Urban Storm Water Runoff

Best Management Practices (BMPs) for Coastal Louisiana Nonpoint Source Pollution

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Providence Engineering and Environmental Group, LLC; the city of High Point Stormwater Services Division; and the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS)

FORWARD

Copies of this manual in handbook or electronic format are available from the Louisiana Department of Natural Resources, Coastal Management Division online at http://dnr.louisiana.gov/crm/

Comments or suggestions on the practices provided in this manual should be submitted in writing to the Coastal Management Division at the following address:

Louisiana Department of Natural Resources
Coastal Management Division
P.O. Box 44487
Baton Rouge, Louisiana 70804

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All programs and services of the federal, state, and local agencies and organizations that were involved in this project are available on a nondiscriminatory basis regardless of race, color, nationality, religious affiliation, sex, age, marital status, or disability.

Prepared by

For the Louisiana Department of Natural Resources
Baton Rouge, Louisiana
2008

Purpose and Use of this Manual

This manual was prepared as a field guide for urban, suburban, and rural public and private landowners and land users, including contractors, field workers, homeowners, and public officials, to minimize coastal impact from recreational and developmental activities.

This manual provides a comprehensive overview of the nonpoint source pollution Best Management Practices (BMPs) specific to the Louisiana Coastal Zone. This manual is only one part of the Coastal Nonpoint Pollution Control Program (CNPCP) efforts. The overall goal of the program is to protect, maintain, and sustain Louisiana coastal waters and wetlands. This manual provides thorough, concise, and efficient communication of Louisiana coastal BMPs to anyone involved in the use of Louisiana coastal resources. The recommendations provided in this manual were determined based on cost efficiency, effectiveness, relevant usage in other coastal states, and ease of design and construction. These recommendations are based on local site judgments and are not intended to supersede local ordinances or good engineering judgment.

CNPCP would like to thank the private and public participants who have helped in the development of this manual including members of the Calcasieu and Vermillion Parish Police Juries, representatives from the Louisiana Corps of Engineers, the Louisiana Department of Natural Resources, and Providence Engineering and Environmental Group LLC.

For more public education/outreach and other program efforts beyond this manual, please visit the CNPCP website at:
http://dnr.louisiana.gov/crm/coastmgt/interagencyaff/nonpoint/nonpoint.asp

Denotations

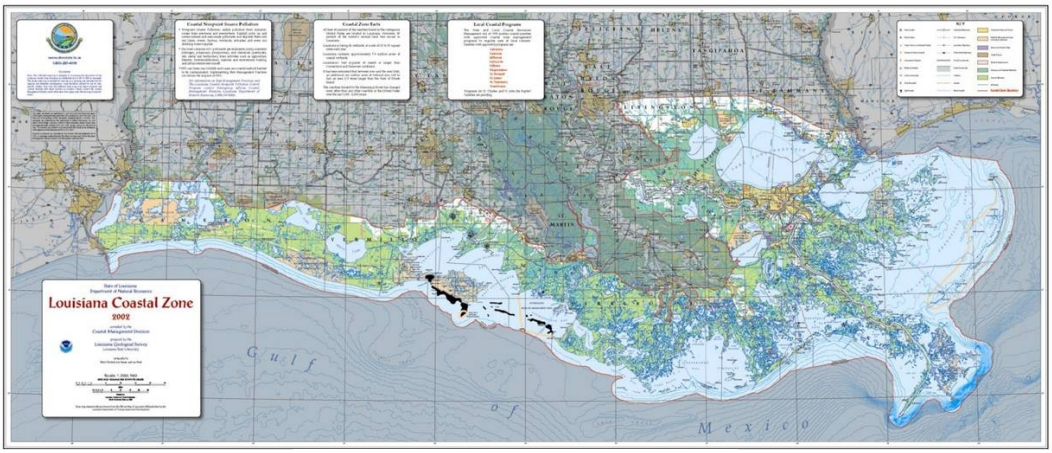
Pages with a green box in the upper corners are construction-specific BMPs

T Pages labeled with a boxed “T” describe temporary BMP measures

P Pages labeled with a boxed “P” describe permanent BMP measures

Additional note: Slope ratios are presented as horizontal (run) : vertical (rise)

Background and Introduction



The Louisiana Coastal Zone

In 1990, the Coastal Zone Act Reauthorization Amendments (CZARA) were passed. These amendments required the development and implementation of CNPCPs in states with federally approved coastal zone management programs. The Louisiana CNPCP must implement management measures that address the control and prevention of nonpoint source (NPS) pollution from five designated sources: agriculture, forestry, hydromodification, marinas and recreational boating, and urban runoff. The developed management measures must be approved by both the National Oceanic and Atmospheric Administration (NOAA) and the United States Environmental Protection Agency (USEPA).

In response to CZARA requirements, management measures were thoroughly researched, evaluated, and approved by USEPA as appropriate and effective coastal zone management practices. These recommendations do not represent mandated government regulations. Rather, this manual aims to prevent the necessity of increased state and federal regulation of coastal zone activities. These BMPs are intended as voluntary guidelines. We are dependent upon the cooperation of government agencies and private citizens to help implement these BMPs.

Three manuals have been developed which address NPS pollution from three major sources: urban storm water runoff; urban storm water from roads, highways, and bridges; and hydromodification.

