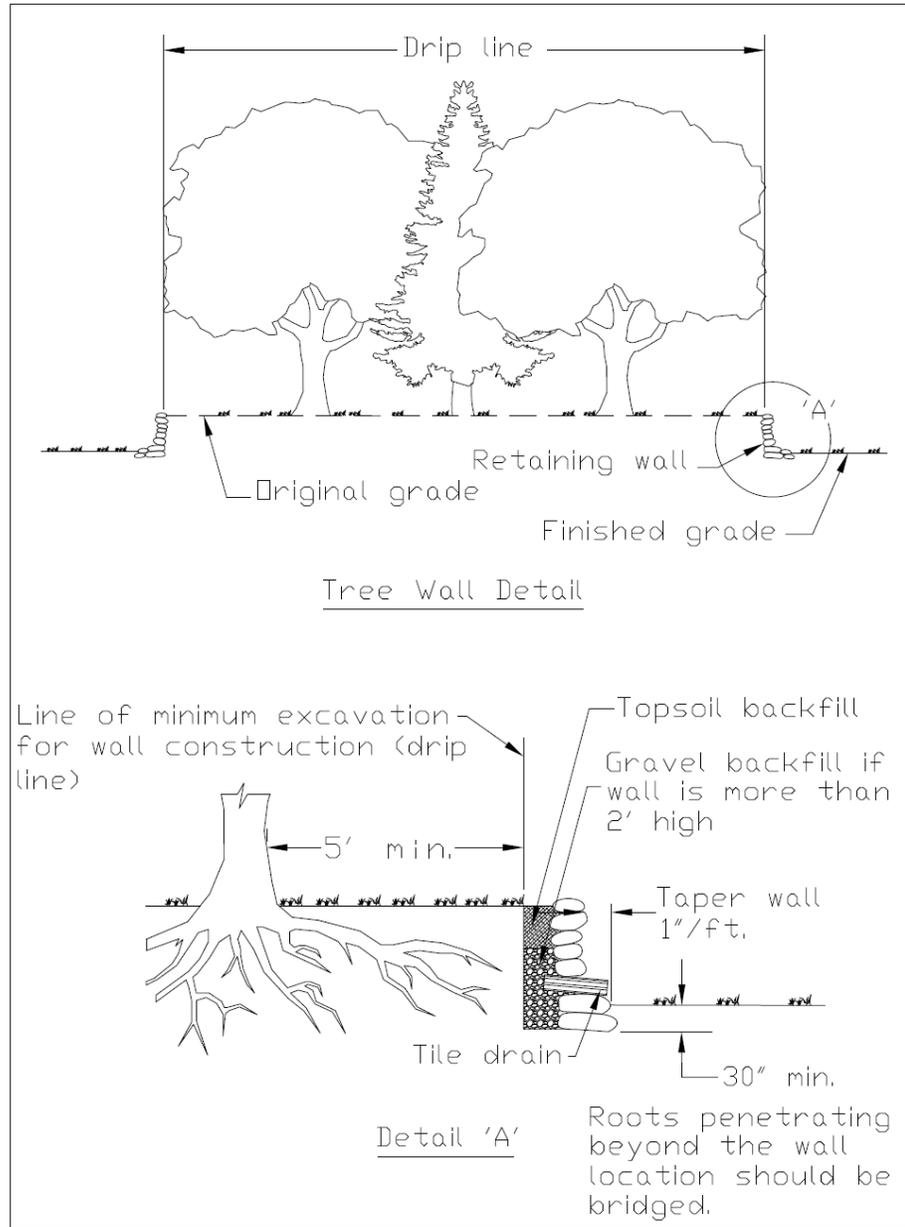


Figure PV-4 Tree Wall Detail

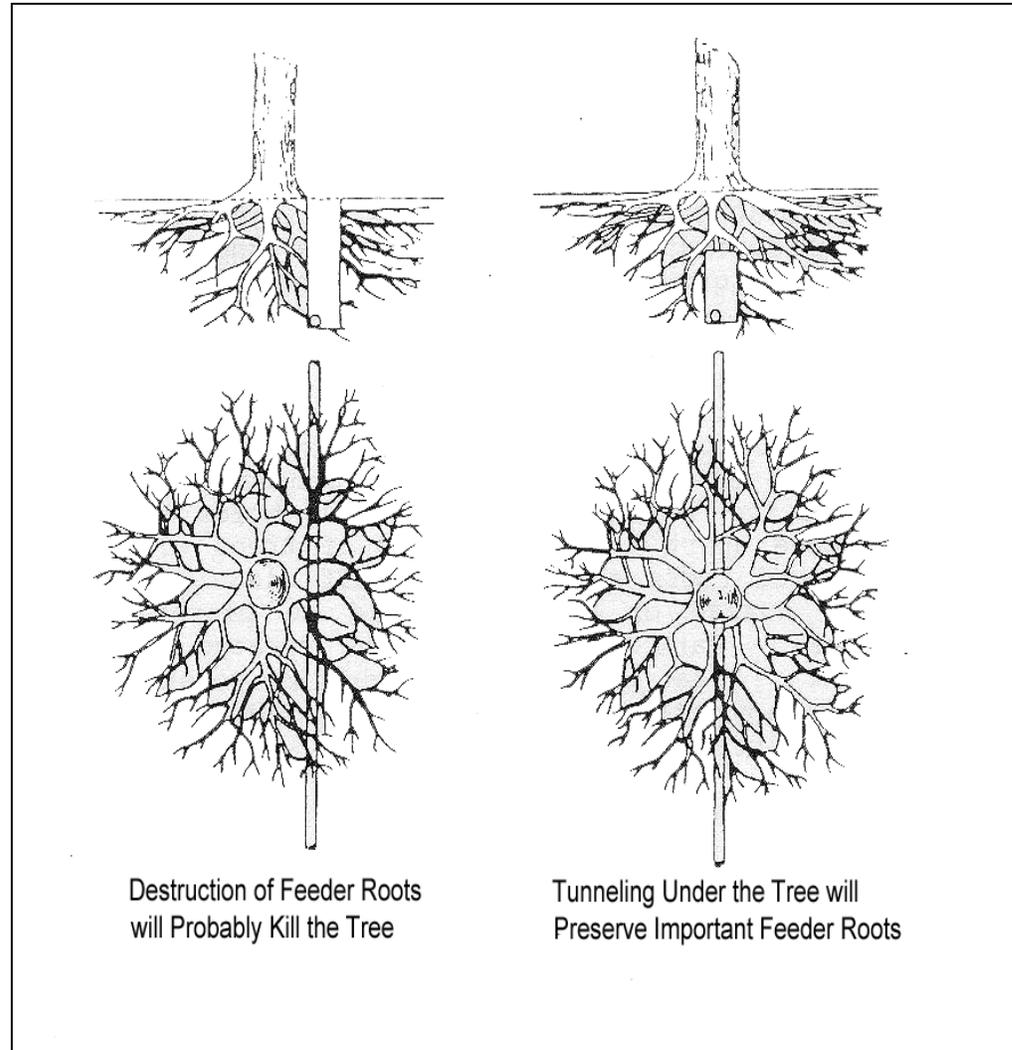


Figure PV-5 Trenching vs Tunneling

### *Treating Damaged Trees*

When trees are damaged during construction activities certain maintenance practices can be applied to protect the health of the tree.

Soil aeration may be needed if the soil has been compacted. The soil around trees can be aerated by punching holes 1 foot deep and 18" apart under the crown of trees with an iron pipe.

