Appendix B

Northeast Utilities' *Construction and Maintenance Environmental Requirements Best Management Practices Manual: Connecticut, December 2011*

Tighe&Bond

Construction & Maintenance
Environmental Requirements

Best Management Practices Manual: Connecticut

Prepared For:

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107 Selden Street
Berlin, CT

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Type	Applicable Control	Location
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Section 1
Introduction

1.1 Purpose

As a matter of Northeast Utilities (NU) policy regarding environmental stewardship and in accordance with local, state, and federal regulations, all transmission construction and maintenance projects shall use environmentally sound best management practices (BMPs) to minimize or eliminate environmental disturbances that may result from construction activities. Regardless of whether a specific permit is needed for the work, construction and maintenance projects must follow clear and enforceable environmental performance standards, which is why these BMPs have been compiled. In most cases, maintenance activities are exempt from regulatory authorization as described in further detail in Appendix B of this BMP manual. Permits are typically required for new work. Contractors will be provided with copies of any project specific permits, and will be required to adhere to any and all provisions of the permit(s). Permit conditions that are more detailed than the BMPs outlined in this manual should always be given deference. However, where certain construction elements are not addressed by permit conditions, or where permitting is not required, or for emergency situations where obtaining a permit before the work occurs may not be an option, these BMPs shall be considered as NU's standards. In some cases, and at the discretion of the NU Management, the BMPs presented herein may be modified to be more appropriate for site-specific conditions.

1.2 Scope and Applicability

These BMPs primarily address the disturbance of soil, water, and vegetation incidental to construction within on- and off-road utility corridors, substations, including the establishment of access roads and work areas, in and near wetlands, watercourses, or other sensitive natural areas, including storm drain systems (e.g. catchbasins). Types of construction include, but are not limited to installation or maintenance of underground and overhead utilities, substations and other facilities. Other common construction issues such as noise, air pollution, oil spill procedures, handling of contaminated soils, and work safety rules are addressed in the Northeast Utilities Contractor Work Rules and related appendices.

1.3 Definitions

The following definitions are provided to clarify use of common terms throughout this document.

Casing: A galvanized steel corrugated pipe that serves as a "foundation" for utility pole installation.

Emergency Projects: Limited to actions needed to maintain the operational integrity of the system or activities necessary to maintain or restore public health and safety in response to a sudden and unexpected event. Determinations of emergency status will be made by the NU Transmission Line and Maintenance Manager in consultation with Transmission Siting and Permitting staff. Some emergency response actions may require after-the-fact permitting/notification with regulatory agencies.

Embedded Culvert: A culvert that is installed in such a way that the bottom of the structure is below the stream bed and there is substrate in the culvert.

Erosion control: A measure to prevent soil from becoming dislodged.

Existing Access Roads: Previously permitted or grandfathered access roads that are used to access structures that are clearly visible or can be found by mowing or by the presence of road materials in soil cores.

General Permit Category 1: Projects with minimal disturbance to wetlands and waters of the U.S. that do not require a formal permit application to be submitted to the U.S. Army Corps of Engineers (Corps). Projects completed under Category 1 must meet the General Conditions of the General Permit. Refer to General Permit appendices for Category 1 thresholds. Under the General Permit, a Category 1 Form must be submitted to the Corps and CTDEEP certifying that the work will be conducted in accordance with the General Conditions of the General Permit prior to the commencement of work.

General Permit Category 2: Projects which require a formal permit application to be submitted to the Corps and CTDEEP. The Corps coordinates the review of Category 2 activities with state and federal agencies to ensure that a proposed activity results in no more than a minimal impact to the aquatic environment. Category 2 activities must meet the General Conditions of the General Permit. Refer to General Permit appendices for Category 2 thresholds. There is no established timeframe for a Category 2 permit review, but a general review timeframe is approximately 60 days. Projects that cannot be completed under Category 2 must file for an Individual Permit with the Corps.

Individual Permit: Projects which are not eligible under Category 1 or 2 or which do not meet the General Conditions of the General Permit will require the submission of an application for an Individual Permit to the Corps. An Individual Permit is generally required for projects which propose more than a minimal impact to the aquatic environment. There is no established timeframe for an Individual Permit review, but a general review timeframe is approximately 60 days following the publishing of a Public Notice. When a project also requires an individual water quality certification or coastal zone management consistency concurrence, it is required that those permits be obtained from the State of Connecticut before the Corps issues its Individual Permit.

Intermittent Watercourse: Per the Connecticut Inland Wetland and Watercourses Act, intermittent watercourses are delineated by a defined permanent channel and bank and the occurrence of two or more of the following characteristics: (A) Evidence of scour or deposits of recent alluvium or detritus, (B) the presence of standing or flowing water for a duration longer than a particular storm incident, and (C) the presence of hydrophytic vegetation.

Low-Impact Vehicles: Vehicles that have a lesser impact on an environmentally sensitive area due to the vehicle being smaller, lighter, or different in another way than a vehicle which would have a greater impact. Low impact vehicles could include ATVs, tracked vehicles with low ground pressure, or vehicles with oversized balloon-type tires.

Maintenance Projects: Typically consist of activities limited to the repair and/or replacement of existing and lawfully located electrical utility structures and/or facilities where no change in the original structure or footprint is proposed. Maintenance activities also include vegetation management.

Minimization: Causing as little disturbance to an area as possible during construction.

New construction: Also referred to as capital projects, they are required to go through a full permit review by the NU Siting and Permitting Department.

Restoration/Rehabilitation: To return a disturbed area to its former, original or unimpaired condition. A site is considered fully restored when it has returned (as closely as possible) to its original state. Restore disturbed areas as soon as possible.

Re-vegetation: Establishment of plant material for temporary or permanent soil stabilization.

Stabilization: A system of permanent or temporary measures used alone or in combination to minimize erosion from disturbed areas.

Sediment Control: Control of sediment after it has been dislodged.

Vehicles with Low Ground Pressure: Vehicles which have tires or tracks that apply less than three pounds per square inch (psi) on the ground surface.

Work: For the purposes of this BMP Manual, the disturbance of soil, water, and vegetation incidental to construction within on- and off-road utility corridors, substations, including but not limited to the establishment of access roads and work areas, in and near wetlands, watercourses, or other sensitive natural areas, including storm drain systems (e.g. catchbasins). Types of construction include, but are not limited to installation or maintenance of underground and overhead utilities, substations and other facilities.

1.4 Contacts (Transmission Siting and Permitting)

TABLE 1-1
NU Contacts (Berlin, CT)

Group/Location	Phone
Transmission Siting & Permitting Manager	(860) 665-2036

1.5 BMP References

The following table lists the public guidance documents utilized during the preparation of this BMP manual. Refer to these documents for additional information.

TABLE 1-2

Document Title
Best Management Practices (BMPs) Manual for Access Road Crossings of Wetlands and Waterbodies, EPRI, Palo Alto, CA: 2002. 1005188.
Gas Research Institute. Horizontal Directional Drilling Best Management Practices Manual. 2002. ENSR Corporation, Westford, MA and Trenchless Engineering Corp., Houston, TX.
Connecticut Department of Transportation (ConnDOT). ConnDOT Drainage Manual (October 2000) http://www.ct.gov/dot/cwp/view.asp?a=1385&Q=260116
Connecticut Standard Specifications for Roads, Bridges and Incidental Construction, FORM 815 METRIC VERSION, 1995.
Connecticut Department of Energy & Environmental Protection. Connecticut Guidelines for Erosion and Sediment Control. 2002.
Connecticut Department of Energy & Environmental Protection, Bureau of Natural Resources, Division of Forestry. Best Management Practices for Water Quality While Harvesting Forest Products. 2007. http://www.ct.gov/dep/lib/dep/forestry/best_management_practices/best_practicesmanual.pdf

Section 2
Project Planning

All projects are required to go through a permit review by the Transmission Siting and Permitting Group. A summary of potentially applicable laws and regulations is provided in Appendix B of this document.

2.1 Types of Wetlands

Federal and state regulatory definitions of wetlands are provided in Appendix B. Wetland areas common to New England and common to Connecticut include, but are not limited to, the following:

Forested Wetlands

Forested wetlands, which are dominated by trees 20 feet or taller, are typically drier wetlands with standing water during periods of seasonal high groundwater, high precipitation, and/or snowmelt and runoff (early spring through mid summer). Tree species typical of this type of wetland include red maple (*Acer rubrum*) and eastern hemlock (*Tsuga canadensis*). "Pit and mound" topography is common in forested wetlands, where mature trees grow on the higher and drier mounds and obligate wetland species are found in the lower pits.

Scrub-Shrub Wetlands

Scrub-shrub wetlands are dominated by woody vegetation less than 20 feet tall, and may include peat bogs. Typical bog species include leatherleaf (*Chamaedaphne calyculata*), cotton grasses (*Eriophorum* sp), cranberry (*Vaccinium macrocarpon, V. oxycoccus*), and black spruce (*Picea marina*). Other non-bog scrub-shrub wetlands are characterized by buttonbush (*Cephalanthus occidentalis*), alders (*Alnus* sp), dogwoods (*Cornus* sp), and arrowwoods (*Viburnum* sp).

Marshes

Marshes are dominated by erect, herbaceous vegetation and appear as grasslands or stands of reedy growth. These wetlands are commonly referred to by a host of terms, including marsh, wet meadow, fen. These areas are flooded all or most of the year and, in New England, tend to be dominated by cattails (*Typha* sp).

Wet Meadows

Typical wet meadow species include grasses such as bluejoint (*Calamagrostis canadensis*) and reed canary grass (*Phalaris arundinacea*), sedges (*Carex* sp) and rushes (*Juncus* sp), and various other forbs such as Joe-Pye-weeds (*Eupatorium* sp) and asters (*Aster* sp).

Floodplains

In Connecticut, areas that contain alluvial or floodplain soils are regulated as wetlands. These areas may flood so infrequently or be so freely drained that hydrophytic vegetation and hydric soils are not present. Soils in these areas must be examined carefully to determine whether well drained alluvial or floodplain soils are present.

Streams

A stream is any natural flowing body of water that empties to any ocean, lake, pond or other river. Perennial streams, or rivers, have flows throughout the year. Intermittent streams do not have surface flows throughout the year, though surface water may remain in isolated pockets.

Vernal Pools

Vernal pools are typically contained basin depressions lacking permanent aboveground outlets. These areas fill with water with the rising water table of fall and winter and/or with the meltwater and runoff of winter and spring snow and rain. The pools contain water for a few months in the spring and early summer. Due to periodic drying cycles, vernal pools do not support breeding fish populations and can thus serve as breeding grounds for a variety of amphibians, including some rare and protected species of frogs and salamanders.

Other Considerations

Other regulated factors taken into consideration during the project planning process include the presence of protected (i.e. threatened, rare or endangered) species, non-native invasive plant species and/or historical and archaeological. Special requirements may need to be evaluated as part of new construction and/or some maintenance activities.

2.2 Meetings

Pre-construction meetings are typically held prior to the commencement of all work to appoint responsible parties, discuss timing of work, and further consider options to avoid and/or minimize disturbance to sensitive areas. These meetings can occur on or off-site and should include all the applicable stakeholders (i.e., NU, contractors, consultants, inspectors and/or monitors, and regulatory agency personnel). A brief **Pre-job briefing** would suffice for smaller maintenance projects.

Pre-job briefings are daily or otherwise routine meetings that are conducted on-site with the work crew throughout the duration of work. These meetings are a way of keeping everyone up to date, confirming there is consensus on work methods and responsibilities, and ensuring that tasks are being fulfilled with as little disturbance to the environment as possible.

2.3 Construction Monitoring

Some construction projects may require an environmental monitor. This is a way to keep a chronological record of pre-construction site conditions, progress, and changes that are made, as well as to document problems and authorized solutions.

If work will occur in a wetland resource area or an area mapped or otherwise designated as rare or endangered species habitat, permit conditions may dictate that construction be monitored by a qualified and pre-approved wetland or wildlife specialist.

All construction inspections performed by NU personnel will be entered into the siting and permitting database. Other wise construction inspections will be stored in NU's Records Information Management system.

2.4 Signage

Where appropriate (e.g. during construction projects), signage shall be installed that makes clear where critical boundaries (i.e. the limits of jurisdictional wetland resource areas and/or rare species habitat) and setbacks occur, regulatory authorization by agencies, and issues prohibitions of certain uses on ROWs, such as off-road vehicle (ORV) traffic.

Signage shall be installed along sediment and erosion control barriers at appropriate intervals to ensure that the presence and location of said barriers is clear to construction personnel during deep snow or other low visibility conditions. Inspection and maintenance of this signage shall be conducted on a regular basis to ensure effectiveness.

Examples of signage at wetlands.

Section 3
Construction Considerations

During all project activities (e.g. maintenance, new construction), federal, state, and local regulatory authorities require steps be taken to avoid, minimize, and/or mitigate disturbance to the environment. Wetlands and other sensitive areas should be avoided whenever possible. However, some work may require entrance into these areas in order to access a work site. This section discusses measures that should be taken to minimize disturbance to sensitive areas during work area access if disturbance is unavoidable.

BMPs have been developed to aid in this process and should be carefully selected and implemented based on the proposed activities and the nature of sensitive area(s) encountered at each site. Proper selection of BMPs should take into consideration the project goals, permit requirements, and site specific information. Once an assessment of the area has been made and requirements of the project have been established, all BMPs should be considered and implemented as appropriate.

Tables TOC-1 and TOC-2 summarize BMP types. This Section addresses BMPs specific to construction of new access roads, repair of existing access roads, installation of work pads, structure-related work, and soil stockpile management. Information regarding recommended erosion and sedimentation controls or stormwater controls is also discussed. Please refer to Appendix A for typicals and representative photographs of BMPS used for erosion and sedimentation control and water diversion during construction.

3.1 Access Roads

Construction access roads are generally previously permitted or grandfathered unpaved roadways which work crews use to access a site. If new access road construction is planned as part of a major project, please refer to the existing Development and Management Plans approved by the Connecticut Siting Council (CSC) specifically for the project.

3.1.1 New Access Roads

New access roads are generally associated with new or large-scale projects that have separate permitting requirements. Installation of access roads will be based on the approved CSC Development and Management Plan and as regulated by any federal and state permits. If a new access road is needed and not associated with a large project, the Transmission Siting and Permitting Group should be notified to make a decision on best access routes. Permit requirements must be followed.

3.1.2 Existing Access Roads

Access roads in upland areas should not exceed 16 feet in width, including side slopes. Maintaining existing access roads includes mowing of vegetation, grading, placement/replacement of stone, and the installation/maintenance of erosion control features (ie. water bars, swales, sedimentation basins).

When access roads are in wetlands, measures should always be taken to avoid disturbance to wetlands, waterways, and sensitive areas. If avoidance is not possible, then measures should be taken to minimize the extent of disturbance. Alternate access

routes or staging areas should always be considered. Below is a list of methods that should be considered where disturbance is unavoidable:

- Minimize the width of typical access roads through wetlands. If an existing access road is evident in the wetland, you must maintain the width of the original access road. If unable to ascertain the original width of the access then make every effort to keep road less than or equal to 16 feet wide;
- Use low-impact vehicles and/or vehicles with low ground pressure when driving through wetlands;
- Coordinate timing of work to the extent feasible to cause the least amount of disturbance (e.g. during the regulatory low-flow period (July 1 – September 30), when water/ground is frozen, after the spring songbird nesting season);
- Use swamp, timber, or similar mats in wetlands to minimize soil disturbance and rutting when work needs to occur during non-frozen ground conditions; and
- Conduct work manually if warranted (decision to be made by scientist)

Existing access roads that have become part of the wetland are considered previous fill that were either permitted or grandfathered and where it is evident that an access road exists, it is acceptable to place stone over the previously placed fill. Where the existing access road is not evident, Transmission Siting and Permitting must be called to make a determination whether stone can be placed in the wetland. If stone is not evident, through soil cores, hand digging or other method, swamp mats will be used. If permanent access is warranted through the wetland, the new access road will need to have a permitting review and will most likely require permits.

The access road in the wetland will not exceed 12 feet in width (unless there is evidence that the road was originally wider than 12 feet).

Over time, existing access roads require maintenance and repair. Travel by construction equipment and general traffic to reach a particular portion of right-of-way must be via the designated access road and route. Changes in the location of the access road or the use of alternate roads must be approved by the NU Representative prior to their construction or use. Access road routes have been selected to prevent degradation of the utility corridor, and must be constructed, used, and maintained in accordance with this manual, as well as federal, state, and local regulations, and other project plans.

Though in some situations they may be necessary, constructing duplicate access roads should be avoided to the greatest extent possible. Some appropriate reasons for suggesting alternate routes are:

- Poor site conditions along preferred route because of weather or season;
- Property rights constraints, or property owner's preference;
- Equipment requirements;
- Unanticipated off-site access limitations along existing roads; and/or
- Unanticipated access opportunities (e.g., ice, snow, other developments) which may avoid environmental disturbance and/or reduce cost.

General Design: New and Existing Access Roads

Construction access roads that require new grading and/or filling, or are to be heavily used require the creation of a stable, tractable, load-bearing surface resistant to erosion. If the existing soil and subsoil are not well drained, it may be necessary to import an aggregate road base (i.e., gravel borrow) such as that meeting the requirements of aggregate found in the Connecticut *Standard Specifications for Roads, Bridges and Incidental Construction*, Section M1.02. When the construction access road follows the same route as the permanent design road, constructing the grades and subgrade for the permanent roadway early in the construction sequence is recommended.

Construction access roads shall typically not exceed 16 feet in width except for passing points, where necessary. Subgrading shall not extend beyond the space required for the finished road and normal side slopes.

Where possible, construction access roads should conform to the contours of the land, avoiding grades steeper than 10 percent and creating side slopes no steeper than a ratio of 2:1. If the side slopes are steeper than 2:1, then use of engineered slope stabilization methods is imperative (see Stabilization Structures Functional Group, 2002 Connecticut Guidelines for Soil Erosion and Sediment Control). Consider the volume and type of construction traffic as well as the extent that natural ground must be altered to accommodate the traffic. If no grading is required and the construction traffic is very intermittent (e.g., access roads used to maintain utility lines) the measures used may be limited to water bars, or some top dressing with gravel or stone in areas where the vegetation over soft soil is destroyed by traffic.

During wet weather these roadways can generate significant quantities of sediment if not constructed with adequate stormwater management and erosion control measures. Inspection of the construction access road and the associated erosion and sedimentation measures should occur by the person(s) designated at the pre-construction meeting, at the end of each day the road is used, and repairs to controls made immediately. If the road is not used for more than a week, then inspection of the erosion and sedimentation controls should occur at an appropriate frequency as dictated by the specific measures used and extent of heavy rain events. Repairs may include regrading and/or top dressing the traveled surface with additional aggregate to eliminate ruts, as well as those repairs required by each erosion and sedimentation measure used. After the use roadway is no longer needed, the disturbed area shall be seeded and mulched as required to match preconstruction conditions.

Erosion and Sedimentation Controls

Construction personnel are reminded to control erosion and flow conditions during access road construction by utilizing the following erosion and sedimentation measures which are described and illustrated further in Appendix A:

- **Outlet protection**, a **level spreader**, or a **stone check dam** may be used to de-energize concentrated flows from diversions and in temporary channels.
- **Geotextile silt fencing** and **hay-/straw bale barriers** may be utilized to provide protection at the toe of fill slopes and discharges from water bars.
- Side slopes can be protected by installing **erosion control blankets** and **seeding** the area with a fast-growing native or annual grass mix.

- **Dust contro**l should be employed when construction access road conditions create airborne dust.

- **Geotextile fabric** shall be used beneath all new fill and construction entrances.

Best Management Practices

The following are BMPs that are applicable to new access roads in uplands and are described at the following tabs:

Construction Entrance Track Pad – Tab 1A

Stormwater Management BMPs (includes Water Bars, Drainage Swales, and Sedimentation Basins) – Tab 1B

TAB 1A

Construction Entrance Track Pad

Applications: Erosion and sedimentation control; Roadway protection

- Where the construction access road meets a paved access point to prevent construction machinery from tracking soil onto paved roadways.

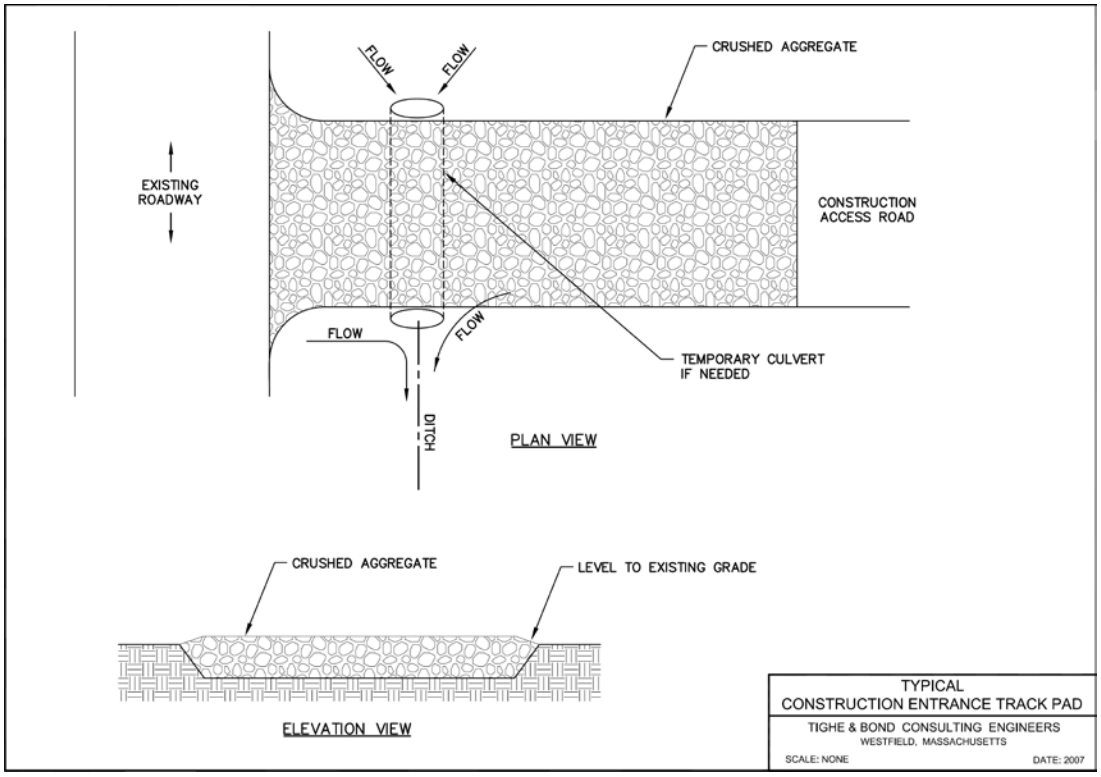
Limitations:

- Stone may need to be removed and refreshed and/or cleaned as needed if the pad becomes clogged with soil;
- Muddy conditions may warrant the use of a tire wash station and procedures should be established to ensure soils are not tracked off site.

How to Use:

- Materials appropriate to construction site soil conditions should be employed and/or replenished, as necessary.
- Where appropriate when safety and environmental conditions are considered, vehicle tires or tracks may be spun quickly ("burn out") on the track pad to further facilitate the removal of soil.
- Stone tracking pads should be at least 50 feet long, and constructed of 3-6 inch washed stone with a depth of at least 12 inches. On sites with clayey soils stone tracking pads should be underlain with a geotextile liner to prevent the stone from sinking into the soil.

Construction entrance track pad.



TAB 1B

Water Bar

Applications: Erosion and sedimentation control

- Linear features constructed across an access way to redirect water flow off of the road surface to prevent erosion.

Limitations:

- Usually must be reinstalled/reworked at the beginning and end of each construction season, due to damage from vehicle traffic and stormwater flows;
- Cannot divert unfiltered runoff to a wetland;
- Can impede vehicular movement;
- Should never be used to direct a watercourse into another waterbody.

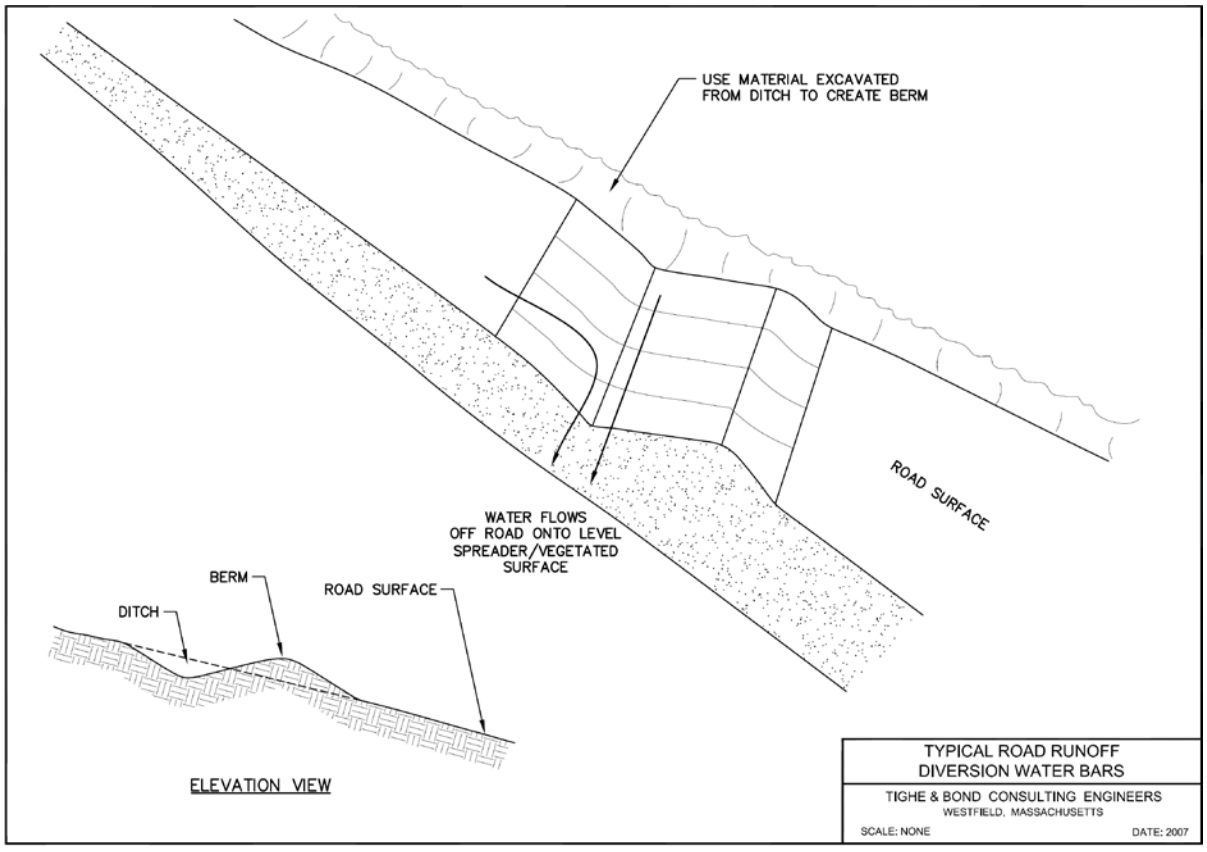
How to Use:

- Consists of a trench dug at least 6 inches below grade followed by an earthen mound at least 6 inches above grade.
- Installed at a downgradient sloping angle across the road, utilizing stable outlets and upland areas adjacent to the road. Design to avoid water bar runoff from upslope waterbars converging with further downgradient water bars.
- Compact the trench and mound with wheeled equipment or other method. Can further stabilize the trench with riprap or stone where applicable.
- Constructed at appropriate intervals along the access way, based on slope, soil type, and surrounding land use. Highly erodible soils or areas with steeper slopes will dictate closer spacing of water bars. Maximum recommended spacing is presented in the table below.

Slope of Road (%)	Maximum Distance Between Waterbars (feet)
1 or less	300
2	200
3-5	150
Greater than 5	100

- Water bars may include the use of hardwood logs to provide structural stability.
- Since they can be damaged by traffic, water bars should be routinely checked and maintained, including removal of accumulated sediment and debris from the trench. Routine inspection will also determine if the original spacing is adequate or if additional water bars need to be constructed.

Diversion waterbar.



Drainage Swales

Applications: Convey stormwater away from work area and/or improve water quality and reduce peak runoff.

- Used to intercept, redirect, and convey surface flows in order to prevent erosion in unprotected areas or flooding in work areas.
- Act as drainage channels and are used during construction or at a disturbed site or road to divert the flows from an unstable area to one that is not as vulnerable to erosion. Can be used to reduce erosion in uplands, and/or prior to discharge of stormwater flows to natural receiving waters – such as wetlands or streams.

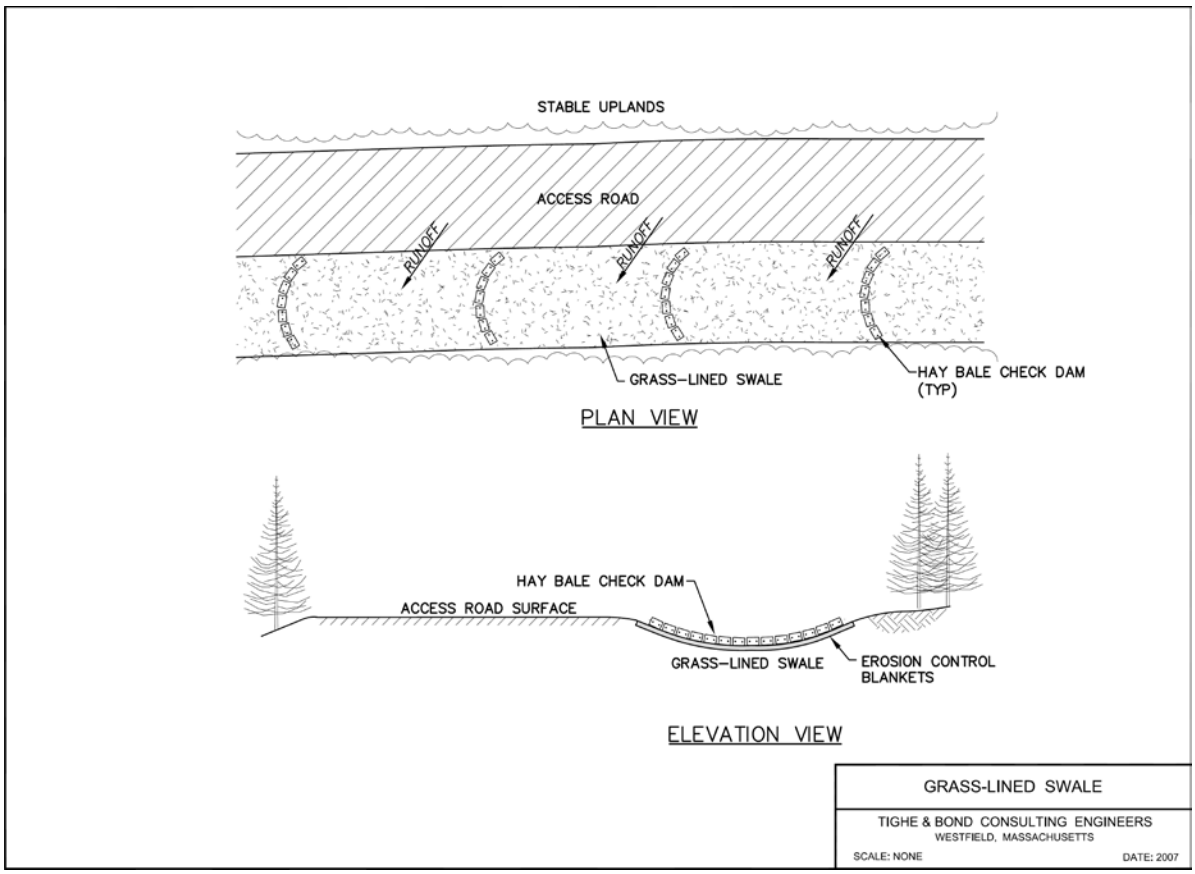
Limitations:

- Vegetated swales need to have adequately established vegetation before flow is diverted to them;
- Need to have adequate bottom stabilization to prevent scouring.

How to Use:

- Usually consist of a ditch that is either vegetated or lined with rip rap, trap rock, erosion control blankets, or other materials.
- Depth and spacing of swales should be dependent on runoff conditions of the specific site.
- Need to be routinely maintained to prevent brush/sediment buildup. Inspect swale regularly and after every rain event (0.25 inches or greater). Repair and/or re-seed rill or gully erosion. Remove accumulated sediments and brush before it reaches a depth of six inches.
- Check dams constructed of hay bales, rip rap, or other materials can be used to slow flows along certain reaches of a swale.
- Temporary swales should be removed once construction is complete or once areas are stabilized. If leaving swales in place will allow for long-term benefits and be compatible with the ultimate use of the site, then they may remain in place.

Grass-lined swale underlain with erosion control blanket and containing hay-bale check dams; used to quickly stabilize soils along a construction access road subjected to significant stormwater runoff. Blue arrow indicates direction of flow.



Sedimentation Basins

Applications: Erosion and sedimentation control

- Used to filter and settle out sediment in stormwater runoff before water is released into a wetland or other unprotected and/or sensitive area and may be used for drainage areas of various sizes.

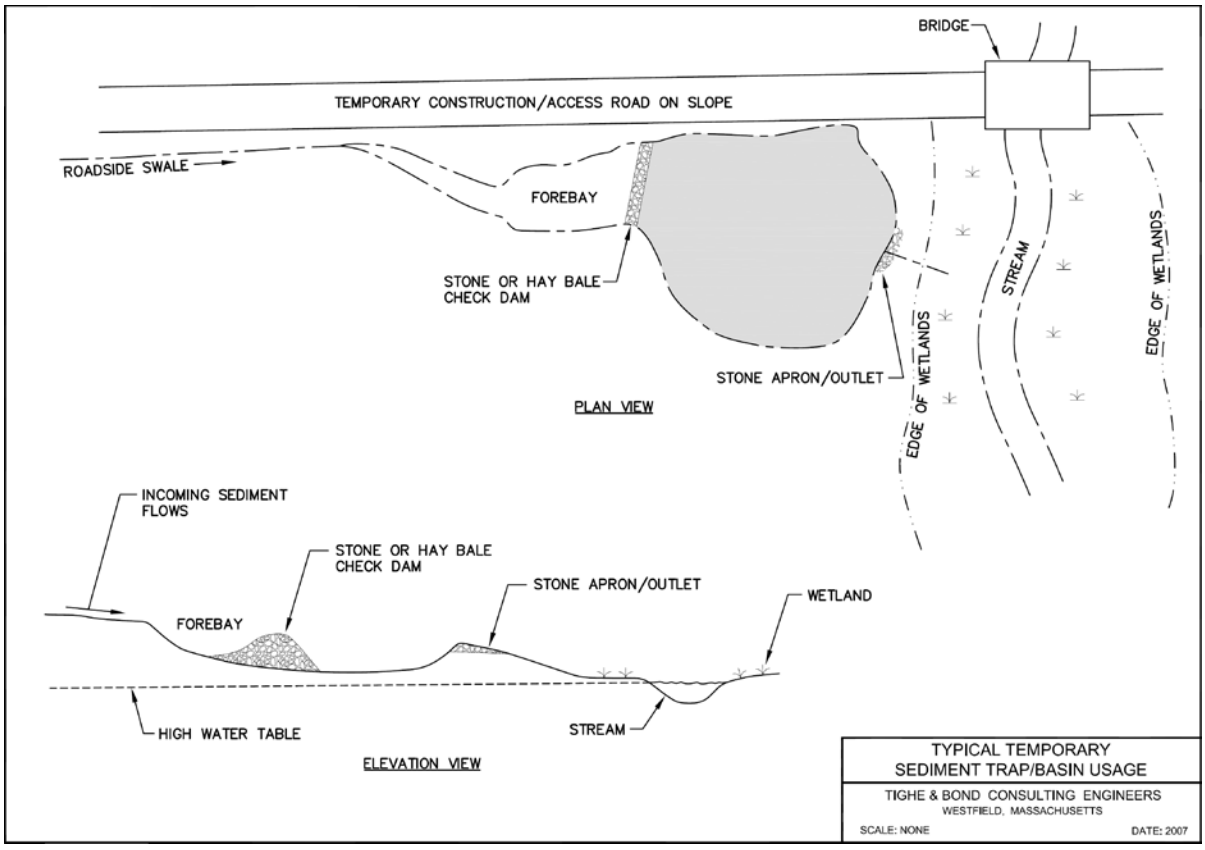
Limitations:

- Needs to be adequately sized based on expected rain events and the contributing drainage area. Based on the size of the project area, a qualified engineer may be required to calculate the appropriate size of the basin. Guidance for basin sizing is provided in the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control (Chapter 5-11). The Guidelines are available at the following website: http://www.ct.gov/dep/cwp/view.asp?A=2720&Q=325660.

How to Use:

- Direct stormwater runoff to sedimentation basins. Basin formed by excavating a depression similar to a small pond, or placing an earthen embankment across an existing drainage swale or naturally low area.
- Clear, grub and strip all vegetation and root material from area of embankment and place embankment fill in lifts, 9 inches per lift at maximum. Compact fill and construct side slopes 2:1 or flatter. Excavate rectangular outlet section from compacted embankment.
- Filter fabric can be installed on bottom and sides of basin, and covered by riprap.
- Extend outlet apron/spillway below toe of dam on level grade until stable conditions are reached (5 feet minimum). Cover inside face of stone outlet section with a 1-foot layer of ½ to ¼ inch aggregate. Vegetate embankments, spillways and disturbed areas down gradient of the basin, either with permanent or temporary seeding.
- Monitor the amount of sedimentation in the basin. Inspect after every rain event and maintain as needed, including removing accumulated sediment, repairing erosion and piping holes, cleaning or replacing the spillway gravel, and re-seeding or planting vegetation.
- Should ideally consist of a forebay where debris and some sediment begins to settle out of the water; a check dam constructed of stone or hay bales which water must flow through, filtering out more sediments; and the actual sediment basin, which is a pool with a slow enough velocity that sediments have time to settle out of the water column before the water flows over the dam at the outlet and is released.
- Sediment basins should be sized to provide a minimum of 12 to 24 hours of detention to maximum expected runoff amounts for the duration of the basin's use.
- Often a critical stormwater management component for larger construction sites, and/or those with poorly drained upland soils.
- Construction of temporary sediment basins should occur before primary construction on a project begins.
- If compatible with the eventual (post-construction) site use, it may be appropriate to leave sediment basins in place indefinitely.