List of Contacts

USEPA

Regional
Region 6 Office (Dallas, TX)
Telephone: 214-665-6450

Wetlands Information
Wetlands.helpline@epa.gov
Telephone: (800) 832-7828

LDEQ

Single Point of Contact (SPOC)	225-219-3640
SPOC (Toll-Free)	888-763-5424

LA State Police (For Spill Emergencies)

24-Hour Hotline	225-925-6595
24-Hour Hotline (Toll Free)	877-925-6595

LDNR

Louisiana Dept. of Natural Resources
Coastal Management Division
P.O. Box 44487
Baton Rouge, LA 70804
Telephone: (225) 342-7591
Toll Free: (800) 267-4019
http://dnr.louisiana.gov/crm/

LSU AgCenter

Soil Fertility/Nutrient Management
Telephone: (225) 578-6083
www.lsuagcenter.com/stpal

Permit Information

In 1987, the Clean Water Act established guidelines to control nonpoint source pollution. The Coastal Zone Act Reauthorization Amendments of 1990 entrusted coastal states with the responsibility of managing coastal resources. In 1996, Louisiana was delegated administrative authority to regulate storm water discharges through the Louisiana Pollutant Discharge Elimination System.

Activity	Permit #	Notice of Intent (NOI)
Construction		
Small (1-5 acres)	LAR200000	N/A
Large (> 5 acres)	LAR100000	CSW-G
Industrial (Multi-Sector General Stormwater Permit)	LAR050000	MSGP-G
Sand and Gravel Extraction	LAG490000	SCC3-G
Municipal Separate Storm Water Sewers[1]		
Small	LAR040000	MS4-G
Medium (≥ 100,000 people)		MS4-G
Large (≥ 250,000 people)		MS4-G
Cement, Concrete, and Asphalt Facilities	LAG110000	CCAF-G
Dewatering of Petroleum Storage Tanks, Tanks Beds, New Tanks, and Excavations	LAG300000	DPST-G
Oil and Gas Exploration, Development and Production Facilities Within Coastal Waters	LAG330000	CWOGF-G
Potable Water Treatment Plants	LAG380000	H20-G
Automotive, Motorcycle, and Recreational Vehicle Dealerships, Paint and Body Shops, Automotive Repair and Maintenance Shops	LAG470000	ARB-G
Light Commercial Facilities	LAG480000	LCF-G
Sanitary		
< 5,000 gpd	LAG530000	WPS-G
< 25,000 gpd	LAG540000	WPS-G
< 50,000 gpd	LAG560000	WPS-G
< 100,000 gpd	LAG570000	WPS-G
Hydrostatic Testing Wastewater	LAG670000	HST-G
Exterior Vehicle Washwater	LAG750000	CW-G
Construction, Demolition Debris and Woodwaste Landfills	LAG780000	C&D-G
Implementing Corrective Action Plans for Cleanup of Petroleum UST Systems	LAG830000	PST-G
Treated Groundwater, Potentially Contaminated Stormwater, and/or Associated Waters	LAG940000	CGW-G

Best Management Practices for Coastal Louisiana Nonpoint Source Pollution

CONTENTS

CONTENTS

Urban Storm Water Runoff Overview

Urban storm water runoff is storm water runoff flow, from urban or suburban areas, that does not infiltrate into the soil or evaporate into the air. Runoff flow can originate from streets, parking lots, construction sites, agricultural sites, or residential areas and can carry a variety of nonpoint source contaminants into our bayous, canals, channels, estuaries, lakes, and rivers.

Contaminants come in a multitude of forms and from a variety of activities from household maintenance to construction activity. The most common sources of water pollution in urban runoff are:

Sediments—Soils and other particulate matter are often overlooked as a serious contributor to NPS pollution. However, the USEPA (1998) recognizes suspended solids (sediment) as the number one impairment of the Nation's surface waters.

Fertilizers and Nutrients—Inorganic salts and eroded soils

Hydrocarbons—Carbon and hydrogen-based compounds (including oil and grease by-products)

Pathogens—Disease-causing organisms and materials

Pesticides—Chemicals used to control organisms or vegetative growth

Metals and Non-Metal Components of Metals Products

BMPs for urban storm water runoff have been divided into four categories:

- Site Preparation and Maintenance
- Surface Stabilization
- Runoff Conveyance
- Sediment Control

Site Preparation and Maintenance

Urban storm water runoff has been identified as one of the major contributors to nonpoint source pollution of Louisiana coastal waters. Increases in land use and development in urban areas of the Louisiana Coastal Zone lead to increases in the susceptibility of coastal waters to storm water runoff. There are several pertinent BMPs related to developmental site preparation and responsible urban land use management that can reduce the impact of nonpoint source pollutants on coastal resources.

Surface Stabilization

Erosion and sediment control are critical to the reduction of nonpoint source pollutants and the preservation of the Louisiana Coastal Zone. There are a variety of vegetative, structural, permanent, and temporary measures that can be used alone or in combination to provide surface stability, minimize the production of sediment, and maximize pollution prevention.

Runoff Conveyance

Storm water that is not evaporated or infiltrated will become runoff that can lead to surface erosion or may transport runoff from contaminated sites. Therefore, excess storm water runoff should be concentrated and directed into channels to prevent erosion and the potential contamination of surface water. Runoff conveyance practices can employ a number of different BMPs which serve to safely transport storm water.

Sediment Control

Sediment control practices are based on the presumption that storm water will transfer and deposit a certain amount of particulate matter during runoff. The USEPA has recognized suspended solids as the number one impairment of the Nation's surface waters and as the fourth major contributor to the impairment of Louisiana Wetlands. There are a variety of temporary measures that can be used alone or in combination to control sediment unloading, reduce suspended solids, and maximize pollution prevention.

BMPs
Site Preparation and Maintenance

FERTILIZER AND PESTICIDE CONTROL

Definition/Purpose

Fertilizers and pesticides are chemicals that are used in commercial and residential applications to sustain erosion-controlling vegetation.