Damaged roots should be cut off cleanly and moist peat moss, burlap or topsoil should be placed over the exposed area. Bark damage should be treated by removing loose bark.

Tree limbs damaged during construction or removed for any other reason shall be cut off above the collar at the branch junction.

Trees that have been stressed or damaged should be fertilized to aid their recovery.

Trees should be fertilized in the spring or fall. Fall applications are preferred.

Fertilizer should be applied to the soil over the feeder roots. In no case should it be applied closer than 3 feet to the trunk. Root systems of trees extend some distance beyond the drip line. The area to be fertilized should be increased by  $\frac{1}{4}$  the area of the crown. A soil test is the best way to determine what type of fertilizer to use. In the absence of a soil test, fertilizer should be applied at the rate of 1 to 2 pounds of 10-8-6 or 10-6-4 per inch of dbh for trees under 6" dbh and at the rate of 2 to 4 pounds of 10-8-6 or 10-6-4 per inch of dbh for trees over 6" dbh.

A ground cover or organic mulch layer should be maintained around trees to prevent erosion, protect roots and to conserve water.

## Retaining Wall (RW)



### Practice Description

A retaining wall is a constructed wall used to eliminate steep slopes between areas that have abrupt changes in grade. This practice is used to replace cut or fill slopes in confined areas or where a wall is necessary to achieve stable slopes. A retaining wall can be constructed of reinforced concrete, treated timbers, gabions, reinforced earth (a system of face panels and buried reinforcement strips), and other manufactured products such as interlocking concrete blocks.

### Planning Considerations

Retaining walls to stabilize the site should be used in conjunction with steep cut or fill slopes, which may be unstable due to steepness, space limitations, or poor soil conditions to stabilize the site. Retaining walls may be used to relieve the need to construct cuts into steep hillsides or on small lots where fill toe-outs or slope cut-outs would go off of the property being developed. Retaining walls may be required to get the best or intended use of the property.

Retaining walls can be constructed from the following materials:

- Reinforced concrete
- Concrete cribbing

- Geotextile wrapped face wall
- Geotextile reinforced steep slopes
- Modular blocks
- Treated timbers

Each case is different and the type retaining wall to be used should be selected by a qualified design professional based on the particular site conditions and what best meets the needs of the site. In most cases treated timber is the least desirable material because of its potential to decay.

## Design Criteria

The design of a retaining wall is or can be a complicated engineering procedure. There are many factors to consider. Each case is different and requires a different set of considerations and a different design.

The qualified design professional should consider the stresses and forces outside and within the wall as well as allowable height and minimum thickness. Other considerations are foundation design with respect to loadings, bearing values of soils and footing dimensions.

Additional design factors include safety hazards, drainage aspects and appearance.

Each retaining wall requires a specific engineering design which requires the capabilities of a competent qualified design professional. Retaining walls are engineering structures which affect public property, life and welfare of citizens. Alabama law which regulates the practice of professional engineering in the State of Alabama must be followed on structures such as retaining walls. The State Board of Registration for Professional Engineers and Land Surveyors in Montgomery is responsible for administering the provisions of the law.

## Shrub, Vine and Groundcover Planting (SVG)



### Practice Description

Shrub, vine and groundcover planting is establishing shrubs, vines or groundcover to stabilize landscapes where establishing grass is difficult and mowing is not feasible. The practice is especially suited for steep slopes where aesthetics are important. Incidental benefits include providing food and shelter for wildlife, windbreaks or screens, and improved aesthetics.

### Planning Considerations

Shrubs, vines and groundcovers provide alternatives to grasses and legumes as low-maintenance, long-term erosion control. However, they are normally planted only for special, high-value applications, or for aesthetic reasons, because there is additional cost and labor associated with their use.

Very few of these plants can be dependably planted from seed, and none are capable of providing the rapid cover possible with grasses. Consequently, short-term stabilization efforts must involve using dependable mulch along with special cultural practices to ensure establishment.

Shrubs vary in form and differ from most trees in that multiple stems arise from a common base.

Shrubs can be used to attain additional benefits including the following:

- Increase the aesthetic value of plantings
- Provide visual screening and protective barriers

- Enhance windbreaks
- Provide food and cover for wildlife
- Accelerate the transition to a diverse landscape
- Provide post-construction landscaping

Groundcovers differ in growth rate and shade tolerance. Some are suitable only as part of a high-maintenance landscape; others can be used to stabilize large areas with little maintenance.

Competition from volunteer plants inhibits development and maintenance of the groundcover. Thick durable mulch such as shredded bark (not chips) or pine straw can prevent erosion and reduce weed competition.

Mulch is beneficial to plants at most stages of development but is particularly important for new plantings.

## **Design Criteria**

### *Plant Selection*

Specific characteristics and requirements of recommended species are given in Tables SVG-1 through SVG-5 Plants Suitable for Shrub, Vine and Groundcover Planting in Alabama. Other suitable plants may be identified by qualified design professionals based on plant suitability information including plant adaptation zones (see Figure SVG-1). Exotic invasive species should not be planted!

### *Site Preparation*

Remove debris and other undesirable objects and smooth the area to accommodate the planting and mulching. Sites should be prepared in strips along the contour or at individual spots. Additional preparation will vary according to the type of plant and is discussed later under Planting.

### *Soil Amendments*

Fertilizer and lime requirements are plant specific and the prescription for a planting should be based on a soil test or a plan prepared by a qualified design professional.

Soils low in organic matter may be improved by incorporating peat, compost, aged sawdust or well-rotted manure.

To eliminate competition from weeds, an appropriate preemergent herbicide may be useful if mechanical weeding is not practical or desired.