Sedimentation basin with haybale filters.



3.1.3 Wetland

Construction access roads that are constructed in or across wetlands require the following considerations in addition to the considerations for access roads in uplands:

- Construction of new access roads in wetlands, whether temporary or permanent, that do not utilize swamp mats (i.e. earthen and/or rock fill roads, corduroy roads, etc.) require considerable project specific permitting and design. These kinds of projects should comply with project specific permits and plans, while only using this BMP manual as a general reference source. Permits often also require wetlands replication when permanent new access roads are constructed in wetlands.
- Avoid putting the construction access road in a wetland whenever possible. Explore all feasible and prudent alternatives before determining that a wetland crossing is absolutely necessary. When avoidance is not possible, consider crossings that will result in the least amount of disturbance. This may involve locating the construction access road so that it crosses the wetland at its narrowest width or uses areas previously disturbed for access or other purposes.
- Minimize the width of the temporary construction access road through the wetlands (generally no wider than 16 feet when using swamp mats). It is preferable to have a passing point created before and after the wetland crossing, but internal passing points may be needed if the crossing is very long or critical sight line restrictions exist.
- Consider the soil conditions. Expect deep organic wetland soils to require geotextiles, timber/swamp mats, or other materials during use to keep imported road materials separated from wetland soils. In shallow organic, or saturated soils thick plywood sheets or AlturnaMATS® may be sufficient to support a stable travel surface for small, lightweight vehicles. In addition, in areas which are inundated or have deep organic wetland soils, it may be necessary to use more than one layer of swamp mats.
- Prevent obstructions to surface and subsurface flow across and through the construction access road. Provide adequate drainage. This may require the use of crushed stone, a layer of log corduroy, timber mat bridges, or multiple cross culverts, particularly if the wetland does not contain a well-defined watercourse channel and/or the wetland crossing is long. If the wetland soils are susceptible to seasonal high groundwater tables or flooding, then give additional consideration for maintaining flows across and/or over the construction access road without causing erosion or siltation during such times.
- Plan in advance how the construction access road will be removed and the wetland restored. A road stabilization geotextile can facilitate the segregation of imported soils, crushed stone, and/or log corduroy from the native wetland soils and make wetland restoration easier. However, after the end of an extensive project and a highly traveled crossing, stone and other material removal from the wetland surface will still usually have to occur, even when placed in conjunction with geotextile.

In some cases access roads may not need to be constructed in a wetland to get access into or through a wetland if the work can be designed such that disturbance to the wetland are avoided or negligible. Options to be considered are presented below.

Equipment Selection and Usage

- **Low ground pressure equipment**. Using equipment that reduces the pressure it exerts on the ground can minimize disturbance to sensitive areas. Employing the use of equipment with wide tires, rubberized tracks, and low ground pressure (<3 psi) can help minimize soil compaction.
- **Wide tires**. Increasing the width of tires will increase traveling surface area and therefore reduce the amount of ground compaction that the equipment will cause. Ultimately, this will reduce rutting, and allow for easier maneuvering of the vehicle. However, wide tires may be costly and will require a wider travel area.
- **Tracks**. Equipment with tracks spreads the weight of the vehicle over a much larger surface, reducing ground pressure and enabling the vehicle to move more freely through wet substrates. Each track can be between 1.5 and 3 feet wide, length depending on the width of the vehicle. This can greatly reduce rutting and allow the vehicle to move with less difficulty through wet substrates.
- **Lightweight equipment**. Disturbance in a wetland area can be lessened by reducing the size of equipment (i.e., All-Terrain-Vehicles (ATVs), Gator™, etc.) used in sensitive areas. This reduces the amount of pressure to the travel surface as well as the necessary width of access ways.

Equipment with tracks.

Timing of Work

- **Work during frozen conditions**. Activities conducted once wetland areas are frozen can minimize rutting and other disturbance to the surrounding environment. Work during this time also generally reduces disturbance of aquatic and terrestrial wildlife movement by avoiding sensitive breeding and nesting seasons.
- **Work during the "low flow" period**. The U.S. Army Corps of Engineers regulatory low flow period is designated as July 1 through September 30. Conducting work during the low flow period can reduce disturbance to surface water and generally avoids spawning and breeding seasons of aquatic organisms.

Alternate Access

- **Manual access**. In some cases such as for smaller projects, work areas can be accessed manually – on foot through terrestrial areas, and by boat through open water or ponded areas. Small projects, such as repairs of individual structures, or parts of structures, that do not categorically require the use of heavy machinery, should be accessed manually to the greatest extent practicable.

Use of overhead/aerial access (i.e. helicopters)

- Using overhead or aerial equipment can be expensive and is not always feasible, but it may be appropriate in some situations in order to get vehicles and other equipment to a site that may be otherwise very difficult to access. The use of overhead and/or aerial equipment may be beneficial for work in areas where large water bodies, deep crevices, or mountainous areas hinder ground access.

Erosion and Sedimentation Controls

Construction personnel are reminded to control erosion and flow conditions during new access road construction by utilizing the following erosion and sedimentation measures which are described and illustrated further in Appendix A:

- **Geotextile silt fencing** and **hay/straw bale barriers** may be installed at the edges of earthen roads or swamp mat roads to prevent erosion of soil into wetlands from the road fill or tracked soil on swamp mats.
- Side slopes of earthen roads can be protected by installing **erosion control blankets** and **seeding** the area with a fast-growing native or annual grass mix.
- **Dust control** should be employed as necessary when construction access road conditions create airborne dust when necessary.

Best Management Practices

The following are BMPs that are applicable to new access roads in wetlands and are described at the following tab:

Swamp Mats (includes Timber Mats and Alternative Mats) – Tab 2A

Permeable Road – Tab 2B

Dewatering – Appendix A Section II

TAB 2A

Swamp Mats (also known as construction mats)

Applications: Wetland crossings; rut minimization.

- Used for access where the ground surface is unstable due to shallow, standing water, saturated soils, or other substrates not suitable for heavy vehicles.

Limitations:

- Only for temporary use. Generally mats should be removed within 60 days;
- May float away in high water conditions;
- Need to be installed with heavy machinery;
- AlturnaMATs® limited to smaller vehicles and equipment;
- Equipment operators should remain cautious so as not to drive or slip off the side of the mats;

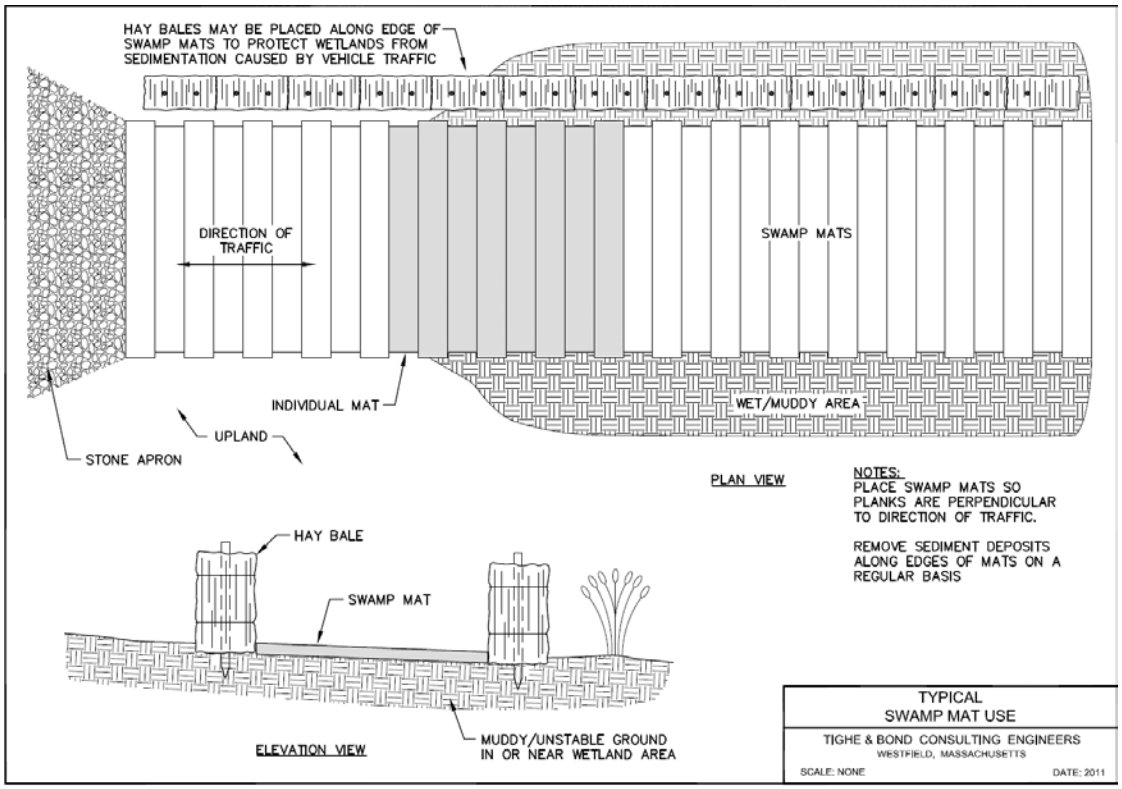
How to Use:

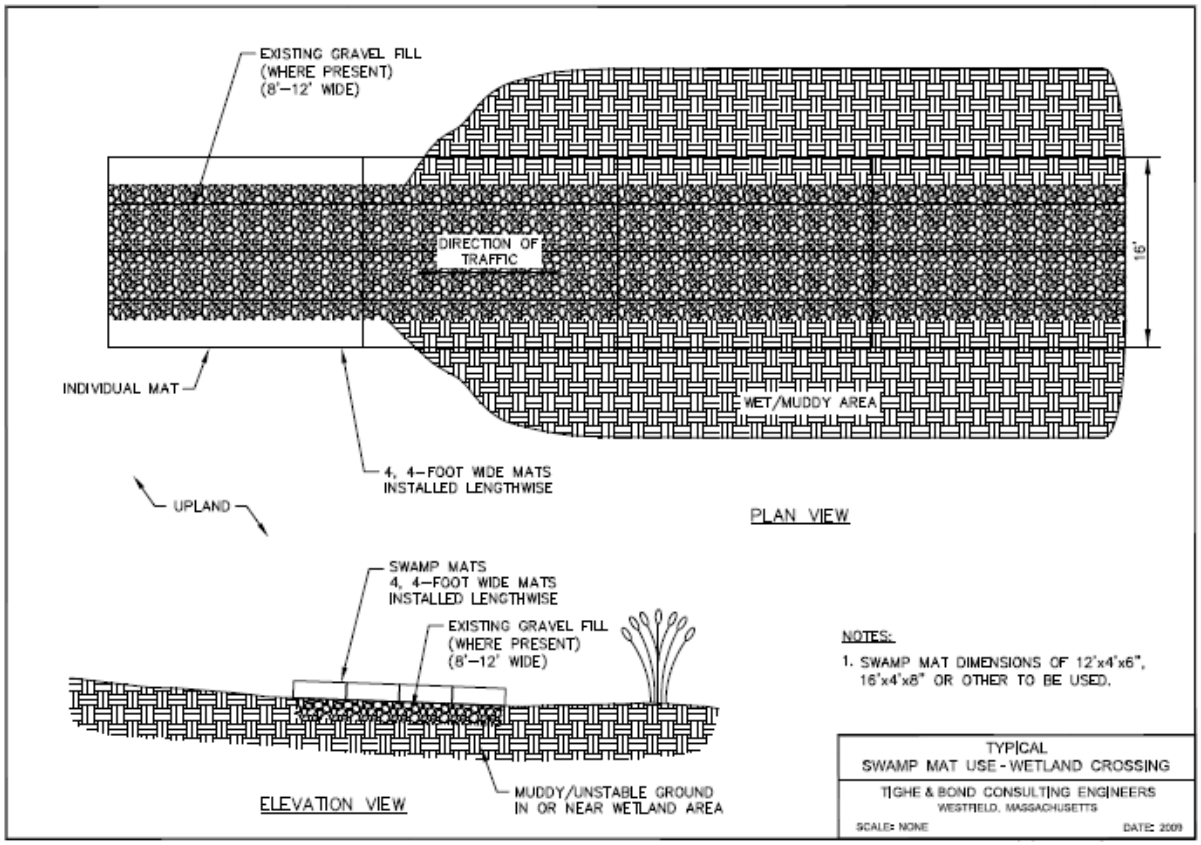
- Should be removed by "backing" out of the site, removing mats one at a time and regrading soils to pre-existing contours while taking care not to compact soils;
- Should be cleaned after use to remove any invasive plant species seed stock. Cleaning methods may include but are not limited to shaking or dropping mats in a controlled manner with a piece of machinery to knock off attached soil and debris, spraying with water or air, and sweeping.

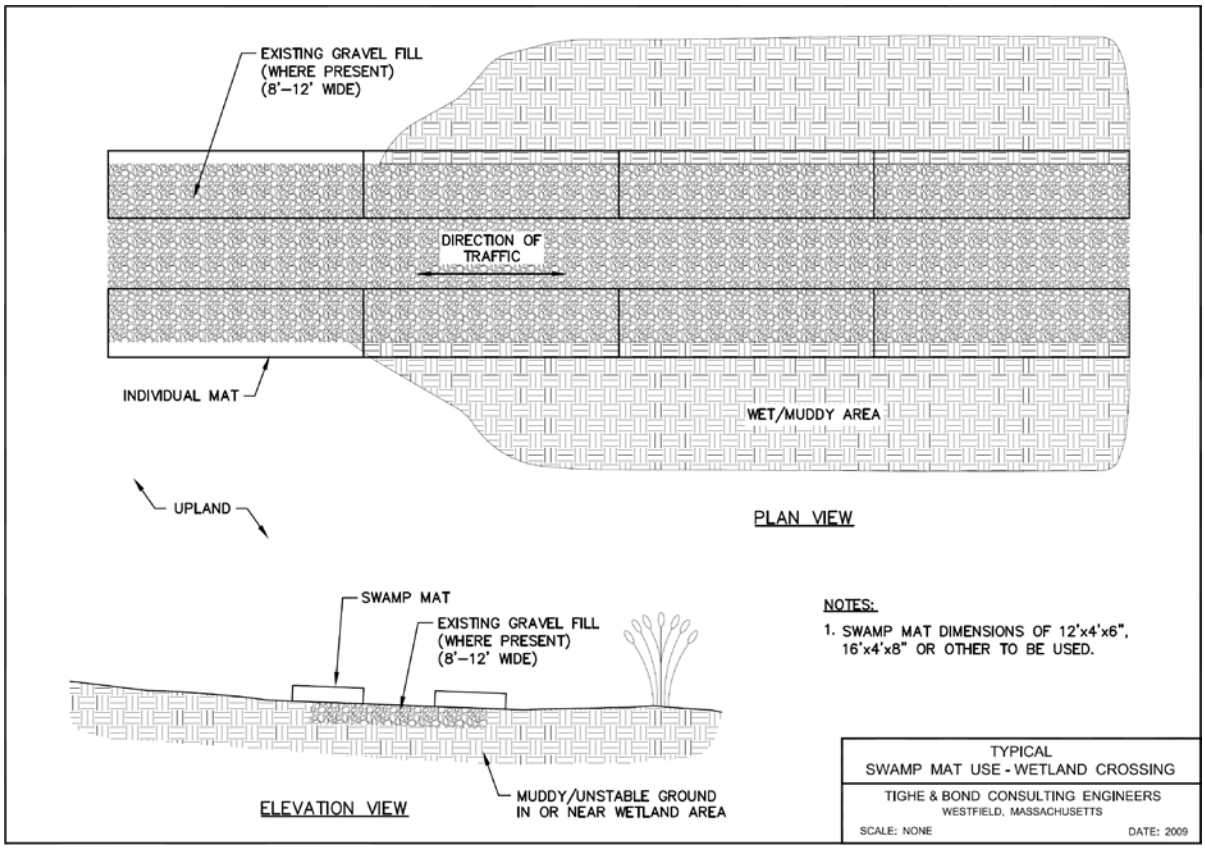
Lightweight, easy to maneuver alternatives to traditional mats, such as AlturnaMATS®, are also available. AlturnaMATS® are half-inch thick polyethylene slip-resistant ground protection mats. They are available in dimensions up to 4 feet by 8 feet and range in weight from 21.5 to 86 pounds. See photograph and typical on following pages.

Swamp mats (or timber mats) are used in areas where the ground surface is unstable due to shallow standing water, saturated soils, or other substrates not suitable for heavy vehicles. For proper swamp mat installation and usage, refer to the below photographs and typicals. In most cases swamp mats should be placed along the travel area so that the individual boards are resting perpendicular to the direction of traffic. No gaps should exist between mats and they should be used far enough on either side of the resource area so as not to result in ruts when equipment enters and exits a sensitive area. Swamp mats should be removed by "backing" out of the site, removing mats one at a time and regarding soils as required to pre-existing contours while taking care not to compact soils.

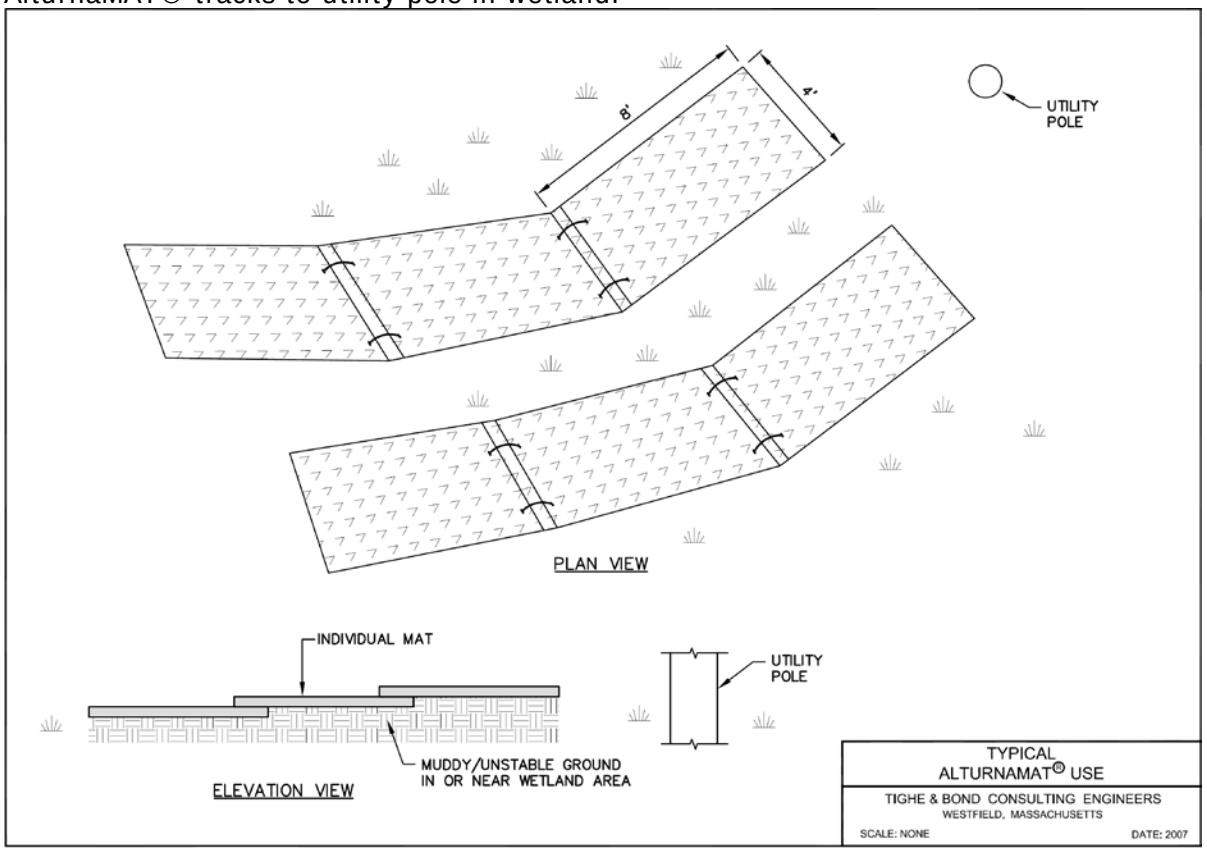
Timber mat access road.




EXISTING GRAVEL FILL
(WHERE PRESENT)
(8'–12' WIDE)
DIRECTION OF TRAFFIC
16'
INDIVIDUAL MAT
WET/MUDDY AREA
4, 4–FOOT WIDE MATS
INSTALLED LENGTHWISE
UPLAND
PLAN VIEW
SWAMP MATS
4, 4–FOOT WIDE MATS
INSTALLED LENGTHWISE
EXISTING GRAVEL FILL
(WHERE PRESENT)
(8'–12' WIDE)
MUDDY/UNSTABLE GROUND
IN OR NEAR WETLAND AREA
ELEVATION VIEW
NOTES:
1. SWAMP MAT DIMENSIONS OF 12'x4'x6",
16'x4'x8" OR OTHER TO BE USED.
TYPICAL
SWAMP MAT USE - WETLAND CROSSING
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2009


EXISTING GRAVEL FILL
(WHERE PRESENT)
(8'–12' WIDE)
DIRECTION OF TRAFFIC
INDIVIDUAL MAT
WET/MUDDY AREA
UPLAND
PLAN VIEW
SWAMP MAT
EXISTING GRAVEL FILL
(WHERE PRESENT)
(8'–12' WIDE)
MUDDY/UNSTABLE GROUND
IN OR NEAR WETLAND AREA
ELEVATION VIEW
NOTES:
1. SWAMP MAT DIMENSIONS OF 12'x4'x6",
16'x4'x8" OR OTHER TO BE USED.
TYPICAL
SWAMP MAT USE - WETLAND CROSSING
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2009

AlturnaMAT® tracks to utility pole in wetland.



TAB 2B

Permeable Road (also known as rock sandwich, French Mattress, or road with continuous cross-drainage,)

Applications: Wetland crossings; rut minimization;

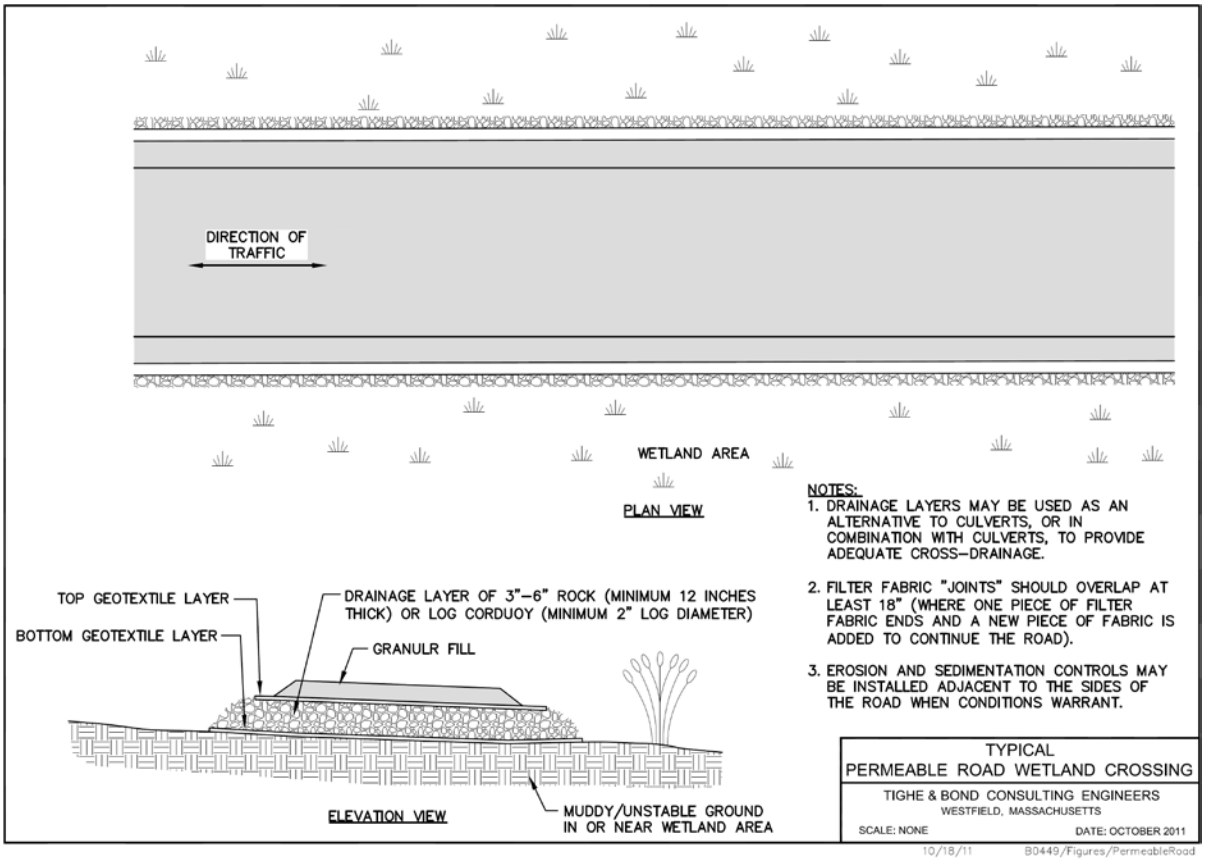
- Used for access where the ground surface is unstable due to shallow, standing water, saturated soils, or other substrates not suitable for heavy vehicles. Can also help prevent groundwater from wicking up into the road fill material and help to minimize the potential for frost action and the creation of potholes.

Limitations:

- Not appropriate for areas where concentrated, high volume and/or velocity water flow will intersect the road (i.e. stream crossings).
- Need to be installed with heavy machinery;
- Equipment operators should remain cautious so as not to drive or slip off the side of the road;

How to Use:

- Road constructed, as shown on the typical on the next page, on top of the soil surface. To minimize impacts to the resource area, excavation of the existing soil is generally not recommended. Existing soil is covered with a geotextile fabric prior to road construction.
- Road should be installed far enough on either side of the resource area so as not to result in ruts when equipment enters and exits a sensitive area.
- Should be removed by “backing” out of the site, removing road one section at a time and regrading soils to pre-existing contours while taking care not to compact soils;
- Edges of cross-drainage layer along the sides of the road should be inspected and cleaned regularly to prevent clogging by debris, leaf litter, sediment, etc.
- Drainage layers may be used in combination with culverts to provide adequate cross drainage.


DIRECTION OF TRAFFIC
WETLAND AREA
PLAN VIEW
TOP GEOTEXTILE LAYER
BOTTOM GEOTEXTILE LAYER
DRAINAGE LAYER OF 3"–6" ROCK (MINIMUM 12 INCHES THICK) OR LOG CORDUOY (MINIMUM 2" LOG DIAMETER)
GRANULR FILL
ELEVATION VIEW
MUDDY/UNSTABLE GROUND IN OR NEAR WETLAND AREA
NOTES:
1. DRAINAGE LAYERS MAY BE USED AS AN ALTERNATIVE TO CULVERTS, OR IN COMBINATION WITH CULVERTS, TO PROVIDE ADEQUATE CROSS–DRAINAGE.
2. FILTER FABRIC "JOINTS" SHOULD OVERLAP AT LEAST 18" (WHERE ONE PIECE OF FILTER FABRIC ENDS AND A NEW PIECE OF FABRIC IS ADDED TO CONTINUE THE ROAD).
3. EROSION AND SEDIMENTATION CONTROLS MAY BE INSTALLED ADJACENT TO THE SIDES OF THE ROAD WHEN CONDITIONS WARRANT.
TYPICAL
PERMEABLE ROAD WETLAND CROSSING
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: OCTOBER 2011
10/18/11
B0449/Figures/PermeableRoad

3.1.4 Watercourse Crossings

There are a number of BMPs that can be selected to minimize disturbance to streams. Each situation should take the current site and project needs into consideration to select the best method which will be most cost-effective and incur the fewest secondary disturbances. Additional erosion and sedimentation controls (e.g. hay or straw bales) may be required in conjunction with the following stream crossing BMPs to protect sensitive areas. The stream crossing methodology chosen will depend largely on the equipment required for a particular task, the existing environmental conditions, and the duration of the crossing.

Erosion and Sedimentation Controls

Construction personnel are reminded to control erosion and flow conditions during new watercourse crossings by utilizing the following erosion and sedimentation measures which are described and illustrated further in Appendix A:

- **Geotextile silt fencing** and **hay/straw bale barriers** may be installed at the edges of earthen roads or swamp mat roads to prevent erosion of soil into watercourses from the road fill or tracked soil on swamp mats. These controls however should generally not be placed within a watercourse.
- Side slopes of earthen roads can be protected by installing **erosion control blankets** and **seeding** the area with a fast-growing native or annual grass mix.

Best Management Practices

The following are BMPs that are applicable to new access roads watercourse crossings and are described at the following tabs:

Stream Crossings Without Bridges (includes limiting turbidity and stone crossing) – Tab 3A

Bridged Crossings (includes swamp mat bridges and railroad car bridges) – Tab 3B

Culverts – Tab 3C

Poled Fords – Tab 3D

Dewatering – Appendix A Section II

TAB 3A

Stream Crossings Without Bridges: Limiting Turbidity

Applications: Turbidity control

- In some situations such as routine or emergency maintenance with small ATVs, pickup trucks or tracked equipment, it may be acceptable for equipment to simply travel (perpendicularly) through a stream. Such crossings are generally considered acceptable where there is a stable stream bottom (rock or sand/gravel), where an existing or historic access road is present, and/or where the crossing is at a relatively narrow reach of the stream and any adjacent wetlands.

Limitations:

- Limited to areas where stream banks and bottoms will not be significantly damaged by the crossing;
- Wet crossings not preferred by regulatory agencies;

How to Use:

- Streams should be crossed slowly to minimize in-stream turbidity.

Stream Crossings Without Bridges: Stone Crossings

Applications: Stream crossing; turbidity control

- Use to cross small streams with stable stream bottoms.

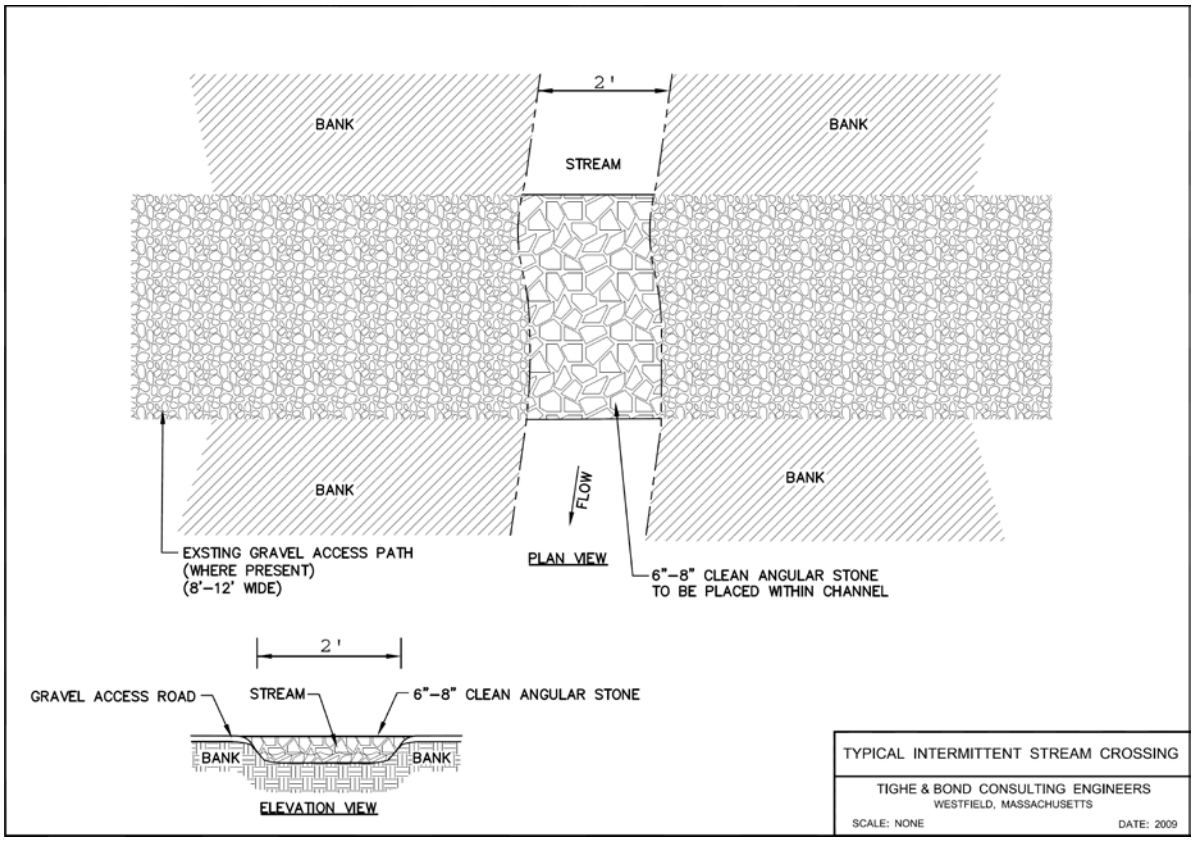
Limitations:

- Only use in small (less than 2-feet wide or braided) intermittent streams which do not appear on USGS topographic maps, and have a downstream section with a gradient greater than 20%;
- Not suitable in areas where there could be a potential for fish passage.
- Stone size should be sufficient to allow for macroinvertebrate passage.
- Not preferred for new access road crossings. Generally is a BMP more suitable for existing access road crossings.

How to Use:

- Carefully place 6-inch to 8-inch clean angular stone within stream at crossing. Limit width of stone to that needed for widest vehicle/equipment to crossing the stream.
- Drive over stone slowly.
- Leave riprap in intermittent streams for future use. More damage will occur by removing stone.

Intermittent stream crossing with angular stone.



TAB 3B

Bridged Crossings: Swamp Mats as Temporary Bridge

Applications: Watercourse crossings

Limitations:

- Require the use of machinery for installation;
- May become unstable under high flows.

How to Use:

- Untreated wooden timber mats may be used as a temporary bridge over a stream to allow construction vehicles access to the work site.
- Small sections of matting are placed on either side of the stream parallel to the flow of water at top of banks. These act as supports. Mats may then be placed perpendicular to the stream, resting on top of the initial swamp map supports.
- It may be necessary to place a large steel plate along the top of the swamp mats for extra stability and to minimize the amount of sediment that could fall between the spaces of each timber.
- Timber mat bridging is suitable for crossing intermittent and perennial streams.
- Before constructing a stream crossing, it should be confirmed that the timber mats are capable of supporting the equipment to be used.

Timber mat bridge.

Bridged Crossings: Rail Car as Temporary Bridge

Applications: Watercourse crossings

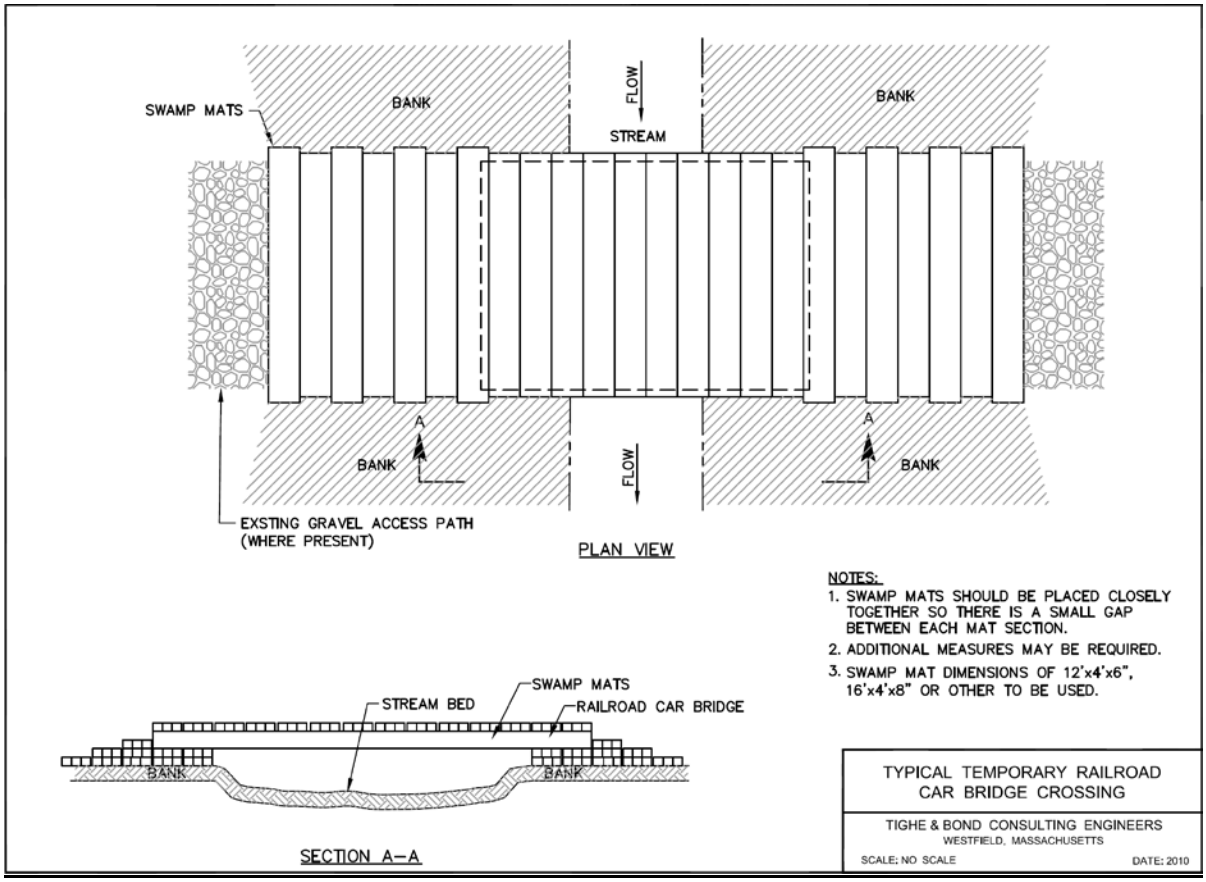
Limitations:

- Requires heavy equipment for transport and installation;
- Expensive;
- Banks must be stable to support heavy loads.