Applicability

- In areas where soil conditions are not ideal
- In areas where weeds or other undesired vegetation offer competition
- In cases where insects or other pests are detrimental to vegetation

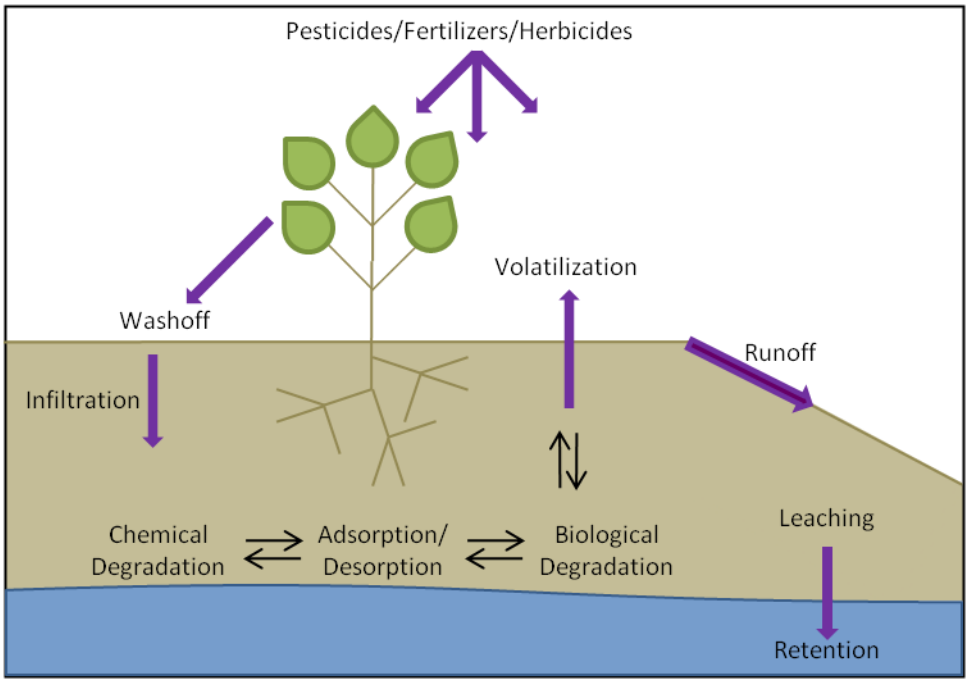
Planning Considerations

- Chemical use depends on strict following of label instructions as well as Louisiana Department of Agriculture and Forestry guidelines regarding the use of all fertilization and pesticide chemicals.
- Handling and distribution of the chemicals should be monitored and controlled with regard to environmental conditions at the time of application.
- Chemicals should not be used within 48 hours of an anticipated rain event.

Recommended Specifications

- See product and State specifications on pesticide/fertilizer use.
- Only commercial fertilizers should be used.
- Chemical composition should be specified by a 3-number sequence representing the percentages (by weight) of nitrogen (N), phosphoric acid (P), and soluble potash (K).
- For controlled-release fertilizer tablet use, the N-P-K composition should be 20-10-5 and contain calcium, sulfur, and iron.
- Acceptable fertilizers should be 8-8-8, 12-12-12, 13-13-13, or 16-16-16.
- Additional information about application rates is given in Appendix C,I.

BMPs
Site Preparation and Maintenance



Maintenance

Usually only offers temporary control. Reapplication is therefore necessary to sustain the effectiveness of this practice.

TIP

Soil testing is a quick, inexpensive (≈ $7), and efficient way to determine whether or not lime or fertilizers are needed. LSU AgCenter Soil Testing and Plant Analysis Laboratory (STPAL) has several lab facilities throughout the state that offer pH and nutrient content soil analysis. Contact information for this lab can be found on page iii.

BMPs
Site Preparation and Maintenance

GOOD HOUSEKEEPING

Photo courtesy of Alabama SWCC

Photo courtesy of Providence

Definition/Purpose

Good housekeeping, or grounds keeping, is the regular and strict compliance with state and federal laws and regulations that have been determined to be essential to controlling erosion and sediment displacement.

Good housekeeping is also considered a good neighbor practice. Private homeowners should be aware that this is not a construction-specific practice. Good housekeeping focuses on keeping both developmental and residential areas clean and orderly and minimizing runoff pollution.

Applicability

General good practice; universally applicable

BMPs
Site Preparation and Maintenance

Planning Considerations:

Construction/Professional

- Practice solid waste collection and control.
- Practice proper solid and hazardous waste disposal.
- Products should be kept properly stored in the original containers.
- Materials should be managed along each step of construction - inventory, handling, use, storage, recycling and disposal.
- Follow established spill prevention and cleanup procedures.
- Perform regular inspection and maintenance of all erosion control measures.
- Effectiveness requires proper work training and appropriate signage for specific guideline reminders.

Recreational/Private

- Regularly sweep and maintain outside areas.
- Read labels and use all household cleaning products as described.
- Practice preventative vehicle maintenance.
- Store fertilizers and pesticides indoors or in covered areas. Never use these products within 48 hours of an anticipated rain event.
- Keep yard waste, trash, and pet waste out of streets and drains.
- Practice proper oil/grease disposal; never dump these products into storm drains.
- Wash vehicles on lawns or unpaved surfaces or use a commercial car wash facility.

Maintenance

This practice should be consistently maintained to receive full benefit of the efforts.

BMPs
Site Preparation and Maintenance

PARKING LOT AND STREET SWEEPING

Photo courtesy of U.S. Geological Survey Wisconsin Water Science Center

Definition

Parking lot and street sweeping involves the collection and removal of various pollutants, including sediment, debris, trash, and trace metals, from roadways and parking lot surfaces.

Purpose

To reduce pollutant contribution to surface waters and catch basins, improve aesthetics, and control dust

BMPs
Site Preparation and Maintenance

Applicability

- Anywhere sediment can be tracked and accumulated onto paved public or private roads
- Most feasible in cities and parishes where the municipality can budget for equipment purchase, maintenance, replacement, and staffing

Planning Considerations

- Purchase and maintenance costs can be high.
- Equipment may have reduced effectiveness on wet sediment/debris.
- Vacuum sweepers may be more effective at picking up both bulk and fine debris than mechanical broom sweepers, but they are more expensive.