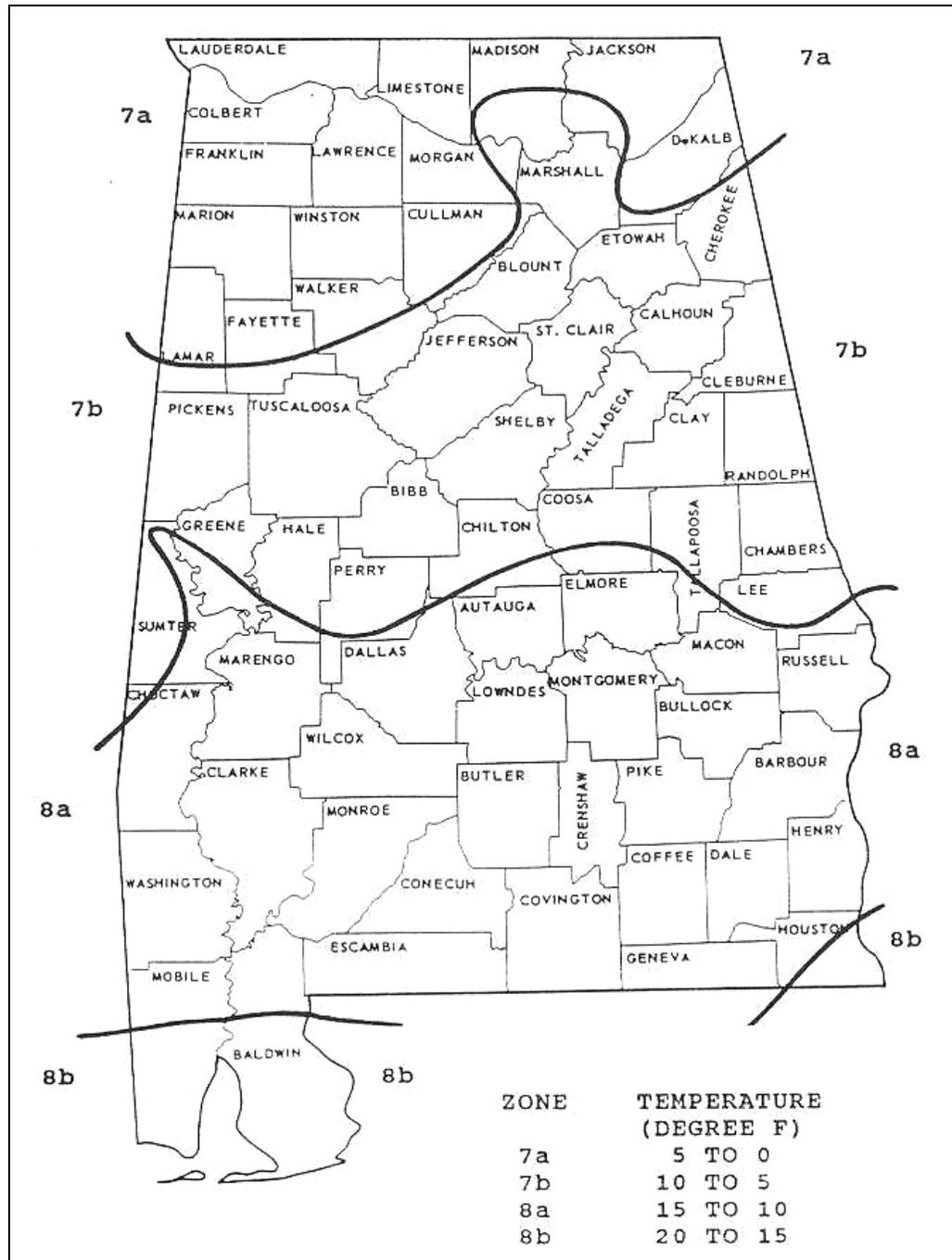


Figure SVG-1 Plant Adaptation Zones

Table SVG-1 Plants Suitable for Vine and Groundcover Planting in Alabama

Botanical Name and Common Name	Normal Height	Growth Rate <sup>1</sup>	Group <sup>2</sup>	Exposure <sup>3</sup>
<i>Bignonia capreolata</i> * Crossvine	50 ft.	M	E	S-PS
<i>Boltonia asteroides</i> False Aster	5-6 ft.	S-M	D	S
<i>Decumaria Barbara</i> * Climbing Hydrangea	12-36 ft.	M	D	PS
<i>Dryopteris ludoviciana</i> Southern Woodfern	3-4 ft.	S-M	E	Sh
<i>Gelsemium sempervirens</i> * Yellow Jessamine	10-20 ft.	M-F	E	S-PS
<i>Hemerocallis</i> sp. Daylily	12-36 in.	M	D	S-PS
<i>Heuchera</i> spp. Heuchera Hybrids/ Alumroot	12-18 in.	M	D	PS
<i>Hypericum calycinum</i> St. Johnswort	12-18 in.	M	E	S-PS
<i>Iris cristata</i> Dwarf Crested Iris	6-12 in.	F	D	PS-Sh
<i>Juniperus conferta</i> Blue Pacific Shore Juniper	12-18 in.	F	E	S
<i>Juniperus horizontalis</i> Creeping Juniper	12-24 in.	M	E	S
<i>Lonicera sempervirens</i> * Coral Honeysuckle	15-20 ft.	M	E	S-PS
<i>Phlox divaricata</i> Creeping Phlox	6-12 in.	F	D	PS-Sh
<i>Phlox subulata</i> Moss Phlox or Thrift	4-6 in.	M	E	S
<i>Osmunda cinnamomea</i> Cinnamon Fern	2-3 ft.	M	D	PS-Sh
<sup>1</sup> Growth Rate: S=slow M=medium, F=fast <sup>2</sup> Group: D=deciduous, E=evergreen <sup>3</sup> Exposure: S=sun, PS=part shade, Sh=shade * Denotes plants used as vines.				

Table SVG-2 Plants Suitable for Small Shrub (2-5 ft.) Planting in Alabama

Botanical Name and Common Name	Normal Height	Growth Rate <sup>1</sup>	Group <sup>2</sup>	Exposure <sup>3</sup>
<i>Abelia x grandiflora</i> 'Prostrata' Prostrate Abelia	2-3 ft.	M	E	S
<i>Baptisia</i> spp. Blue Wild Indigo	2-4 ft.	M	D	S
<i>Chaenomoles speciosa</i> Flowering Quince	3-5 ft.	M-F	D	S-PS
<i>Ilex cornuta</i> 'Carissa' Carissa Holly	3-4 ft.	S	E	S-PS
<i>Ilex cornuta</i> 'Rotunda' Rotunda Holly	3-4 ft.	S	E	S-PS
<i>Ilex crenata</i> 'Compacta' Compacta Holly	4-5 ft.	S	E	S-PS
<i>Ilex crenata</i> 'Green Lustre' Green Lustre Holly	3-4 ft.	M	E	S-PS
<i>Ilex vomitoria</i> 'Nana' Dwarf Yaupon Holly	3-4 ft.	S	E	S-PS
<i>Itea virginica</i> Virginia Sweetspire	3-5 ft.	M-F	E	S-Sh
<i>Jasminum floridum</i> * Showy Jasmine	4-5 ft.	M	E	S-Sh
<i>Jasminum nudiflorum</i> Winter Jasmine	3-4 ft.	F	D	S-Sh
<i>Juniperus horizontalis</i> 'Plumosa' Andorra Juniper	2-3 ft.	S-M	E	S
<i>Leucothoe axillaris</i> Coastal Leucothoe	2-4 ft.	S-M	E	PS-Sh
<i>Raphiolepis indica</i> * Indian Hawthorn	3-4 ft.	S	E	S
<i>Santolina chamaecyparissus</i> Lavender Cotton	2-4 ft.	S	E	S
<i>Spiraea x bumalda</i> 'Anthony Waterer' Anthony Waterer Spirea	3-4 ft.	F	D	S-PS
<i>Spiraea japonica</i> 'Little Princess' Little Princess Spirea	2-3 ft.	M	D	S
<sup>1</sup> Growth Rate: S=slow M=medium, F=fast <sup>2</sup> Group: D=deciduous, E=evergreen <sup>3</sup> Exposure: S=sun, PS=part shade, Sh=shade * For use in Southern half of state.				