How to Use:

- Used rail car frames can be used for crossing larger and deeply incised streams where timber mats are unsuitable.
- For these types of crossings, the rail car frame is placed across the stream from bank to bank perpendicular to the direction of flow (on a timber frame footing if necessary). Timber matting is then placed upon the rail car frame to provide vehicle access

Rail car bridge crossing.


SWAMP MATS
BANK
FLOW
STREAM
BANK
A
BANK
FLOW
A
BANK
EXSTING GRAVEL ACCESS PATH
(WHERE PRESENT)
PLAN VIEW
NOTES:
1. SWAMP MATS SHOULD BE PLACED CLOSELY TOGETHER SO THERE IS A SMALL GAP BETWEEN EACH MAT SECTION.
2. ADDITIONAL MEASURES MAY BE REQUIRED.
3. SWAMP MAT DIMENSIONS OF 12'x4'x6", 16'x4'x8" OR OTHER TO BE USED.
SWAMP MATS
STREAM BED
RAILROAD CAR BRIDGE
BANK
BANK
SECTION A–A
TYPICAL TEMPORARY RAILROAD CAR BRIDGE CROSSING
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NO SCALE
DATE: 2010

TAB 3C

Culvert Installation/Repair/Replacement

***When installing or replacing a culvert, you must contact Transmission Siting and Permitting.**

Applications: Stream and wetland crossings

- Installed when roads cross wetlands or streams. The culvert should maintain the wetland or stream if properly installed.

Limitations:

- May have permitting time of year restrictions on use;
- Installation may require in-stream work and possible dewatering and sedimentation concerns;
- Culverts are susceptible to washouts, sedimentation, erosion, and failure during heavy wet weather events and flooding;
- Culverts require routine and long-term maintenance, as they often become clogged with debris or other obstructions.

How to Use:

- The number and size of culverts should be designed to handle the maximum expected flow of the wetland or watercourse. Multiple culverts are discouraged. It is better to use one large culvert if feasible.
- All crossings require hydraulic calculations to determine the area that will drain the culvert. Culvert(s) must also be adequately sized to accommodate flows from the 100-year storm, at a minimum (preferably 500-year storm).
- Timber mats may be placed over culverts to help structurally protect the culvert from heavy loads.
- Culverts must be maintained to allow flow. Debris and sediment need to be removed on an as-needed basis.
- All temporary and permanent crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed to withstand and prevent the restriction of high flows, and to maintain existing low flows, and so as not to obstruct the movement of aquatic life indigenous to the waterbody.
- Open bottom culverts (semicircle arch, elliptical arch and concrete box culverts) or embedded culverts for perennial streams are required for CTGP Category 1/ Non-Reporting projects. Consultation with the U.S. Army Corps of Engineers is required if open bottom arches, bridge spans or embedded culverts are not practical.
- Open bottom structures must span at least 1.2 times the watercourse bank full width, and have an openness ratio equal to or greater than 0.25 meters.
- Open bottom structures and culverts shall be designed to allow for continuous flow of the 50-year frequency storm flows. This is a Corps requirement.
- Culverts should only be installed under Category 1 Non-Reporting when the tributary watershed to the culvert is less than 1 square mile (640 acres). The

culvert gradient shall be no greater than the streambed gradient upstream or downstream of the culvert.

- For crossings constructed using a single box or pipe arch culvert, the inverts are to be set ≥ 12 inches below the streambed elevation. For crossings with a pipe culvert, the inverts are to be set such that ≥ 25% of the pipe or 12 inches, whichever is less, is set below the streambed elevation.

- Culverts shall be backfilled with natural substrate matching upstream and downstream streambed substrate, even if fish passage is not a concern. Other aquatic organisms rely on natural stream bed sediment to aid their movement.

- The culvert shall be a minimum of 18 inches in diameter.

- The maximum velocity at the culvert outlet shall be consistent with the velocity of the natural channel, or shall be mitigated with outlet protection measures, energy dissipation, and if necessary, channel stabilization.

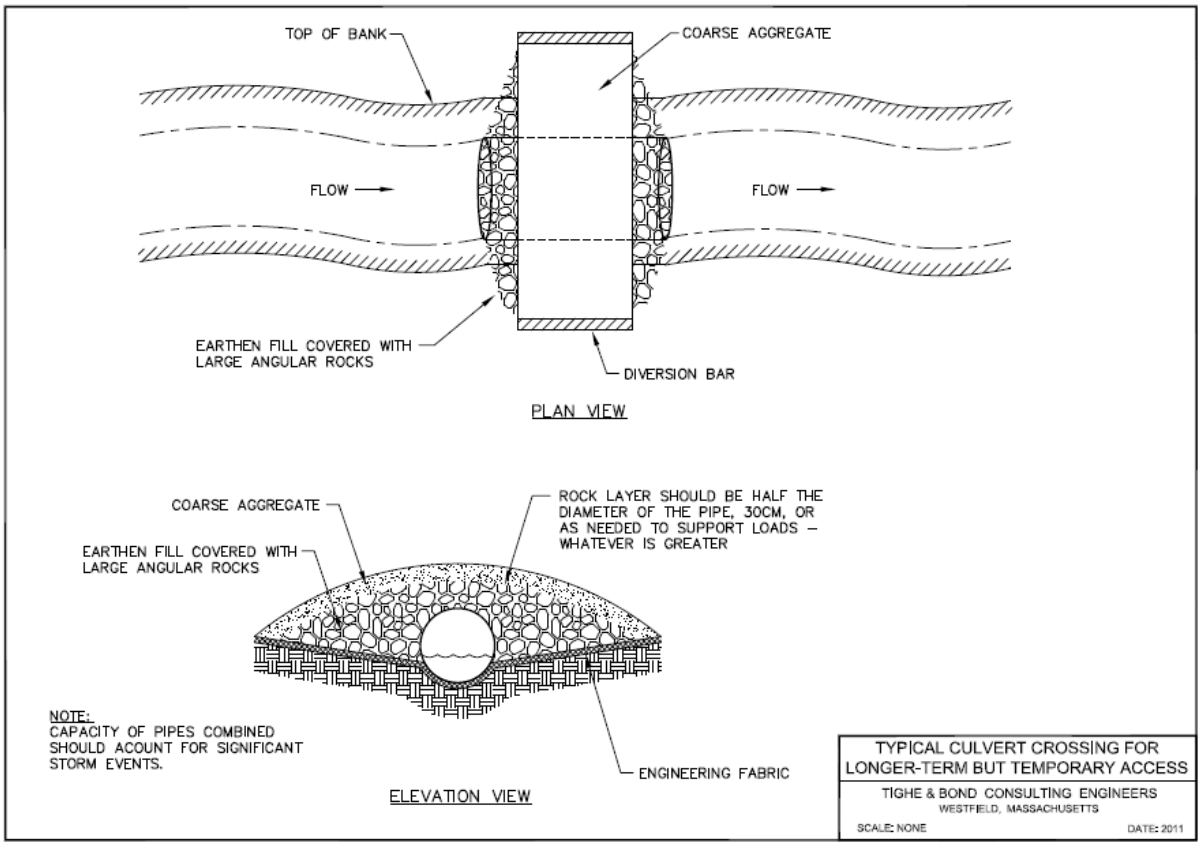
- Culverts shall be designed and installed with minimal disruption to the watercourse and riparian buffer zone.

- Culvert installations that result in the filling of a FEMA established floodway do not qualify under the Category 1 GP.

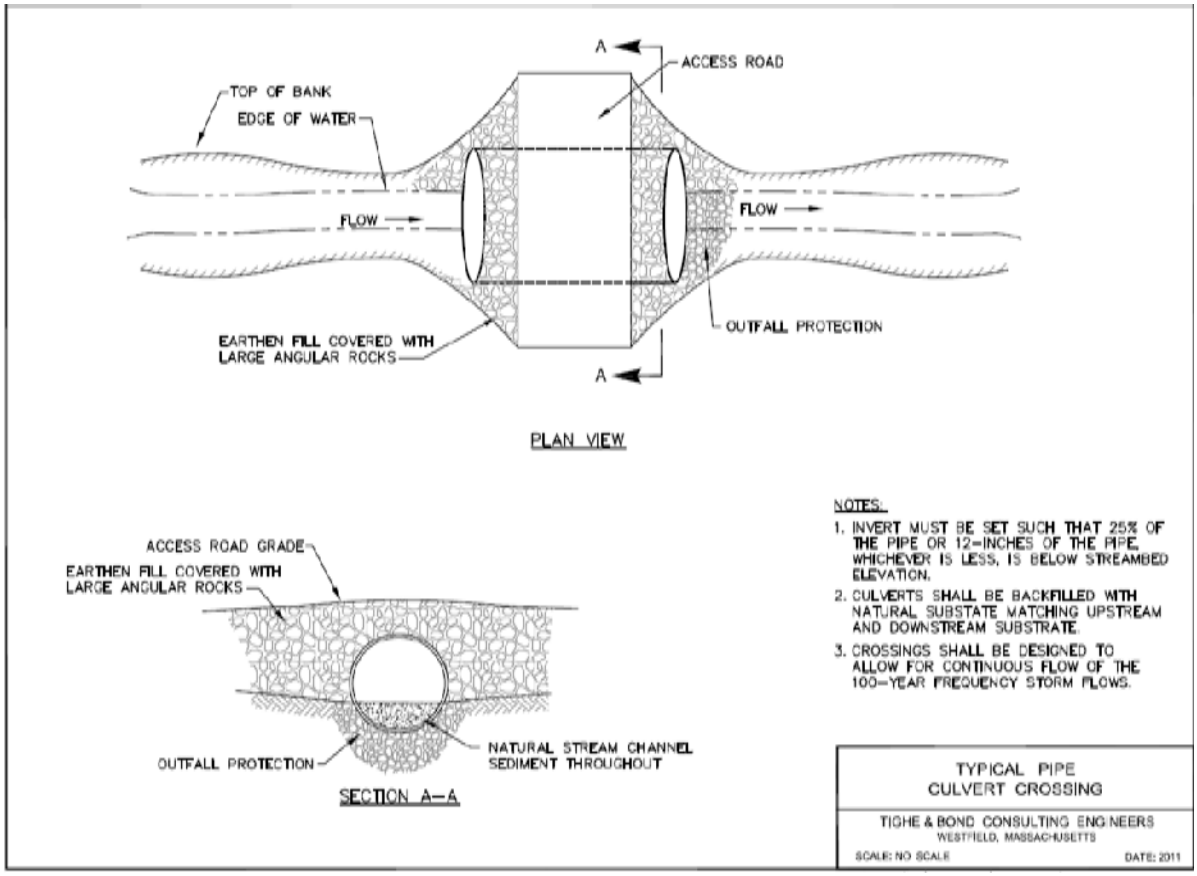
- Corrugated culverts are preferred as they slow the velocity of the water. Plastic pipes are preferred to metal.

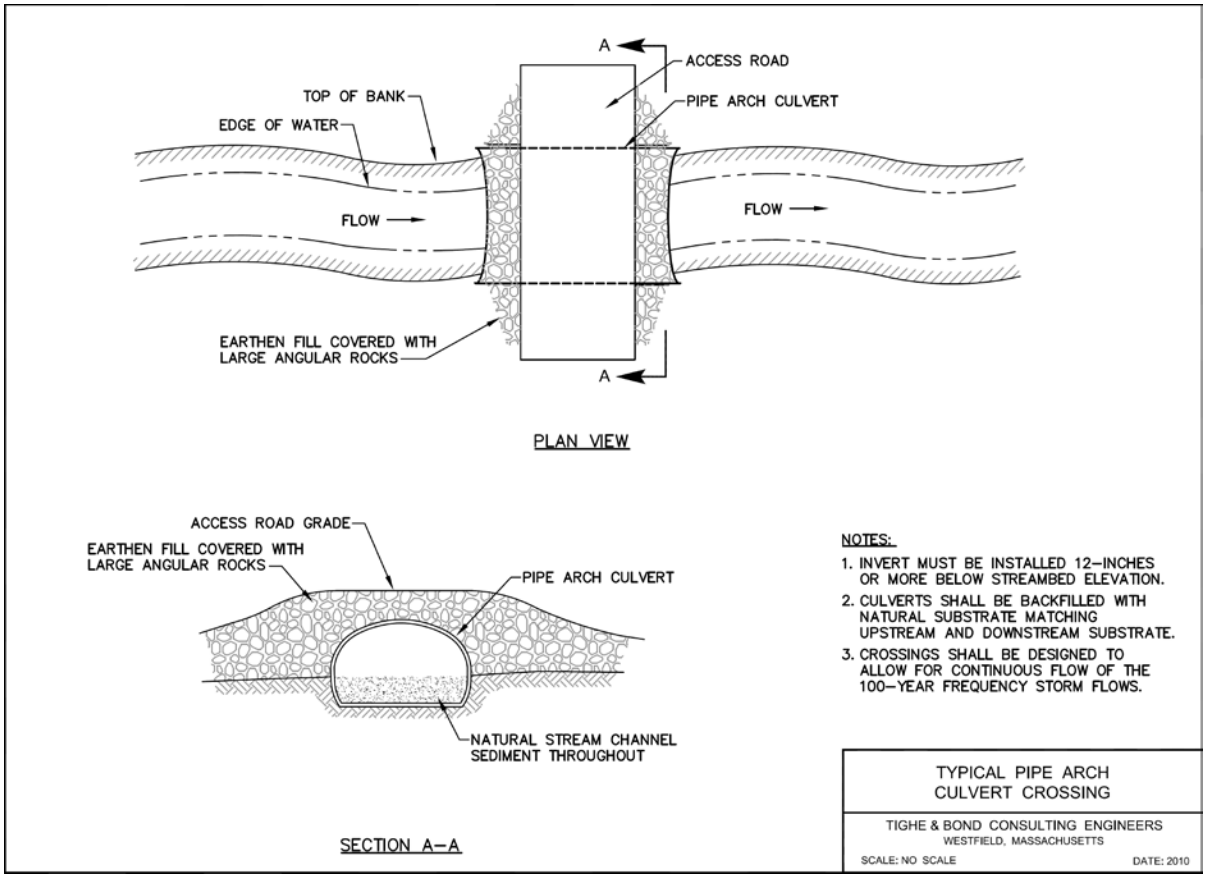
- Culvert length should be as short in length as possible. If the installed culvert extends too far into the natural stream bed it must be cut to size.

Culvert and riprap for stream crossing.

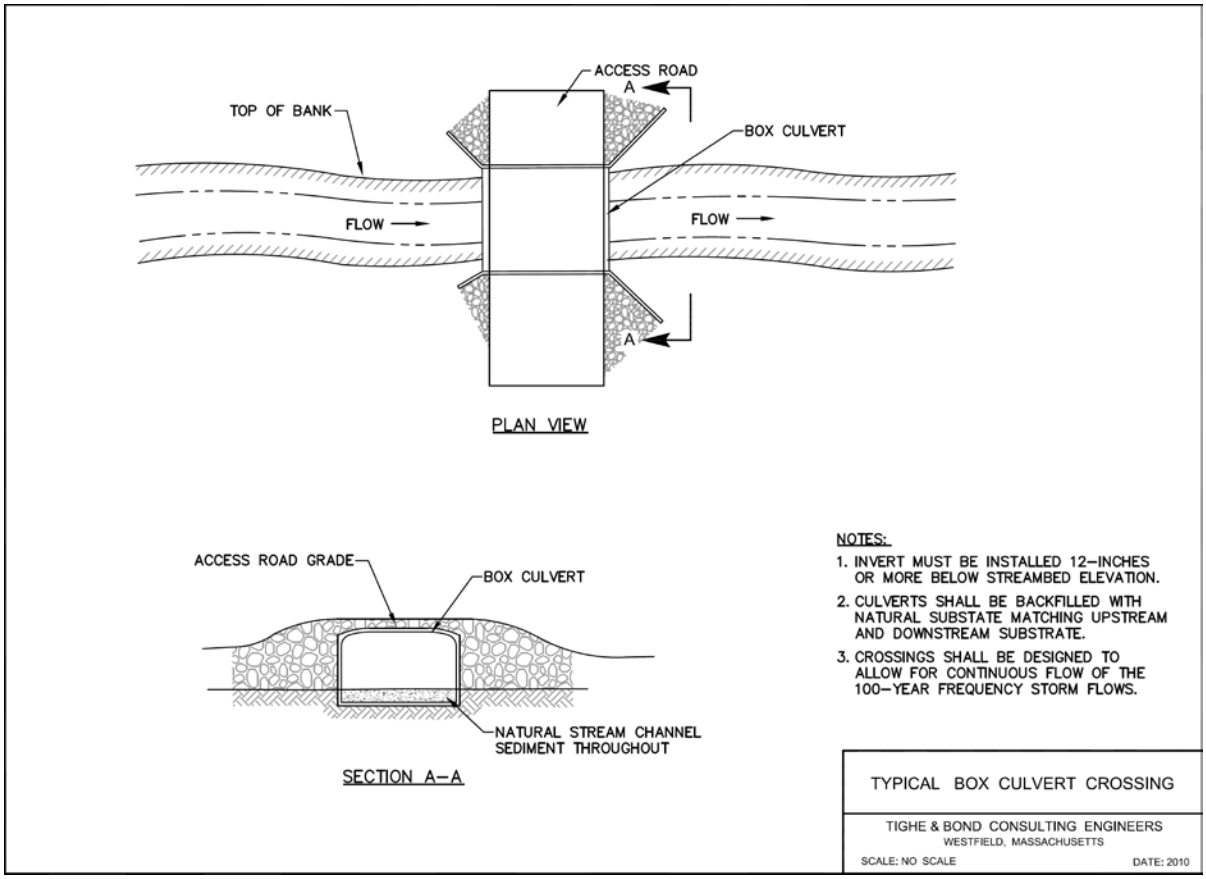


Installing a pipe culvert.


A
ACCESS ROAD
TOP OF BANK
EDGE OF WATER
FLOW
FLOW
OUTFALL PROTECTION
EARTHEN FILL COVERED WITH LARGE ANGULAR ROCKS
A
PLAN VIEW
ACCESS ROAD GRADE
EARTHEN FILL COVERED WITH LARGE ANGULAR ROCKS
OUTFALL PROTECTION
NATURAL STREAM CHANNEL SEDIMENT THROUGHOUT
SECTION A–A
NOTES:
1. INVERT MUST BE SET SUCH THAT 25% OF THE PIPE OR 12-INCHES OF THE PIPE, WHICHEVER IS LESS, IS BELOW STREAMBED ELEVATION.
2. CULVERTS SHALL BE BACKFILLED WITH NATURAL SUBSTATE MATCHING UPSTREAM AND DOWNSTREAM SUBSTRATE.
3. CROSSINGS SHALL BE DESIGNED TO ALLOW FOR CONTINUOUS FLOW OF THE 100-YEAR FREQUENCY STORM FLOWS.
TYPICAL PIPE CULVERT CROSSING
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NO SCALE
DATE: 2011



Embedded box culvert with wing walls.


ACCESS ROAD
A
TOP OF BANK
BOX CULVERT
FLOW
FLOW
A
PLAN VIEW
ACCESS ROAD GRADE
BOX CULVERT
NATURAL STREAM CHANNEL
SEDIMENT THROUGHOUT
SECTION A–A
NOTES:
1. INVERT MUST BE INSTALLED 12–INCHES OR MORE BELOW STREAMBED ELEVATION.
2. CULVERTS SHALL BE BACKFILLED WITH NATURAL SUBSTATE MATCHING UPSTREAM AND DOWNSTREAM SUBSTRATE.
3. CROSSINGS SHALL BE DESIGNED TO ALLOW FOR CONTINUOUS FLOW OF THE 100–YEAR FREQUENCY STORM FLOWS.
TYPICAL BOX CULVERT CROSSING
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NO SCALE
DATE: 2010

TAB 3D

Poled Fords

Applications: Stream Crossings

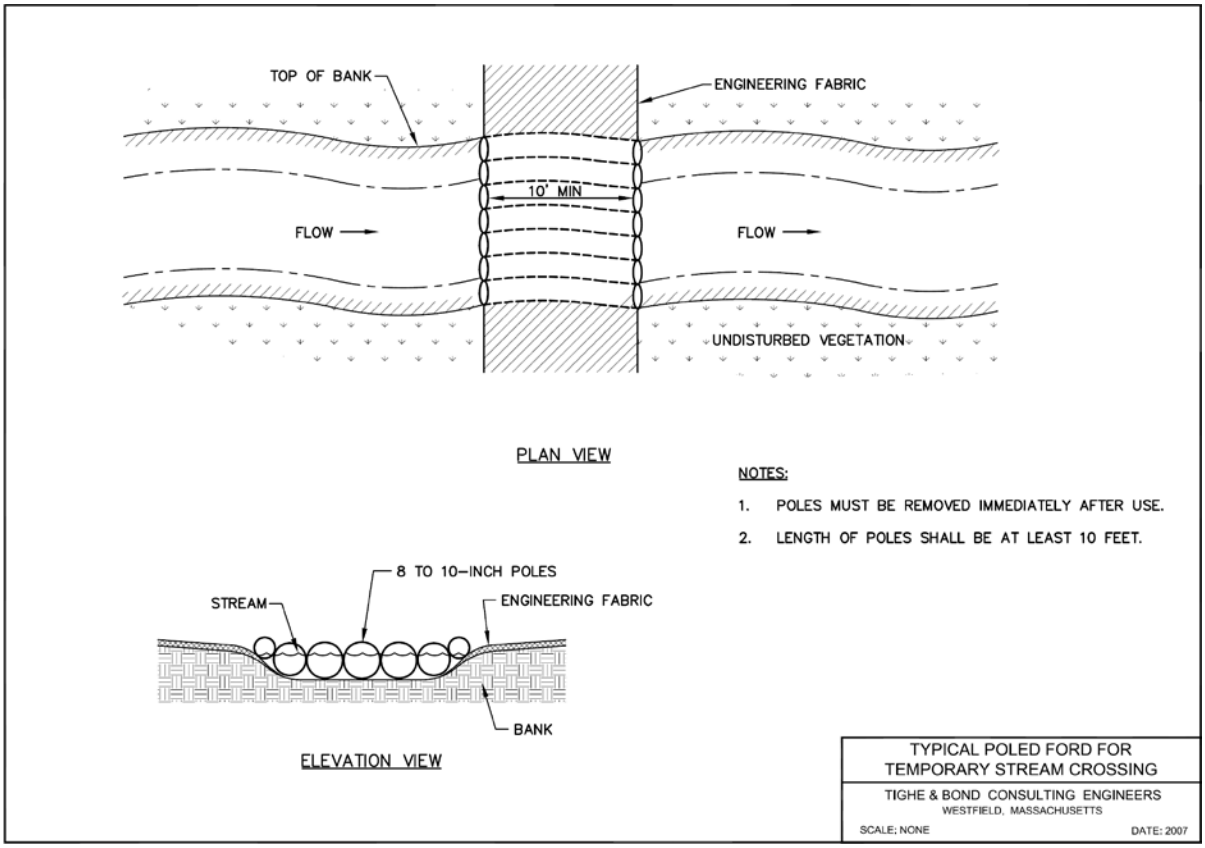
- Poled fords are typically used in remote locations where a stream crossing requires a functional BMP, but it is impractical to bring in such materials. In these situations wood poles or saw logs of sufficient length and diameter can be laid in the streambed parallel to the floor.

Limitations:

- Should be limited to streams with gently sloping adjacent land.

How to Use:

- The road should be gently sloping into and out of the stream at a maximum ration of 1:5 (V:H).
- Engineering fabric covered by an aggregate bed should be installed in the access road at the approach and exit, if necessary, to limit disturbance to the riparian area.
- Length of poles should be at least ten feet.
- Poles must be removed immediately after use.



3.2 Slope Excavation

Engineering designs may be required for any upland changes that could potentially direct or channel water across the face of a terrace escarpment slope. No snow or soil piles; construction materials; or equipment should be stored in the immediate vicinity at the top of a terrace escarpment slope.

3.3 Vegetation Removal

In constructing any stream crossing, care should be taken to limit disturbance to the extent practicable within 100 feet of the stream banks (the riparian area). The riparian area provides habitat to a number of species and provides protection and shading to the stream. It is also an area regulated by municipal Inland Wetlands and Watercourses Agencies.

Grubbing is not preferred as it results in considerable erosion and should be avoided to the extent feasible. Utilize grubbing only when all other methods cannot be used to prepare stable and safe work areas. If grubbing is necessary, the area must be covered with seed and mulch to protect it prior to the end of the work day. During mowing and trimming, large woody debris must not be placed in wetlands or watercourses. Mowing must be kept to a minimum, particularly at road crossings.

3.4 Work Pads

3.4.1 De-Energized and Energized

Applications: Work in wetlands

- Reconnaissance of each workpad area in or adjacent to wetlands should be performed to determine if the swamp mat workpad could be located outside of wetland resource areas. Wetland disturbances should be avoided or minimized where possible. Contact Transmission Siting and Permitting.

Limitations:

- Requires heavy machinery for installation;
- Significant amount of time required for installation and removal;
- Pads for live line work require a considerably larger footprint;
- Several layers of matting may be needed in deep, swampy areas;
- May not be suitable in deep/open water wetlands.

How to Use:

- Work at structures may require placement of swamp mats to provide safe and stable workpads for employees and contractors.
- Live line work, which is work that is done while the line is energized, requires a much larger workpad. Efforts should be made to stay out of wetland areas to the extent possible.
- Sizes of workpads vary based on the type of work being proposed.

- Workpads may extend into wetlands where structures that require maintenance fall within or in close proximity to these areas. Within these areas, untreated wooden swamp mats joined by galvanized steel bolts should be used to limit disturbance.
- Following construction activities all wooden mats at each workpad location and vehicle access location must be removed.
- Matting should be removed by "backing" out of the site, removing mats one at a time. Any rutting or significant indentations identified during mat removal should be regraded immediately, taking care not to compact soils.
- In areas with invasive species, plant material should be removed from matting following removal from the infested area to prevent the spread of invasive species.

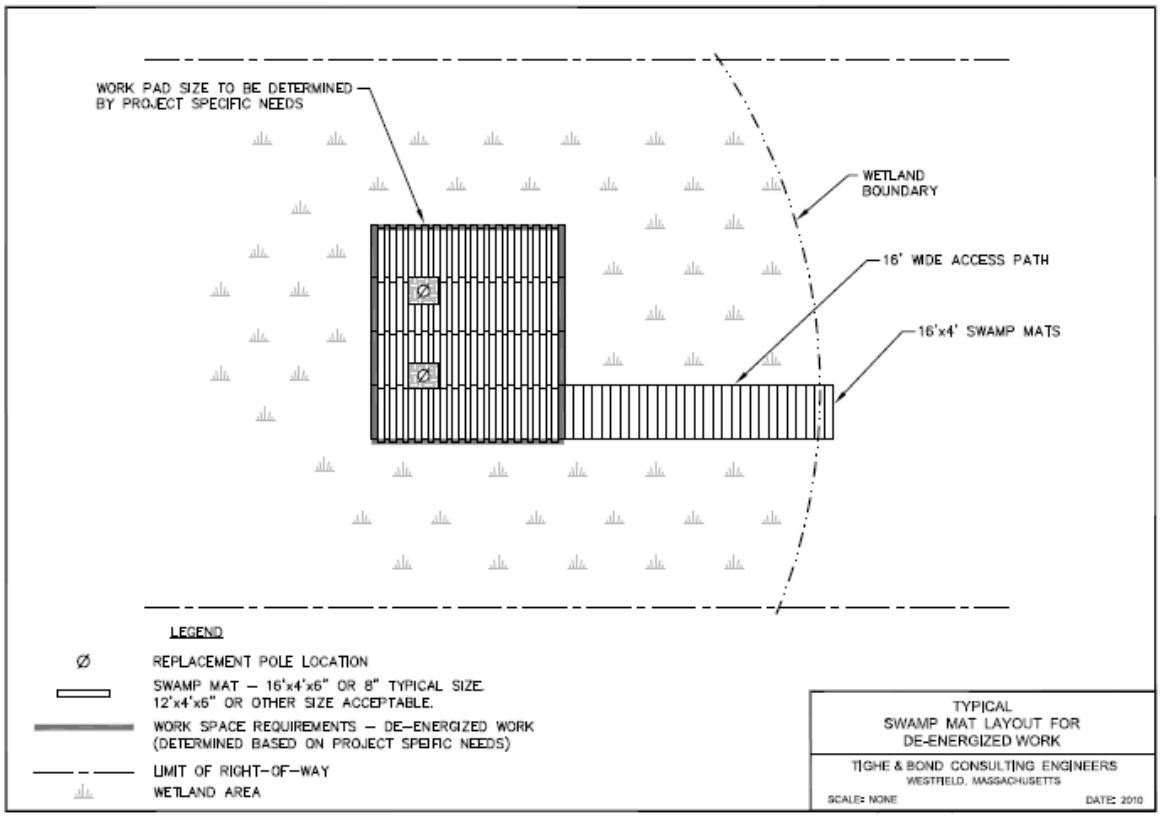
Best Management Practices

De-energized work requires small workpads, while live line work, which is work that is done while the line is energized, requires a much larger workpad.

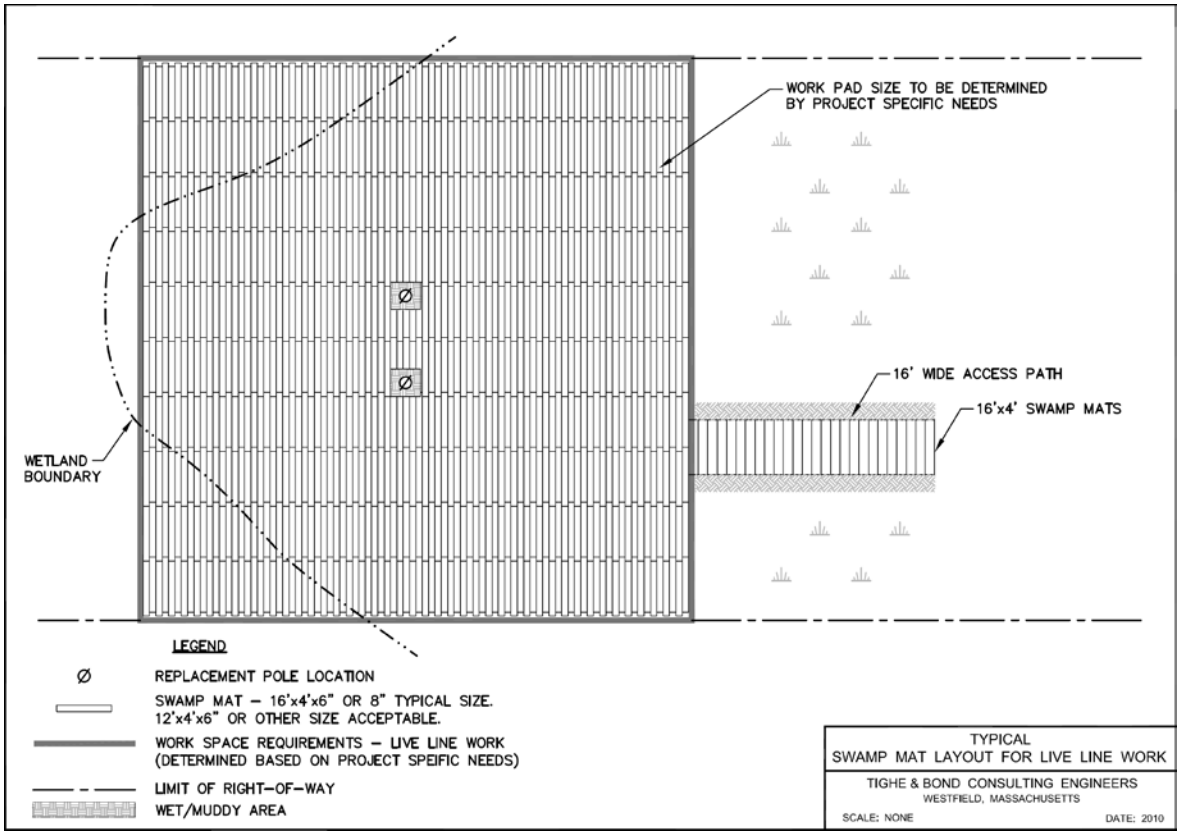
De-energized swamp mat workpads – Tab 4A

Energized swamp mat workpads – Tab 4B

TAB 4A


WORK PAD SIZE TO BE DETERMINED BY PROJECT SPECIFIC NEEDS
WETLAND BOUNDARY
16' WIDE ACCESS PATH
16'x4' SWAMP MATS
LEGEND
REPLACEMENT POLE LOCATION
SWAMP MAT – 16'x4'x6" OR 8" TYPICAL SIZE. 12'x4'x6" OR OTHER SIZE ACCEPTABLE.
WORK SPACE REQUIREMENTS – DE-ENERGIZED WORK (DETERMINED BASED ON PROJECT SPEIFIC NEEDS)
LIMIT OF RIGHT-OF-WAY
WETLAND AREA
TYPICAL SWAMP MAT LAYOUT FOR DE-ENERGIZED WORK
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2010

TAB 4B



Timber mat wetland work platform.

3.4 Structure-Related Work

3.4.1 Wetland

Structure-related activities that may occur in wetlands includes structure replacement/ installation (including casing installation), guy wire anchor installation, counterpoise installation, and pole butt removal. Access to these areas and completion of the activities can cause disturbance to wetland vegetation and soils. Therefore, structure-related activities in wetlands should entail use of adequate workpads and dewatering methods. Inspection of the construction access and associated dewatering measures should occur daily during construction to ensure that controls are in working order, and repairs to damaged/deteriorating controls are made immediately. Repairs may include regrading the traveled surface to eliminate ruts, as well as those repairs required by each erosion and sedimentation measure used.

Structure Replacement / Installation

Structure replacement may require "discharge of dredged or fill material" to install new poles and their casings. Poles that are significantly damaged must be replaced to comply with engineering and safety standards. Not replacing the structures could result in the eventual failure of one or more structures within or adjacent to wetlands and waters of the U.S.

The replacement structures will often be replaced within a few feet of the original structure to maintain the required distances and line sags between other existing structures. Therefore, options for relocating proposed replacement structures are limited. Pole replacement will also require placement of swamp mats in wetlands to provide a safe workpad for the required structure replacement activities. There are no alternatives to conduct this work from nearby upland areas or to install the replacement structures in upland areas. Each structure replacement area should be assessed to determine the required footprint needed for swamp mat workpads.

- At each pole location, remove wetland topsoil with an excavator and stockpile.
- A borehole is then drilled with a truck-mounted auger. Spoils from the drilling are collected and disposed in an upland area.
- A galvanized steel casing up to 48" in diameter and 12' long is then driven into place at least 12" below the ground surface. The new pole is installed within the casing with a crane and backfilled/compacted with crushed rock.
- Stockpiled wetland topsoil is then placed above the casing to the ground surface. No net fill in wetlands occur, as the original poles are removed.
- Following installation of the new structures, the old structures are removed. Each pole is cut with a chainsaw and allowed to fall to the ground, which in wetland areas is protected by swamp mats. Pole butts will remain in place if removing the pole butt will cause more damage than if left in place.
- Remove the pole and all appurtenant accessories (i.e. cross-arms, insulators, etc.) and properly dispose off-site. Remove each pole butt by pulling with an excavator positioned on a swamp mat. If it is apparent that pole removal will compromise the integrity of the new pole installation, or that removal will result in additional disturbance to wetland areas, cut off the old pole at least 12 inches below ground level.

Guy Wire Anchor Installation

There are two types of anchors: 1) screw type and 2) plate type. The screw type anchor is preferred over the plate type anchor because installation results in less disturbance to the wetland.

- Guy wire anchors supporting the structures may also require replacing. The guy wires provide extra stability and support for the associated structures.
- Load test the existing anchor to 15,000 pounds to determine whether it will support the pole structure. In the event the existing anchor cannot be re-used, remove it and install a new anchor.
- Screw in place a special triple helix ("screw type") anchor with 1 ½-inch square rods with an anchor installation rig operated from the matting area. Add rod sections in five foot increments as needed until proper holding capacity of the anchor is achieved.
- Since the anchors are turned into the ground, with only the rods protruding, disturbance to the wetland is minimal, and likely not noticeable. In the event that proper holding cannot be achieved with the screw anchor, install a plate anchor. Excavate the plate anchor to a sufficient depth and if necessary install a concrete footing several feet below surface grade.
- Set the anchor and backfill with native material.
- Segregate the top 12" of wetland topsoil during removal and replace on the surface following backfilling of underlying materials.

Counterpoise Installation/Grounding

To install grounding equipment in wetlands, use hand digging or minimally invasive methods to dig around the structure and restore soil to previous grades. In some cases grounding rods can be driven directly into the ground with hand tools. Where work is occurring in the vicinity of wetland areas, sedimentation and erosion controls will be used to limit disturbance to wetlands.

Underground facility repair/replacement

Underground facilities such as cables and conduits may be present beneath wetland areas. In the event underground facilities require repair, BMPs are required for both access and construction. Swamp mats are used for access where warranted, and sedimentation and erosion controls are used to isolate the work area. During excavation activities, excavate wetland topsoil and store separately from subsurface soils. Dewatering is often required during excavation and repair activities.

An alternative to repairing a subsurface line by excavation would be to install a new line via trenching or horizontal directional drilling. The decision to use one of these alternatives is made on a case by case basis. Consult with Siting and Permitting to determine if any permits will be needed.

Pole Butt Removal

When transmission poles are decommissioned or otherwise taken out of service, the entire pole shall be removed. Treated wood pole butts shall be removed completely from the ground and properly disposed at an off-site location. Locations where the

removal of pole butts may cause significant disturbance will be considered for exception to this practice on a site-by-site basis. The Transmission Line Maintenance Manager will be responsible for determining if a pole butt can be removed if located in a sensitive area.