Recommended Specifications

- This practice requires coordination with other BMPs for the removal of fine solid particulates.
- Sweeping frequency will depend on surface loading characteristics, loading rates, aesthetic requirements, and traffic considerations.

Maintenance

Street sweeping equipment has a minimum life span of about four years with proper equipment maintenance:

- Routine vehicle maintenance
- Adjustment, repair, and replacement of brooms as necessary

☞ TIP

Implementation of this practice will reduce the maintenance requirements of other sediment control measures, such as surface drains, by reducing sediment loads.

BMPs
Site Preparation and Maintenance

TOP SOILING

Definition

Top soiling is the removal, stockpiling, and preservation of the existing soil surface (topsoil) from construction areas for immediate or future use in vegetated areas.

Purpose

To enhance site stabilization and the subsequent establishment of vegetation, especially in poor soil conditions

Applicability

- Any area where the soil surface to be disturbed has desirable properties (high organic matter content, good consistency, high water-retaining capacity, and high nutrient content)
- In areas where vegetative establishment is impeded by poor native soil properties (low-water retaining capacity, low pH)

Planning Considerations

- Topsoil is more erosion resistant than other soils, so strategic replacement of topsoil can help stabilize a site.
- Topsoil may contain weeds and weed seeds that may contribute to undesired vegetation.
- Scrapers are the most effective equipment for stripping topsoil.

Recommended Specifications

- Particle size, pH, organic content, textural class, chemical composition, and soluble salt content should be tested prior to replacement.
- Topsoil should have a pH range of 5.5-8.0 and an organic content of 2% (minimum).

BMPs
Site Preparation and Maintenance

- When being replaced, topsoil should be distributed over the surface to a depth of 6 inches (minimum).
- Stripping should begin in areas of increased elevation and continue towards lower areas for efficient topsoil removal.
- Normal depths for stripping are the uppermost 2-4 inches of soil.

Photo courtesy of Alabama SWCC

Maintenance

Top soiling requires stripping and stockpiling the soil for further use. Removal and reapplication is necessary when the site has been prepared for topsoil use.

☞ TIP

Using temporary practices to vegetate topsoil will help to stabilize topsoil piles while in reserve.

CHEMICAL STABILIZATION

Photo courtesy of Alabama SWCC

Definition/Purpose

Chemical Stabilization is the use of chemical adhesive materials, such as vinyl, asphalt, or rubber emulsions, that can be quickly and easily applied to soil surfaces to provide immediate and temporary soil stabilization.

Applicability

- Areas where vegetation is hard to establish due to environmental constraints or where timely stabilization is key
- As a complementary practice (in combination with another BMP) to enhance soil and erosion control

Planning Considerations

- Use proper application to allow water infiltration and decrease runoff.
- Choosing a chemical stabilizer requires considerations for soil type, application methods, and chemical characteristics.
- Manufacturers instructions for application rates and procedures should be closely followed.
- If improperly applied, chemical stabilizers can have the opposite effect by creating impervious soil surfaces which may increase surface runoff.

Recommended Specifications

Mixtures containing polyacrylamide (PAM) may not be applied during extremely cold temperatures (≤41°F) or extremely windy (≥20 miles/hr) conditions.

Maintenance

Chemical stabilizers are compatible with and gradually penetrate the soil. Therefore, chemical stabilizers provide only temporary stabilization so reapplication may be necessary if relied on for extended periods.

DRY DETENTION PONDS

Definition

Dry detention ponds are basins which collect and detain storm water runoff, allowing slow and controlled drainage through pond outlets.

Purpose

To achieve peak flow detention of storm water runoff allowing particulates and particulate pollutants to settle out before draining through an outlet

Applicability

- Flood control during peak flow events
- Sediment collection
- Downstream erosion prevention

Planning Considerations

- Dry basins are not considered a viable practice for the removal of soluble pollutants or as a means of controlling overall runoff volume.
- Detention ponds should be individually designed based on anticipated flow rates. Capacity should allow for the minimum detention time to achieve maximal sediment settling.
- Vegetated buffers should be maintained along the pond perimeter at all times.
- Ponds should have protected entrance points to prevent inlet erosion and offer channel protection.
- Potential downstream impacts of overall runoff volumes during non-peak flow should be evaluated and taken into consideration.
- Dry ponds may have an overall negative impact on home value (for aesthetic reasons).

Recommended Specifications

- Basins are most suitable for use with large drainage areas (10 acres, minimum).
- Dry ponds can support runoff from slopes up to 15% (maximum).
- Pond bottoms should not intersect groundwater table.
- Dry ponds should be designed to retain total volume for a specific amount of time, usually between 12 hours (minimum) and 48 hours (maximum).
- Increasing pond length to width ratio 1.5:1 (minimum) will help increase pond detention time.

Maintenance

- Annual inspection of pond inlets and outlets to ensure basins are draining properly and that no shallow pools are persisting
- Semi-annual monitoring of pond banks and bed for erosion

DUST CONTROL

Photo courtesy of Providence

Definition/Purpose

Dust control measures aim to reduce soil surface activity and air movement that cause dust generation.

Applicability

- Construction sites
- Large open areas

TIP

The number one way to reduce dust generation is to plan construction activities to limit the total amount of exposed soil at any one time!

Planning Considerations

- Environmental conditions may limit dust control options; for example, in dry conditions, evaporation may limit the effectiveness of irrigation practices.
- Additional oversight may be necessary for chemical stabilization controls (see pgs. 11-12 for details on chemical stabilization methods).