Table SVG-3 Plants Suitable for Medium Shrub (5-8 ft.) Planting in Alabama

Botanical Name and Common Name	Normal Height	Growth Rate <sup>1</sup>	Group <sup>2</sup>	Exposure <sup>3</sup>
<i>Abelia x grandiflora</i> Glossy Abelia	4-5 ft.	M-F	E	S-PS
<i>Callicarpa americana</i> American Beautyberry	3-8 ft.	M-F	D	S-PS
<i>Clethra alnifolia</i> Summersweet Clethra	4-8 ft.	S-M	D	S-PS
<i>Euonymus americanus</i> Brook Euonymus / Hearts-a-busting	4-6 ft.	M	D	PS
<i>Euonymus alatus</i> 'Compactus' Dwarf Winged Euonymus	5-6 ft.	S	D	S-PS
<i>Forsythia x intermedia</i> Border Forsythia	8-10 ft.	F	D	S
<i>Hydrangea quercifolia</i> Oakleaf Hydrangea	6-8 ft.	S-M	D	S-PS
<i>Ilex cornuta</i> 'Burfordii Nana' Dwarf Burford Holly	6-7 ft.	S	E	S-PS
<i>Ilex glabra</i> Inkberry Holly	6-8 ft.	S	E	S-Sh
<i>Illicium anisatum</i> Japanses Anise Tree	6-10 ft.	M-F	E	PS
<i>Illicium floridanum</i> Florida Anise Tree	6-10 ft.	M-F	E	PS-Sh
<i>Physocarpus opulifolius</i> Ninebark	6-10 ft.	M	D	S-PS
<i>Viburnum dentatum</i> Arrowwood Viburnum	6-8 ft.	M-F	D	S-PS
<sup>1</sup> Growth Rate: S=slow M=medium, F=fast <sup>2</sup> Group: D=deciduous, E=evergreen <sup>3</sup> Exposure: S=sun, PS=part shade, Sh=shade				

Table SVG-4 Plants Suitable for Large Shrub (8 ft. and up) Planting in Alabama

Botanical Name and Common Name	Normal Height	Growth Rate <sup>1</sup>	Group <sup>2</sup>	Exposure <sup>3</sup>
<i>Aescula parviflora</i> Bottlebrush Buckeye	8-12 ft.	S-M	D	S-PS
<i>Agarista populifolia</i> Pipestem Plant	8-12 ft.	M-F	E	Sh
<i>Calycanthus floridus</i> Sweetshrub	8-10 ft.	M	D	S-Sh
<i>Ilex cornuta</i> "Burfordii" Burford Holly	10-15 ft.	M	E	S-Sh
<i>Morella cerifera</i> * Southern Waxmyrtle	8-10 ft.	M	E	S-PS
<i>Ternstroemia gymnanthera</i> Cleyera	8-10 ft.	S	E	PS-Sh
<i>Viburnum lantana</i> Wayfaringtree Viburnum	10-15 ft.	M	D	S-PS
<i>Viburnum plicatum</i> var. <i>tomentosum</i> ** Doublefile Viburnum	8-10 ft.	M	D	PS
<i>Viburnum x pragense</i> Prague Viburnum	8-10 ft.	M	D	S-PS
<sup>1</sup> Growth Rate: S=slow M=medium, F=fast <sup>2</sup> Group: D=deciduous, E=evergreen <sup>3</sup> Exposure: S=sun, PS=part shade, Sh=shade * For use in southern half of the state. ** For use in the northern half of the state.				

Table SVG-5 Plants Suitable for Ornamental Grass Planting in Alabama

Botanical Name and Common Name	Height and Spread	Exposure <sup>1</sup>
<i>Andropogon gerardii</i> Big Blue Stem	4-6 ft.	S
<i>Carex pensylvanica</i> Pennsylvania Sedge	2-3 ft.	PS
<i>Carex stricta</i> Upright Sedge	1-3 ft.	S
<i>Chasmanthium latifolium</i> River Oats	2-4 ft.	PS-Sh
<i>Deschampsia flexuosa</i> * Crinkle Hair Grass	6-12 in.	PS
<i>Muhlenbergia capillaries</i> Muhly Grass	2-3 ft.	S-Sh
<i>Panicum virgatum</i> Switchgrass	3-6 ft.	S-PS
<sup>1</sup> Exposure: S=sun, PS=part shade, Sh=shade * For use only in the northern half of the state.		

## Planting

### *Individual Shrubs with Root Ball*

Provide a relatively large area for initial root development. The hole should be dug to a depth that allows the root ball to extend 1" above the soil surface, and should be as big around as 3 to 5 times the diameter of the root ball. As soil is added the hole should be filled with water until the filling of the hole is complete.

### *Shrubs in Prepared Beds*

Till or spade a bed to a depth of 8" to 12". Contrary to the individual planting, soil amendments, such as peat or compost at a rate of 1 part amendment to 3 parts native soil, are beneficial to shrubs because they provide a uniform root environment across the bed area. Organic soil amendments enable plants to respond positively to water and fertilizers when they are applied. The hole for the shrub planted in a bed area should be a few inches wider in diameter than the root ball.

### *Plants in Containers*

Remove container plants from their containers, cutting the container if necessary. If the plant is root-bound (roots circling the outside of the root ball), score the roots from top to bottom about 4 times, cutting about ¼ " deep with a knife, or gently massage the root ball until roots point outward. Place the shrub into the hole. Using only the native backfill, add soil back to the hole until it is ½ to ⅔ full. Water in the backfill soil around the root ball. Add soil to ground level and

thoroughly water again. A small dike may be formed around the edge of the planting hole to hold water around the root ball if in sandy soils or on slopes. *Caution: in a dense clay soil, trapping additional water in the root zone can be detrimental because water drains poorly and creates an extended period of wetness.*

#### *Bare Root Plants*

Soak bare root plants in water. When planting, spread the roots in the hole and gradually add soil. Firm the soil, being careful to avoid breaking roots. Fill the hole with water, and allow it to drain. Then fill the hole with soil, and water again thoroughly.

#### *Burlapped Plants*

Cut any wire or string that is around plants stems. Do not remove the burlap. Fold the burlap back so it will be buried by soil. Burlap which is allowed to remain exposed after planting can act as a wick, causing the root ball to dry out. Follow the same procedure for filling the hole as that described for container plants.

#### *Vine and Groundcovers*

Most groundcovers are planted from container-grown nursery stock. Planting density determines how quickly full cover is achieved; a 1 foot spacing is often used for rapid cover. Large plants such as junipers can be spaced on 3 foot centers. Transplanting to the prepared seedbed can be done using a small trowel or a spade. Make a hole large enough to accommodate the roots and soil. Backfill and firm the soil around the plant, water immediately, and keep well watered until established. Water slowly and over longer periods to allow for infiltration and reduce runoff.

#### *When to plant*

Late winter (before leaves emerge) is the best time for planting deciduous shrubs and early fall is the best for evergreen shrubs. Shrubs grown in containers can be planted anytime during the year except when the ground is frozen.

Shrubs, vines and groundcovers are best planted in early fall or early spring. Plantings made at other times are likely to encounter periods of drought or cold weather that may affect survivability

#### *Mulching*

Once plants are installed, add mulch. On steep slopes or highly erodible soils, install erosion control netting or matting prior to planting, and tuck plants into the soil through slits in the net. Plant in a staggered pattern (see Mulching practice for more details on mulching).

*Watering*

Shrubs, vines and groundcovers need about an inch of water a week for the first 2 years after planting. When rain does not supply this need, plants should be watered. Shrubs should be watered deeply and not more than once a week. Vines and groundcover should be watered more frequently during the first few months in the area over and beyond the root ball if rainfall does not supply 1" of water per week.

## Sodding (SOD)



### Practice Description

Sodding is the use of a transplanted vegetative cover to provide immediate erosion control in disturbed areas. Sodding is well suited for stabilizing erodible areas such as grass-lined channels, slopes around storm drain inlets and outlets, diversions, swales, and slopes and filter strips that cannot be established by seed or that need immediate cover.

### Planning Considerations

Advantages of sod include immediate erosion control, nearly year-round establishment capability, less chance of failure than with seeding, and rapid stabilization of surfaces for traffic areas, channel linings, or critical areas.