All holes left by pole butts must be backfilled and compacted with appropriate fill material consistent with native soils. Existing material on-site may be reused.

Disposal

Treated and non-treated wood products owned by the Transmission Group shall be stored in an area(s) designated by the Transmission Line Construction/Contract Field Services supervisor until collected by an approved disposal vendor.

3.5 Soil Stockpile Management

Some projects may involve excavation and stockpiling of soil. Stockpiles should be located outside sensitive areas to the extent practicable and managed to prevent erosion and sedimentation of adjacent areas. Typical measures include the installation of protective measures (e.g. siltation fence and/or haybales) around the perimeter of the stockpile. The stockpile must be seeded if left in place for more than 30 days. No snow or soil piles; construction materials; or equipment should be stored in the immediate vicinity at the top of a terrace escarpment slope.

When polluted/contaminated soil is encountered, it must be handled in accordance with the appropriate regulatory requirements. In addition to the measures discussed above, contaminated soils should be stockpiled on and covered by polyethylene sheeting. Sheeting used to cover the stockpile should be weighted down to prevent the wind migration of contaminated dust.

For soil stockpiles in substations, contact Transmission Siting and Permitting.

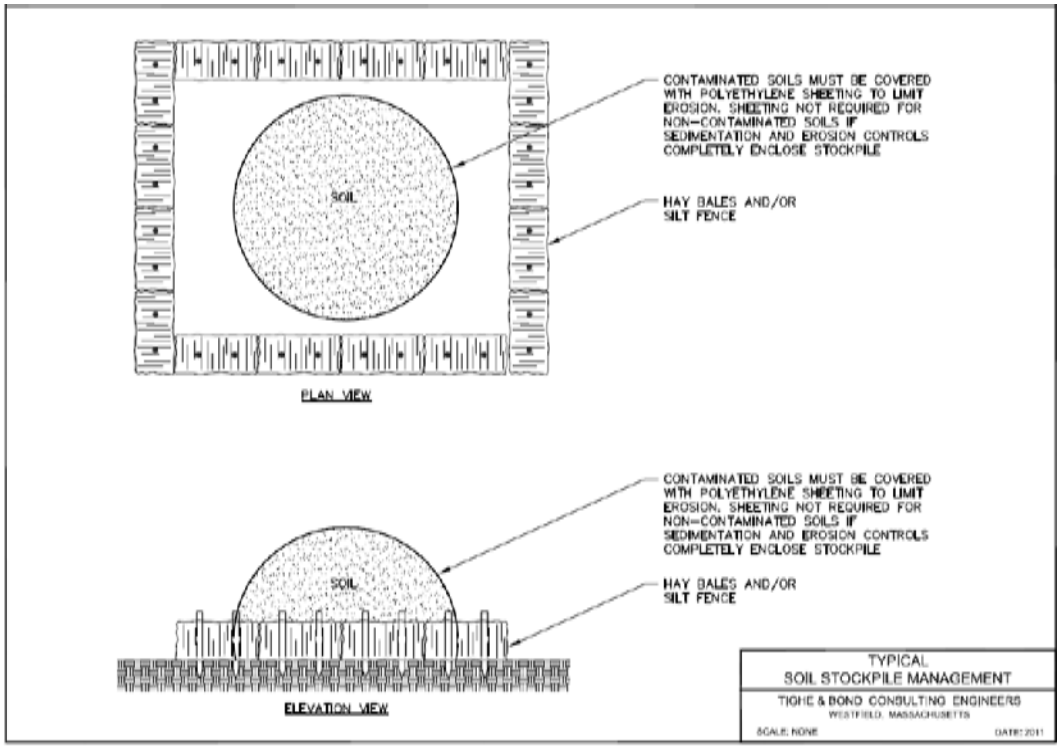
Best Management Practices

The following BMP is applicable to soil stockpile management and is described at the following tab:

Soil Stockpile Management – Tab 5A

TAB 5A

Soil stockpile management.



Section 4
Inspection and Maintenance

A pre-construction meeting will be held to discuss how often and who will be checking that all erosion and sedimentation controls are in working order. All BMP's will be inspected after major storm events (rainfall events greater than 0.25 inches) and on a weekly basis.

4.1 During Construction

Since construction sites and construction access roads are usually in constant use and undergoing continuous change, they should be closely monitored. Construction sites, construction access roads, and the associated erosion and sedimentation controls should be inspected by the person(s) designated at the pre-construction meeting, at the end of each day they are used, and any damage observed must be repaired immediately, at least within 48 hours of observation. If an access road is not used for more than a week, then inspection should occur at a frequency as required by the specific erosion and sedimentation measures in use, and number of heavy rain events. Repairs may include regrading and/or top dressing the traveled surface with additional aggregate to eliminate ruts as well as those repairs required by each erosion and sedimentation measure used.

All inspections will be documented and placed in the Transmission Siting and Permitting Inspection Database. Field supervisors have access to this database. For inspections done by third-parties, inspection forms will be stored in RIM.

4.1.1 Vehicle Storage

Unless permit conditions have been agreed to for larger, less mobile equipment such as drill rigs or large cranes, all storage and refueling of vehicles and other equipment must occur outside of and as far away as practical from sensitive areas such as wetlands, streams, and drinking water supplies. A proper location for refueling should be identified and designated before site work begins. The recommended minimum distance from wetland areas for storage of fuel and refueling is 100 feet, and the Water Quality Certification General Conditions require a minimum distance of 25 feet. Additionally, equipment should be checked regularly for evidence of leaks. Construction material storage should also be located at least 100 feet from wetlands. The Water Quality Certification General Conditions prohibit the storage of any materials at the site which are buoyant, hazardous, flammable, explosive, soluble, expansive, radioactive, or which could in the event of a flood be injurious to human, animal or plant life, below the elevation of the 500 year flood. Any other material or equipment stored at the site below this elevation must be firmly anchored, restrained or enclosed to prevent flotation. The quantity of fuel for equipment at the site stored below such elevation shall not exceed the quantity of fuel that is expected to be used by such equipment in one day.

4.1.2 Maintenance of E&S Controls

Spare erosion and sedimentation control materials such as hay/straw bales and silt fencing should be kept on site or readily available so they may be replaced if they become non-functional due to deterioration or damaged during a storm, extreme water or wind, or other unexpected event.

4.1.3 Spills

Spill kits consist of emergency cleanup and spill containment materials that can be used in the event of a fuel or other chemical spill. Spill kits must be kept on site and accessible at all times in case of an emergency spill. Such kits should generally contain multiple absorbent socks and/or pillows and wipes and temporary disposal bags. Follow the applicable NU Contractor Work Rules.

4.1.4 Post Construction

Post-construction inspections of restored areas will be conducted at regular intervals throughout the growing season, as required by any applicable permits, and/or after major storm events. Sites should be inspected for success or failure of revegetation, invasive species colonization, and erosion and sedimentation. In the event additional measures are required to achieve site restoration and stabilization, corrective actions shall be identified and implemented.

All information collected during inspections, regular maintenance, and repair procedures should be documented in written form. In addition, photographic or diagrammatic logs may be kept to help record certain events and for documentation of project progress and any noteworthy observations.

The construction work is not complete until all areas have been restored.

Section 5
Rehabilitation and Restoration

5.1 Restoration

At a minimum, all areas disturbed by construction, repair, and maintenance activities shall be restored to pre-construction conditions. Please refer to Appendix A Section I regarding photos and typicals for loaming, seeding and mulching. Minimize the extent and duration of soil exposure. Protect disturbed areas from stormwater runoff and stabilize as soon as possible.

5.1.1 Seed Mixes

Several different seed mixes are available for upland and wetland restoration. Chapter 5, Section 4 (Vegetative Soil Cover) of the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control provides a comprehensive summary of seed mixes for both temporary and permanent seeding of disturbed sites. This summary is provided in Appendix C. The Guidelines are available at the following website: http://www.ct.gov/dep/cwp/view.asp?A=2720&Q=325660.

Wetland Seed Mix. If the wetland vegetation is stressed upon removal of timber mats, a wetland seed mix shall be placed at a rate of 18 pounds per acre after regrading activities.

Wetland Plants. If significant grading or wetland alteration has occurred it may be advantageous to install new wetland plantings to restore a wetland area.

5.1.2 Upland

The following restoration techniques apply to restoration projects in upland areas.

- Soil excavated during construction and not used as backfill must be evenly spread onto disturbed areas to restore grades. Topsoil shall be stripped and separated to the greatest extent practical, for re-use. Permanent soil protection shall be provided for all areas disturbed by construction activities. All areas will be seeded. If areas cannot be seeded due to the time of year, then mulch (hay) is still required prior to the next precipitation event.
- Topsoil removed during construction activities will be replaced, seeded, and mulched.
- All seeded areas shall be treated with a layer of mulch (i.e. hay, but preferably straw) up to one inch thick to enhance moisture retention, dissipate disturbance from precipitation, and detract birds foraging on broadcast seed.
- Rehabilitation of access routes and other areas must be performed as soon as possible after construction is completed, including reestablishment of water bars or other BMPs to control erosion of the access road, and the removal and restoration of temporary wetland or waterway crossings.
    - Temporary breaks in construction activities may warrant seeding and mulching of disturbed areas as interim erosion control measures.
- Erosion control measures shall remain in place until soils are clearly stabilized.. Once soils are stable, erosion controls – especially silt fence, which presents an

obstacle to movement of small animals – shall be removed and properly disposed. Stakes should be removed from haybales and spread as mulch to remove barriers to wildlife movement.

- Straw may be used instead of hay, if preferred, to prevent spread of invasive plant species seed stock.

- If a grading operation at a site shall be suspended for a period of more than 29 consecutive days, the disturbed area shall be stabilized by seeding, mulching, and/or other appropriate means within the first 7 days of the suspension of grading.

- Within 7 days after a final grade is established in any grading operation the disturbed area shall be stabilized by seeding, loaming, and/or other appropriate means.

5.1.3 Wetland/Watercourses

Regrading of Ruts. Upon removal of timber mats, or other BMP, the wetland resource area should be inspected for rutting or disturbance from upland soils. Any rutting should be regraded to pre-existing contours and upland soils removed from wetland areas while taking care not to compact soils.

The following restoration techniques apply to restoration project in wetlands:

Maintenance, Repair, and Emergency Projects (When No Permit is Required)

- Soils excavated from wetland areas shall be segregated and stockpiled separately (i.e. topsoil/muck apart from mineral subsoil) in a dry/upland area to facilitate restoration activities at least 100 feet from wetland boundaries.
- Excavated wetland soils that have been stockpiled during underground utility installations within wetlands shall be replaced in the same order (i.e. mineral subsoil beneath organic topsoil/muck) to the extent practicable and restored to pre-disturbance grades.
    - Grading activities should include the elimination of ruts within the area to be restored.
- If replacement of soil associated with temporary wetland or watercourse crossings for access roads is necessary, disturbed areas must be restored to pre-disturbance grades, either seeded and mulched, or allowed to revegetate from the natural seed bank.
- Disturbed wetland areas shall generally be allowed to revegetate from the natural seed bank. Measures to discourage the establishment or spread of plant species identified as non-native, invasive species by federal or state agencies shall be considered. Transmission Siting and Permitting can evaluate whether to let the wetland vegetate naturally.
- Any restoration plantings or seed mixes used in restoration shall consist of species native to the project area and, if feasible, from local nursery stock (see Section 5.2).
- Any stream banks and beds damaged shall be restored through use of geotextile erosion control blankets, and or coir logs .

- All seeded areas shall be treated with a layer of mulch (i.e. hay, but preferably straw) up to one inch thick to enhance moisture retention, dissipate disturbance from precipitation, and detract songbirds foraging on broadcast seed.

- Matting should be removed by "backing" out of the site, removing mats one at a time (without dragging them). Any rutting or significant indentations identified during mat removal should be regraded immediately.

5.2 Limiting Access to Private Property

Access to and along the right-of-way over private property must be improved to the extent necessary to ensure suitable passage for construction equipment, provide erosion control, and maintenance of proper drainage. Upon completion of construction activities, altered areas must be restored to a condition equal to or better than before their use for the construction project. If access is over a property off the transmission easement, then it is the responsibility of a construction representative to determine if legal access rights are available to cross the property.

Tighe&Bond

APPENDIX A

Adequate erosion and sedimentation control management measures shall be installed and properly maintained to reduce erosion and retain sediment on site during and after construction. These devices shall be capable of preventing erosion, collecting sediment (suspended and floating materials) and filtering fine sediment. Sediments collected by these devices shall be removed and placed in an upland location beyond buffer zones/upland review areas and any other regulatory setbacks preventing later migration into a waterway or wetland. Once work has been completed, all areas shall be stabilized with erosion control blankets and/or robust vegetation and erosion control devices shall then be removed. Erosion and sedimentation controls are provided in Section I of this Appendix. Note that stormwater management is an important part of erosion and sedimentation control. Accordingly, temporary stormwater management measures are outlined in Section II of this Appendix. Please refer to the below table for a complete list of BMP typicals and photos provided in this appendix.

Appendix A: Erosion / Sedimentation and Water Control Summary Table

Appendix A

Section I

Erosion/Sedimentation Controls

Hay (or Straw) Bales

Applications: Erosion control; mulch

Limitations:

- Haybales degrade quickly. Therefore, barriers should be checked often and replaced as needed. Additionally, sediment buildup must be routinely removed and disposed of in a stable upland area.
- Haybale height can provide an obstacle to movement of smaller wildlife
- Should not be used as a temporary check dam/ stormwater control within waterways
- Difficult to install during frozen conditions.
- Generally only effective for 3-6 months (hay) or 6-12 months (straw) before replacement

How to Use:

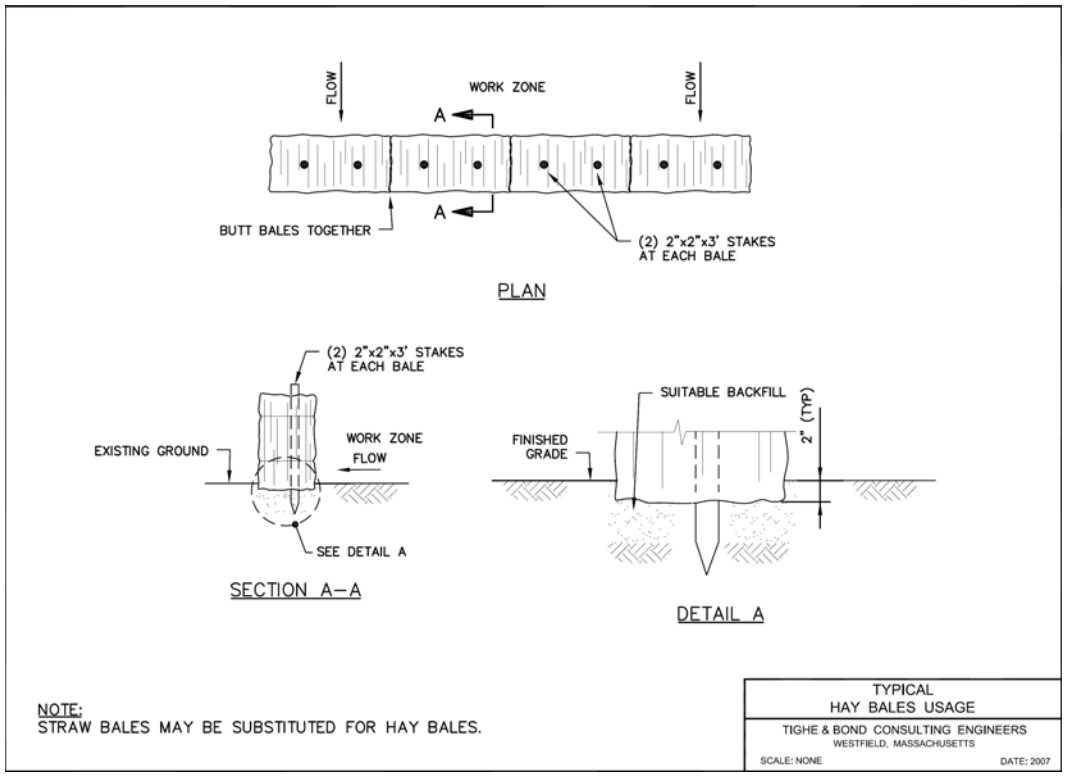
Straw bales are favored over hay bales for use as erosion control barriers. Since straw bales are composed of the dried stalks left over after a grain is harvested, they do not contain the plant's seeds and therefore will not spread growth of such species, some of which may be exotic, invasive or otherwise undesirable. Hay bales are generally less expensive, but consist of the seed heads and the upper, thinner portion of the stems which generally decay faster than straw.

Hay/straw bales should be placed end-to-end to form a temporary sedimentation control barrier. This barrier should run perpendicular to the slope and direction of runoff, and should be installed downgradient of the disturbed site (i.e., construction area). Hay/straw bales are intended to slow the velocity of flows and trap sediments behind them preventing siltation of sensitive areas – most specifically downgradient areas with open and/or flowing water. Once the project is complete and soils are stabilized with erosion control blankets and/or well-established vegetation, barriers should be removed.

- Install hay/straw bales end-to-end lengthwise along the toe of a slope or along a slope contour being sure the bales are butted tightly against each other without gaps between them. The outer ends of the barrier should be turned slightly upslope. If additional protection is needed, hay/straw bales can be set in a shallow trench and backfilled on the upslope and down-slope side to ensure better contact with the ground, so that sediment passage through or beneath them is further reduced.
- Each hay/straw bale should be staked into the ground by two stakes each approximately 3 feet long
- If a silt fence is being used with the hay/straw bale barrier, position the silt fence downgradient of the hay/straw bales (haybales filter first).

- Since hay/straw bales degrade quickly, barriers should be checked often and replaced as needed. In addition, sediment buildup should be routinely removed and disposed of in a stable upland area.
- The hay/straw bale barrier should be as far away from downgradient sensitive areas, and as close to the work areas as construction limitations allow, in order to minimize the total work area and disturb as little area as possible.
- Accumulated sediment should be removed and properly disposed outside sensitive areas when it has reached a thickness of ½ to ⅔ the height of the bale.
- Once the project is complete and soils are stabilized, hay/straw bales should generally be compacted and allowed to decay in place, as their height can provide an obstacle to movement of smaller wildlife. Spreading haybales around a site as mulch could introduce weed seeds. Using hay/straw as mulch is not generally problematic if the site is already colonized by invasive species. Plastic bailing twine should be removed from hay/straw bales. Wooden stakes should also be removed.

Properly installed hay bale barrier with silt fence.



Silt Fence

Applications: Sedimentation control, work limits, temporary animal barrier, and slow flows on steep slopes.

Limitations:

- Frozen or rocky ground
- May prevent critical movements of sensitive wildlife species
- Disposal

How to Use:

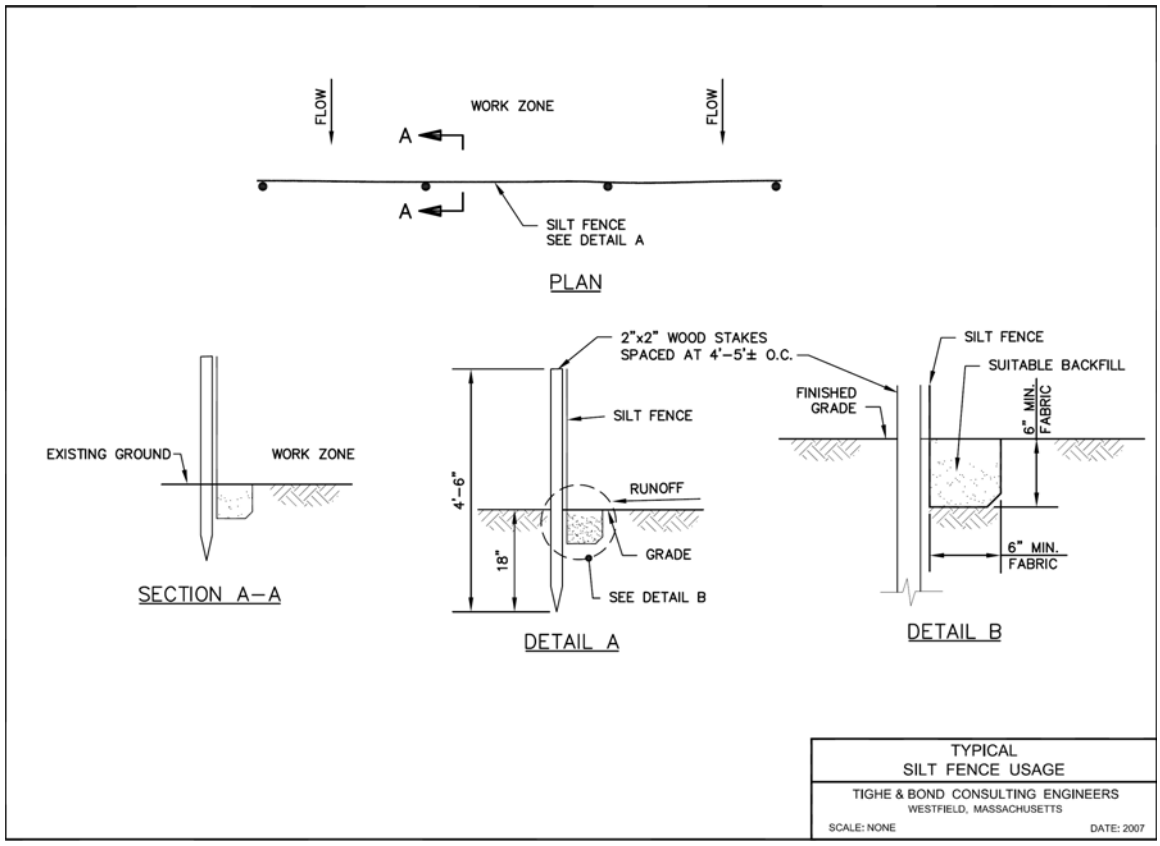
Silt fence is constructed of a permeable geotextile fabric secured by wooden stakes driven into the ground. It is installed as a temporary barrier to prevent sediments from flowing into an unprotected and/or sensitive area from a disturbed site. A silt fence should be installed downgradient of the work area. Once the project is complete and soils are stabilized, silt fence materials (i.e., geotextile fabric and wooden stakes) must be removed and properly disposed off-site (see environmental scientist to determine if area is stabilized).

- Install silt fence along the toe of a slope or along a fairly level contour with the outermost ends directed upslope. The fabric should be laid into a 6-inch wide by 6-inch deep trench dug on the upslope side of the fence and tamped down with fill material to ensure a sturdy base and so sediments will not flow beneath the fabric. Use of a Ditch Witch® or similar equipment is suggested for this task.
- The silt fence stakes should be driven into the ground until secure (≥6 inches below grade).
- If a hay bale or straw bale barrier is being used with the silt fence, position the silt fence downgradient of the bales.
- The silt fence should be as far away from down-gradient sensitive areas, and as close to the work areas as construction limitations allow, in order to disturb as little area as possible.

Silt fence should be inspected often and replaced or repaired as needed, especially during long-term projects. In addition, sediment buildup up should be routinely removed and properly disposed in a stable upland area. Sediment should be removed and properly disposed outside sensitive areas when it has accumulated to a thickness of ½ the height of the silt fence.

A silt fence must be installed in an excavated trench and must be located where shallow pools can form so sediment can settle, and the fence must be placed along the contour. If placed otherwise, water may concentrate to a low point and is likely to flow beneath the fence.

Properly installed and functioning silt fence. Direction of flow indicated by blue arrow.


FLOW
WORK ZONE
FLOW
A
A
SILT FENCE
SEE DETAIL A
PLAN
EXISTING GROUND
WORK ZONE
SECTION A–A
2"x2" WOOD STAKES
SPACED AT 4'–5'± O.C.
SILT FENCE
RUNOFF
GRADE
SEE DETAIL B
4'–6"
18"
DETAIL A
SILT FENCE
SUITABLE BACKFILL
FINISHED
GRADE
6" MIN.
FABRIC
6" MIN.
FABRIC
DETAIL B
TYPICAL
SILT FENCE USAGE
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2007

Erosion Control Blankets

Applications: Slope stabilization; erosion and sedimentation control

Limitations:

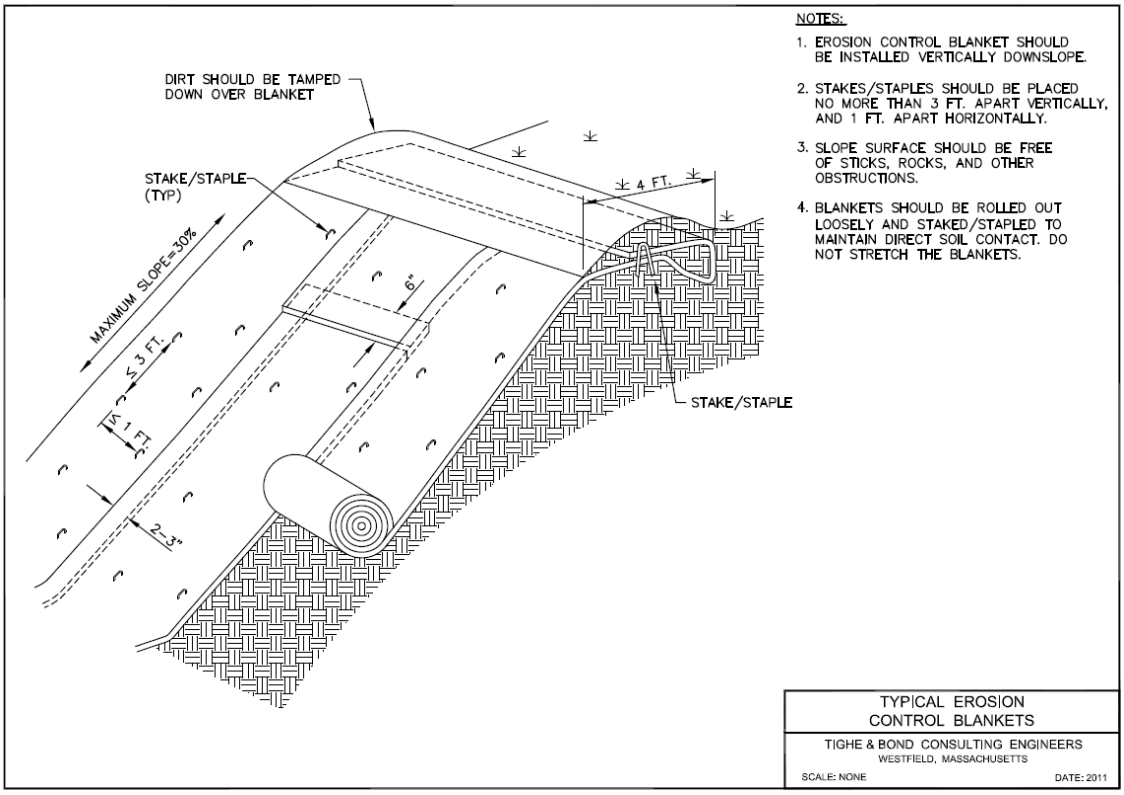
- Can be used on steep (i.e. greater than 45 degrees) slopes but not on rocky soils.
- Mulches may be more cost effective on flatter areas.

How to Use:

Erosion control blankets are generally composed of biodegradable or synthetic materials and are used as a temporary or permanent aid in the stabilization of disturbed soil on slopes. These blankets are used to prevent erosion, stabilize soils, and protect seeds from foragers while vegetation is recolonized. Representative erosion control blanket photos are included at the end of this Section.

- Always follow manufacturer's instructions for properly installing erosion control blankets. Different composition blankets are recommended for site-specific conditions (e.g. slope grades, contributing watershed areas) and use requirements (e.g. biodegradable, photodegradable, non-biodegradable).
- Prior to installation, the slope should be cleared of any rocks, branches, or other debris.
- Blankets should be rolled out in a downward direction starting at the highest point of installation and should be secured above the crest of the slope by a berm tamped down along the top of the disturbed area.
- Blankets should be tacked down with stakes or staples every 11 to 12 inches (or closer) horizontally and every 3 feet (or closer) vertically. Biodegrable staples are preferred.

Each section of the blanket should overlap the next section horizontally by approximately 2 or 3 inches. Vertical overlaps should be approximately 6 inches, with the upslope section overlaying that of the down-slope section.


DIRT SHOULD BE TAMPED DOWN OVER BLANKET
STAKE/STAPLE (TYP)
MAXIMUM SLOPE=30%
≤ 3 FT.
≥ 1 FT.
2:1
2-3"
4 FT.
6"
STAKE/STAPLE
NOTES:
1. EROSION CONTROL BLANKET SHOULD BE INSTALLED VERTICALLY DOWNSLOPE.
2. STAKES/STAPLES SHOULD BE PLACED NO MORE THAN 3 FT. APART VERTICALLY, AND 1 FT. APART HORIZONTALLY.
3. SLOPE SURFACE SHOULD BE FREE OF STICKS, ROCKS, AND OTHER OBSTRUCTIONS.
4. BLANKETS SHOULD BE ROLLED OUT LOOSELY AND STAKED/STAPLED TO MAINTAIN DIRECT SOIL CONTACT. DO NOT STRETCH THE BLANKETS.
TYPICAL EROSION CONTROL BLANKETS
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2011

Straw Wattles

Applications: Erosion and sedimentation control; work limits

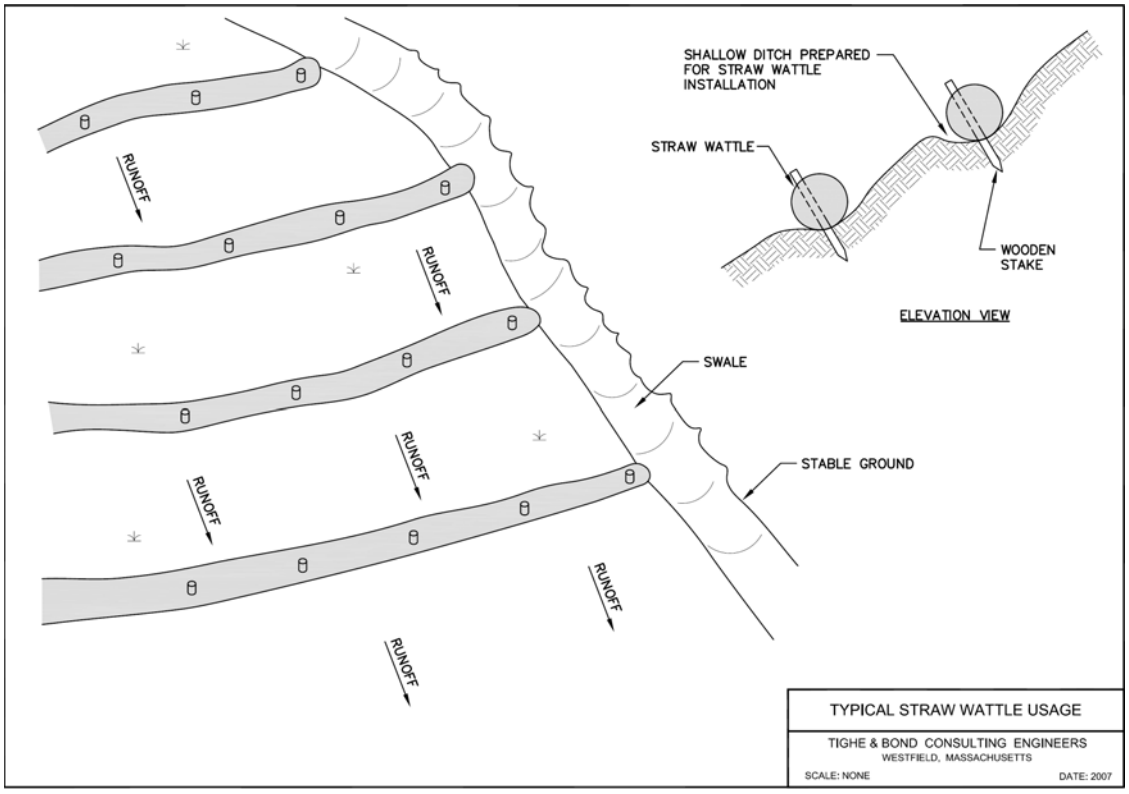
Limitations:

- Not recommended for steep slopes.

How to Use:

Straw wattles are used as an erosion control device to slow runoff velocities, entrain suspended sediments, and also promote vegetation growth until an area is stabilized. They are not generally intended for steep slopes, but rather, to stabilize low to moderate grades where there is a broad area of disturbance. They should be placed lengthwise, perpendicular to the direction of runoff. Straw wattles may also be used along small stream banks to protect areas before vegetation has stabilized the soils. The wattles are constructed from a biodegradable netting sock stuffed with straw and may be left to biodegrade in place once a project is complete.

- The spacing of each row of wattles on a slope depends on the angle of the slope, and typically ranges from about 10 to 40 feet apart. Additionally, the texture of the soil should also be taken into consideration – for soft, loamy soils, wattles should be placed closer together; for coarse, rocky soils, they may be placed further apart.
- The ends of each row of wattles on a slope should be slightly turned downhill to prevent ponding behind them.
- Where straw wattles are installed end-to-end, the wattles should be butted tightly together so as not to allow water/sediments to flow between them.
- Straw wattles should be placed in a shallow trench to assure stabilization and soil should be packed against the wattle on the uphill side.
- Straw wattles should be staked securely to the ground by driving a stake directly through the wattle approximately every four feet. A portion of each stake should remain approximately 2 to 3 inches above the wattle.


SHALLOW DITCH PREPARED FOR STRAW WATTLE INSTALLATION
STRAW WATTLE
WOODEN STAKE
ELEVATION VIEW
RUNOFF
RUNOFF
RUNOFF
RUNOFF
RUNOFF
RUNOFF
SWALE
STABLE GROUND
TYPICAL STRAW WATTLE USAGE
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2007

Wood Chip Bags

Applications: Erosion and sedimentation control; mulch

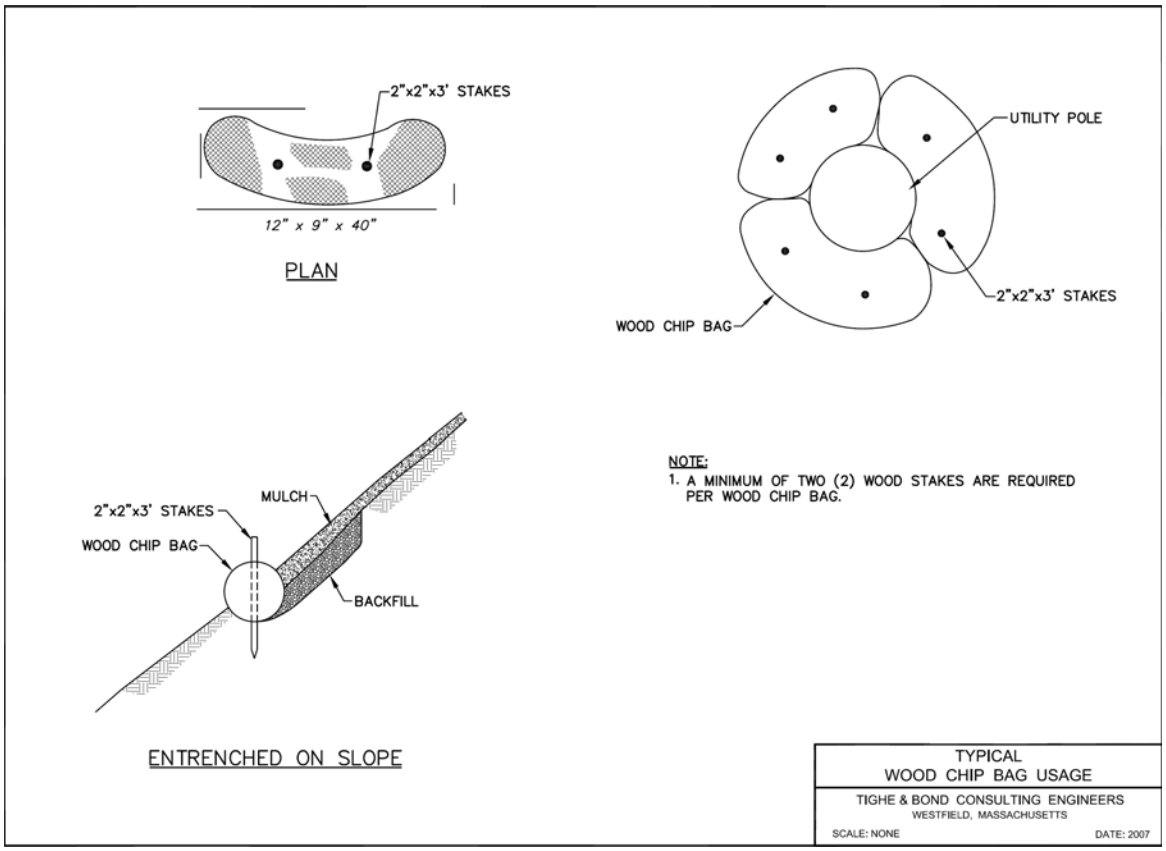
Limitations:

- Frozen ground or rocky ground (for installing stakes).
- Can pose a barrier to small animal movements.
- Requires close attention for maintenance and repair.
- Remove accumulated sediment when it reaches two thirds the height of the bag.

How to Use:

- Install wood chip bags end-to-end lengthwise in a single row, lengthwise along the toe of a slope or along a slope contour being sure the bags are butted tightly against each other without gaps between them.
- Wood chip bags can stabilize soils in a number of applications. They may be left in place as they eventually photo-degrade, as long as they do not pose a barrier to small animal movements.
- Each hay/straw bale should be staked into the ground by two stakes each approximately 3 feet long

Wood chips in photo-degradable bags used to stabilize soils.