Recommended Specifications

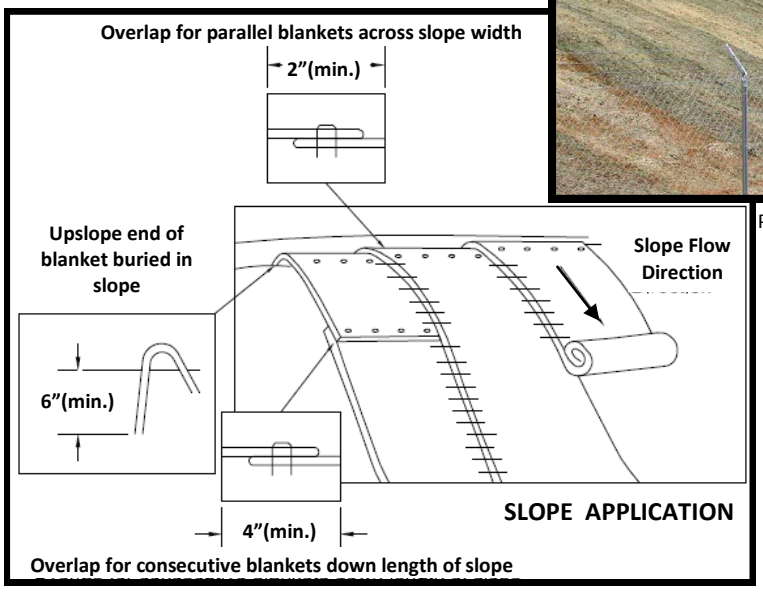
- Sprinkling/Irrigation—keeping the soil moist will reduce sediment dispersion.
- Mulching—can reduce wind erosion by up to 80%.
- Wind barriers—effective in retaining windborne sediment. This effectiveness varies based on permeability of the material chosen and the height of the barrier. Generally, for each foot raised, an 8 foot to 10 foot deposition zone will develop.
- Tillage—can reduce soil losses by up to 80%.
- Stone placement—reduces soil erosion. Larger stones (≥ 20 cm) are more effective than smaller stones. Stone offers a permanent solution to dust control unlike mulching, barriers, tillage, and chemical treatments.
- Spray-on chemical soil treatments—can reduce soil erosion by 70-90%. However, these treatments must be used responsibly to avoid contamination of muck soils, surface water, and groundwater.

Maintenance

With the exception of stone installments, these treatments offer only temporary solutions to dust control. Therefore, areas should be routinely inspected to determine if there are any areas of exposed soil where retreatment is necessary.

EROSION CONTROL BLANKET

Photo courtesy of Alabama SWCC



Definition/Purpose

Erosion Control Blankets are protective coverings made of environmentally-friendly, biodegradable materials that provide temporary, maintenance-free stabilization of soil, typically until vegetation can be established.

Applicability

- Areas of slow vegetative growth
- Slopes or other high-runoff erosion areas where vegetative seed displacement potential is high

Planning Considerations

- Material selection depends on intended use, surface and environmental conditions, and desired protection timecourse.

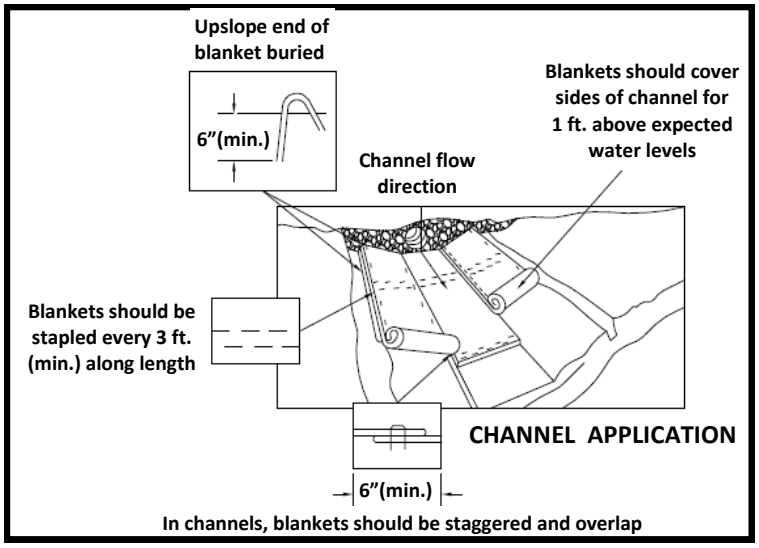
- Blankets are typically used on areas with a limited length and steepness (generally no greater than 2:1).

TIP

Preparation (compaction) of subsoil is necessary before installing an erosion control blanket.

Recommended Specifications

- Follow manufacturer directions for installation and maintenance.
- Blankets should always be installed parallel to the direction of flow.
- Blankets should be buried at least 6 inches deep at upslope end.
- After placement, blankets should be stapled every 3 feet (minimum) along the length of the blanket.



Maintenance

Low, because they degrade as vegetation establishes. Minimal maintenance includes:

- Periodic inspection and removal of sediment build-up of ≥ 2 inches over the blanket surface
- Immediate repair or replacement if blanket is damaged, there is visible erosion of the blanket, or if washout occurs

MULCHING

Definition

Mulching is the application of material such as grass, hay, wood chips, wood fibers, straw, or gravel to soil surfaces.

Purpose

To effectively and immediately prevent erosion by stabilizing soil, reducing runoff velocity, and improving soil infiltration

Applicability

- In promoting vegetative growth by providing protection of seeds, moisture retention, and thermal insulation
- Can be used on steep slopes or other high-runoff erosion areas where vegetative seed displacement potential is high

Planning Considerations

Mulching can cause alteration of soil surface conditions which may delay germination, so periodic monitoring may be necessary to ensure vegetation is being established.

☞ TIP

- Preparation (compaction) of subsoil is necessary before laying mulch.
- Organic mulches should be used whenever possible.