Initially it is more costly to install sod than to plant seed; however, the higher cost may be justified for specific situations where sod performs better than a seeded cover. Sodding may be more cost-efficient in the long term.

Sod can be laid during the times of the year when seeded grasses may fail, provided there is adequate water available for irrigation in the early establishment period. Irrigation is essential, at all times of the year, to ensure establishment of sod.

Sod placed around drop inlets can prevent erosion around the inlet and help maintain the necessary grade around the inlet.

The site to be sodded should be prepared for the sod before it is delivered so that the sod can be installed immediately. Leaving sod stacked or rolled can cause severe damage and loss of plant material.

Failure to remove compaction and to address pH and soil fertility deficiencies will likely cause a sodded stand to perform poorly or fail.

## Design Criteria

### *Sod Selection*

The species of sod selected should be adapted to both the site and the intended purpose. Species used in Alabama include bermuda, zoysia, centipede, St. Augustine, tall fescue, and bahiagrass. Tall fescue and bahiagrass are not readily available but can be obtained from some growers. Species selection is primarily determined by region, availability, and intended use. Use Table SOD-1 and Figure SOD-1 for guidance in selecting sod.

Table SOD-1 Grasses Adapted for Sodding in Alabama

<b>Warm Season Grasses</b>		
<b>Species</b>	<b>Variety<sup>1</sup></b>	<b>Area Adapted</b>
<b>Bermudagrass</b>	Tifway, TifSport, Celebration, TifGrand, Common	North, Central, South
<b>Bahiagrass</b>	Pensacola	Central, South
<b>Centipede</b>	Common, TifBlair	Central, South
<b>St. Augustine</b>	Common, and a few commercial varieties	South
<b>Zoysia</b>	Any selection available in Alabama, Zenith is seeded	Central, South
<b>Cool Season Grasses</b>		
<b>Tall Fescue</b>	Kentucky 31, Rebel (turf type)	North

<sup>1</sup>Listing of a variety is not an endorsement of a Company product. New and better varieties may become available over time.

### *Surface Preparation*

Prior to laying sod, clear the soil surface of trash, debris, roots, branches, stones, and clods larger than 2" in diameter. Fill or level low spots in order to avoid standing water. Rake or harrow the site to achieve a smooth and mowable final grade. Apply appropriate soil amendments prior to final disking. Complete soil preparation by disking, chiseling or other appropriate means and then rolling or cultipacking to firm the soil. Limit the use of heavy equipment on the area to be sodded, particularly when the soil is wet, as this may cause excessive compaction and make it difficult for the sod to penetrate the soil and develop the root system that it should attain.



practice. Minor surface smoothing may be necessary after incorporation of soil amendments.

### *Installing the Sod*

A step-by-step procedure for installing sod is illustrated in Figure SOD-2 and described below.

Moistening the sod after it is unrolled helps maintain its viability. Store it in the shade during installation.

Rake the soil surface to break the crust just before laying sod. During the summer, lightly irrigate the soil, immediately before laying the sod to cool the soil and reduce root burning and dieback.

Do not lay sod on gravel, frozen soils, or soils that have been recently sterilized or treated with herbicides.

Lay the first row of sod in a straight line with subsequent rows placed parallel to and butting tightly against each other. Stagger strips in a brick-like pattern (see Figure SOD – 2). Be sure that the sod is not stretched or overlapped and that all joints are butted tightly to prevent voids. Use a knife or sharp spade to trim and fit irregularly shaped areas.

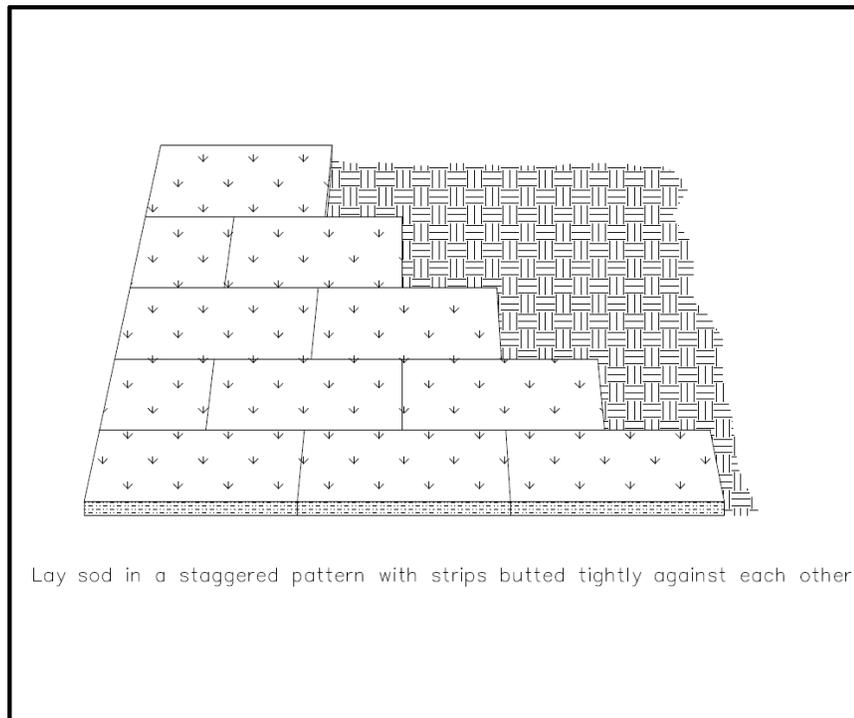


Figure SOD-2 Typical Installation of Grass Sod

Install strips of sod with their longest dimension perpendicular to the slope. On slopes 3:1 or greater, in grass swales or wherever erosion may be a problem, secure

sod with pegs or staples. Jute or other netting material may be pegged over the sod for extra protection on critical areas (see Figure SOD – 3).

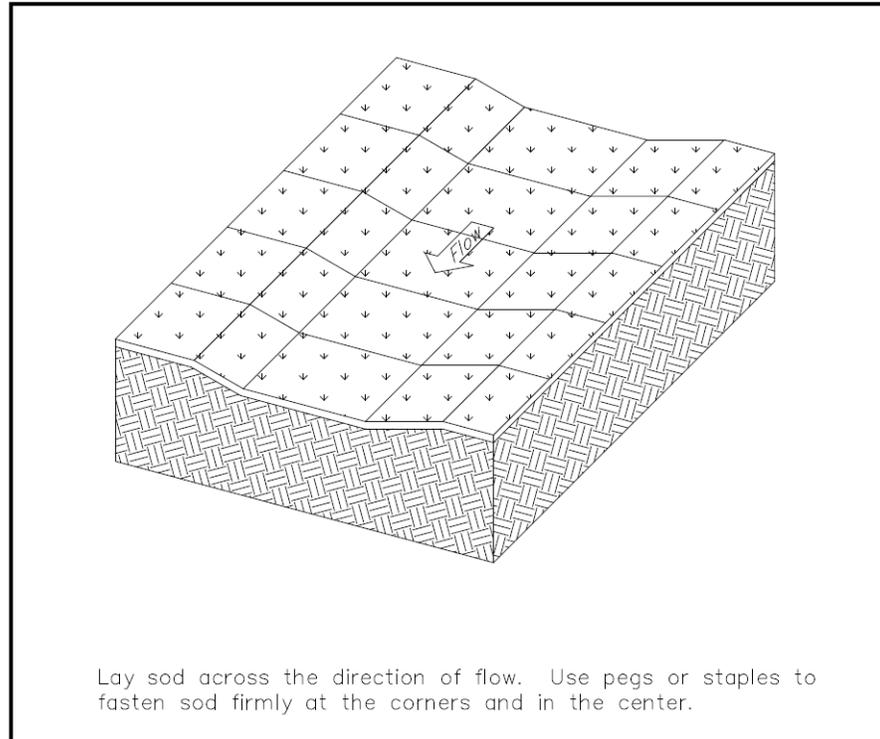


Figure SOD-3 Installation of Sod in Areas with Channel Flows

As sodding of clearly defined areas is completed, use a weighted roller on the sod to provide firm contact between roots and soil.