2"x2"x3' STAKES
12" x 9" x 40"
PLAN
UTILITY POLE
2"x2"x3' STAKES
WOOD CHIP BAG
2"x2"x3' STAKES
MULCH
WOOD CHIP BAG
BACKFILL
ENTRENCHED ON SLOPE
NOTE:
1. A MINIMUM OF TWO (2) WOOD STAKES ARE REQUIRED PER WOOD CHIP BAG.
TYPICAL
WOOD CHIP BAG USAGE
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2007

Inlet Catch Basin Sediment Filter

Applications: Erosion and sedimentation control

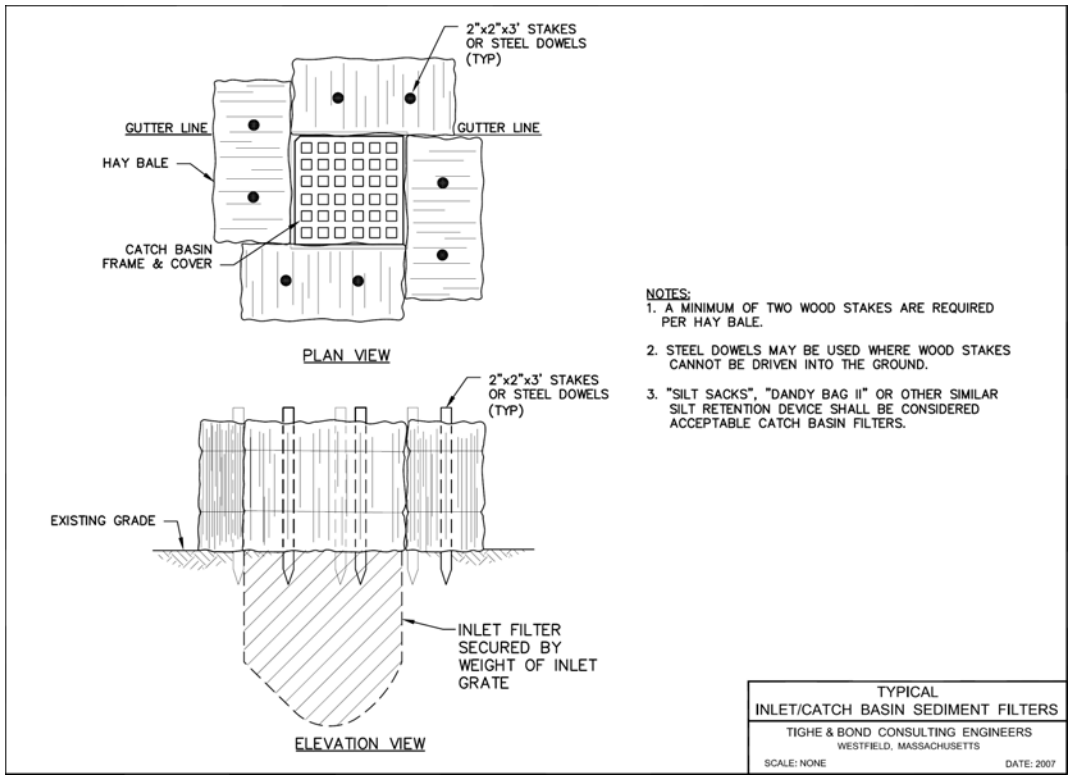
Limitations:

- Ineffective for very silty water
- May require authorization from local government for discharge to municipal system
- Fabric drop inlet should be used where stormwater runoff velocities are low and where the inlet drains a small, nearly level area.
- Undercutting and erosion under filter fabric if fabric is not buried at bottom.

How to Use:

- Installation is similar to perimeter hay/straw bale barriers.
- Hay/straw bales should be installed in a box configuration around the drop inlet and the ends of the bales should be placed tightly against each other.
- If the area is unpaved, anchor bales using two stakes driven through the bale and into the ground.
- Hay bales can be placed around the perimeter of the inlet in order to extend the life of the filter by removing much of the sediment before-hand.
- Discharge of clean water into municipal system catch basins may be an option for certain sites. However, this activity must be coordinated with the municipality and shall not occur without their written consent.
- To protect catch basins from excessive sediment, filters can be installed into the basin that are specifically designed for this purpose.
- In cases of curb drop inlets, additional protective measures (e.g. filter sock, gutter buddy) should be utilized in conjunction with a silt sack.
- Avoid setting top of fabric too high, which will lead to flow bypassing the inlet.
- Inspect and remove accumulated sediment on a regular basis.
- Remove after area is permanently stabilized.

Catchbasin protected from sedimentation by filter fabric.


2"x2"x3' STAKES OR STEEL DOWELS (TYP)
GUTTER LINE
GUTTER LINE
HAY BALE
CATCH BASIN FRAME & COVER
PLAN VIEW
2"x2"x3' STAKES OR STEEL DOWELS (TYP)
EXISTING GRADE
INLET FILTER SECURED BY WEIGHT OF INLET GRATE
ELEVATION VIEW
NOTES:
1. A MINIMUM OF TWO WOOD STAKES ARE REQUIRED PER HAY BALE.
2. STEEL DOWELS MAY BE USED WHERE WOOD STAKES CANNOT BE DRIVEN INTO THE GROUND.
3. "SILT SACKS", "DANDY BAG II" OR OTHER SIMILAR SILT RETENTION DEVICE SHALL BE CONSIDERED ACCEPTABLE CATCH BASIN FILTERS.
TYPICAL
INLET/CATCH BASIN SEDIMENT FILTERS
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2007

Temporary Sedimentation Basin

Applications: Erosion and sedimentation control

- Used to filter and settle out sediment in stormwater runoff before water is released into a wetland or other unprotected and/or sensitive area and may be used for drainage areas of various sizes.

Limitations:

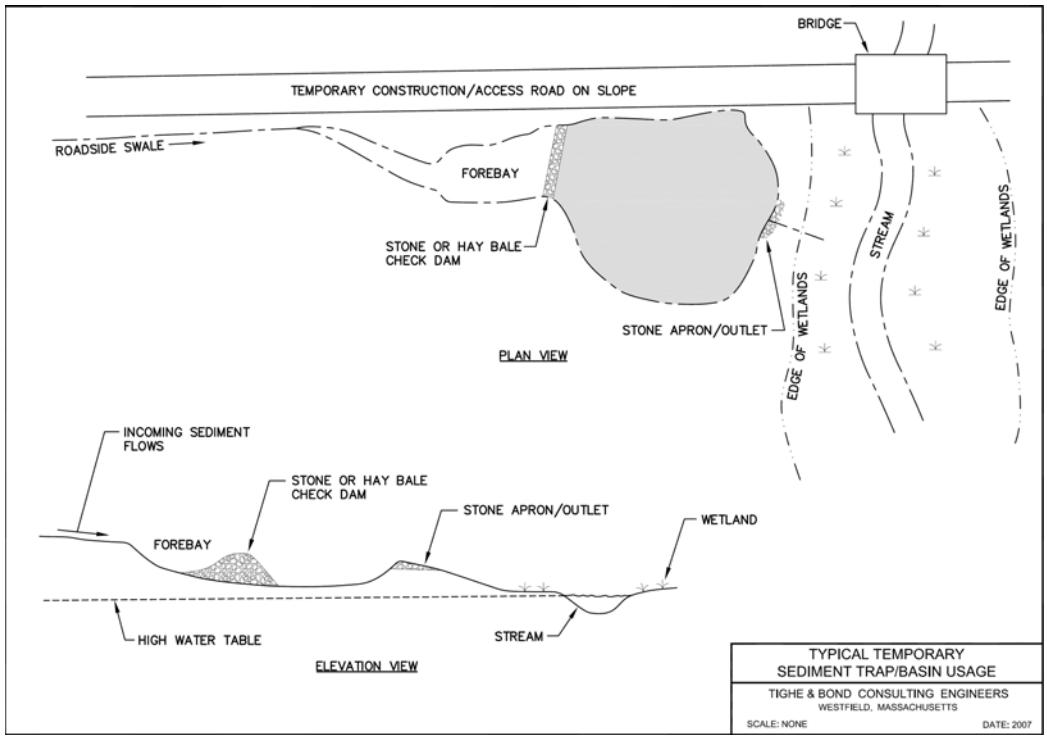
- Needs to be adequately sized based on expected rain events and the contributing drainage area.

How to Use:

- Direct stormwater runoff to sedimentation basins. Basin formed by excavating a depression similar to a small pond, or placing an earthen embankment across an existing drainage swale or naturally low area.
- 9:1 (L:W) ratio is recommended. The ratio between the basin length and width should be greater than 3:1.
- Clear, grub and strip all vegetation and root material from area of embankment and place embankment fill in lifts, 9 inches per lift at maximum. Compact fill and construct side slopes 2:1 or flatter. Excavate rectangular outlet section from compacted embankment.
- Filter fabric can be installed on bottom and sides of basin, and covered by riprap.
- Extend outlet apron/spillway below toe of dam on level grade until stable conditions are reached (5 feet minimum). Cover inside face of stone outlet section with a 1-foot layer of ½ to ¼ inch aggregate. Vegetate embankments, spillways and disturbed areas down gradient of the basin, either with permanent or temporary seeding.
- Monitor the amount of sedimentation in the basin. Inspect after every rain event and maintain as needed, including removing accumulated sediment, repairing erosion and piping holes, cleaning or replacing the spillway gravel, and re-seeding or planting vegetation.
- Should ideally consist of a forebay where debris and some sediment begins to settle out of the water; a check dam constructed of stone or hay bales which water must flow through, filtering out more sediments; and the actual sediment basin, which is a pool with a slow enough velocity that sediments have time to settle out of the water column before the water flows over the dam at the outlet and is released.
- Sediment basins should be sized to provide a minimum of 12 to 24 hours of detention to maximum expected runoff amounts for the duration of the basin's use.
- Often a critical stormwater management component for larger construction sites, and/or those with poorly drained upland soils.
- Construction of temporary sediment basins should occur before primary construction on a project begins.

- If compatible with the eventual (post-construction) site use, it may be appropriate to leave sediment basins in place indefinitely.

Sedimentation basin with haybale filters.



Loaming and Seeding

Applications: Erosion control, site restoration

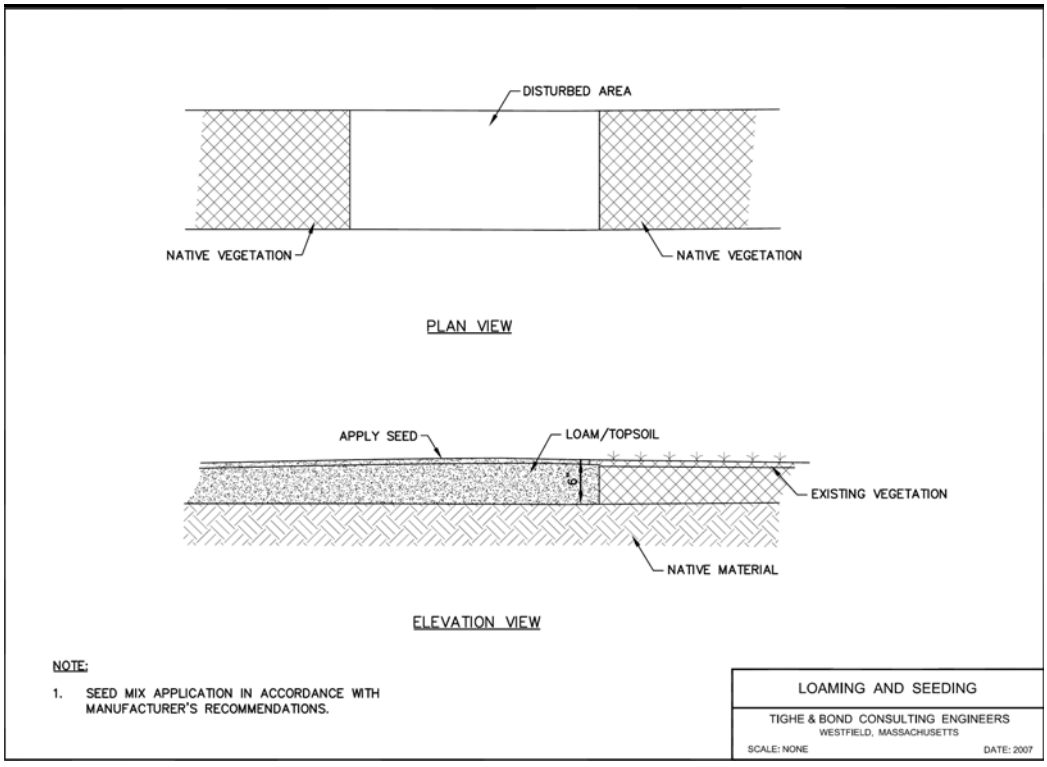
Limitations:

- May be site specific limitations (e.g. permit or State requirements); otherwise none.
- Applies to upland areas only.

How to Use:

- Permanent seeding is appropriate for vegetated swales, steep slopes, or filter strips. Temporary seeding is appropriate if construction has ceased and if an area will be exposed.
- Apply loam/topsoil prior to spreading seed mix per manufacturer's recommendations. Apply water, fertilizer and mulch as needed to seedbed.
- Plant native species of grasses and legumes where possible.
- Inspect on regular basis until vegetation has established.
- If appropriate, repair surface, re-seed, re-mulch and install new netting if washout or erosion occurs.
- Follow permit requirements regarding use of wetland seed mix in wetlands where required.

Loaming and seeding of recently disturbed right-of-way.



Mulching with Hay/Straw/Woodchips

Applications: Erosion control; site restoration

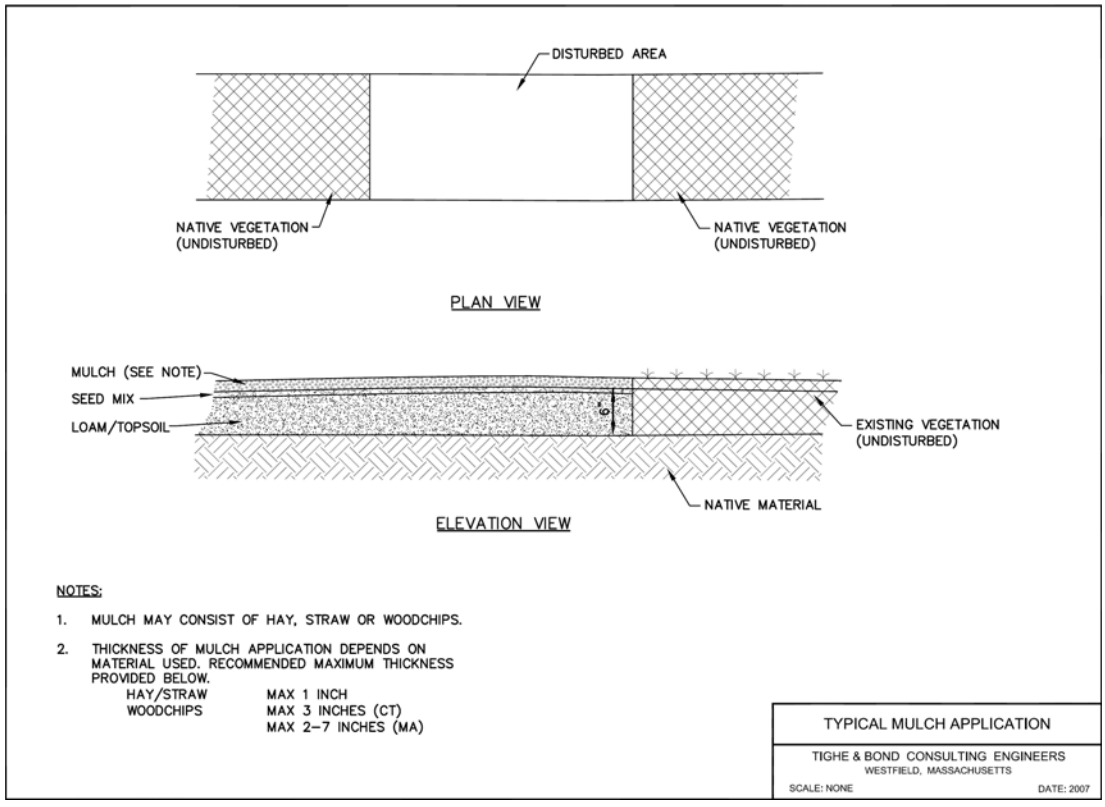
Limitations:

- May be site specific limitations (e.g. permit or State requirements); otherwise none.
- Applies to upland areas only.
- Thick mulch may prevent seed germinations.
- Mulch on steep slopes must be secured with netting to prevent it from being washed away.

How to Use:

- Use in areas which have been temporarily or permanently seeded.
- Use mulch netting on slopes greater than 3% or in concentrated flows.
- Mulch prior to winter (ideally in mid summer).
- Note that application rates and technique depend on material used. Select mulch material based on soil type, site conditions and season. Straw/hay provides the densest cover if applied at the appropriate rate (at least ½ inch). and should be mechanically or chemically secured to the soil surface. Woodchip application can be less expensive if on-site materials are used.
- Inspect on regular basis until vegetation has established.
- If appropriate, repair surface, re-seed, re-mulch and install new netting if washout or erosion occurs.

Typical view of light mulching atop unstable, seeded soils.



Coir Log Use for Bank Stabilization

Applications: Bank stabilization; wetlands and watercourse restoration

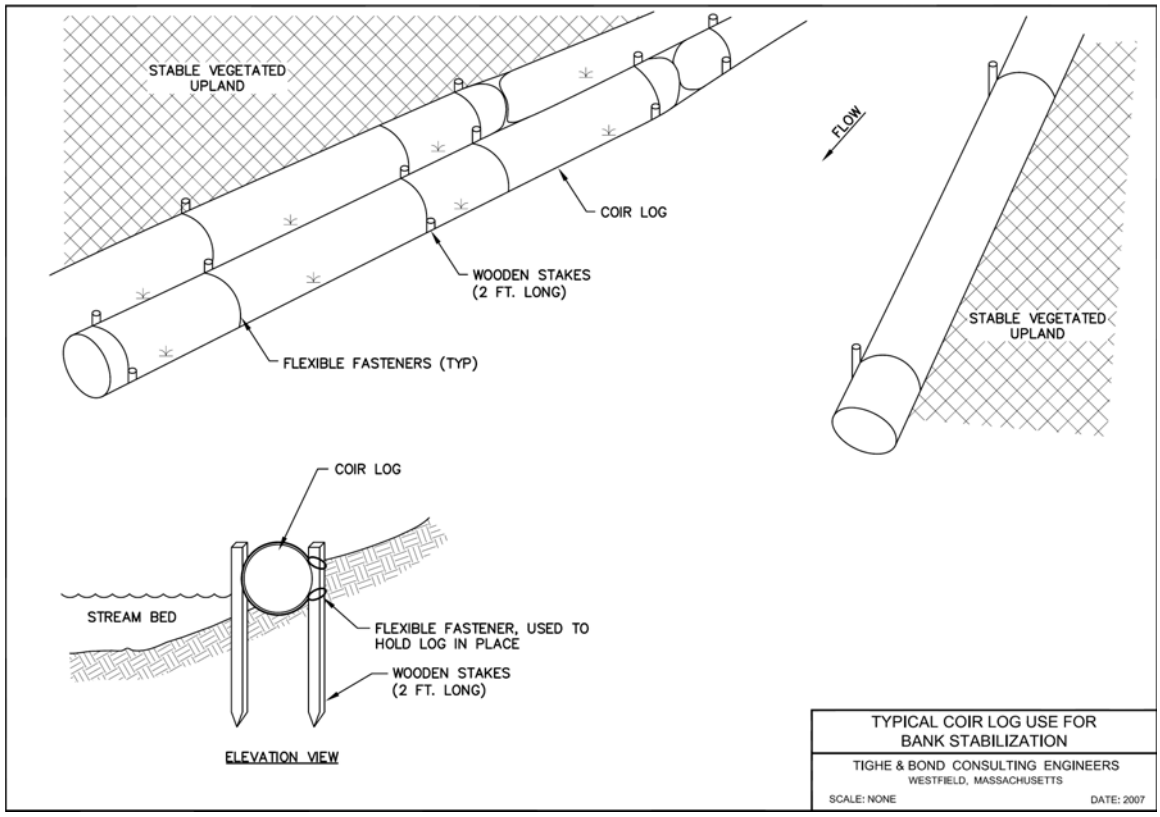
Limitations:

- Need to be installed with heavy machinery.

How to Use:

- Refer to permit requirements (if applicable) and manufacturer's specifications.
- Install along banks between upland and watercourse using wooden stakes (2 foot long) and flexible fasteners (to hold log in place).

Coir logs used to restore a stream bed and banks.


STABLE VEGETATED UPLAND
COIR LOG
WOODEN STAKES (2 FT. LONG)
FLEXIBLE FASTENERS (TYP)
FLOW
STABLE VEGETATED UPLAND
COIR LOG
STREAM BED
FLEXIBLE FASTENER, USED TO HOLD LOG IN PLACE
WOODEN STAKES (2 FT. LONG)
ELEVATION VIEW
TYPICAL COIR LOG USE FOR BANK STABILIZATION
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2007

Check dams

Applications: Stormwater management; erosion control

Limitations:

- Need to be adequately sized based on expected rain events

How to Use:

Check dams are structures placed across a drainageway to reduce the velocity of concentrated stormwater flows, thereby reducing erosion of the drainageway and/or to temporarily pond stormwater runoff to allow sediment in the water column to settle out. Permanent or long-term check dams are typically constructed of rip rap or other stone material. Short-term check dams can be constructed of rip rap. Staked haybales have been proven ineffective (sediment does not stay trapped).

- Place stone by hand or machine, making side slopes no steeper than 1:1 with a maximum height of 3 feet at the center of the check dam. A geotextile may be used under the stone to provide a stable foundation and/or to facilitate removal of the stone.
- The minimum height of the check dam shall be the flow depth of the drainageway, but shall not exceed 3 feet at the center.
- The width of the check dam shall span the full width of the drainageway, plus 18 inches on each side leaving the center of the check dam approximately 6 inches lower than the height of the outer edges.
- The maximum spacing between check dams shall be such that the toe of the upstream check dam is at the same elevation as the top of the center of the downstream check dam.
- For permanent stone check dams, inspect and maintain the check dam in accordance with the standards and specifications provided in the design for the site.
- For temporary check dams, inspect at least once per week and within 24 hours of the end of a precipitation event of 0.5 inches or more to determine maintenance needs.
- Maintenance may include, but are not limited to, the replacement of stone, repair of erosion around or under the structure, and/or the removal and proper disposal of accumulated sediment.

Stone check dams at construction site.

Stone check dam at construction site.

Appendix A

Section II

Water Control

Several methods exist for temporarily diverting and dewatering surface water from work areas. No untreated groundwater shall be discharged to wetlands or water bodies. A variety of methods may be employed to prevent sedimentation due to dewatering. These methods, which are primarily appropriate during construction of capital projects, are described below.

Discharge Hose Filter Socks

Applications: Dewatering

Limitations:

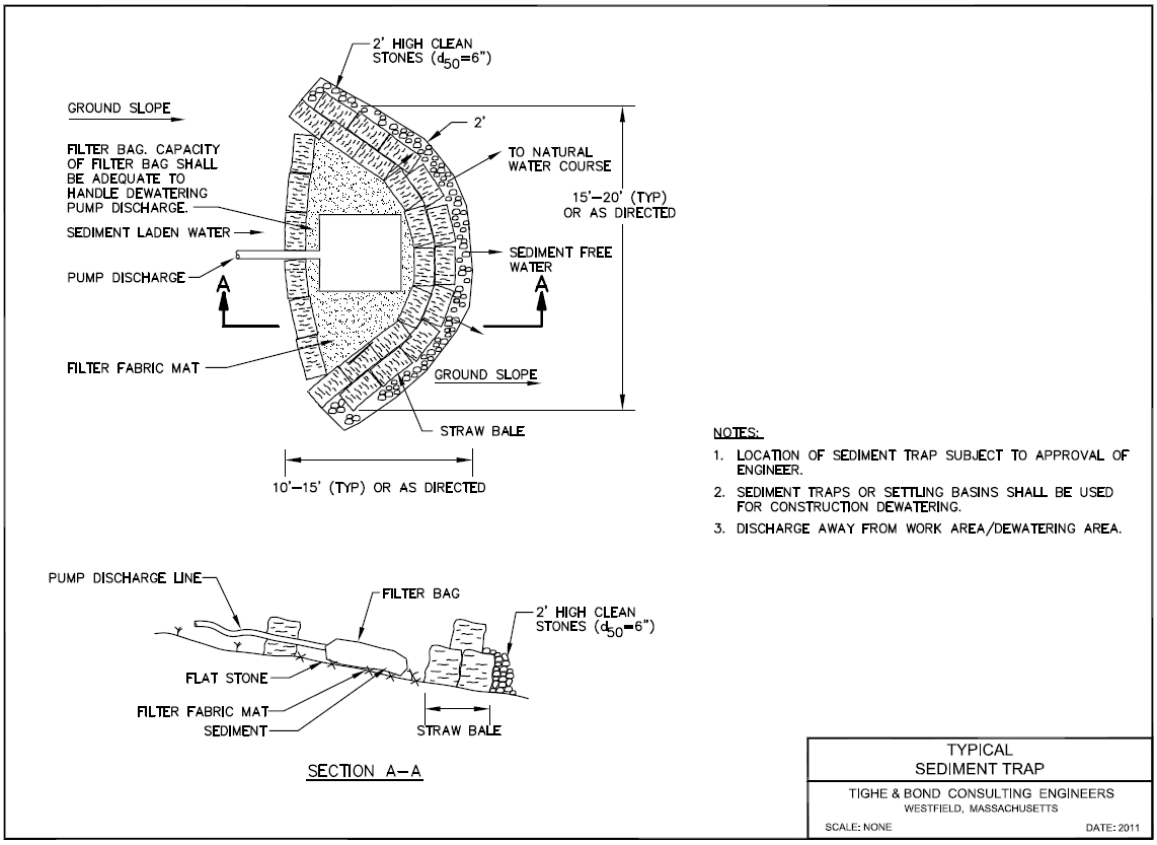
- Ineffective for very silty water

How to Use:

- At sites where there isn't sufficient space to construct sediment basins or enough suitable uplands for overland flow and infiltration to be an option, filter "socks" or bags can be affixed to the end for the discharge hose of the pump and used for dewatering.
- It is important that enough socks be on hand at the site to accommodate the anticipated need, as they fill fast with more turbid water.
- Additional measures such as hay or straw bales can be installed around the filter device for added protection.

Dewatering to filter “sock” surrounded by haybales.

Riprap underlain by geotextile fabric


2' HIGH CLEAN STONES (d_{50}=6")
GROUND SLOPE
2'
TO NATURAL WATER COURSE
FILTER BAG. CAPACITY OF FILTER BAG SHALL BE ADEQUATE TO HANDLE DEWATERING PUMP DISCHARGE.
15'–20' (TYP) OR AS DIRECTED
SEDIMENT LADEN WATER
SEDIMENT FREE WATER
PUMP DISCHARGE
A
A
FILTER FABRIC MAT
GROUND SLOPE
STRAW BALE
10'–15' (TYP) OR AS DIRECTED
NOTES:
1. LOCATION OF SEDIMENT TRAP SUBJECT TO APPROVAL OF ENGINEER.
2. SEDIMENT TRAPS OR SETTLING BASINS SHALL BE USED FOR CONSTRUCTION DEWATERING.
3. DISCHARGE AWAY FROM WORK AREA/DEWATERING AREA.
PUMP DISCHARGE LINE
FILTER BAG
2' HIGH CLEAN STONES (d_{50}=6")
FLAT STONE
FILTER FABRIC MAT
SEDIMENT
STRAW BALE
SECTION A–A
TYPICAL SEDIMENT TRAP
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2011

Coffer Dam and Stream Bypass Pumping

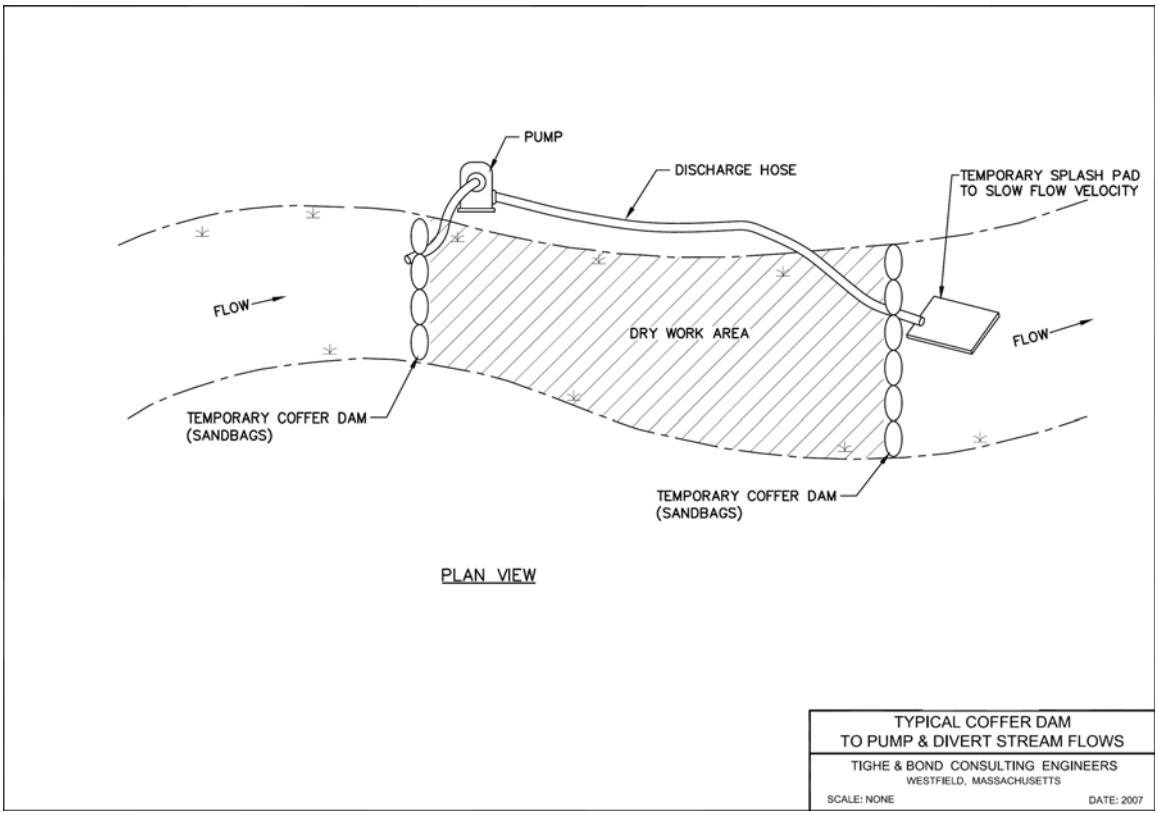
Applications: Dewatering/ Water diversion

Limitations:

- Pipes need to be adequately sized to accommodate heavy rain events
- Coffer dams require careful maintenance at all times.

How to Use:

- Dewatering measures may be necessary if groundwater is encountered within an excavation (e.g., during installation or repair of a buried cable, footings, foundations or structure replacement) or other area if the presence of water is incompatible with construction. In rare cases, surface water diversions will be necessary in order to create dry working conditions for subsurface work in water bodies.
- Coffer dams may be used to make an impoundment upstream of a work area, and then pumps used to remove the water from inside the dammed (isolated) area, and down beyond the work area
- Where gravity flows cannot be circumvented through a coffer dam and temporary flexible pipe via gravity, a pump, discharge hose and downstream temporary splash pad to slow flow velocity can be used.
- Use in areas with high flows where siltation barriers are not effective.
- Construction of coffer dams for instream work is site specific.
- Coffer dams can consist of sandbags, concrete structures or pre-manufactured products and should be used on a site by site basis according to engineering specifications and/or manufacturer's instructions.


PUMP
DISCHARGE HOSE
TEMPORARY SPLASH PAD
TO SLOW FLOW VELOCITY
FLOW
DRY WORK AREA
FLOW
TEMPORARY COFFER DAM
(SANDBAGS)
TEMPORARY COFFER DAM
(SANDBAGS)
PLAN VIEW
TYPICAL COFFER DAM
TO PUMP & DIVERT STREAM FLOWS
TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS
SCALE: NONE
DATE: 2007

Coffer Dam and Stream Bypass via Gravity

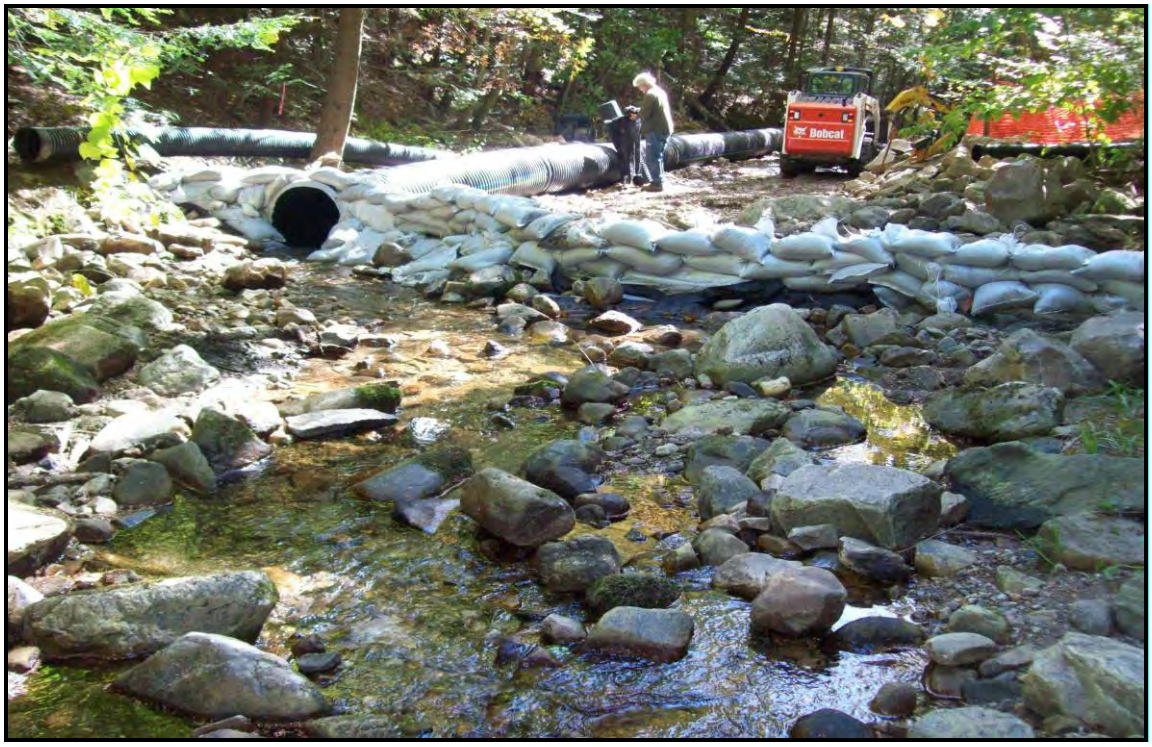
Applications: Dewatering/ Water diversion

Limitations:

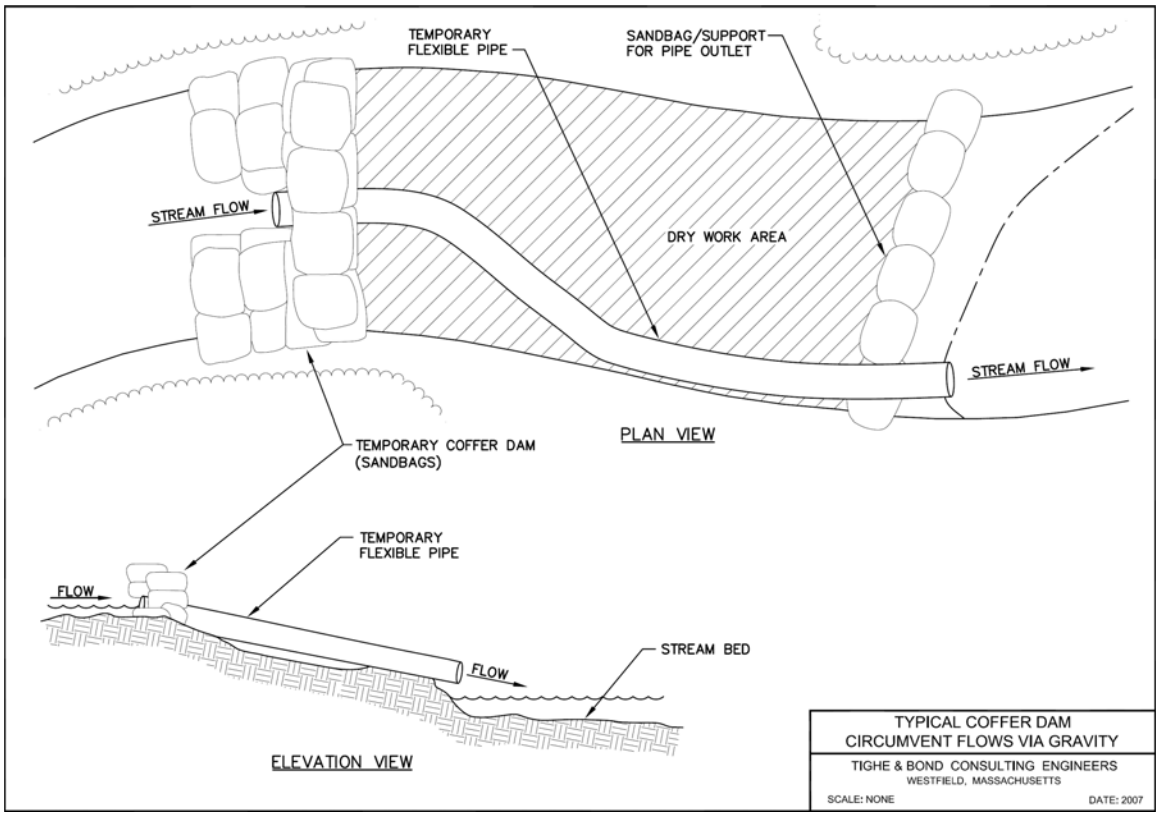
- Pipes need to be adequately sized to accommodate heavy rain events
- Coffer dams require careful maintenance at all times.