Recommended Specifications

- Mulch should be applied within 48 hours of seeding.
- Mulch application should begin on the top of slopes and move downward.
- Mulch will be ineffective or lost to wind and runoff if improperly or insufficiently applied. USEPA has provided the following table of mulch material application data.

Material	Rate per Acre	Specific Requirements	Notes
Straw	1-2 tons	Dry; unchopped; un-weathered; free of weeds	Must be tacked down; may be spread manually or with a mulching machine
Wood (fiber or cellulose)	1/2—1 ton		Use with hydroseeder; may be used to tack straw; not for use in hot, arid conditions
Wood chips	5-6 tons	Air dry; add fertilizer	May be spread manually, with a blower, or with a chip handler; not for fine turf areas; slope < 3:1

Photo courtesy of Alabama SWCC

Maintenance

Mulch material itself may erode over time or be lost to washout during rain events so this practice requires regular maintenance, including repairing, reseeding or remulching, to remain effective.

P

OUTLET PROTECTION

Photo courtesy of USDA NRCS

Definition/Purpose

Structurally lined aprons or other energy dissipating devices located at the outlets of pipes or paved channel sections that prevent erosion through the reduction of concentrated storm water flow velocity.

Applicability

At pipe and channel outlets where high velocity discharge exceeds the erosion-resistance of the outlet reservoir

Planning Considerations

- Riprap, grouted riprap, or concrete can be used for outlet protection.
- The end of the apron or structure should merge smoothly with the receiving channel so that discharge velocities do not increase at the end of the apron.

Recommended Specifications

- Apron structure should not slope, outlet elevation should equal the elevation of the downstream end of the receiving channel.

- When riprap is used, riprap size requirements should be well-defined (information on these requirements can be found in Appendix C,V).
- When riprap is used, apron thickness should be 1.5 times the maximum stone diameter, but thickness should be at least 6 inches; for concrete use, apron thickness should be a minimum of 4 inches.
- Apron width should be at least 3 times the diameter of the pipe or paved channel section discharging onto the apron.
- Required apron lengths are greater for larger discharge velocities and outlet pipe diameters (see table below). Apron structures should have a minimum length of 8 feet.

Minimum Length of Apron (feet)

Discharge (cubic feet per second)	Pipe Diameter (inches)											
	12	15	18	21	24	27	30	36	42	48	54	60
3	8											
5	8											
8	11	10										
10	14	12	10									
15	18	16	14	12								
20		18	18	16	12							
30			22	20	18	16						
40			26	24	24	20	18					
50				26	26	24	22	18				
70					30	30	28	25				
100						36	36	33	27			
150						42	42	42	38	33	28	
200								48	45	42	37	32

Table adapted from USDA Soil Conservation Service

Maintenance

Outlet protection practices are typically low maintenance. Outlets should be inspected periodically for cracks in the concrete or misplaced riprap stones, and repairs or replacement should be done immediately.

P

PRESERVATION OF VEGETATION

Photo courtesy of Providence

Definition/Purpose

The purpose of this practice is to preserve and protect natural vegetation to maintain inherent erosion control, storm water detention, biofiltration, and aesthetics. Established vegetation is more effective at processing storm water runoff than newly seeded vegetation.

Applicability

- Wherever desirable pre-development vegetation exists
- In areas where natural vegetation does not interfere with project advancement or where preconstruction foresight has enabled planning around existing vegetation
- In areas where alternative erosion controls would be difficult to establish, install, or maintain

Planning Considerations

- Vegetation preservation may restrict equipment movement, so routes may have to be planned to enable maneuvering around vegetation.
- Changes in hydrology or other environmental conditions could be detrimental to vegetative preservation. Plan to adhere to pre-construction conditions.

Recommended Specifications

- Buffer zones should be created around preservation areas. The size of the buffer area will vary depending on the species of vegetation being preserved.
- Choosing which vegetation to preserve takes into account several factors including: age, species, and vigor of the vegetation.
- Natural drainage patterns at the site should also be taken into consideration when deciding upon vegetative preservation.

Maintenance

- Replacement or remedy of vegetation damaged during construction
- Monitoring of vegetation to ensure that new development/structures have no adverse affect on the preserved vegetation

☞ TIP

This practice will also help to limit surface disturbances through the restriction of land area available for modification with construction activities.

SEEDING

Definition/Purpose

Seeding provides permanent soil stabilization, controls runoff and prevents erosion through the establishment of vegetation from seed.

Applicability

As an economical and universally adaptable practice that is less costly and less labor intensive than other means of vegetative establishment

Planning Considerations

Seeding is most effective when careful research is done regarding:

- the type of vegetation supported by a specific climate, soil, and topography,
- the best vegetative choices for other specific environmental and soil temperature characteristics, and
- optimal seed planting and germination times.

☞ TIP

Soil testing prior to seeding is a quick, inexpensive (≈ $7), and efficient way to determine the most compatible vegetation for the soil type. LSU AgCenter is one of several local lab facilities that offers pH and nutrient content soil analysis. Contact information for LSU is provided in the front of this manual.

Recommended Specifications

- Seed type, soil compatibility, and additional information are provided in Appendix C,III.
- For most seeding applications, soil pH should be in the range of 6.0-6.5.
- Seedbed preparation should be done prior to laying seed.
- Mulching is a highly recommended cooperative BMP that is an effective means of preventing seed displacement and stabilizing soil temperature and moisture content during seed germination and early vegetation growth stages.

☞ TIP

Effects are not immediate. Alternative temporary measures should be considered until vegetation establishes from seed.

Photos courtesy of USDA NRCS

Maintenance

Maintenance requirements vary based on the type of vegetation being used. Areas that will be used intensely or have certain aesthetic demands are typically high-maintenance. These areas require frequent mowing, fertilization, and may have more stringent watering needs. Alternatively, low-maintenance seeded areas are composed of robust vegetative species that are able to persist with little to no additional fertilization or hydration requirements and typically require infrequent to no mowing.