After rolling, irrigate until the soil is wet at least 6” below the sod.

Keep sodden areas moist to a depth of 4” until the grass takes root. This can be determined by gently tugging on the sod. Resistance indicates that rooting has occurred.

Mowing should not be attempted until the sod is firmly rooted, usually in 2 to 3 weeks.

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## Temporary Seeding (TS)



### Practice Description

Temporary seeding is the establishment of fast-growing annual vegetation from seed on disturbed areas. Temporary vegetation provides economical erosion control for up to a year and reduces the amount of sediment moving off the site.

This practice applies where short-lived vegetation can be established before final grading or in a season not suitable for planting the desired permanent species. It helps prevent costly maintenance operations on other practices such as sediment basins and sediment barriers. In addition, it reduces problems of mud and dust production from bare soil surfaces during construction. Temporary or permanent seeding is necessary to protect earthen structures such as dikes, diversions, grass-lined channels and the banks and dams of sediment basins.

### Planning Considerations

Temporary vegetative cover can provide significant short-term erosion and sediment reduction before establishing perennial vegetation.

Temporary vegetation will reduce the amount of maintenance associated with sediment basins.

Temporary vegetation is used to provide cover for no more than 1 year. Permanent vegetation should be established at the proper planting time for permanent vegetative cover.

Certain plants species used for temporary vegetation will produce large quantities of residue which can provide mulch for establishment of the permanent vegetation.

Proper seedbed preparation and selection of appropriate species are important with this practice. Failure to follow establishment guidelines and recommendations carefully may result in an inadequate or short-lived stand of vegetation that will not control erosion.

The selection of plants for temporary vegetation must be site specific. Factors that should be considered are type of soils, climate, establishment rate, and management requirements of the vegetation. Other factors that may be important are wear, mowing tolerance, and salt tolerance of vegetation.

Seeding properly carried out within the optimum dates has a higher probability of success. It is also possible to have satisfactory establishment when seeding outside these dates. However, as plantings are deviated from the optimum dates, the probability of failure increases rapidly. Seeding dates should be taken into account in scheduling land-disturbing activities.

Site quality impacts both short-term and long-term plant success. Sites that have compacted soils should be modified whenever practical to improve the potential for plant growth.

The operation of equipment is restricted on slopes steeper than 3:1, severely limiting the quality of the seedbed that can be prepared. Provisions for establishment of vegetation on steep slopes can be made during final grading. In construction of fill slopes, for example, the last 4-6" might not be compacted. A loose, rough seedbed with irregularities that hold seeds and fertilizer is essential for hydroseeding. Cut slopes should be roughened (see practice Land Grading).

Good mulching practices are critical to protect against erosion on steep slopes. When using straw, anchor with netting or asphalt. On slopes steeper than 2:1, either hydraulic mulch or erosion control blanket is more appropriate than straw to protect the slope.

The use of irrigation (temporary or permanent) will greatly improve the success of vegetation establishment.

## **Design Criteria**

### *Plant Selection*

Select plants that can be expected to meet planting objectives. To simplify plant selection, use Table TS-1, Commonly Used Plants for Temporary Cover and Figure TS-1, Geographical Areas for Species Adaptation and Seeding Dates. Seeding mixtures commonly specified by the Alabama Department of Transportation are an

appropriate alternative for plantings on rights-of-ways. Additional information related to plantings in Alabama is found in Chapter 2 in the section Non-woody Vegetation for Erosion and Sediment Control.

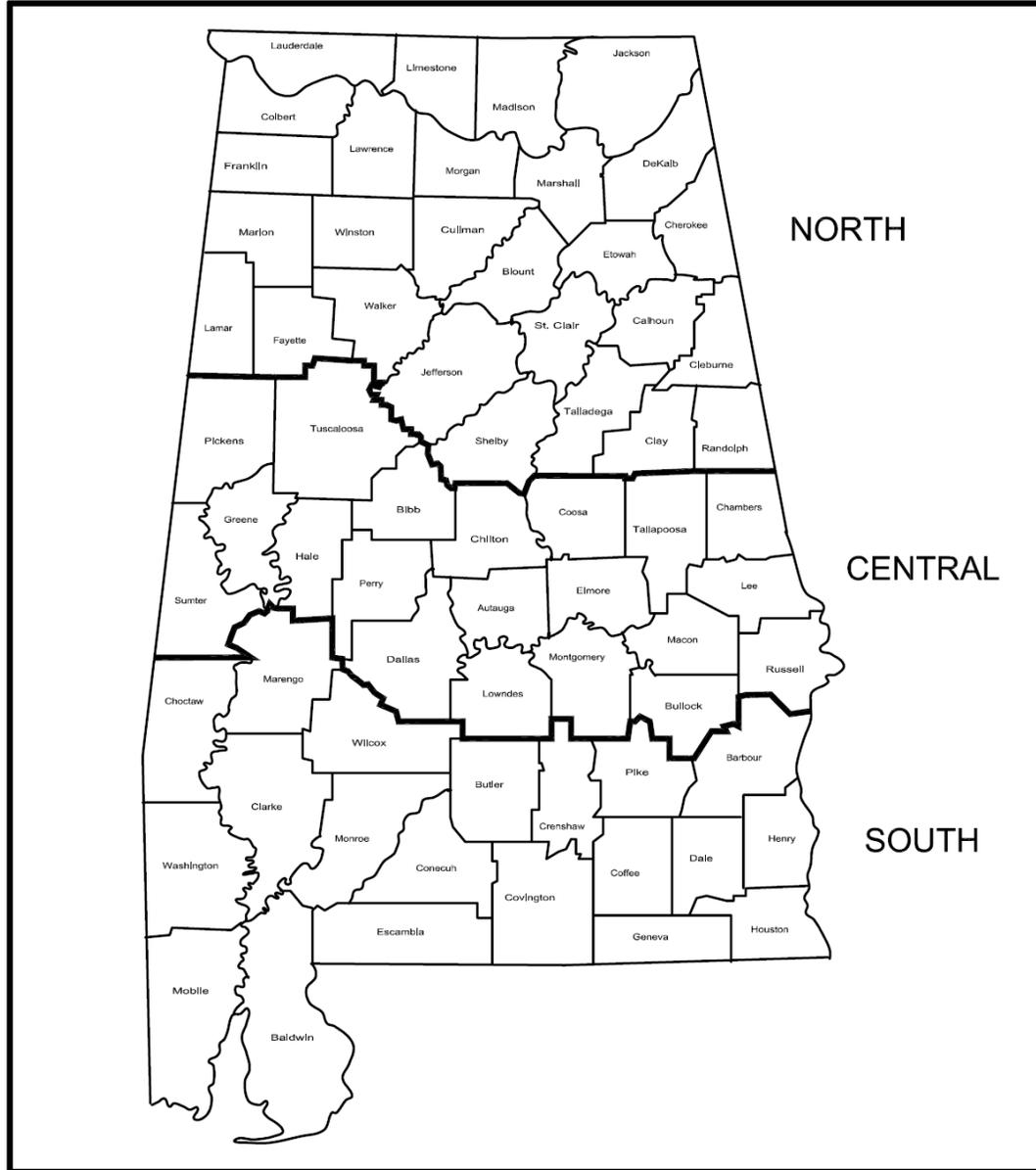


Figure TS-1 Geographical Areas for Species Adaptation and Seeding Dates

*Note: Site conditions related to soils and aspect in counties adjacent to or close to county boundaries may justify adjustments in planting dates by qualified design professionals.*