How to Use:

- Dewatering measures may be necessary if groundwater is encountered within an excavation (e.g., during installation or repair of a buried cable, footings, foundations or structure replacement) or other area if the presence of water is incompatible with construction. In rare cases, surface water diversions will be necessary in order to create dry working conditions for subsurface work in water bodies.
- Coffer dams and temporary pipes can be used to divert flows and dry out a work area where use of pumps is impractical.
- Where gravity flows cannot be circumvented through a coffer dam and temporary flexible pipe via gravity, a pump, discharge hose and downstream temporary splash pad to slow flow velocity can be used.
- Use in areas with high flows where siltation barriers are not effective.
- Construction of coffer dams for instream work is site specific.
- Coffer dams can consist of sandbags, concrete structures or pre-manufactured products and should be used on a site by site basis according to engineering specifications and/or manufacturer's instructions.



Sand bag coffer dam and streamflow gravity bypass.



Overland Flow

Applications: Dewatering

Limitations:

- Space constraints and adjacent wetlands or watercourses may prevent use of this dewatering method.

How to Use:

- Excess water may be discharged overland to well drained, upland areas and allowed to naturally infiltrate into soils.
- Select discharge location where there is no potential for discharged water to flow overland into wetlands or watercourses.

Frac Tank

Applications: Dewatering; Managing contaminated groundwater

Limitations:

- May be site specific limitations (e.g. extremely unlevel ground); expensive; may require proper disposal at a regulated facility (in cases of contaminated groundwater)

How to Use:

- Frac tanks are pre-fabricated self-contained units that are shipped to construction sites. They contain a series of baffles that allow fine materials to settle out of the water column.

- Use of frac tanks is most appropriate when work that requires dewatering will occur in an area with contaminated groundwater and/or very silty water.

Frac tank on-site for dewatering activities.

Tighe&Bond

APPENDIX B

Section 1 Appendix B

Section 1
Appendix B

1.1 Applicable Laws/Regulations

In Connecticut, there are no fewer than nine potentially pertinent regulatory programs associated with activities proposed in environmentally sensitive areas. The following list of laws and regulations are most likely to apply to electrical utility projects in the State.

- Connecticut Inland Wetlands and Watercourses Act (C.G.S. §§ 22a-36 through 22a-45a)
- Municipal inland wetland and zoning regulations
- Stream Channel Encroachment Lines (C.G.S. §§ 22a-342 through 22a-349a)
- Connecticut General Permit for Placement of Utilities and Drainage within Inland Wetlands and Stream Channel Encroachment Lines (C.G.S. §§ 22a-6, 22a-45a through 22a-349a)
- Connecticut Environmental Policy Act (C.G.S. §§ 22a-1a through 22a-1h)
- Connecticut Coastal Management Act (C.G.S. §§ 22a-359 through 22a-363; 22a-28 through 22a-35; 22a-90 through 22a-112; 33 U.S.C. § 1314)
- Connecticut Water Diversion Policy Act (C.G.S. §§ 22a-365 through 22a-379)
- Connecticut Endangered Species Act (C.G.S. §§ 26-303 through 26-315)
- Section 10 of the Rivers and Harbors Act of 1899 (C.G.S. §§ 22a-426; 33 U.S.C. § 403)
- Section 401 of the Clean Water Act (33 U.S.C. § 1251)
- Section 404 of the Clean Water Act (33 U.S.C. § 1344)

1.2 Geographic Areas Subject to Jurisdiction

The following areas are subject to regulatory jurisdiction by at least one of the regulatory programs discussed in this section: It is important to note that more than one jurisdictional resource type may be present at any given location.

- Inland wetlands, watercourses (rivers, streams, lakes, ponds), and floodplains
- Areas subject to municipal wetlands bylaws or ordinances. (These vary by town.)
- Coastal Resource Areas (beaches, dunes, bluffs, escarpments, coastal hazard areas, coastal waters, nearshore waters, offshore waters, estuarine embayments, developed shorefront, intertidal flats, islands, rocky shorefronts, shellfish concentration areas, shorelands, and tidal wetlands)
- Navigable waters
- Essential Fish Habitat (EFH)
- Rare species habitat as mapped by the Connecticut Natural Diversity Database

1.3 Applicable Regulatory Agencies

Activities subject to jurisdiction under the above-referenced programs will generally be subject to review by one or more regulatory agencies (refer to list below). Most stream and wetland crossings will require notification or consultation with municipal Inland Wetland and Watercourses Agencies, and may require permitting with the U.S. Army Corps of Engineers (Corps) and Connecticut Department of Energy & Environmental Protection (CT DEEP) under Sections 404 and 401 of the Clean Water Act. Any work within established stream encroachment lines will require permitting with the CT DEEP Inland Water Resources Division. Coordination with CT DEEP may also be required for projects located within areas mapped by the Connecticut Natural Diversity Database. For work within tidal, coastal or navigable waters or in tidal wetlands, permitting will be required with the Connecticut Department of Energy & Environmental Protection (CT DEEP) Office of Long Island Sound Program (OLISP).

- Municipal Conservation Commissions
- Connecticut Department of Energy & Environmental Protection (CT DEEP) Bureau of Water Management, Inland Water Resources Division
- CT DEEP Wildlife Division
- CT DEEP Office of Environmental Review
- CT DEEP Office of Long Island Sound Programs (OLISP)
- United States Army Corps of Engineers (Corps) New England District

The State of Connecticut and the Federal Government define wetlands differently. According to the Inland Wetlands and Watercourses Act, inland wetlands are defined as "land, including submerged land, not regulated pursuant to Sections 22a-28 through 22a-35 of the Connecticut General Statutes, as amended, which consists of any of the soil types designated as poorly drained, very poorly drained, alluvial, and floodplain by the National Cooperative Soil Survey, as it may be amended from time to time by the United States Department of Agriculture Natural Resource Conservation Service. Such areas may include filled, graded, or excavated sites which possess an aquic (saturated) soil moisture regime as defined by the National Cooperative Soil Survey." State wetland identification is based solely on the presence of these soil types.

"Watercourses" means rivers, streams, brooks, waterways, lakes, ponds, marshes, swamps, bogs and all other bodies of water, natural or artificial, vernal or intermittent, public or private, which are contained within, flow through or border upon this state or any portion thereof. Intermittent watercourses shall be delineated by a defined permanent channel and bank and the occurrence of two or more of the following characteristics: (A) Evidence of scour or deposits of recent alluvium or detritus, (B) the presence of standing or flowing water for a duration longer than a particular storm incident, and (C) the presence of hydrophytic vegetation.

The Federal Government defines wetlands as "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Federal wetland identification is based on a three parameter approach, where a prevalence of hydrophytic vegetation, hydric soils, and wetland hydrology is used to make a wetland determination.

1.4 Maintenance, Repair, or Emergency Projects

Most regulatory programs contain provisions that allow normal maintenance of existing structures and/or response to emergency situations that require immediate attention.

Prior to commencement of new construction, all jurisdictional wetland areas within the work corridor should be delineated by a qualified wetland and soil scientist. The specialist shall delineate areas in accordance with the General Statutes of Connecticut (revised January 1, 2007) as set forth at Title 22a Chapter 440 "Inland Wetlands and Watercourses Act", the U.S. Army Corps of Engineers 1987 Wetland Delineation Manual, and any local inland wetland regulations, ordinances or bylaws that may exist. Refer to each set of regulations regarding applicable wetland definitions. Wetland areas shall be clearly demarcated using appropriate flagging tape or similar means. It is important to note that certain jurisdictional wetland areas in Connecticut can actually occur in uplands, such as floodplains. In addition, Upland Review Areas generally apply to work activities and vary in each community. This makes consultation with a wetland specialist particularly important.

1.4.1 Maintain, Repair and/or Replace

Exemptions or considerations for maintenance, repair, and/or replacement of existing electrical utility structures exist in some environmental regulations, but not all. The exemptions are limited to work related to existing and lawfully located structures where no change in the original structure or footprint is proposed. It is not for the selected contractor of a particular project to make a determination as to whether an activity is exempt. This determination will be made prior to work by the NU project manager, in consultation with NU environmental staff.

These exemptions/considerations are afforded at:

- CT Inland Wetlands & Watercourses Act (RCSA § 22a-39-4)
- CT General Permit (Section 3)
- CT Coastal Management Act (RCSA § 22a-363b)
- CT GP [33 CFR 323.4(a)(2)]
- CT Water Diversion Policy Act (RCSA § 22a-377(b)1)

1.4.2 Emergency Projects

Emergency provisions are generally afforded to activities that need to abate conditions that pose a threat to public health or safety. These provisions generally do not allow work beyond what is necessary to abate the emergency condition, and will generally require an after-the-fact permit. It is not for the selected contractor of a particular project to make a determination as to whether an activity is an emergency. This determination will be made prior to work by the NU project manager, in consultation with NU environmental staff.

It is important to note that invocation of an emergency provision does not release the project proponent from reporting requirements.

Emergency provisions are afforded at:

- CEPA (RCSA § 22a-1a-3)
- CT Coastal Management Act (RCSA § 22a-29)
- CT GP [33 CFR Part 323.4(a)(2)]

1.5 Municipal Permitting

Work within wetlands, watercourses and designated Upland Review Areas typically requires notification to municipal staff, (Department of Public Works and/or the Inland Wetland and Watercourse Agency staff). In October 1996 the Connecticut Department of Public Utility Control opened a docket (Docket Number 95-08-34) to conduct a generic investigation on the allocation of siting jurisdiction over utility plant facilities. This included an investigation as to whether local authorities (including local Inland Wetlands and Watercourses Agencies) have jurisdiction over public utility projects.

The investigation resulted in several orders which provide guidance on how public utility companies should coordinate with municipalities on the construction of new facilities, upgrades, significant maintenance activities, and routine maintenance activities.

- For the construction of new facilities, alterations to existing facilities (including upgrades) or significant maintenance involving substantial disturbance of soil, water or vegetation which would regularly fall under the review requirements of certain local authorities (ie. Planning and Zoning Authority; Inland Wetlands Commission; Public Works Department; Historic District Commission), the utility shall at least notify and consult with such local authority, or its designated agent or staff, toward the development of mutually agreeable schedules and procedures for the proposed activity.
- For routine maintenance activities or alterations to existing facilities (including upgrades) involving minor disturbance of soil, water or vegetation which would regularly fall under the review and approval requirements of certain local authorities, the utility shall make local authorities or their designated agent or staff aware of such ongoing activities.

1.6 CT Department of Energy & Environmental Protection

If the project requires formal permitting with the Corps (Category 2 or Individual Permit), copies of the application should be forwarded to CT DEEP for review under Section 401 of the Clean Water Act. The CT DEEP requires that a GP Addendum form be completed and submitted along with the Corps application. If the project qualifies as Category 1 under the Corps GP, the project also is granted authorization (Water Quality Certification, WQC) with no formal application under Section 401 of the Clean Water Act, provided the project meets the additional WQC general conditions. The general conditions commonly applicable to utility projects include:

- Prohibiting dumping of any quantity of oil, chemicals, or other deleterious material on the ground;

- Immediately informing the CT DEEP Oil and Chemical Spill Response Division at (860) 424-3338 (24 hours) of any adverse impact or hazard to the environment including any discharge or spillage of oil or chemical liquids or solids;

- Separating staging areas at the site from the regulated areas by silt fences or stray/hay bales at all times;

- Prohibiting storage of any fuel and refueling of equipment within 25 feet from any wetland or watercourse;

- Following the document "Connecticut Guidelines for Soil and Erosion Control," inspecting employed controls at least once per week, after each rainfall, and at least daily during prolonged rainfall, and correcting any deficiencies within 48 hours of being found.

- Prohibiting the storage of any materials at the site which are buoyant, hazardous, flammable, explosive, soluble, expansive, radioactive, or which could in the event of a flood be injurious to human, animal or plant life, below the elevation of the 500 year flood. Any other material or equipment stored at the site below this elevation must be firmly anchored, restrained or enclosed to prevent flotation. The quantity of fuel for equipment at the site stored below such elevation shall not exceed the quantity of fuel that is expected to be used by such equipment in one day.

- Immediately informing DEEP at (860) 424-3019 and the Corps at (617) 647-8674 of the occurrence of pollution or other environmental damage in violation of the WQC, and within 48 hours support a written report including information specified in the general conditions.

If the project falls within areas mapped by the Connecticut Natural Diversity Database, or is less than 0.50 miles upstream or downstream of a mapped area, a data request and possible coordination will be required with the Natural Diversity Database.

In some circumstances a wetland or stream crossing may fall within designated stream channel encroachment lines. Approximately 270 linear miles of riverine floodplain in Connecticut have been assigned stream channel encroachment lines to lessen the hazards to life and property due to flooding. Any work riverward of a designated stream channel encroachment line requires a permit from the CT DEEP Inland Water Resources Division. The CT DEEP should be consulted regarding temporary crossings within established stream channel encroachment lines.

If a project is located within tidal, coastal or navigable waters of the state or in tidal wetlands, permitting may be required with the CT DEEP OLISP. For the routine maintenance of previously permitted structures or structures that were in place prior to June 24, 1939, no permitting is required. For significant maintenance of previously permitted structures or structures that were in place prior to June 24, 1939, a Certificate of Permission is required. For new projects a Structures, Dredging and Fill Permit and/or a Tidal Wetlands Permit may be required. The CT DEEP OLISP should be consulted prior to preparing permits to conduct a pre-application meeting and determine the appropriate permitting route.

1.7 U.S. Army Corps of Engineers

Work within wetlands and waters of the United States is subject to jurisdiction under Section 404 of the Clean Water Act, which is administered by the Corps. Work within navigable waters is also administered by the Corps under Section 10 of the Rivers and Harbors Act of 1899. The Corps has issued a General Permit (GP) which establishes categories for projects based on their nature of impacts. The current permit was issued on July 15, 2011, and expires on July 15, 2016. The permit will be reissued by July 15, 2016 for another five years. Applications are not required for Category 1 projects, but submittal of a Category 1 Form before the work occurs and submittal of a Compliance Certification Form within one month after the work is completed is required. The Category 1 Form and Compliance Certification Form entails self-certification by applicants that their project complies with the terms and conditions of Category 1 of the GP. Category 2 projects require the submittal of an application to the Corps, followed by a screening of the application by the Corps, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, National Marine Fisheries Service and CT DEEP, and consultation with the Connecticut Commission on Culture and Tourism and Tribal Historic Preservation Officers. Category 2 projects may not proceed until written approval from the Corps is received. Written approval is generally provided within 45 days of the multi-agency screening. After written approval is received, a Work-Start Notification Form must be submitted before the work occurs, and a Compliance Certification Form must be submitted within one month after the work is completed.

For work proposed within a FEMA floodway or floodplain, the Corps recommends that the applicant apply for and receive a Flood Management Certification (if required), prior to applying to the Corps. Additionally, applications for Category 2 inland projects that propose fill in Corps jurisdiction must include an Invasive Species Control Plan (ISCP), unless otherwise directed by the Corps.

An Individual Permit requires a formal permit application to be submitted to the Corps. The application is reviewed in detail by both state and federal agencies, and a Public Notice is released for public comment. Projects which trigger an Individual Permit generally result in significant impacts to wetlands and/or watercourses.

Stream and wetland crossings are only subject to jurisdiction under the Corps if there is **a discharge of dredge or fill material into wetlands or waters of the United States**. Equipment access through a stream or wetland with no structural BMP is not regulated by the Corps if there is no discharge of dredge or fill material (note that equipment rutting as a result of not using an appropriate BMP can be considered a "discharge of dredge material"). Similarly, the use of a timber or rail car bridge that extends from bank to bank with no stream impacts is not regulated by the Corps. Additionally, the use of timber mats and stone is considered "fill material" by the Corps, and must be calculated to determine overall impacts. Temporary mats are not counted towards the 1 acre threshold under Category 2 if they are adequately cleaned after previous use, removed immediately after completion of construction and disposed of at an upland site.

Maintenance, including emergency reconstruction of currently serviceable structures, is exempt from Corps jurisdiction and does not require formal permitting. Maintenance does not include any modification that changes the character, scope, or size of the original fill design. Emergency reconstruction must occur within a reasonable period of time after damage occurs to qualify for this exemption.

Stream and wetland crossings that involve the discharge of dredge and fill material may be conducted under Category 1 if the work complies with the general conditions and Category 1 criteria of the GP. The following are Category 1 criteria that are commonly applicable to stream and wetland crossings in utility rights of way. See Section 1.8 for additional criteria for culvert crossings:

- The work results in less than 5,000 square feet of impacts to wetlands or waters of the United States. Replacement of utility line projects with impacts solely within wetlands greater than 5,000 square feet may be eligible for Category 1 Authorization after consultation with the Corps about the specific project;
- Temporary fill, with the exceptions of swamp and timber mats, discharged to wetlands shall be placed on geotextile fabric laid on the pre-construction wetland grade. Unconfined temporary fill discharged into flowing water (rivers and streams) shall consist only of clean stone. All temporary fill shall be removed as soon as it is no longer needed, and disposed of at an appropriate upland site.
- Any unconfined in-stream work, including construction, installation or removal of sheet pile cofferdam structures, is conducted during the low-flow period between July 1 and September 30. However, installation of cofferdams, other than sheet pile cofferdams, is not restricted to the low-flow period;
- No work will occur in the main stem or tributary streams of the Connecticut River watershed that are being managed for Atlantic salmon (*Salmo salar*). (Work of this nature requires screening for potential impacts to designated Essential Fish Habitat.);
- The work does not result in direct or secondary impacts to Special Wetlands, Threatened, Endangered or Special Concern Species, or Significant Natural Communities identified by the Connecticut Natural Diversity Database. Work within 750 feet of vernal pools shall be minimized;
- The project does not require a Corps permit with associated construction activities within 100 feet of Special Wetlands;
- The project does not result in fill placed within a FEMA established floodway, unless the applicant has a State of Connecticut Flood Management Certification pursuant to Section 25-68d of the Connecticut General Statutes;
- The project does not result in fill placed within a FEMA established floodplain that would adversely affect the hydraulic characteristics of the floodplain;
- The project does not entail stormwater detention or retention in inland waters or wetlands;
- The project is not located in a segment of a National Wild and Scenic River System (includes rivers officially designated by Congress as active study status rivers for possible inclusion) or within 0.25 miles upstream or downstream of the main stem or tributaries to such a system;
- The project has no potential for an effect on a historic property which is listed or eligible for listing in the National Register of Historic Places;
- The project does not impinge upon the value of any National Wildlife Refuge, National Forest, or any other area administered by the U.S. Fish and Wildlife Service, U.S. Forest Service or National Park Service;

- Section 106 needs to be taken into account for all work that requires federal permitting – including Category 1;

- The project does not use slip lining, plastic pipes, or High Density Polyethylene Pipes (HDPP).

- Appropriate BMPs are employed in regards to heavy equipment in wetlands (General Condition 16) and sedimentation and erosion controls (General Condition 20).

- Disturbed inland wetland areas are restored in accordance with General Condition 18.

Stream and wetland crossings that involve the discharge of dredge and fill material may be conducted under Category 2 if the work complies with the general conditions and Category 2 criteria of the GP. The following are Category 2 criteria that are commonly applicable to stream and wetland crossings in utility right of ways.. See Section 1.8 for additional criteria for culvert crossings:

- The work results in less than one acre of impacts to wetlands or waters of the United States;
- The project does not result in fill placed within a FEMA established floodplain that would adversely affect the hydraulic characteristics of the floodplain;
- The project does not entail stormwater detention or retention in inland waters or wetlands.
- Temporary fill, with the exceptions of swamp and timber mats, discharged to wetlands shall be placed on geotextile fabric laid on the pre-construction wetland grade. Unconfined temporary fill discharged into flowing water (rivers and streams) shall consist only of clean stone. All temporary fill shall be removed as soon as it is no longer needed, and disposed of at an appropriate upland site.

- Appropriate BMPs are employed in regards to heavy equipment in wetlands (General Condition 16) and sedimentation and erosion controls (General Condition 20).

- Disturbed inland wetland areas are restored in accordance with General Condition 18.

Stream and wetland crossings that cannot meet Category 1 or Category 2 criteria may require review under an Individual Permit. The Corps should be consulted before assuming an Individual Permit will be required, as exceptions can be made under certain circumstances.

1.8 Culvert Installation

New culvert installation or existing culvert replacements will require notification or consultation with municipal staffers which might include the Department of Public Works and/or the inland wetlands officer, and may require permitting with the Corps under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act of 1899, and the CT DEEP under Section 401 of the Clean Water Act. Any work within established stream encroachment lines or work which requires a water diversion will require

permitting with the CT DEEP Inland Water Resources Division. Coordination with CT DEEP may also be required for projects located within areas mapped by the Connecticut Natural Diversity Database. For work within tidal, coastal or navigable waters or in tidal wetlands, permitting will be required with the CT DEEP Office of Long Island Sound Program (OLISP).

1.8.1 Municipal Permitting

See Section 1.5 for general local permitting guidance.

- For the installation of new culverts and the replacement of culverts that involve substantial disturbance of soil, water or vegetation which would regularly fall under the review and approval requirements of certain local authorities (ie. Planning and Zoning Authority; Inland Wetlands Commission; Public Works Department; Historic District Commission), the utility shall at least notify and consult with such local authority, or its designated agent or staff, toward the development of mutually agreeable schedules and procedures for the proposed activity.
- For the replacement of culverts involving only minor disturbance of soil, water or vegetation which would regularly fall under the review and approval requirements of certain local authorities, the utility shall make local authorities or their designated agent or staff aware of such ongoing activities.

1.8.2 CT Department of Energy & Environmental Protection

If the project requires formal permitting with the Corps, copies of the application should be forwarded to CT DEEP for review under Section 401 of the Clean Water Act. The CT DEEP requires that a PGP Addendum form be completed and submitted along with the Corps application.

If a culvert project falls within areas mapped by the Connecticut Natural Diversity Database, or falls within 0.50 miles upstream or downstream of a mapped area, a data request and possible coordination will be required with the Natural Diversity Database.

In some circumstances a culvert project may fall within designated stream channel encroachment lines. Approximately 270 linear miles of riverine floodplain in Connecticut have been assigned stream channel encroachment lines to lessen the hazards to life and property due to flooding. Any work riverward of a designated stream channel encroachment line requires a permit from the CT DEEP Inland Water Resources Division. Additionally, work which requires a water diversion may require also require permitting with the CT DEEP Inland Water Resources Division.

If a culvert project is located within tidal, coastal or navigable waters of the state or in tidal wetlands, permitting will be required with the CT DEEP OLISP. For new projects a Structures, Dredging and Fill Permit and/or a Tidal Wetlands Permit will be required. For replacement structures which were previously permitted, or which were in place prior to June 24, 1939, a Certificate of Permission may only be required, which entails a shorter permitting process.

1.8.3 U.S. Army Corps of Engineers

See Section 1.7 for general Corps permitting requirements. Open bottom arches, bridge spans or embedded culverts are preferred over traditional culverts and are required for

Category 1 projects. However, where site constraints make these approaches impractical, the Corps should be consulted.

New bridge or open-bottom structure crossings may be conducted under Category 1 or Category 2 if the following criteria are met in addition to meeting any applicable general criteria listed in section 1.7 of this manual:

- The work spans at least 1.2 times the watercourse bank full width;
- The structure has an openness ratio equal to or greater than 0.25 meters;
- The structure allows for continuous flow of the 50-year frequency storm flows.

New culvert installations may be conducted under Category 1 if the work complies with the general conditions and Category 1 criteria of the GP. The following are Category 1 criteria that are commonly applicable to new culvert installations in utility right of ways:

- Work is conducted in accordance with the design requirements listed in Section 3.1.3 of the Best Management Practices Manual;
- Plastic and High Density Polyethylene Pipes (HDPE) are not used;
- The work results in less than 5,000 square feet of impacts to wetlands or waters of the United States;
- Any unconfined in-stream work, including construction, installation or removal of sheet pile cofferdam structures, is conducted during the low-flow period between July 1 and September 30, except in instances where a specific written exception has been issued by the Connecticut Department of Energy & Environmental Protection. However, installation of cofferdams, other than sheet pile cofferdams, is not restricted to the low-flow period;
- No open trench excavation is conducted within flowing waters. Work within flowing waters can be avoided by using temporary flume pipes, culverts, cofferdams, etc. to isolate work areas and maintain normal flows;
- The tributary watershed to the culvert does not exceed 1.0 square mile (640 acres);
- The culvert gradient (slope) is not steeper than the streambed gradient immediately upstream or downstream of the culvert;
- For a single box or pipe arch culvert crossing, the inverts are set not less than 12 inches below the streambed elevation;
- For a multiple box or pipe arch culvert crossing, the inverts of one of the boxes or pipe arch culverts are set not less than 12 inches below the elevation of the streambed;
- For a pipe culvert crossing, the inverts are set such that not less than 25% of the pipe diameter or 12 inches, whichever is less, is set below the streambed elevation;
- The culvert is backfilled with natural substrate material matching upstream and downstream streambed substrate;
- The structure does not otherwise impede the passage of fish and other aquatic organisms;

- The structure allows for continuous flow of the 50-year frequency storm flows;
- The work does not result in direct or secondary impacts to Special Wetlands, Threatened, Endangered or Special Concern Species, or Significant Natural Communities identified by the Connecticut Natural Diversity Database. Work within 750 feet of vernal pools shall be minimized;
- The project does not require a Corps permit with associated construction activities within 100 feet of Special Wetlands;
- The project does not result in fill placed within a FEMA established floodway, unless the applicant has a State of Connecticut Flood Management Certification pursuant to section 25-68d of the Connecticut General Statutes;
- The project does not result in fill placed within a FEMA established floodplain that would adversely affect the hydraulic characteristics of the floodplain;
- The project does not entail stormwater detention or retention in inland waters or wetlands;
- The project is not located in a segment of a National Wild and Scenic River System (includes rivers officially designated by Congress as active study status rivers for possible inclusion) or within 0.25 miles upstream or downstream of the main stem or tributaries to such a system;
- The project has no potential for an effect on a historic property which is listed or eligible for listing in the National Register of Historic Places;
- The project does not impinge upon the value of any National Wildlife Refuge, National Forest, or any other area administered by the U.S. Fish and Wildlife Service, U.S. Forest Service or National Park Service.
- Appropriate BMPs are employed in regards to sedimentation and erosion controls (General Condition 20).

New culvert installations may be conducted under Category 2 if the work complies with the general conditions and Category 2 criteria of the GP. The following are Category 2 criteria that are commonly applicable to new culvert installations in utility right of ways:

- Work is conducted in accordance with the design requirements listed in Section 3.1.3 of the Best Management Practices Manual;
- The work results in less than one acre of impacts to wetlands or waters of the United States;
- The project does not result in fill placed within a FEMA established floodplain that would adversely affect the hydraulic characteristics of the floodplain;
- There is no practicable alternative location for the crossing that would have less environmental impacts;
- The use of a bridge or open-bottom structure is determined to be not practicable;
- For a single box or pipe arch culvert crossing, the inverts are set not less than 12 inches below the streambed elevation;
- For a multiple box or pipe arch culvert crossing, the inverts of one of the boxes or pipe arch culverts are set not less than 12 inches below the elevation of the streambed;

- For a pipe culvert crossing, the inverts are set such that not less than the pipe diameter or 12 inches, whichever is less, is set below the streambed elevation;
- The culvert is backfilled with natural substrate material matching upstream and downstream streambed substrate;
- The culvert has an openness ratio equal to or greater than 0.25 meters;
- The structure does not result in a change in the normal water surface elevation of the upstream waters or wetlands;
- The structure allows for continuous flow of the 50-year frequency storm flows;
- Appropriate BMPs are employed in regards to sedimentation and erosion controls (General Condition 20).

New culvert installations that cannot meet Category 1 or Category 2 criteria may require review under an Individual Permit. The Corps should be consulted before assuming an Individual Permit will be required, as exceptions can be made under certain circumstances.

In-kind replacement of culverts using the same materials is exempt from Section 404 of the Clean Water Act, and does not require permitting with the Corps. The Corps, however, should be consulted before assuming an activity is exempt from their jurisdiction. Consult with Siting and Permitting.

Bridge or open-bottom structure replacements may be conducted under Category 1 if the conditions for a new bridge or open-bottom structure replacement have been met. In addition, bridge or open-bottom structure replacements should not result in a change in the normal surface elevation of the upstream waters or wetland, and the replacement structure should have a riparian bank on one or both sides for wildlife passage. Culvert replacements may be conducted under Category 1 if the conditions for new culvert installation are met.

Bridge or open-bottom structure replacements may be conducted under Category 2 if the conditions for a new bridge or open-bottom structure replacement have been met. Culvert replacements may be conducted under Category 2 if the following conditions are met:

- The work results in 5,000 square feet to less than one acre of impacts to wetlands or waters of the United States;
- The use of a bridge or open-bottom structure is determined to be not practicable;
- For a single box or pipe arch culvert crossing, the inverts are set not less than 12 inches below the streambed elevation;
- For a multiple box or pipe arch culvert crossing, the inverts of one of the boxes or pipe arch culverts are set not less than 12 inches below the elevation of the streambed;
- For a pipe culvert crossing, the inverts are set such that not less than the pipe diameter or 12 inches, whichever is less, is set below the streambed elevation;
- The culvert is backfilled with natural substrate material matching upstream and downstream streambed substrate;
- The culvert has an openness ratio equal to or greater than 0.25 meters;

- The structure does not result in a change in the normal water surface elevation of the upstream waters or wetlands;
- The structure allows for continuous flow of the 50-year frequency storm flows.
- Appropriate BMPs are employed in regards to sedimentation and erosion controls (General Condition 20).

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APPENDIX C

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Planning Considerations

The measures included in the vegetative soil cover group include **Temporary Seeding, Permanent Seeding, Sodding** and **Landscape Planting.** These measures serve the common function of stabilizing the soil through the establishment of a vegetative cover.

The **Temporary Seeding** measure is applicable to those areas where the phasing and sequencing of a project require an initial disturbance followed by an extended period of inactivity that is greater than 30 days but less than 1 year. It is important to note that temporary seedings will not provide the same level of protection that permanent vegetation will provide. Temporary seeding mixtures do not develop a "turf" or "sod." Temporary seedings do not generally receive the same level of maintenance as permanent seedings. This measure is used with the **Mulch for Seed** measure.

The **Permanent Seeding** measure is applicable to those areas that have been disturbed and will remain so for 1 year or more. It is also applicable to those areas that have been brought to a final grade and ready for final vegetation establishment. This measure is used with the **Mulch for Seed**, **Topsoiling, Temporary Erosion Control Blanket** and **Permanent Turf Reinforcement Mat** measures.

The **Sodding** measure is recommended for lands needing rapid establishment and highly effective grass cover. It provides almost instantaneous soil protection with high aesthetic value and is very useful in critical watersheds, particularly at times outside of the recommended seeding dates. This measure may be used following the **Topsoiling** and **Permanent Turf Reinforcement Mat** measures.

The **Landscape Planting** measure is most commonly used where aesthetics, wildlife habitat and noise control are needed. It is frequently used in conjunction with the **Landscape Mulch** measure.

The early establishment of either temporary or permanent vegetative cover can reduce and even prevent costly maintenance operations for other erosion control systems. For example, the frequency of cleaning out sediment basins will be reduced if the drainage area of the basin is seeded where grading and construction are not taking place. The establishment of grass cover is essential to preserve the integrity of earthen structures used to control sediment, such as dikes, diversions, and the banks and dams of sediment basins.

3-Vegetative Soil Cover

Temporary Seeding (TS)

Definition
Establishment of temporary stand of grass and/or legumes by seeding and mulching soils that will be exposed for a period greater than 1 month but less than 12 months.

Purpose
To temporarily stabilize the soil and reduce damage from wind and/or water erosion and sedimentation until permanent stabilization is accomplished.

Applicability
- Within the first 7 days of suspending work on a grading operation that exposes erodible soils where such suspension is expected to last for 1 to 12 months. Such areas include soil stockpiles, borrow pits, road banks and other disturbed or unstable areas.
- Not for use on areas that are to be left dormant for more than 1 year. Use permanent vegetative measures in those situations.

Specifications

Seed Selection
Select grass species appropriate for the season and site conditions from **Figure TS-2**.

Timing Considerations
Seed with a temporary seed mixture within 7 days after the suspension of grading work in disturbed areas where the suspension of work is expected to be more than 30 days but less than 1 year. Seeding outside the optimum seeding dates given in **Figure TS-2** may result in either inadequate germination or low plant survival rates, reducing erosion control effectiveness.

Site Preparation
Install needed erosion control measures such as diversions, grade stabilization structures, sediment basins and grassed waterways in accordance with the approved plan.

Grade according to plans and allow for the use of appropriate equipment for seedbed preparation, seeding, mulch application, and mulch anchoring. All grading should be done in accordance with the **Land Grading** measure.

Seedbed Preparation
Loosen the soil to a depth of 3-4 inches with a slightly roughened surface. If the area has been recently loosened or disturbed, no further roughening is required. Soil preparation can be accomplished by tracking with a bulldozer, discing, harrowing, raking or dragging with a section of chain link fence. Avoid excessive compaction of the surface by equipment traveling back and forth over the surface. If the slope is tracked, the cleat marks shall be perpendicular to the anticipated direction of the flow of surface water (see **Surface Roughening** measure).

Apply ground limestone and fertilizer according to soil test recommendations (such as those offered by the University of Connecticut Soil Testing Laboratory or other reliable source). Soil sample mailers are available from the local Cooperative Extension System office. Appendix E contains a listing of the Cooperative Extension System offices.

If soil testing is not feasible on small or variable sites, or where timing is critical, fertilizer may be applied at the rate of 300 pounds per acre or 7.5 pounds per 1,000 square feet of 10-10-10 or equivalent. Additionally, lime may be applied using rates given in **Figure TS-1**.

Figure TS-1 Soil Texture vs. Liming Rates

Soil Texture	Tons / Acre of Lime	Lbs / 1000 ft² of Lime
Clay, clay loam and high organic soil	3	135
Sandy loam, loam, silt loam	2	90
Loamy sand, sand	1	45

Seeding
Apply seed uniformly by hand, cyclone seeder, drill, cultipacker type seeder or hydroseeder at a minimum rate for the selected seed identified in **Figure TS-2**. Increase

seeding rates by 10% when hydroseeding.

Mulching

Temporary seedings made during optimum seeding dates shall be mulched according to the **Mulch for Seed** measure. Note when seeding outside of the optimum seeding dates, increase the application of mulch to provide 95%-100% coverage.

Maintenance

Inspect seeded area at least once a week and within 24 hours of the end of a storm with a rainfall amount of 0.5 inch or greater for seed and mulch movement and rill erosion.

Where seed has moved or where soil erosion has occurred, determine the cause of the failure. Bird feeding may be a problem if mulch was applied too thinly to protect seed. Re-seed and re- mulch. If movement was the result of wind, then repair erosion damage (if any), reapply seed and mulch and apply mulch anchoring. If failure was caused by concentrated runoff, install additional measures to control water and sediment movement, repair erosion damage, re-seed and re-apply mulch with anchoring or use **Temporary Erosion Control Blanket** measure.

Continue inspections until the grasses are firmly established. Grasses shall not be considered established until a ground cover is achieved which is mature enough to control soil erosion and to survive severe weather conditions (approximately 80% vegetative surface cover).

Figure TS-2 Temporary Seeding Rates and Dates

Species[4]	Seeding Rates (pounds) /Acre	Seeding Rates (pounds) /1000 sq. ft.	Optimum Seed Depth[2] (inches)	Optimum Seeding Dates[1] 3/1 4/1 5/1 6/1 7/1 8/1 9/1 10/1 (3/15 4/15 5/15 6/15 7/15 8/15 9/15 10/15)	Plant Characteristics
Annual ryegrass Lolium multiflorum	40	1.0	0.5		May be added in mixes. Will mow out of most stands
Perennial ryegrass Lolium perenne	40	1.0	0.5		Use for winter cover. Tolerates cold and low moisture.
Winter Rye Secale cereale	120	3.0	1.0		Quick germination and heavy spring growth. Dies back in June with little regrowth.
Oats Avena sativa	86	2.0	1.0		In northern CT. will winter kill with the first killing frost and may through-out the state in severe winters.
Winter Wheat Triticum aestivum	120	3.0	1.0		Quick germination with moderate growth. Dies back in June with no regrowth.
Millet Echinochloa crusgalli	20	0.5	1.0		Warm season small grain. Dies with frost in September.
Sudangrass Sorghum sudanense	30	0.7	1.0		Tolerates warm temperatures and droughty conditions.
Buckwheat Fagopyrum esculentum	15	0.4	1.0		Hardy plant that will reseed itself and is good as a green manure crop.
Weeping lovegrass Eragostis curbula	5	0.2	0.25		Warm-season perennial. May bunch. Tolerates hot, dry slopes, acid infertile soils. Excellent nurse crop. Usually winter kills.
DOT All Purpose Mix[3]	150	3.4	0.5		Suitable for all conditions.

[1] May be planted throughout summer if soil moisture is adequate or can be irrigated. Fall seeding may be extended 15 days in the coastal towns.

[2] Seed at twice the indicated depth for sandy soils.

[3] See Permanent Seeding **Figure PS-3** for seeding mixture requirements.

[4] Listed species may be used in combinations to obtain a broader time spectrum. If used in combinations, reduce each species planting rate by 20% of that listed.

Source: USDA–NRCS

Permanent Seeding (PS)

Definition
Establishment of permanent stand of grass and/or legumes by seeding and mulching exposed soils with a seed mixture appropriate for long term stabilization.

Purpose
To permanently stabilize the soil with a vegetative cover that will prevent damage from wind and/or water erosion and sedimentation.

Applicability
- On disturbed or erodible soils have been brought to final grade or where the suspension of work is expected to exceed 1 year, and
- Where slopes gradients are no steeper than 2:1. For slopes steeper than 2:1, use slope stabilization measures from the Stabilization Structures Functional Group.

Planning Considerations
There are several factors that should be considered when evaluating a site for the establishment of permanent vegetation.