SODDING

Photo courtesy of Alabama SWCC

Definition/Purpose

The transplantation of a continuous vegetative cover, usually grass sod, to exposed soil to provide immediate and permanent soil stabilization, erosion control, and reduction of runoff velocity in areas that cannot be vegetated by seed.

Applicability

- In providing immediate vegetative cover to areas where it is difficult or slow to establish vegetative growth from seed
- For immediate stabilization (unlike seeding, sodding has no seasonal restrictions)
- To stabilize channels or swales that convey concentrated flows
- In the removal of total suspended solids (TSS) from runoff

Planning Considerations

Sod can be difficult to obtain, transport, and store:

- Minimum cut depth requirements of 1 inch (field grown) or 1.5 inches (nursery grown)
- Must be transported on rolls handling a maximum 225 sq ft of sod or on pallets with a maximum of 50 sq yds of sod
- Must be placed within 48 hours of being cut and kept moist until laid

☞ TIP

According to analysis of USEPA cost estimates, sodding is about 20X more expensive than seeding. However, despite the cost, sodding is still recommended when vegetation cannot be established from seed. Vegetative practices are always the best choice for stabilization.

Recommended Specifications

- To prepare area for sodding, soil surface should be pulverized to a depth of at least 3 inches, graded, and removed of weeds and other debris.
- Sod strips should be laid down perpendicular to the direction of water flow and staggered in a brick-like pattern.
- After placement, sod should be rolled or hand tamped and stapled down on the corners and at the middle.
- Specifics on approved sod species can be found in Appendix C,VI.

Maintenance

Water three times a week (minimum) for the first 30 days after installation. Adequate irrigation is necessary during installation and for the first few weeks following installation for sod to root and establish.

TEMPORARY SEEDING/VEGETATION

Photos courtesy of USDA NRCS

Definition

Temporary vegetative practices involve the establishment of fast-growing annual vegetation from seed.

Purpose

To provide economical erosion control and reduce sediment transport for a short period (usually up to one year) and to help reduce maintenance operations and prevent mud and dust production during construction

Applicability

- Where short-lived vegetation can be established prior to final grading
- When environmental conditions are not favorable for the establishment of permanent vegetation
- Necessary along dikes, diversions, channels, and basins if permanent vegetation cannot be established

Planning Considerations

This practice is most successful when fast-growing annuals are used.

Recommended Specifications

- Seed type, soil compatibility, and additional info are provided in Appendix C,III.
- For most seeding applications, soil pH should be in the range of 6.0-6.5.
- Seedbed preparation should be done prior to laying seed.
- Mulching is a highly recommended cooperative BMP that is an effective means of preventing seed displacement and stabilizing soil temperature and moisture content during seed germination and early vegetation growth stages.

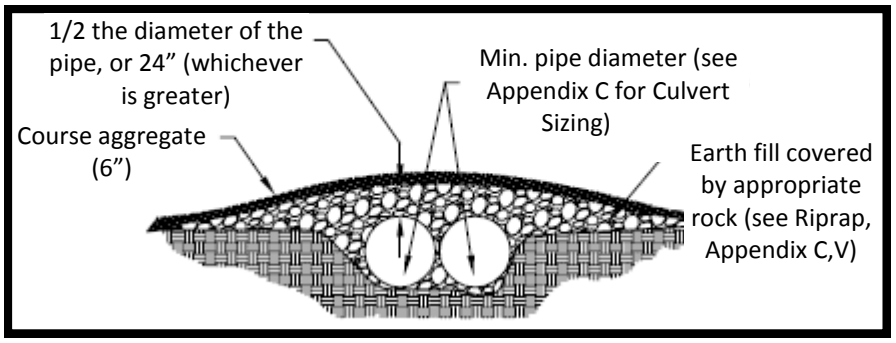
☞ TIP

For temporary seeding in winter months, Annual Rye is the only acceptable grass vegetation.

Maintenance

- Reseeding or remulching may be necessary if vegetation does not establish or if erosion occurs.
- Protect from disturbances, including mowing.

TEMPORARY DITCH/CHANNEL/BAYOU CROSSING



Definition/Purpose

A temporary crossing is a non-permanent structure, typically a bridge, culvert, or ford, that provides a safe and stable way for construction vehicle traffic to cross a watercourse.

Applicability

Temporary (construction) sites where equipment or materials need to be transported across streams or channels

Planning Considerations

- When implementing temporary water crossings, it is important to provide bank stabilization, minimize the risk of damage to the streambed or channel, and minimize sediment loading from construction traffic.
- Impacts on surrounding areas during construction, placement, and removal need to be evaluated and monitored.

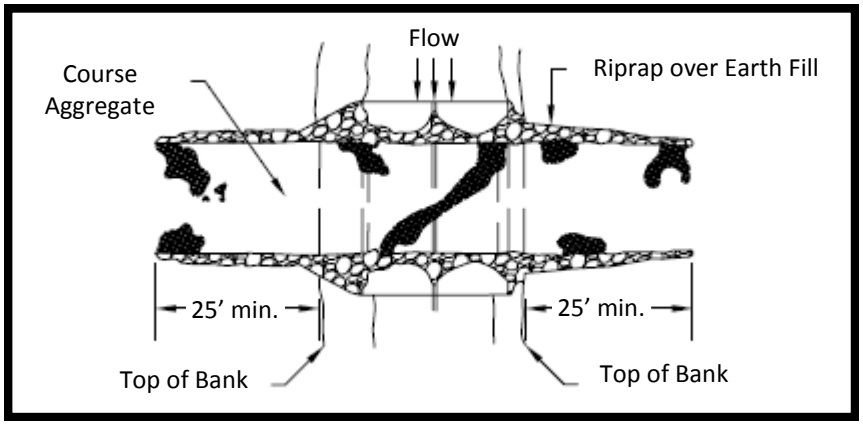
☞ TIP

Whenever possible, the need to construct temporary waterway crossings should be avoided. However, when necessary, bridges are the best option because they result in the least bank erosion and sediment loading damage.