Table TS-1 Commonly Used Plants for Temporary Cover

Species	Seeding Rate/AC PLS	North	Central		South
			Seeding Dates		
<b>Millet, Browntop or German</b>	40 lbs	Apr1-Aug 1	Apr1- Aug 15	Apr 1-Aug 15	
<b>Rye</b>	3 bu	Sep 1-Nov 15	Sep 15-Nov 15	Sep 15-Nov 15	
<b>Ryegrass</b>	30 lbs	Aug 1-Sep 15	Sep 1-Oct 15	Sep 1-Oct 15	
<b>Sorghum-Sudan Hybrids</b>	40 lbs	May 1-Aug 1	Apr 15-Aug 1	Apr 1-Aug 15	
<b>Sudangrass</b>	40 lbs	May 1-Aug 1	Apr 15-Aug 1	Apr 1-Aug 15	
<b>Wheat</b>	3 bu	Sep 1-Nov 1	Sep 15-Nov 15	Sep 15-Nov 15	
<b>Common Bermudagrass</b>	10 lbs	Apr 1-July 1	Mar 15-July 15	Mar 1-July 15	
<b>Crimson Clover</b>	10lbs	Sept 1-Nov 1	Sept 1-Nov 1	Sept 1-Nov 1	

PLS means pure live seed and is used to adjust seeding rates. For example, to plant 10 lbs PLS of a species with germination of 80% and purity of 90%,  $PLS = 0.8 \times 0.9 = 72\%$ . 10 lbs PLS =  $10/0.72 = 13.9$  lbs of the species to be planted.

### *Site Preparation and Soil Amendments*

Complete grading and shaping before applying soil amendments if needed to provide a surface on which equipment can safely and efficiently be used to apply soil amendments and accomplish seedbed preparation and seeding.

#### *Lime*

Apply lime according to soil test recommendations. If a soil test is not available, use 1 ton of agricultural limestone or equivalent per acre on coarse textured soils and 2 tons per acre on fine textured soils. Do not apply lime to alkaline soils or to areas which have been limed during the preceding 2 years. Other liming materials that may be selected should be provided in amounts that provide equal value to the criteria listed for agricultural lime or be used in combination with agricultural limestone or Selma chalk to provide equivalent values to agricultural limestone.

#### *Fertilizer*

Apply fertilizer according to soil test results. If a soil test is not available, apply 8-24-24 fertilizer.

When vegetation has emerged to a stand and is growing, 30 to 40 lbs/acre (approximately 0.8 lbs/1000 ft<sup>2</sup>) of additional nitrogen fertilizer should be applied.

*Note: Fertilizer can be blended to meet exact fertilizer recommendations. Take soil test recommendations to local fertilizer dealer for bulk fertilizer blends. This may be more economical than bagged fertilizer.*

### *Application of Soil Amendments*

Incorporate lime and fertilizer into the top 6" of soil during seedbed preparation.

### *Seedbed Preparation*

Good seedbed preparation is essential to successful plant establishment. A good seedbed is well pulverized, loose, and smooth. If soils become compacted during grading, loosen them to a depth of 6" to 8" using a ripper or chisel plow.

If rainfall has caused the surface to become sealed or crusted, loosen it just prior to seeding by disking, raking, harrowing, or other suitable methods. When hydroseeding methods are used, the surface should be left with a more irregular surface of clods.

### *Planting Methods*

#### *Seeding*

Evenly apply seed using a cyclone seeder (broadcast), drill seeder, cultipacker seeder, or hydroseeder. Broadcast seeding and hydroseeding are appropriate for steep slopes where equipment cannot operate safely. Small grains should be planted no more than 1" deep, and grasses and legumes no more than ½" deep. Seed that are broadcast must be covered by raking or chain dragging, and then lightly firmed with a roller or cultipacker.

#### *Hydroseeding*

Surface roughening is particularly important when hydroseeding, as a roughened slope will provide some natural coverage for lime, fertilizer, and seed. The surface should not be compacted or smooth. Fine seedbed preparation is not necessary for hydroseeding operations; large clods, stones, and irregularities provide cavities in which seeds can lodge.

Mix seed, inoculant if required, and a seed carrier with water and apply as slurry uniformly over the area to be treated. The seed carrier should be a cellulose fiber, natural wood fiber or other approved fiber mulch material which is dyed an appropriate color to facilitate uniform application of seed. Use the correct legume inoculant at 4 times the recommended rate when adding inoculant to hydroseeder slurry. The mixture should be applied within one hour after mixing to reduce damage to seed.

Fertilizer should not be mixed with the seed-inoculant mixture because fertilizer salts may damage seed and reduce germination and seedling vigor. Fertilizer may be applied with a hydro seeder as a separate operation after seedlings are established.

### *Mulching*

The use of appropriate mulch provides instant cover and helps ensure establishment of vegetative cover under normal conditions and is essential to seeding success

under harsh site conditions (see the Mulching practice for guidance). Harsh site conditions include the following: slopes steeper than 3:1 and adverse soils (soils that are shallow to rock, rocky, or high in clay or sand). Areas with concentrated flow should be treated differently and require a hydromulch formulated for channels or an appropriate erosion control blanket.

## Tree Planting On Disturbed Areas (TP)



### Practice Description

Tree planting on disturbed areas is planting trees on construction sites or other disturbed areas to stabilize the soil. The practice reduces erosion and minimizes the maintenance requirements after a site is stabilized. The practice is applicable to those areas where tree cover is desired and is compatible with the planned use of the area, particularly on steep slopes and adjacent to streams. Tree planting is usually used with other cover practices such as permanent seeding or sodding.

### Planning Considerations

Control grasses and legumes when planted in combination with trees to reduce competition for moisture, nutrients and sunlight.

Select trees that are adapted to soil and climate.

Avoid planting species which are invasive or may become a nuisance.

Avoid trees that have undesirable characteristics.

Select trees that will improve aesthetics and provide food and cover for wildlife.

Consider using tree tubes as they will help protect the trees from wildlife damage, mowers, weed-eaters, etc. and increase growth of the seedling during the first year.

Tree mats around young seedlings can be helpful in reducing competition from weeds and grasses during the critical first year of growth.

## Design Criteria

### *Planting Bare-rooted Tree Seedlings*

#### *Site Preparation*

Compacted soil should be ripped or chiseled on the contour to permit adequate root development and proper tree growth. Debris should be removed from the site to facilitate tree planting.

#### *Planting Methods*

Tree seedlings may be planted by hand or machine. Any tool or piece of equipment that gives satisfactory results may be used. Dibble bars, mattocks, augers, post-hole diggers and shovels may be used to plant trees by hand. Wildland tree planting machines should be used on rough areas or areas with clayey or compacted soils. Old field tree planters should be limited to areas with sandy soils that are not compacted. Plantings on sloping land should be done on the contour.