Time Of Year
Seeding dates in Connecticut are normally April 1 through June 15 and August 15 through October 1. Spring seedings give the best results and spring seedings of all mixes with legumes is recommended. There are two exceptions to the above dates. The first exception is when seedings will be made in the areas of Connecticut known as the Coastal Slope and the Connecticut River Valley. The Coastal Slope includes the coastal towns of New London, Middlesex, New Haven, and Fairfield counties. In these areas, with the exception of crown vetch[1], the final fall seeding dates can be extended an additional 15 days. The second exception is frost crack or dormant seeding. In this type of seeding, the seed is applied during the time of year when no germination can be expected, normally November through February. Germination will take place when weather conditions improve. In this type of seeding, mulching is extremely important to protect the seed from wind and surface erosion and to provide erosion protection until the seeding becomes established.

Topsoiling Needs
The need to topsoil is determined by a combination of existing soil fertility and intended use. The poorer the site is in terms of natural fertility and soil texture, the greater the need for topsoil. This is especially true on sites where a high quality vegetative cover is needed either for erosion control or aesthetics.

Soil Texture
Soil texture (ratio of gravel, sand, silt, clay and organic matter) can affect the choice of a seed mixture for vegetating disturbed areas. For example, sites which have soils with a large percentage of sands and gravels will tend to be droughty and therefore require a drought tolerant mixture. Conversely, sites that exhibit somewhat poorly or poorly drained characteristics will require a mixture that will tolerate wet conditions. Soil texture of the site may warrant consideration for the use of topsoil (see **Topsoiling** measure) or sodding (see **Sodding** measure).

Intended Use
Referring to **Figure PS-2**, consider the ultimate use and maintenance requirements of the area when choosing a seed mixture to be used. There are two levels of maintenance: areas that will be mowed and areas that will not.

Areas that will be mowed can have different levels of maintenance and mowing. Golf courses and recreation areas will require more intensive management than roadside banks and medians.

Areas such as spoil banks, gravel pits and steep roadbanks once seeded and established will require no further mowing and little, if any, maintenance.

Topography or Finished Grade
Do not use permanent seeding on slopes steeper than 2:1. Under saturated conditions slopes could develop deep or shallow surface failures. In cases such as this, maintenance can be a constant problem and there can be danger to structures. A thorough site investigation is needed to determine if alternatives such as benching or

[1] When crown vetch is seeded in late summer, at least 35% of the seed should be hard seed (unscarified).

other structural methods are needed to ensure soil stability before seeding is done.

Cool Season versus Warm Season Grasses

Cool season grasses are those species that normally begin growth very early in the spring (late March to early April) and will continue to grow until warm weather sets in mid-June. At the onset of hot weather, cool season grasses will enter a stage of dormancy and exhibit little growth. They will maintain that dormant state until the cooler weather of the fall (end of August) and will then begin to grow again until late fall (end of October). Warm season grasses on the other hand, do not begin vigorous growth until warm weather (late May) and will continue growth until cool weather in the late fall (mid-September). Cool season grasses generally are the sod formers, such as bluegrass, while the warm season grasses, such as the perennial ryes, do not form sod.

Presence of Mulch

Sometimes seeding will occur after a previous application of mulch. If wood chips, bark or similar materials were used on the seeding area, plan on either removing the mulch or incorporating it into the soil and applying more nitrogen (see **Seed Bed Preparation**). Previously applied hay and straw mulch can be incorporated into the soil without adding supplemental nitrogen.

Specifications

Seed Selection and Quantity

Select a seed mixture appropriate to the intended use and soil conditions from **Figure PS-2** and **Figure PS-3** or use mixture recommended by the NRCS. For seed mixtures containing legumes, select the type and amount of inoculant that is specific for the legume to be used.

When buying seed make sure the quality of the seed is given for pure live seed and germination rate. Ask the supplier for an affidavit of purity and germination rate if there is any question. Expect a purity between of 95% and 98% and a germination rate between 70% and 90%. Some seeding mixtures call for pure live seed. An example of calculating pure live seed is given in **Figure PS-3**.

Increase seeding rates 10% when using frost crack seeding[2] or hydroseeding.

Timing

Seed with a permanent seed mixture within 7 days after establishing final grades or when grading work within a disturbed area is to be suspended for a period of more than 1 year. Seeding is recommended from April 1 through June 15 and August 15 through October 1, with the following exceptions:

- *for the coastal towns and in the Connecticut River Valley final fall seeding dates can be extended an additional 15 days, and*
- *dormant or frost crack seeding is done after the ground is frozen.*

Site Preparation

Grade in accordance with the **Land Grading** measure.

Install all necessary surface water controls.

For areas to be mowed remove all surface stones 2 inches or larger. Remove all other debris such as wire, cable, tree roots, pieces of concrete, clods, lumps or other unsuitable material.

Note: *On areas where wood chips and/or bark mulch was previously applied, either remove the mulch or incorporate it into the soil with a nitrogen fertilizer added. Nitrogen application rate is determined by soil test at time of seeding; anticipate 12 lbs nitrogen per ton of wood chips and/or bark mulch.*

Seedbed Preparation

Apply topsoil, if necessary, in accordance with the **Topsoiling** measure.

Apply fertilizer and ground limestone according to soil tests conducted by the University of Connecticut Soil Testing Laboratory or other reliable source. A pH range of 6.2 to 7.0 is optimal for plant growth of most grass species.

Where soil testing is not feasible on small or variable sites, or where timing is critical, fertilizer may be applied at the rate of 300 pounds per acre or 7.5 pounds per 1,000 square feet using 10-10-10 or equivalent and limestone at 4 tons per acre or 200 pounds per 1,000 square feet. Additionally, lime may be applied using rates given in **Figure PS-1**. A pH of 6.2 to 7.0 is optimal.

For areas that were previously mulched with wood chips or bark and the wood chips or bark are to be incorporated into the soil, apply additional nitrogen at a rate that is determined by soil tests at time of seeding.

Figure PS-1 Soil Texture vs. Liming Rates

Soil Texture	Tons / Acre of Lime	Lbs / 1000 ft² of Lime
Clay, clay loam and high organic soil	3	135
Sandy loam, loam, silt loam	2	90
Loamy sand, sand	1	45

[2] Frost crack or dormant seeding is a method used to establish a seeding during the off season and should be used only in extreme cases as there is a smaller chance of success. It can be an effective way to plant grass seed during late winter or early spring. This method is most effective on frozen ground where a seedbed has been prepared, or on areas that have been disturbed and where topsoil exists but vegetation has not been established. Frost crack or dormant seeding can also be used to re-seed or over-seed an area previously seeded, but where the survival was poor. The existing plants will remain undamaged, while the frost works the seed into the soil in bare areas. In all cases, seedings of this type need to be mulched to protect the seed from wind and water until satisfactory growing conditions occur (See Mulch for Seed measure). This method works particularly well with legumes, such as crown vetch and flat pea, which have a hard seed coat and the freezing action breaks down the seed coat to allow for germination.

Work lime and fertilizer into the soil to a depth of 3 to 4 inches with a disc or other suitable equipment.

Continue tillage until a reasonably uniform, fine seedbed is prepared. For areas to be mowed the final soil loosening and surface roughening operation is by hand, harrow or disk. If done by harrow or disc, it is generally done on the contour. Areas not to be mowed can be tracked with cleated earthmoving equipment perpendicular to the slope (see **Surface Roughening** measure). However, for areas where **Temporary Erosion Control Blankets** are to be used instead of **Mulch for Seed** prepare the seed bed in accordance with blanket manufacturer's recommendations.

Inspect seedbed just before seeding. If the soil is compacted, crusted or hardened, scarify the area prior to seeding.

Seed Application

Apply selected seed at rates provided in **Figure PS-3** uniformly by hand, cyclone seeder, drill, cultipacker type seeder or hydroseeder (slurry including seed, fertilizer.). Normal seeding depth is from 0.25 to 0.5 inch. Increase seeding rates by 10% when hydroseeding or frost crack seeding.

Seed warm season grasses during the spring period only.

Apply mulch according to the **Mulch for Seed** measure.

Irrigation for Summer Seeding

When seeding outside of the recommended seeding dates in the summer months, watering may be essential to the establish a new seeding. Irrigation is a specialized practice and care needs to be taken not to exceed the infiltration rate of the soil. Each application must be uniformly applied with 1 to 2 inches of water applied per application, soaking the ground to a depth of 4 inches.

Maintenance

Initial Establishment

Inspect seeded area at least once a week and within 24 hours of the end of a storm with a rainfall amount of 0.5 inch or greater during the first growing season.

Where seed has been moved or where soil erosion has occurred determine the cause of the failure. Bird damage may be a problem if mulch was applied too thinly to protect seed. Re-seed and re-mulch. If movement was the result of wind, repair erosion damage (if any), re-apply seed and mulch, and apply mulch anchoring. If failure was caused by concentrated water, (1) install additional measures to control water and sediment movement, (2) repair erosion damage, (3) re-seed and (4) re-apply mulch with anchoring or use **Temporary Erosion Control Blanket** measure and/or **Permanent Turf Reinforcement Mat** measure).

If there is no erosion, but seed survival is less than 100 plants per square foot after 4 weeks of growth, re-seed as planting season allows.

Continue inspections until at least 100 plants per square foot have grown at least 6 inches tall or until the first mowing.

First Mowing

Allow the majority of plants to achieve a height of least 6 inches before mowing it the first time. Do not mow while the surface is wet. Mowing while the surface is still wet may pull many seedlings from the soil and often leaves a series of unnecessary ruts. The first mowing should remove approximately one third of the growth, depending upon the type of grass and where it is being used. Do not mow grass below 3 inches.

If the seeding was mulched, do not attempt to rake out the mulching material. Normal mowing will gradually remove all unwanted debris.

Long Term Maintenance

Mow and fertilize at a rate that sustains the area in a condition that supports the intended use. If appropriate the height of cut may be adjusted downward, by degrees, as new plants become established. Carry out any fertilization program in accordance with approved soil tests that determine the proper amount of lime and fertilizer needed to maintain a vigorous sod yet prevent excessive leaching of nutrients to the groundwater or runoff to surface waters.

Although weeds may appear to be a problem, they shade the new seedlings and help conserve surface moisture. Do not apply weed control until the new seeding has been mowed at least four times.

Figure PS-2 Selecting Seed Mix to Match Need

Area To Be Seeded	Mixture Number[1]	
	Mowing Desired	Mowing Not Required
BORROW AREAS, ROADSIDES, DIKES, LEVEES, POND BANKS AND OTHER SLOPES AND BANKS		
A) Well or excessively drained soil[2]	1,2,3,4,5 or 8	5, 6, 7, 8, 9, 10, 11, 12, 16, ***22***
B) Somewhat poorly drained soils[2]	2	5, 6
C) Variable drainage soils[2]	2	5, 6, 11
DRAINAGE DITCH AND CHANNEL BANKS		
A) Well or excessively drained soils[2]	1, 2, 3, or 4	9, 10, 11, 12
B) Somewhat poorly drained soils[2]	2	
C) Variable drainage soils[2]	2	
DIVERSIONS		
A) Well or excessively drained soils[2]	2, 3 or 4	9, 10, 11
B) Somewhat poorly drained soils[2]	2	
C) Variable drainage soils[2]	2	
EFFLUENT DISPOSAL		5 or 6
GRAVEL PITS[3]		26, 27, 28
GULLIED AND ERODED AREAS		3, 4, 5, 8, 10, 11, 12
MINESPOIL & WASTE, AND OTHER SPOIL BANKS (If toxic substances & physical properties not limiting)[3]		15, 16, 17, 18, 26, 27, 28
SHORELINES (Fluctuating water levels)		5 or 6
SKI SLOPES		4, 10
SOD WATERWAYS AND SPILLWAYS	1, 2, 3, 4, 6, 7, or 8	1, 2, 3, 4, 6, 7, or 8
SUNNY RECREATION AREAS (Picnic areas and playgrounds or driving and archery ranges, nature trails)	1, 2 or ***23***	
CAMPING AND PARKING, NATURE TRAILS (Shaded)	19, ***21*** or ***23***	
SAND DUNES (Blowing sand)	25	
WOODLAND ACCESS ROADS, SKID TRAILS AND LOG YARDING AREAS		9, 10, 16, ***22***, 26
LAWNS AND HIGH MAINTENANCE AREAS	1, 19, ***21*** or ***29***	

[1] The numbers following in these columns refer to seed mixtures in **Figure PS-3**. Mixes for shady areas are in ***bold-italics*** print (including mixes 20 through 24).

[2] See county soil survey for drainage class. Soil surveys are available from the County Soil and Water Conservation District Office.

[3] Use mix 26 when soil passing a 200 mesh sieve is less than 15% of total weight. Use mix 26 & 27 when soil passing a 200 mesh sieve is between 15 and 20% of total weight. Use mix 26, 27 & 28 when soil passing a 200 mesh sieve is above 20% of total weight.

Source: USDA-NRCS

Figure PS-3 Seed Mixtures for Permanent Seeding

No.	Seed Mixture (Variety) [4]	Lbs/Acre	Lbs/1,000 Sq. Ft.
1[5]	Kentucky Bluegrass Creeping Red Fescue (Pennlawn, Wintergreen) Perennial Ryegrass (Norlea, Manhatten)	20 20 5 Total 45	.45 .45 .10 1.00
2[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Redtop (Streeker, Common) Tall Fescue (Kentucky 31) or Smooth Bromegrass (Saratoga, Lincoln)	20 2 20 Total 42	.45 .05 .45 .95
3[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Bird's-foot Trefoil (Empire, Viking) with inoculant[1] Tall Fescue (Kentucky 31) or Smooth Bromegrass (Saratoga, Lincoln)	20 8 20 Total 48	.45 .20 .45 1.10
4[5]	Creeping Red Fescue (Pennlawn, Wintergreen) or Tall Fescue (Kentucky 31) Redtop (Streeker, Common) Bird's-foot Trefoil (Empire, Viking) with inoculant[1]	20 2 8 Total 30	.45 .05 .20 .70
5[5]	White Clover Perennial Rye Grass	10 2 Total 12	.25 .05 .30
6[5]	Creeping Red Fescue Redtop (Streeker, Common) Perennial Rye Grass	20 2 20 Total 42	.50 .05 .50 1.05
7[5]	Smooth Bromegrass (Saratoga, Lincoln) Perennial Ryegrass (Norlea, Manhatten) Bird's-foot Trefoil (Empire, Viking) with inoculant[1]	15 5 10 Total 30	.35 .10 .25 .79
8[6]	Switchgrass (Blackwell, Shelter, Cave-in-rock) Weeping lovegrass Little Bluestem (Blaze, Aldous, Camper)	10[1] 3 10[1] Total 23	.25 .07 .25 .57
9[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Crown Vetch (Chemung, Penngift) with inoculant[1] (or Flatpea (Lathco) with inoculant[1]) Tall Fescue (Kentucky 31) or Smooth Bromegrass (Saratoga, Lincoln) Redtop (Streeker, Common)	10 15 (30) 15 2 Total 42 (or 57)	.25 .35 (.75) .35 .05 1.00 (or 1.40)
10[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Redtop (Streeker, Common) Crown Vetch (Chemung, Penngift) with inoculant[1] (or Flatpea (Lathco) with inoculant[1])	20 2 15 (30) Total 37 (or 52)	.45 .05 .35 (.75) .85 (or 1.25)
11[5]	Bird's-foot Trefoil (Empire, Viking) with inoculant[1] Crown Vetch (Chemung, Penngift) with inoculant[1] Creeping Red Fescue (Pennlawn, Wintergreen) or Tall Fescue (Kentucky 31) or Smooth Bromegrass (Saratoga, Lincoln)	8 15 20 Total 43	.20 .35 .45 1.00

continued

Figure PS-3 Seed Mixtures for Permanent Seeding (con't)

No.	Seed Mixture (Variety) [4]	Lbs/1,000 Lbs/Acre	No. Sq. Ft.
12[6]	Switchgrass (Blackwell, Shelter, Cave-in-rock)	101	.25
	Perennial Ryegrass (Norlea, Manhatten)	5	.10
	Crown Vetch (Chemung, Penngift) with inoculant[1]	15	.35
		Total 45	1.05
13[6]	Crown Vetch (Chemung, Penngift) with inoculant[1]	10	.25
	(or (Flatpea (Lathco) with inoculant[1])	(30)	(.75)
	Switchgrass (Blackwell, Shelter, Cave-in-rock)	5[1]	.10
	Perennial Ryegrass (Norlea, Manhatten)	5	.10
		Total 20 (or 40)	.45 (or .95)
14[5]	Crown Vetch (Chemung, Penngift) with inoculant[1]	15	.35
	(or (Flatpea (Lathco) with inoculant[1])	(30)	(.75)
	Perennial Ryegrass (Norlea, Manhatten)	10	.25
		Total 25 (or 40)	.60 (or 1.00)
15[6]	Switchgrass (Blackwell, Shelter, Cave-in-rock)	5[1]	.10
	Big Bluestem (Niagra, Kaw) or Little Bluestem (Blaze, Aldous, Camper)	5[1]	.10
	Perennial Ryegrass (Norlea, Manhatten)	5	.10
	Bird's-foot Trefoil (Empire, Viking) with inoculant[1]	5	.10
		Total 20	.40
16[5]	Tall Fescue (Kentucky 31)	20	.45
	Flatpea (Lathco) with inoculant[1]	30	.75
		Total 50	1.20
17[6]	Deer Tongue (Tioga) with inoculant[1]	10[1]	.25
	Bird's-foot Trefoil (Empire, Viking) with inoculant[1]	8	.20
	Perennial Ryegrass (Norlea, Manhatten)	3	.07
		Total 21	.52
18[6]	Deer Tongue (Tioga) with inoculant[1]	10[1]	.25
	Crown Vetch (Chemung, Penngift) with inoculant[1]	15	.35
	Perennial Ryegrass (Norlea, Manhatten)	3	.07
		Total 28	.67
19[3]	Chewings Fescue	35	.80
	Hard Fescue	30	.70
	Colonial Bentgrass	5	.10
	Bird's-foot Trefoil (Empire, Viking) with inoculant[1]	10	.20
	Perennial Ryegrass	20	.50
		Total 100	2.30
20[5]	Deleted due to invasive species		
21[5]	Creeping Red Fescue (Pennlawn, Wintergreen)	Total 60	1.35
22[5]	Creeping Red Fescue (Pennlawn, Wintergreen)	40	.90
	Tall Fescue (Kentucky 31)	20	.45
		Total 60	1.35
23[5]	Creeping Red Fescue (Pennlawn, Wintergreen)	15	.35
	Flatpea (Lathco) with inoculant[1]	30	.75
		Total 45	3.60
24[5]	Tall Fescue (Kentucky 31)	Total 150	3.60

Figure PS-3 Seed Mixtures for Permanent Seeding (con't)

No.	Seed Mixture (Variety)[4]	Lbs/Acre	Lbs/1,000 Sq. Ft.
25[5]	American Beachgrass (Cape)	58,500 culms/acre	1,345 culms/ 100 sq. ft.
26[6]	Switchgrass (Blackwell, Shelter, Cave-in-rock) Big Bluestem (Niagra, Kaw) Little Bluestem (Blaze, Aldous, Camper) Sand Lovegrass (NE-27, Bend) Bird's-foot Trefoil (Empire Viking)	4.0 4.0 2.0 1.5 2.0 Total 13.5	.10 .10 .05 .03 .05 .33
27[5]	Flatpea (Lathco) Perennial Pea (Lancer) Crown Vetch (Chemung, Penngift) Tall Fescue (Kentucky 31)	10 2 10 2 Total 24	.20 .05 .20 .20 .65
28[5]	Orchardgrass (Pennlate, Kay, Potomac) Tall Fescue (Kentucky 31) Redtop (Streeker, Common) Birds-foot Trefoil (Empire Viking)	5 10 2 5 Total 22	.10 .20 .05 .10 .45
29	Turf Type Tall Fescue (Bonanza, Mustang, Rebel II, Spartan, Jaguar) or Perennial Rye ("Future 2000" mix; Fiesta II, Blazer II, and Dasher II)	175 to 250	6 to 8

[1] Use proper inoculant for legume seeds, use four times recommended rate when hydroseeding.

[2] Use Pure Live Seed (PLS) = $\frac{\%\ \text{Germination X}\ \%\ \text{Purity}}{100}$

EXAMPLE: Common Bermuda seed with 70% germination and 80% purity=

$\frac{70 \times 80}{100}$ or $\frac{56}{100}$ or 56%

$\frac{10\ \text{lbs PLS/acre}}{56\%}$ = 17.9 lbs/acre of bagged seed

[3] DOT All purpose mix

[4] Wild flower mix containing New England Aster, Baby's Breath, Black Eye Susan, Catchfly, Dwarf Columbine, Purple Coneflower, Lance-leaved Coreopsis, Cornflower, Ox-eye Daisy, Scarlet Flax, Foxglove, Gayfeather, Rocky Larkspur, Spanish Larkspur, Corn Poppy, Spurred Snapdragon, Wallflower and/or Yarrow may be added to any seed mix given. Most seed suppliers carry a wild flower mixture that is suitable for the Northeast and contains a variety of both annual and perennial flowers. Seeding rates for the specific mixtures should be followed.

[5] Considered to be a cool season mix.

[6] Considered to be a warm season mix.

Sodding (SO)

Definition

Stabilizing fine-graded disturbed areas with the use of cut pieces of turf.

Purpose

- To permanently stabilize the soil.
- To immediately reduce erosion and the production of dust.
- To filter runoff water, reduce pollution.
- To improve site aesthetics.

Applicability

- On slopes 2:1 or flatter, except on very short slopes where the slope length is no longer than the width of the cut sod.
- In channels where the design velocity does not exceed 5 feet per second (fps) with a duration of 1 hour or less when the velocity is at or near 5 fps. For design velocities that exceed 5 fps, refer to the **Riprap** and **Permanent Turf Reinforcement Mat** measures.
- On sediment producing areas such as drainageways carrying intermittent flows, around drop inlets, in grassed drainageways, cut and fill slopes and other areas where conventional methods of turf establishment may be difficult or risky.
- In watersheds where maintenance of high water quality is particularly important.
- Where establishing turf grass and lawn is needed in the shortest time possible.

Planning Considerations

While the initial cost of sod is much higher than seed and mulch/erosion control blankets, sodding has some distinct advantages. Properly installed, sodding provides the following benefits which may justify the initial added expense:

- *Provides initial higher level of erosion control than seeding and mulching, capable of withstanding heavier rainfalls and velocities without failure and subsequent need for repair;*
- *Is an immediate soil cover and erosion protection where concentrated surface runoff would prevent the establishment of sod by normal seeding procedures;*
- *Establishes of a grass cover outside of the non-seeding dates.*
- *Offers immediate filtration of storm water runoff;*
- *Allows use of site in a much shorter length of time;*
- *Provides a quality controlled product, free from weeds, with predictable results; and*
- *Is aesthetically impressive.*

These reasons are particularly true where quick establishment and protection is important, such as sites in public water supply watersheds or near watercourses, where maintenance of high water quality may be particularly important to fisheries or human consumption.

Additionally, in drainageways and intermittent waterways where concentrated flow will occur, properly installed sod is preferable to seed because there is no time lapse between installation and the time when the channel is protected. Sodding can reduce maintenance to other sediment controls by keeping them free from the silts, sediments and other debris that can result from conventional methods of turf establishment. However, sod is limited in its ability to withstand high velocity and/or long duration flows.

Note: *The application of sod within a drainage way should be based on a determination that vegetation will satisfactorily resist channel velocities. Channel velocities for the design storm should not exceed 5 fps with a duration of less than 1 hour at or near 5 fps.*

As with any other seeding or planting of vegetation, a decision on top soiling must be made. Generally speaking, the poorer the site in terms of natural fertility and soil texture, and where a high quality vegetative cover is needed either for erosion control or aesthetics, the

greater the need for topsoil.

Specifications

Materials

Sod consists of:

- *stoloniferous or rhizomatous grasses that form a dense mat of plants, being cut at a uniform soil thickness of 0.75 inch ±0.25 inch) at the time of cutting, excluding the shoot growth and thatch, and*

- *standard size sections of sod strong enough to support their own weight and retain their size and shape when suspended from a firm grasp on one end of the section.*

For sodded waterways, the sod type shall consist of plant materials able to withstand the design velocity (see **Vegetated Waterway** measure).

Timing Limitations

Sod may be placed anytime during the year for slope stabilization but shall not be installed on frozen ground, nor for waterway applications during the months of December, January or February.

Sod shall be harvested, delivered, and installed within 36 hours. Plan site preparation (see below) and delivery of sod accordingly. Have sod delivered to the site as soon as practical after harvesting. During hot weather, delivery should be made within 6 hours and may be extended to 48 hours during cool seasons. It is generally unwise to move sod during July and August. If moved during this period, sod may need to be cut thicker and will require frequent irrigation.

Selection of Sod

Select sod grown from seed of adapted varieties or types and under cultural practices conducive to quality sod that will be free of any serious thatch, weed, insect, disease, and other pest problems.

Select species and varieties best suited for the sites to be stabilized. Use mixtures tested and approved by state experiment stations.

Select sod at least 15 months old but no older than three years. Cultivated turf grass is usually considered ready for harvest when a cut portion of sod 3 feet long by 1 to 1.5 feet wide will support its own weight when suspended vertically from the upper 10% of the section. The most common age of sod when cut is 15 to 24 months.

Select sod cuts of width and length suited to the equipment and job. Generally, sod cuts are from 12 to 24 inches wide with 18 inches being the most common width in New England. Lengths of cuts vary from 4 to 8 feet. Sod may also be available in rolls 16-48" wide with lengths as much as 100 feet in length. In New England, this "big roll" system commonly cuts sod in 200 sq. ft. or 250 sq. ft. rolls made up of 3 units, each 16 inches wide (4 ft. total) and 50 ft. or 62.3 ft long. Mechanical equipment is required for installation. Sod may be cut and rolled or folded in the middle and stacked on pallets.

Folded sod is cut shorter than rolled sod, about 3 to 4 feet in length. About 80% of all rhizomes are in the top fl inch of soil. The thinner the sod is cut the more quickly it will knit to the soil. However, the thinner the sod, the greater the need for irrigation as the thin sod will be more susceptible to drying out.

Site Preparation

Prior to soil preparation, bring to grade areas to be sodded in accordance with the approved plan.

Install and/or repair other sediment control measures needed to control water movement into the area to be sodded.

Clean soil surface of trash, debris, large roots, branches, stones and clods in excess of 1 inch in length or diameter. Do not apply sod to gravel or non-soil surfaces.

Place topsoil as needed, meeting the requirements of Topsoiling measure.

Perform soil tests to determine the exact requirements for lime and fertilizer. The soil tests may be conducted by the agronomy laboratory at the University of Connecticut Soil Testing Laboratory or a reputable commercial laboratory. Information on soil tests and procedures are available from county Cooperative Extension System, commercial nurserymen, lawn care professionals or other reliable source.

When required, spread these amendments evenly over the area to be sodded, and incorporate into the top 3 to 6 inches of the soil (if possible) by discing, harrowing or other acceptable means.

Fill or level any irregularities in the soil surface resulting from top soiling or other operations in order to prevent the formation of depressions or water pockets.

Note: *If the soil is hot or dry, lightly irrigate the soil immediately prior to laying the sod to cool the soil and reduce root burning and die back.*

Sod Installation (see **Figure SO-1**)

Install the first row of sod in a straight line with subsequent rows placed parallel to and butting tightly against each other. Stagger lateral joints to promote more uniform growth and strength. Take care to ensure that sod is not stretched or overlapped and that all joints are butted tight in order to prevent voids which would cause drying of the roots.

On slopes 3:1 or steeper or wherever erosion may be a problem, lay sod with staggered joints perpendicular to the direction of flow (i.e. on the contour) and secure by pegging or other approved methods. If the site of sodding is to be mowed, the use of wood pegs or biodegradable staples is recommend over metal staples for anchoring to reduce problems caused by mowing equipment hitting metal staples should they get lifted over time from the sod surface. Also, for these areas, sod cut into long strips and rolled for transport is desired because it minimizes the number of sections.

As sodding is completed, roll and tamp the sod to ensure contact with the soil.

After rolling, irrigate the sod to a depth sufficient to

thoroughly wet the underside of the sod pad and the 4 inches of soil below the sod.

Sodded Waterway Installations

Follow site preparation requirements listed above.

Use a sod capable of withstanding the design velocity. Lay sod strips perpendicular to the direction of channel flow, taking care to butt the ends of strips tightly.

As sodding of clearly defined areas is completed; roll or tamp the sod to ensure contact with the soil.

Peg or staple to resist washout during the establishment period. Fasten every 3 inches on the leading edge and 1 to 2 ft. laterally. If the site of sodding is to be mowed, the use of wood pegs or biodegradable staples is recommended over metal staples for anchoring to reduce problems caused by mowing equipment hitting metal staples should they get lifted over time from the sod surface.

After rolling, sod shall be irrigated to a depth sufficient to thoroughly wet the underside of the sod pad and the 4 inches below the sod.

Maintenance

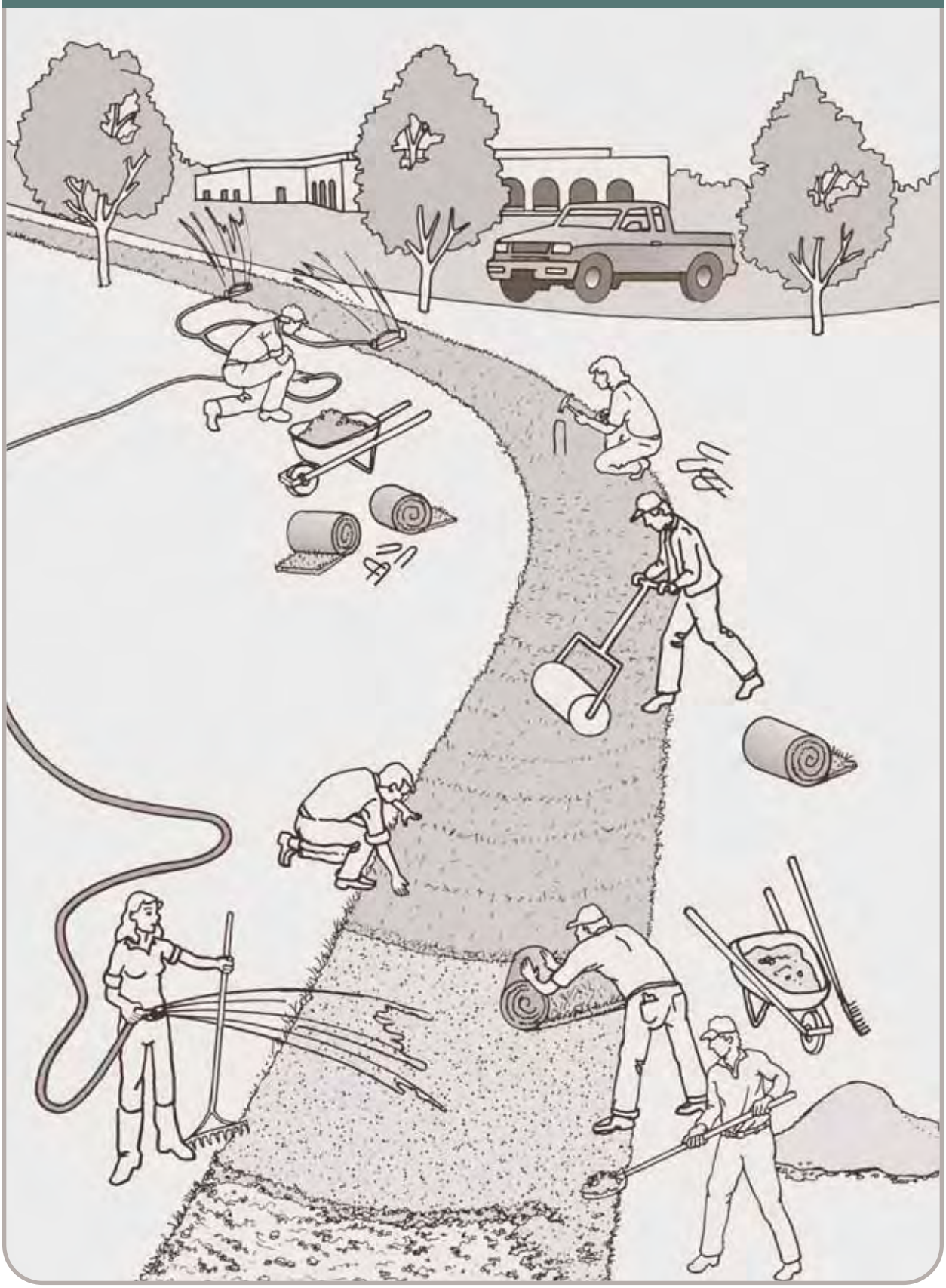
During the first week, inspect daily and if rainfall is inadequate, then water the sod as often as necessary to maintain moist soil to a depth of at least 4 inches below the sod. Subsequent waterings may be necessary to ensure establishment and maintain adequate growth.
After the first week, inspect sodded area at least once a week and within 24 hours of the end of a storm with a rainfall amount of 0.5 inch or greater during the first growing season.

Where sod has died or has been moved or where soil erosion has occurred, determine if the failure was caused by inadequate irrigation, poorly prepared surface, improper anchoring, excessive sedimentation or excessive flows. If the failure was caused by concentrated flow, check water velocities and duration to ensure it does not exceed 5 fps or a duration greater than 1 hour at or near 5 fps. Install additional measures to control water and sediment, repair erosion damage, and reinstall sodding with anchoring.

Do not mow until the sod is firmly rooted, usually 2 to 3 weeks. Do not remove more than 1/3 of the grass leaf at any one cutting.

Long term maintenance of the sod should be commensurate with the planned use of the area. For liming and fertilization, follow soil test recommendations when possible.

Figure SO-1 Sod Installation



3-Vegetative Soil Cover

Landscape Planting (LP)

Definition

Planting trees, shrubs, or ground covers for stabilization of disturbed areas.

Purpose

- To aid in protecting and stabilizing soil.
- To intercept precipitation and retard runoff while providing increased plant diversity, food and shelter for wildlife, and improved air quality; to develop high quality riparian buffers and enhanced site aesthetics.

Applicability

- On steep or irregular terrain, where mowing to maintain an herbaceous plant cover is not feasible.
- Where ornamental plantings are desired to improve site aesthetics.
- In shady areas where turf establishment is difficult.
- Where woody plants are desirable for soil conservation, plant diversity, or to create or enhance wildlife habitat.
- Where permanent plantings will reduce the extent of lawn and lawn maintenance requirements.
- Where riparian or other functional buffers need to be extended, re-established or created.
- Where wind breaks are needed.

Planning Considerations

The initial function of any vegetation to be established on disturbed soils is to prevent soil detachment and subsequent erosion. However, other factors are considered when choosing whether to plant grass and/or other herbaceous vegetation, or whether woody landscape plantings should be utilized.

Some disadvantages to using grass are:

- *Permanent grass cover requires periodic mowing to prevent the area from being occupied with shrubs and tree seedlings through the process of natural succession.*
- *Grass cover does little to control access by pedestrians or vehicles. In areas of heavy pedestrian use, soil compaction may result in death of the plants, increasing erosion potential.*
- *Grass provides limited value for wildlife. However, extensive turf may also provide an attractive feeding habitat for wildlife which may become a nuisance. (e.g. Canada Geese).*

Landscape plantings of trees, shrubs, and ground covers have particular attributes which provide benefits that grass or herbaceous cover cannot. These benefits include:

- *Improving air quality;*
- *Modifying air circulation patterns;*
- *Reducing heating and cooling costs;*
- *Providing shade;*
- *Preventing blinding reflections;*
- *Softening architectural features;*
- *Screening undesirable views;*
- *Controlling or screening undesirable noises;*
- *Calming and controlling traffic;*
- *Providing wildlife food and shelter; and*
- *Restoring natural conditions to a disturbed site.*

Landscape planting plan

If landscape plantings are intended, then a landscape planting plan should be developed. The landscape planting plan should identify the species, location, number of each planting specified to be planted, the type of planting stock (i.e. bare-root, balled and burlapped, etc.), and the timing for planting.

Newly transplanted trees and shrubs which are carefully selected to match the site conditions will need the least aftercare, and will become established quickly. Conversely, plants put under stress by being transplanted into an environment they are not well adapted to will need extraordinary and long term maintenance. The following characteristics should be taken into account when developing a landscape planting plan and selecting plant material:

Adaptability to Site Conditions: Proper selection of landscape plants requires a careful study of the characteristics of the site, a thorough knowledge of the species available and hardy to the area, and a thorough knowledge of all the potential insect, disease, and cultural problems which may weigh against the plant selected for the required function.

Site characteristics such as soil type, surface and subsurface drainage, and light availability are primary limiting factors that determine if a given plant will survive. Other site specific factors such as exposure to salt at shoreline or roadsides, high winds, polluted air, or heat from reflected sun may limit plant survivability. The specific conditions at each site must be taken into account when selecting the appropriate plant for the site.

Hardiness Zones: Woody landscape plants must be hardy to the area in which they are planted in order to survive. Hardiness zones are geographical areas mapped according to the approximate range of average annual minimum temperatures. Plants adaptable to conditions in specific zones are said to be hardy in those zones (see **Figure LP-1**). Connecticut has three hardiness zones, reflecting the milder conditions along the southwestern shoreline, cooler weather in the eastern and western highlands, and a transitional area dominating the bulk of the central and eastern portions of the state.

Mature Height and Spread: To minimize future maintenance and replacement costs and to enhance long term plant health, select plants to match the species to the site, and place plants to provide adequate space for the plant to grow to its natural mature size.

Consideration must be given to the height and location of overhead utilities, the location and depth of underground facilities, lines of sight around intersections of roadways, road and sidewalk clearance needed for snow removal operations, clearance from buildings, and all other potential situations where the maturing plant will become an obstruction, nuisance, or hazard.

If the space allotted to the plant selected is inadequate, suitable periodic maintenance pruning must be planned in accordance with the needs of the species, limitations of the site, or the intended effect. Normally, plants installed for erosion control purposes are not intended to be pruned, and should be selected and placed with knowledge and consideration of mature sizes.