#### *When*

Bare-root seedlings should be planted from December 1 to March 15. Planting should be done when the soil is neither too dry nor too wet. Planting should be avoided during freezing weather and when the ground is frozen.

#### *Planting Rate*

To control erosion pines should be planted at a rate of 600 to 700 trees per acre and hardwoods should be planted at a rate of 300 to 500 trees per acre. Severely eroding areas should be planted at the rate of 600 to 900 trees per acre for both pine and hardwood species.

#### *Depth of Planting*

Trees should be planted deeper than they grew in the nursery. Plant small stock 1" deeper and medium to large stock ½" deeper. On most soils, longleaf pine seedlings should be planted ¼" deeper than they grew in the nursery (note: this is not true for planting depth of container grown longleaf seedlings – see Site Preparation in next section for container grown seedlings).

### *Condition of Roots*

Roots should be planted straight down and not twisted, balled, nor U-shaped. Soil should be packed firmly around the planted seedlings. No air pockets should be left in either machine furrows or holes made by planting tools.

### *Care of Seedlings*

The roots of seedlings must be kept moist and cool at all times. After lifting, seedlings should not be exposed to sun, wind, heating, drying or freezing before they are planted. Baled seedlings may be kept up to 3 weeks if they are properly stacked, watered, and kept in a cool place. When planting is delayed longer than 3 weeks, the roots of seedlings should be covered with moist soil (heeled-in) or the seedlings should be put in cold storage.

During planting, the roots of seedlings must be kept moist and only one seedling should be planted at a time. At the end of each day, loose seedlings should be either repacked in wet moss or heeled-in.

### *Mulching*

Mulching may be necessary on sloping land to reduce erosion. Mulch with wood chips, bark, pine needles, peanut hulls etc. should be done to a depth of no more than 3". Mulch should not be placed against the trunk of the tree.

## *Planting Balled and Burlapped and Container-Grown Trees*

### *Site Preparation*

The planting hole should be dug deep and wide enough to allow proper placement of the root ball. The final level of the root ball's top should be level with the ground surface (See Figure TP-1). For container grown longleaf seedlings, the planting depth should be slightly higher than the depth grown in the nursery.

As the hole is dug the topsoil should be kept separate from the subsoil. If possible the subsoil should be replaced with topsoil. If topsoil is unavailable the subsoil can be improved by mixing in 1/3 volume of peat moss or well-rotted manure.

Heavy or poorly drained soils are not good growth media for trees. When it is necessary to transplant trees into such soils, extra care should be taken.

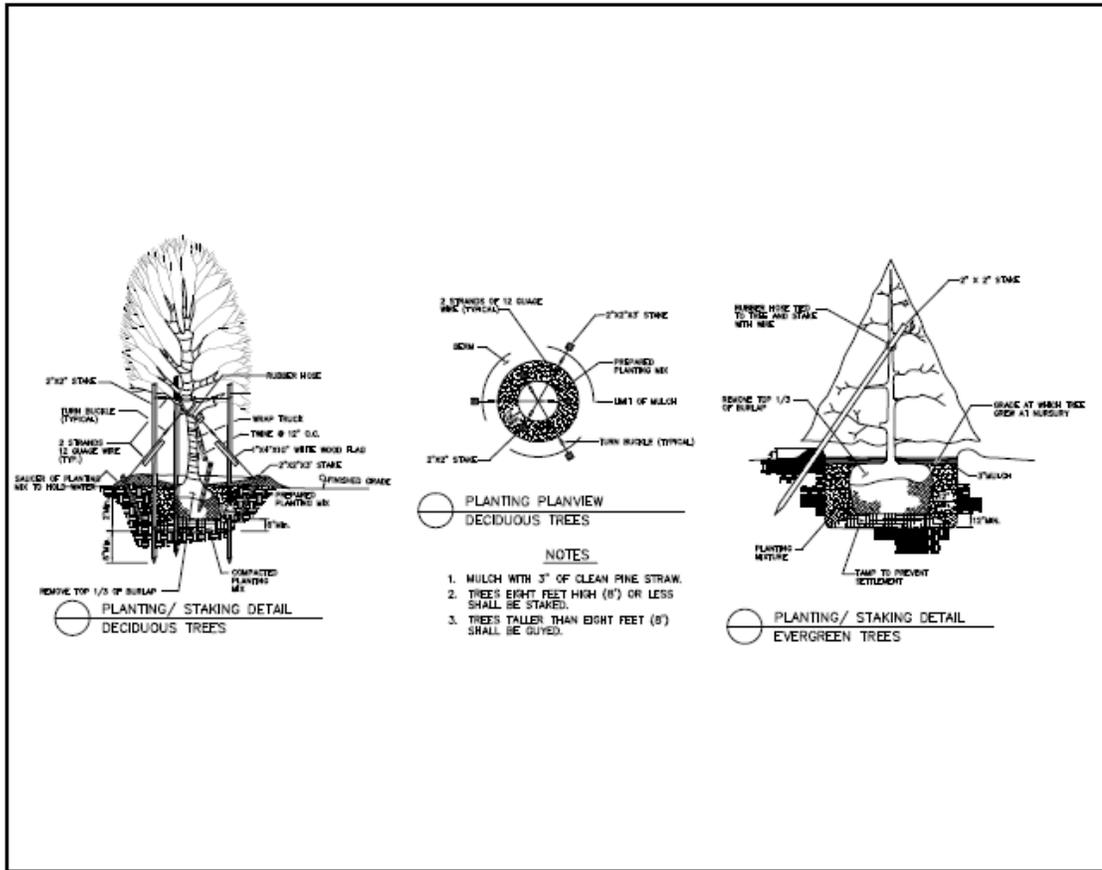


Figure TP-1 Tree Planting Diagram

*Tree Preparation*

The proper digging of a tree includes the conservation of as much of the root system as possible, particularly the fine roots. Soil adhering to the roots should be damp when the tree is dug, and kept moist until planting. The soil ball should be 12" in diameter for each inch of diameter of the trunk. The tree should be carefully excavated and the soil ball wrapped in burlap and tied with rope. Use of a mechanical tree spade is also acceptable.

Any trees that are to be transported for a long distance should have the branches bound with a soft rope to prevent damage.

### *Planting the Tree*

Depth of planting must be close to the original depth. The tree may be set just a few inches higher than in its former location, especially if soil is poorly drained. Do not set the tree lower than before. Soil to be placed around the root ball should be moist but not wet.

Set the tree in the hole and if the tree is balled and burlapped remove the rope which holds the burlap. Loosen the burlap and remove completely if practical. Do not break the soil of the root ball. Fill the hole with soil halfway and add water to settle the soil and eliminate air pockets. When the water has drained off, fill the hole the remainder of the way. Use extra soil to form a shallow basin around the tree. This will help retain water.

Newly planted trees may need artificial support to prevent excessive swaying. Stakes and guy wires may be used (see Figure TP-1). Guying should be loose enough to allow some movement of the tree.

### *Mulching*

Mulching may be necessary on sloping land to reduce erosion and should be used around balled and burlapped trees and container grown trees to help conserve soil moisture and reduce competition from weeds and grass. Apply mulch using wood chips, bark, pine needles, peanut hulls etc. to a depth of no more than 3". Mulch should not be placed against the trunk of the tree.

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