Growth and Establishment Rate: Some trees and shrubs attain their mature sizes very rapidly, whereas others are slow to grow to mature size. Some shrubs and vines will become established quite rapidly, with growth characteristics like rooting from the growing tips of the stem and sprouting from root systems and underground stems. Knowing how fast a tree, shrub, or vine will become established and how quickly it will grow to mature size is important in order to select the right plant, and the number of plants (spacing) for the particular situation. Growth and establishment rates are also linked to how well the plant has been selected to match the site conditions. Plants that are well adapted to the site will become established quicker, live longer and will require less aftercare.

Ornamental Characteristics, Sanitation: Since these Guidelines are intended to be concerned primarily with landscape planting as it relates to soil erosion and sediment control, no attempt has been made to provide guidance on plant selection for ornamental or aesthetic purposes. However, plants in a landscape design can and should be selected for specific functional attributes which contribute to the goal of soil erosion and sediment control.

Functional characteristics of specific plants should be considered carefully so that the plant chosen will fulfill its intended role. For instance, to control soil erosion, plants with rapidly growing aggressive root systems may be selected. To absorb sound or screen views in winter conditions, deep, dense planting of evergreens may be selected. To filter dust from summer winds, a deciduous tree with coarse, hairy leaves could be chosen for its enhanced ability to trap airborne dust. Plants that provide a variety of nuts and berries as sources of food for wildlife may contribute significantly to the habitat value of a particular location.

Undesirable attributes of plants must also be considered. Aggressive root systems beneficial in one application may create problems in other applications where the roots may enter and obstruct underground pipelines. Root penetration from trees and shrubs may create internal pathways for water in earthen dams and dikes, and roots may also damage sidewalks, structures, pavement, and underground utility installations. Trees with large leaves or that drop excessive quantities of seed pods, nuts, fruits, or other debris may be undesirable for aesthetic, safety, or convenience reasons. Potential clogging of drainage systems with debris from trees must be considered in selecting street trees. Tree species that don't drop troublesome parts, and trees with smaller, thinner leaves, or with leaves that drop gradually are preferred in situations where clogging of drainage systems is a primary concern.

Timing of Transplanting: When plants may be transplanted depends on how they are grown and supplied. Balled and burlapped and container grown plants can be planted any time of the year, provided that the soil at the planting site is not waterlogged or frozen.

Deciduous trees are normally dug and balled for transplanting in the early spring, before flowers or leaves develop. Some species transplant best in either the spring or fall of the year, and balled in burlap stock may not be available other than during the optimal season for transplanting. Normally, spring flowering trees are not dug while flowering, so summer availability of field grown balled and burlapped trees is usually somewhat restricted to those dug early in the season.

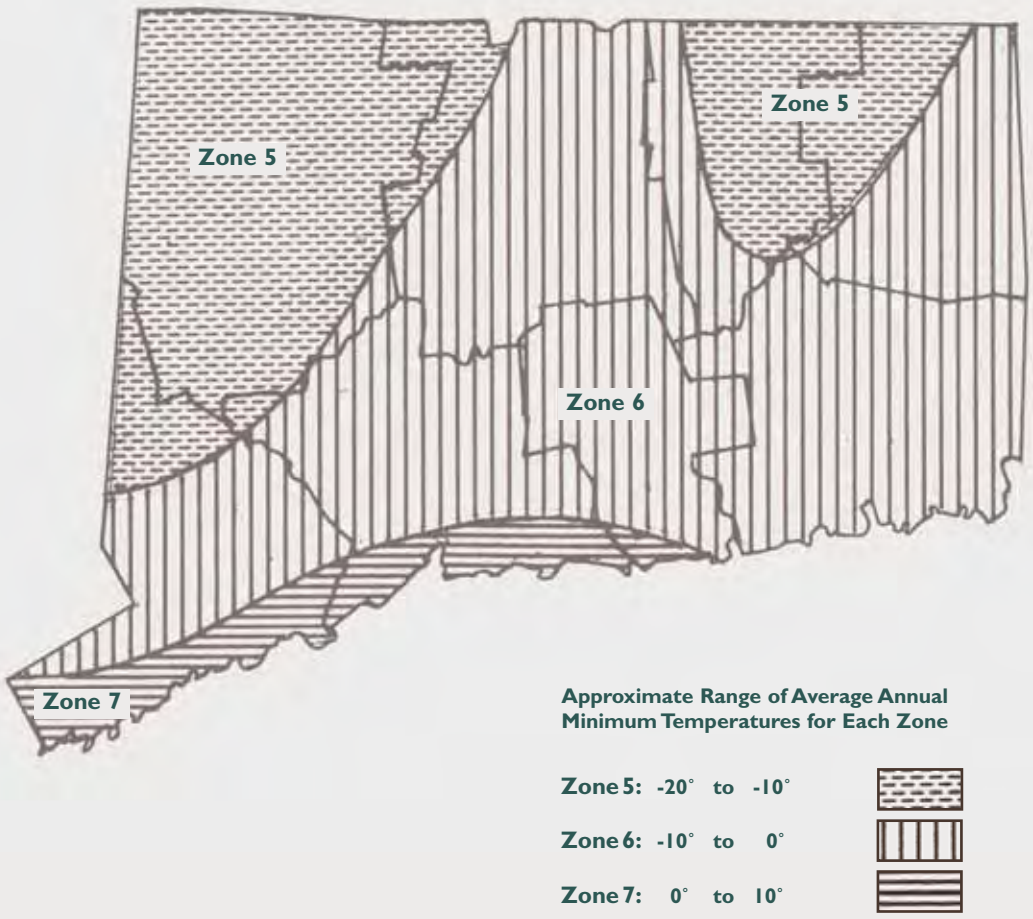
Balled and burlapped plants may lose 90% or more of their root system from the digging operation. If dug during the active summer growth period, significant stress may be placed on the plant. For this reason, digging and balling operations normally cease during the summer months. Summer digging of deciduous trees may be done, but requires special preparation and aftercare to minimize potentially fatal stresses on the plant. Evergreens may also be dug and balled in burlap in the early spring, but are also successfully dug and transplanted in summer after new growth has hardened off.

Trees and shrubs to be planted as bare-root plants should be handled only when dormant in spring, or after leaf fall in autumn.

Landscape Plant Forms, Standards, and Sources: Landscape plants may be bought as balled in burlap or similar material, containerized, or as bare rooted stock. All plants shall comply with the American Standard for Nursery Stock (ANSI Z60.1), produced by the American Association of Nurserymen, which provides a comprehensive and consistent set of measurement and specification standards for all types of plant material.

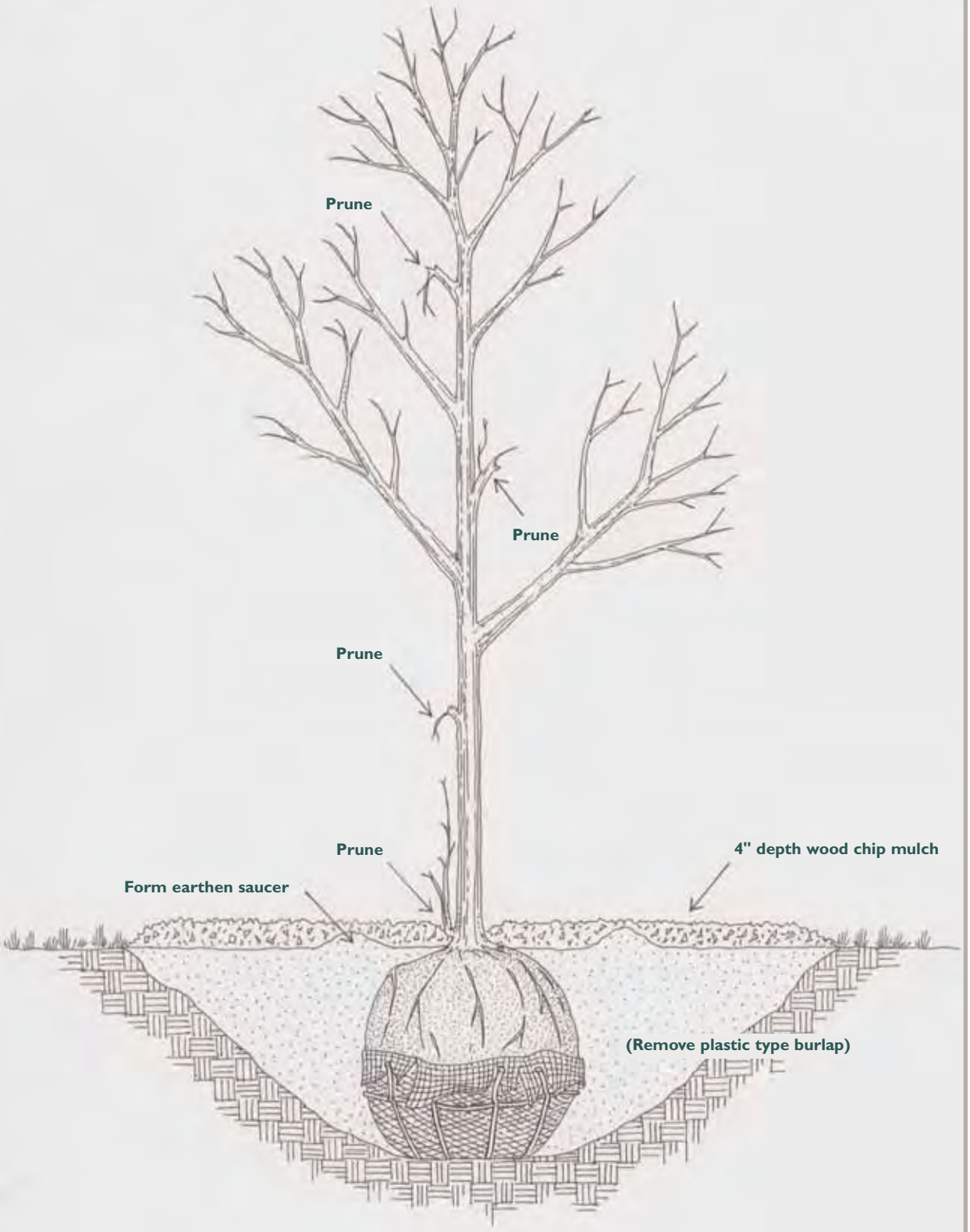
The plants identified in **Figure LP-4, Figure LP-5** and **Figure LP-6** are usually available at commercial nurseries balled in burlap, or in containers. Trees and shrubs may also be purchased from the state nursery or from county Soil and Water Conservation Districts.

Figure LP-1 Hardiness Zone Map of Connecticut



Source: Adapted from USDA-NRCS FOTG Section I iii Maps. July 1994.

Figure LP-2 Transplanting Balled and Burlapped Plants



A broad range of plant material is available to fulfill the desired functions of a landscape planting. Although some plants known to be hardy to Connecticut are included in the list below, information on additional appropriate plants may be obtained from Connecticut licensed Arborists, a landscape architects licensed to practice in Connecticut, the USDA Natural Resources Conservation Service, the Connecticut Agricultural Experiment Station, and the Connecticut Cooperative Extension System.

Invasive Species: Certain introduced shrubs, like Autumn Olive (Elaegnus umbellata), Honeysuckles (Lonicera spp), Multiflora Rose (Rosa multiflora), Winged Euonymus (Euonymus alatus), and Asiatic Bittersweet (Celastrus orbiculatus) have been identified as undesirable because they are not native, and are invasive into otherwise naturally vegetated areas. Native plants are preferred in most soil erosion and sediment control applications. The Center for Conservation and Biodiversity at The University of Connecticut maintains a list entitled: "Invasive, Non-Native Plant Species Occurring in Connecticut", listed as Publication #1, which should be consulted to avoid selecting undesirable, non-native invasive plants.

Specifications

Delivery and Storage of Materials

Upon receipt of plant stock, check to see that adequate protection during transit has been provided. If shipped by open truck, the plants should have been covered with a tarpaulin or canvas to minimize desiccation from exposure to the sun and wind. When delivery is made by an enclosed vehicle, the plants should have been carefully packed and adequately ventilated to prevent "sweating" of the plants. Physical injuries should have been prevented by careful packing.

In all cases, plants must be kept cool and moist until planting.

Insofar as practical, all plant material should be planted on the day of delivery. Plants which must be temporarily stored on site should be kept in the shade and protected from drying winds. For balled stock, root balls must be protected by covering the root ball with soil or other acceptable material and must be kept moist. Container stock held on site may also require watering if planting is delayed. Bare root plant may be stored in a cool, shaded area for as long as 10 days. If bare root plants must be kept for longer than 10 days, they should be "heeled in" (temporarily planted in a trench) until they can be permanently planted. All stock should be handled carefully and as few times as possible.

Transplanting Procedures

Transplanting Balled in Burlap Plant Material: Figure LP-2 shows the proper planting of balled and burlapped plant material, using a deciduous tree as an illustration.

Stock Examination: Determining Proper Planting Depth - Proper planting depth of a plant balled in burlap may vary depending upon how the plant was dug and balled. Each plant should be examined to determine if the plant was dug and balled properly. To do this, locate the crown of the plant - the point where the root mass or first major root originates from the stem. This point should be at or slightly below the top of the soil. Also use this point as a reference to determine if excess soil cover has been placed over the root ball by improper digging and balling.

Ball sizes should always be of a diameter and depth to encompass enough of the fibrous and feeding root system as necessary for the full recovery of the plant. Recommended ball depth to diameter ratios are shown in **Figure LP-3**. Under certain soil and regional conditions, plants have roots systems of proportionally less depth and greater diameter. Those require a more shallow but wider ball to properly encompass the roots. Conversely, in other soils and in certain regions roots develop greater depth and less spread, requiring an exceptionally deep ball which may be smaller in diameter and greater in depth than the size recommended.

Compare the ball size in relation to the size of the plant, using the current American Standard for Nursery Stock (ANSI Z60.1) and note the size of the roots cut when dug to be balled in burlap. Undersize root balls or large cut roots are a clue that digging may have been improper, and that actual root mass may be inadequate to support the plant during its establishment period.

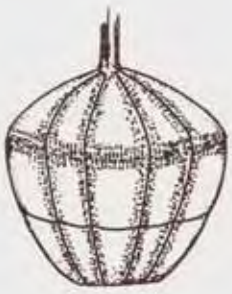
Site Preparation (see **Figure LP-2**)**:** Thoroughly examine the root ball to determine the proper planting depth for each plant (see Stock Examination above). Excavate a planting site whose top width is 3 times the width of the root ball to a depth that is no deeper than the proper planting depth with sloped sides tapering to the surface. The soil under the root ball should remain undisturbed, or if disturbed, should be tamped prior to planting, to prevent settling of the root ball. Since most new roots will grow horizontally from the root ball, compacted soil under the ball will not inhibit rooting.

Planting site preparation should focus on providing the highest quality environment possible for root development during the first year or two after transplanting. Long term survival depends on selecting the proper species for the site. More intensive site preparation will be necessary in urban soil conditions and on disturbed sites than when planting in high quality undisturbed soil.

Handling and Setting the Plant: Set the plant in the planting site so that it is plumb, level, and centered. Do not use the trunks of trees as levers to adjust the position of the root ball, as this may fracture the root ball and damage roots. Instead, move the root ball itself, being careful not to pull on ropes which may lay against bark (especially in spring, when bark slips easily).

When the plant is properly positioned in the planting site, **cut all twines and other tying material encircling the trunk**. For natural burlap wrapping pull it back and cut off the excess and discard, do not tuck it into the hole where it can cause problems with air pockets and moisture retention, both of which may lead to rotted roots. Remove synthetic burlap completely. To test fabric to see if it is synthetic, burn an edge with a match. If it melts, it is synthetic and must be completely removed.

Figure LP-3 Ball Depth to Diameter Ratio



Diameter less than 20". Depth not less than 75% of diameter or 3/4 of width.

Diameter 20 to 30". Depth not less than 66.6% or 2/3 of width.

Diameter 31 to 48". Depth not less than 60% or 3/5 of width.
Balls with a diameter of 30" or more should be drum laced.

Wire baskets are commonly used to contain and transport some balled and burlapped plant material. Cut and remove as much of the wire basket as possible to avoid future interference with root growth.

Backfilling, Watering and Mulching: After all tying materials and wire baskets are removed as appropriate, backfill the site to original grade with original soil. Soil amendments are unnecessary in most planting situations. Water the backfill soil thoroughly, allowing the water to settle the soil, removing air pockets. Do not pack with feet or tools. Use enough water to ensure thorough saturation of the soil. Add soil to bring the soil level back up to grade when the water has infiltrated. As a temporary measure to aid in establishment, a low (3" to 6") rim of tamped soil can be built to help hold water for subsequent watering. Locate the inside edge of the rim at or outside the edge of the root ball. Mulch the disturbed area with **Landscape Mulch** (see **Figure LP-2**).

Fertilization: Under normal circumstances, it is not recommended to fertilize woody plants upon initial planting.

Staking: Staking or guying trees using wire covered with rubber hose sections is not recommended in most circumstances. Failure to remove stakes and wires has caused severe damage to trees by girdling the trees at the point of wire attachment. By allowing the tree to flex somewhat in the wind, the tree will be able to develop a proper taper and anchoring roots to naturally resist movement in the wind. Staking and guying may become necessary due to loose root balls, unusually high or persistent prevailing winds, or other specific conditions. In these cases, use of a flexible and biodegradable type of tree tying material is preferred.

Transplanting Bare Root Plant Material

Figure LP-7 shows how to properly plant bare rooted plants and shows the proper minimum root spread for bare root deciduous shrubs. Dig the hole deep and wide enough to accommodate all the roots, and allow them to spread out without bunching or curling. (No "J"- shaped roots.) If the roots are excessively long, they may be pruned back to a length of 10 to 12 inches. Place the plant at the same depth in the soil at which it was planted when rooted in the nursery. Add soil as necessary to fill planting hole to existing grade. Water thoroughly after planting. Make sure that there are no turned up roots or air pockets in the soil.

Either use **Landscape Mulch** or prepare the site by very low cutting of grass and weeds to reduce initial competition. It is very important to prevent grasses, vines, and other vegetation from competing with the newly transplanted plants for sunlight, water, and soil nutrients.

While this section is meant to refer primarily to the planting of relatively small, bare root shrubs, larger plants including trees may be obtained as bare root stock. When larger shrubs or trees are planted bare root, staking and guying will likely be necessary. As above, use of a flexible and biodegradable type of tree tying material is preferred to the traditional hose and wire system.

Transplanting Container Grown Plants

Stock Examination: For plants grown in containers, carefully remove the plant from the container, and inspect the root mass to determine if the plant has well developed roots, and to be sure it has not been recently repotted to a larger pot size. Containerized stock should have well developed roots, but should not be pot bound, which causes roots to encircle the container, resulting in difficulties in establishment.

Site Preparation: Site preparation for container grown plants is the same as for balled and burlapped plants.

Handling and Setting the plant: When container grown plants have well developed root systems that encircle the pot, either loosen the roots or slice the root ball with a sharp knife vertically three or four times, cutting about an inch deep. This will promote new roots to develop and spread out, rather than continuing to follow the circular rooting pattern. If excess soil in the pot had buried the original soil level just above the crown of the plant, be sure to adjust the planting depth to place the plant back at or slightly above the original soil level.

Backfilling, Watering and Mulching: Backfill the site to original grade with original soil. Soil amendments are unnecessary in most planting situations. Water the backfill soil thoroughly, allowing the water to settle the soil, removing air pockets. Do not pack the soil tightly with feet or tools. Use enough water to ensure thorough saturation of the soil. Add soil to bring the soil level back up to grade when the water has infiltrated. Mulch the disturbed area with **Landscape Mulch**.

Fertilization: Under normal circumstances, it is not recommended to fertilize woody plants upon initial planting.

Maintenance

Maintenance of trees, shrubs, and ground covers is an exhaustive topic which is not addressed by these Guidelines. Instead, the most critical maintenance needs for the first year of a newly transplanted plant are described below.

Inspection Requirements

Inspect plants until they are established or at least monthly for 1 year following planting, and more frequently during hot dry periods for mulch adequacy, soil moisture and general plant condition. When a plant has regrown a sufficient root system such that it can withstand normal variations in climate and soil conditions, and has resumed normal growth, it is considered to be established. An established plant will exhibit normal growth patterns of bud break and leaf fall, and will have resumed a growth rate considered normal for the species.

Larger plants, especially balled in burlap trees which have lost a significant amount of their roots systems upon transplanting will need the most attention during

the initial establishment period.

Mulch and Water

Apply additional landscape mulch around landscape plants as needed to keep soil covered and to inhibit weed growth. Keeping all newly transplanted plants adequately mulched is important to moderate fluctuations in soil moisture and temperature. Trees that are mulched will recover from transplanting, become established, and resume normal growth more quickly than trees planted without the benefit of mulch.

Water plants during hot dry periods when soil around the plants begins to dry out. If leaves of recent landscape plantings are wilted, severe water deficiency is indicated, and permanent damage to the plantings may result if supplemental water is not provided promptly. For successful establishment of summer plantings, adequate watering during the balance of the summer and into the fall is especially important.

Note: *A useful rule of thumb in Connecticut is that new plantings should receive at least 1 inch of rain per week.*

Pruning

Prune to remove only dead or damaged limbs on newly planted trees unless an arborist has recommended otherwise. Pruning the top of the tree will severely weaken the tree's ability to grow a healthy new root system in the new site. This is especially important for trees balled in burlap, which lose a large portion of their original root system when the are dug from the field. For new roots to form from plants grown in containers, top pruning should be delayed for at least a year. Ideally, newly planted trees should not be pruned until after their third year, and then only to remove dead and weak branches, and to train the tree's future growth by removing or pruning any wayward branches which will lead to future problems, or detract from the natural shape of the plant.

Insect and Disease Control

All plants in the natural environment are host to a wide variety of insect and disease organisms. When insects or disease problems on a plant become threatening to the life or practical value of the plant, corrective or preventative actions may become necessary. When a problem occurs, positive identification of the host, and then of the insect or disease problem is vital to successfully resolving the problem. Plants should be selected to avoid common insect or disease problems by choosing those species resistant to common plant diseases, or unpalatable to common insect problems.

The Cooperative Extension System or a state licensed arborist can help identify insect and disease problems and suggest solutions.

Figure LP-4 Trees for Landscape Planting

Common Name (*Botanical Name*)	Leaf type[1]	Height	Soil Moisture Preferred Wet	Moist	Dry	pH range	Users: Lawns	Seashore	Street	Shade tolerance	Salt tolerance[2]	Pollution Tolerance[2] O_3	SO_2	F	Remarks
BEECH *(Fagus grandifolia)*	D	70-120		X		6.5-7.5	X			Fair	S	-	S	-	Long-lived. Has edible nuts. Needs lots of space.
BIRCH, BLACK, WHITE and GRAY *(Betula spp.)*	D	50-80	X	X		4.0-5.0	X			Good	-	S	S	-	Prefers deep, moist soils such as stream banks. Graceful form.
CEDAR, EASTERN RED *(Juniperus virginiana)*	E	20-50	X	X	X	6.0-6.5	X			Good	-	T	T	T	Long-lived.
CHERRY, JAPANESE *(Prunus serrulata)*	D	15-20		X		6.5-7.5	X	X		Good	-	-	-	T	Very showy pink or white flowers. Usually grafted on 6-7 ft. stem.
CRABAPPLE *(Malus spp.)*	D	15-20		X		6.5-7.5	X	X	X	Fair	I	S	S	-	White or pink flowers. Many varieties, some with edible fruit.
DOGWOOD, FLOWERING *(Cornus kousa)*	D	30-40		X		5.0-6.5	X	X		Good	-	T	T	T	Ideal street tree. White or pink flowers. Has poor drought resistance.
HAWTHORN *(Crataegus spp.)*	D	15-25		X		6.0-7.5	X	X		Fair	I	-	S	-	Thorny, Washington and Lavalle types are good ornamentals. Tolerates parking lot conditions. Has some insect and disease problems.
LOCUST, HONEY *(Gleditsia tri-acanthos inermis)*	D	50-75	X	X	X	6.5-7.5	X	X	X	Good	T	S	-	-	Sturdy, wind-firm tree. Overused in urban areas.
MAPLE, HEDGE *(Acer campestre)*	D	20-30		X	X	6.5-7.5	X	X		Good	-	T	T	I	Prefers well-drained, deep fertile soil. May be used in clipped hedges.
MAPLE, RED *(Acer rubrum)*	D	50-80	X	X		4.5-7.5	X	X	X	Good	S	T	T	-	Grows rapidly when young. Good tree for suburbs but not city.
MAPLE, SUGAR *(Acer saccharum)*	D	50-70	X	X	X	6.5-7.5	X			Fair	I	T	T	-	Outstanding fall foliage. Suburban, but not city tree. Slow-growing and shapely. Intolerant of salt.
OAK, PIN *(Querus palustris)*	D	60-80	X	X	X	5.5-6.5	X	X		Good	T	S	S	I	Most easily transplanted of the oaks.
OAK, RED NORTHERN *(Querus rubra borealis)*	D	70-90		X	X	4.5-6.0	X	X	X	Good	T	T	T	I	Most rapid-growing oak. Needs room.
OAK, SCARLET *(Querus coccinea)*	D	60-80			X	6.0-6.5	X	X		Good	T	S	T	I	Prefers sandy or gravelly soils.
OAK, WHITE *(Querus alba)*	D	60-80		X	X	6.5-7.5	X	X	X	Fair	T	S	S	I	Long-lived, stately tree. Grows slowly.
PINE, AUSTRIAN *(Pinus nigra)*	E	30-50		X	X	4.0-6.5	X		X	Good	T	-	-	-	Very hardy and rapid-growing. Will tolerate shallow soil and drought.
PINE, JAPANESE BLACK *(Pinus thunbergii)*	E	30-50		X	X	4.0-6.5	X		X	Fair	T	-	-	-	Disease problems.
PINE, SCOTCH *(Pinus sylvestris)*	E	60-90			X	4.0-6.5	X			Good	I	S	S	S	Disease problems.
PINE, WHITE *(Pinus strobus)*	E	80-100			X	4.0-6.5	X			Fair	S	S	S	S	Very attractive, rapid-growing tree. Prefers deep sandy loam. Subject to white pine blister rust.
YEW, JAPANESE *(Taxus cuspidata)*	E	15-20		X		6.0-6.5	X			Good	-	T	-	I	Hedges and borders. Preferred food of white-tailed deer.

[1] D is deciduous plants
E is evergreen or coniferous plant

[2] Pollution tolerance and salt tolerance: "S" Sensitive. Will show physical damage.
"T" Tolerant.
"I" Intermediate. Damage depends on growing conditions and exposure to pollutant.
"-" No information at this time.

Source: USDA-NRCS

Figure LP-5 Shrubs for Landscape Planting

Common Name (Botanical Name)	Leaf type[1]	Drainage Tolerance	Shade tolerance	pH range	Mature Height	Uses
AMERICAN CRANBERRY BUSH *(Viburnum trilobum)*	D	Moderately Well-Drained to Poorly Drained	Fair	6.5-7.5	6-7	Hedges and borders. Flowers inconspicuous, red berries, winter food for birds. Fruits in 4-5 years.
ARROWWOOD *(Viburnum recognitum or dentatum)*	D	Well-Drained to Poorly Drained	Good	5.5-7.0	5-10	Hedges and borders.White flowers, blue to blue-black berries. Screens or naturalized mass. Edible by both birds and humans
BAYBERRY *(Myrica pensylvanica)*	E	Droughty to Moderately Well-Drained	Poor	5.0-6.0	6-8	Revegetating sand dunes; ornamental for droughty areas. Flowers inconspicuous, waxy grey berries. Fixes nitrogen in soil.
BEACH PLUM *(Prunus maritima)*	D	Droughty to Moderately Well-Drained	Fair	6.0-8.0	7	Revegetating sand dunes and droughty areas. Flowers white, fruit purple, plum-like and edible. Fruit used for jelly and baking, also favored by wildlife.
BLUEBERRY HIGHBUSH *(Vaccinium corymbosum)*	D	Droughty to Somewhat Poorly Drained	Good	4.5-5.5	8-12	Borders and hedges or individual. Flowers white to pinkish, berries blue-black.
BLUEBERRY LOWBUSH *(Vaccinium angustifolium or vacillan)*	D	Droughty to Somewhat Poorly Drained	Good	4.5-5.5	1-3	An excellent ground cover. Flowers white, berries blue.
BRISTLY LOCUST "ARNOT" *(Robinia fertilis)*	D	Droughty to Moderately Well-Drained	Fair	5.0-7.5	6	Steep slopes, gravelly infertile areas. Fixes nitrogen. Spread by sprouting from roots. Flowers pink, seeds in pods.
GRAY DOGWOOD *(Cornus racemosa)*	D	Droughty to Poorly Drained	Fair	4.5-6.0	7-10	Good for stream banks.
CORALBERRY *(Symphoricarpos orbiculatus)*	D	Droughty to Well-Drained	Fair	4.5-6.0	4-6	Flowers yellow.
ELDERBERRY *(Sambucus canadensis)*	D	Well-Drained to Poorly Drained	Fair	6.0-7.5	12	Provides food for birds and deer. Flowers white, fruit edible purple berries. Fruit in 4-5 years.
FIRETHORN *(Pyracantha coccinea)*	E	Droughty to Moderately Well-Drained	Fair	6.0-8.0	10-15	Southern CT only. Screens, barriers. Flowers white, fruit orange or red berries. Food for songbirds. Low-growing and upright types available.
HORIZONTAL JUNIPER *(Juniperus spp.)*	E	Droughty to Well-Drained	Poor	5.0-6.0	1-2	Used as ground cover or ornamental. Set plants 2 feet apart for cover in 2-3 years. Flowers and fruit inconspicuous.
JAPANESE YEW *(Taxus cuspidata)*	E	Moderately Well-Drained to Somewhat Poorly Drained	Good	6.0-6.5	15-20	Used for hedges and screens. Flowers and fruit inconspicuous.
MOUNTAIN LAUREL *(Kalmia latifolia)*	E	Droughty to Somewhat Poorly Drained	Fair	4.5-5.5	7-15	Erect shrub, naturalized mass. Flowers white, pink to deep rose, fruit inconspicuous and poisonous to both humans and animals in quantity.
RED OSIER DOGWOOD *(Cornus stolonifera)*	D	Moderately Well-Drained to Poorly Drained	Fair	4.5-6.0	4-6	Good for stream banks, damp soils.
RUGOSA ROSE *(Rosa rugosa)*	D	Droughty to Moderately Well-Drained	Fair	6.0-7.0	3-5	Stabilizing sand dunes and landscaping. Flowers white to pink, fruits red hips in 1-2 years. Food and cover for songbirds and rabbits. Sprawling growth habit, but not aggressive.
SHADBUSH *(Amelanchier canadensis)*	D	Well-Drained to Somewhat Poorly Drained	Fair	5.5-6.5	3-6	Natural mass, specimen. Flowers white, fruit red to black.

continued

Figure LP-5 Shrubs for Landscape Planting (con't)

Common Name (Botanical Name)	Leaf type[1]	Drainage Tolerance	Shade tolerance	pH range	Mature Height in Ft.	Uses
SHORE JUNIPER "EMERALD SEA" *(Juniperus conferta)*	E	Droughty to Well-Drained	Fair	5.0-6.0	1	Stabilizing sand dunes and sandy road banks. Flowers and fruits inconspicuous.
SIEBOLD FORSYTHIA *(Forsythia suspensa seibold)*	D	Droughty to Well-Drained	Poor	4.5-6.0	4-6	Over used. Flowers yellow, fruit inconspicuous.
SWEETFERN *(Comptonia peregrina)*	D	Droughty to Moderately Well-Drained	Fair	5.0-6.0	3-4	Natural masses. Flowers inconspicuous.
SWEET PEPPERBUSH *(Clethra alnifolia)*	D	Moderately Well-Drained to Poorly Drained	Good	5.5-6.5	3-8	Borders and hedges. Flowers white, fruit inconspicuous.
WINTERBERRY *(Ilex verticillata)*	D	Well-Drained to Poorly Drained	Fair	5.0-6.0	10	Ornamental screens. Flowers inconspicuous, fruits red berries in 3-4 years. Winter food for songbirds.
WYTHEROD VIBURNUM *(Viburnum cassinoides)*	D	Well-Drained to Somewhat Poorly Drained	Good	5.5-6.5	4-6	Natural mass. Flowers white, fruit green to black. Very showy in fall.

[1] E-Evergreen D-Deciduous

Source: USDA-NRCS

Figure LP-6 Vines and Ground Covers for Landscape Planting

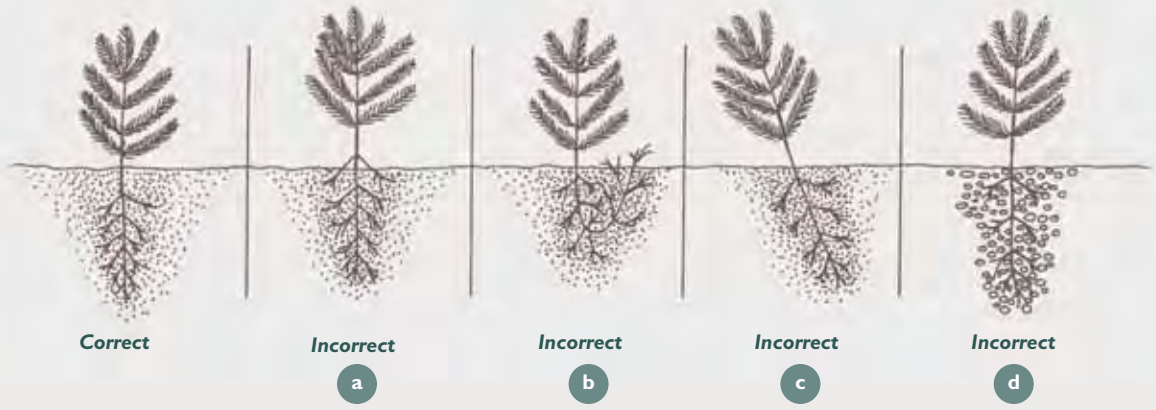
Common Name (Botanical Name)	Leaf Type[1]	Drainage Tolerance	Shade Tolerance	pH Range	Characteristics
BEARBERRY *(Arctostaphylos uva-ursi)*	E	Droughty to Well Drained	Good	4.5-6.0	Trailing groundcover. Low-fertility sandy areas, dunes, flowers inconspicuous. Set plants 18 in. apart for cover in 2-4 years.
BUGLEWEED *(Ajuga reptans)*	E	Well Drained to Moderately Well Drained	Excl.	6.0-7.5	Small, low-growing broad-leafed herbaceous plants, in bronze or green, flowers blue, white or red spiles. Set plants 1 ft. apart for cover in 1 year.
CROWN VETCH *(Coronilla varia)*	D	Droughty to Moderately Well Drained	Fair	4.0-7.5	Slow growing, 1-2 ft. high. Prefers sun, 2-3 years to form a cover. Flowers pink.
DAYLILY *(Hemerocallis fulva)*	D	Droughty to Poorly Drained	Fair	6.0-8.0	Grass-like foliage, flowers orange, showy. Unusually adaptable and free of pests and disease.
DUSTY MILLER (Beach Wormwood) *(Artemisia stelleriana)*	E	Droughty to Well Drained	Poor	6.0-7.5	Silvery foliage, 1-2 ft. tall, flowers inconspicuous. Spreads by underground stems. Stabilizing groundcover on coastal dunes. Set plants 2 ft. apart for cover in 2 years.
ENGLISH IVY *(Hedera helix)*	E	Droughty to Moderately Well Drained	Good	6.0-8.0	Low maintenance vine for large areas, flowers inconspicuous. Will climb on trees, walls, etc. Set plants or rooted cuttings 1 ft. apart for cover in 2 years.
LILY-OF-THE-VALLEY *(Convallaria majalis)*	E	Droughty to Somewhat Poorly Drained	Excl.	4.5-6.0	Low maintenance cover for partial or full shade, flowers fragrant white bells on short stalks. Set plants 1 ft. apart for cover in 2-3 years.
LILY-TURF *(Liriope specata)*	E	Droughty to Poorly Drained	Good	4.5-6.0	Grass-like low maintenance cover for droughty, infertile soils. Spreads by underground stems. Available in variegated form. Set plants 6-12 in. apart for cover in 2 years.
PACHYSANDRA *(Pachysandra terminalis)*	E	Well Drained to Moderately Well Drained	Excl.	4.5-5.5	Low-growing, attractive cover for borders and as lawn substitute under trees and other shady areas. Flowers small white spikes. Set plants 1 ft. apart for cover in 1-2 years.
PERIWINKLE (Vinca) *(Vinca minor)*	E	Well Drained to Moderately Well Drained	Excl.	6.0-7.5	Lawn substitute for shady areas. Small blue flowers. Spreads by stolons; not aggressive. Grows in full sun as well as shade. Set plants 1 ft. apart for cover in 1-2 years.
SMALL-LEAVED COTONEASTER *(Cotoneaster microphylla)*	E	Well Drained to Moderately Well Drained	Fair	6.0-7.0	Prostrate shrub, tiny white flowers. Informal cover for large areas. Set plants 2 ft. apart for cover in 2 years.
VIRGINIA CREEPER *(Parthenocissus quinquefolia)*	D	Droughty to Well Drained	Fair	5.0-7.5	Ground cover for dunes and other dry areas; will climb trees. Flowers inconspicuous. Attractive crimson foliage in fall. Berries eaten by songbirds. Set plants 18" apart for cover in 1-2 years.

[1] E-Evergreen D-Deciduous

Source: USDA-NRCS

Figure LP-7 Planting Bare Root Stock

1. Insert bar at angle shown and push forward to upright position.
2. Remove bar and place seedling at correct depth.
3. Insert bar two inches toward planter from seedling.
4. Pull bar toward planter firming soil at bottom of roots.
5. Push bar forward from planter firming soil at top of roots.
6. Fill in last hole by stamping with heel.
7. Firm soil around seedling with feet.
8. Test planting by pulling lightly on seedling.



a. Don't expose roots to air during freeze or plant in frozen ground.
b. Don't bend roots so that they grow upwards out of the ground.
c. Plant seedlings upright – not at an angle.
d. Always plant in soil – never loose leaves or debris. Pack soil tightly.

Source: Virginia Erosion and Sediment Control Handbook, 1992.