- Culverts should be appropriately sized to support flow and soil conditions.
- Culvert size should be adequately designed to support, and not interfere with, migrating fish in the channel.
- Bridges require engineering design and more careful construction and maintenance to guarantee safe usage.
- Fords should only be used if no practical alternative is available and only during low flow periods to minimize stream pollution.

Recommended Specifications

- Bridges require support beams at 8 foot intervals along the width of a channel.
- Additional information on culvert design is given in Appendix C,VIII.
- Filter cloth should be used to cover streambeds when culverts are used.
- Filter cloth coverage should extend a minimum of 6 inches and maximum of 1 foot beyond the culvert.
- 18 inches (minimum) of compacted fill is recommended over culverts.



Maintenance

Maintenance requirements vary depending upon the type of crossing used; however, all crossings should be inspected at least once a week. Repairs to temporary structures or banks should be done immediately.

P

TREES, SHRUBS, VINES AND GROUND COVERS

Photo courtesy of Providence

Definition/Purpose

This practice involves the use of vegetative cover to stabilize soil surfaces in disturbed areas.

Applicability

Areas where establishment and maintenance of seed or sod is difficult

Planning Considerations

- Establishment may be slow and require coordination with temporary stabilization practices.
- Costs can vary significantly based on plant choices and implementation.

Recommended Specifications

Table adapted from 'Best Management Practices for Hydromodification Activities', LDEQ

Species	Spacing (maximum)	Planting Period	Wildlife Ranking[1]
Trees			
Water oak	12' x 12'	11/1—3/1	1
Willow oak	12' x 12'	11/1—3/1	2
Sweet pecan	12' x 12'	11/1—3/1	3
Nuttall oak	12' x 12'	11/1—3/1	4
Sawtooth oak	12' x 12'	11/1—3/1	5
Shrubs			
Hawthorn	12' x 12'	11/1—3/1	1
Autumn olive	12' x 12'	11/1—3/1	2
Amur honeysuckle	12' x 12'	11/1—3/1	3
Crabapple	12' x 12'	11/1—3/1	4
Russian olive	12' x 12'	11/1—3/1	5
Vines			
Honeysuckle	12' x 12'	11/1—3/15	---

[1]Rankings from high (1) to low (5)

Maintenance

Maintenance requirements vary based on plant selections. This practice can be low-maintenance if robust indigenous vegetative species are chosen.

P

VEGETATIVE FILTER STRIPS

Photo courtesy of Alabama SWCC

Definition/Purpose

Vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. This practice is successful in decreasing runoff velocities, filtering particulate pollutant, promoting soil infiltration, and in some cases, groundwater recharge.

Applicability

Large areas of low-velocity, sheet flow surface runoff

☞ TIP

In many urban areas, every square foot is valuable; therefore, space needs to be portioned out to allow for installation of a filter strip of appropriate width. When this cannot be done, seeding or sodding may have to be used.

Planning Considerations

In order to be effective, strips must be properly designed. If sheet flow cannot be maintained and high-velocity channels are allowed to form, the effectiveness of this practice can be compromised.

Recommended Specifications

- Filter strips should be used on slopes with 2% (minimum) to 6% (maximum) grade.
- Minimum effective filter strip widths (feet):

Table adapted from "Best Management Practices for Hydromodification Activities', LDEQ

Soil Type	Slope (%)	Surface Distance Draining Across Filter (feet)				
		0-50	51-75	76-100	101-150	151+
1	**≤ 8**	10	12	15	18	20
1	**8.1-12**	12	15	18	20	20
2	**≤ 3**	10	12	15	18	20
2	**3.1-8**	12	12	18	20	20
2	**8.1-12**	12	15	20	20	20

Minimum effective filter strip widths

1 Fine-Medium Soils: sand-sandy loam
2 Medium-Heavy Soils: sandy loam-clay

- See Appendix C,III (ref. Seeding) for appropriate filter strip species.

Maintenance

Comparable to regular landscape maintenance:

- Height generally maintained between 3-12 inches, depending on species
- Regular inspection to check for soil build-up that may impound water
- Re-grading or re-seeding, as necessary

CHECK DAM

Photo courtesy of Alabama SWCC

Definition

Check dams are small, temporary structures that are constructed across areas of concentrated flow, such as a swale or a channel.

Purpose

Used to temporarily slow velocity of concentrated water flows and reduce erosion

Applicability

- In channels that have temporary periods of concentrated runoff flows (as opposed to live flow streams)
- As a temporary erosion control measure in channels that cannot be permanently stabilized

TIP

Implementation Guidelines

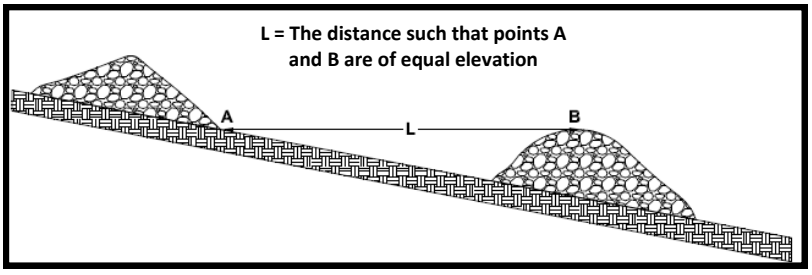
Material	Diameter (inches)
Logs	6 - 8
Rocks	2 - 4

Planning Considerations

- Construction materials (gravel, logs, rock, sandbags, and straw bales) vary in terms of effectiveness and maintenance needs.
- Check dams are ineffective as a stand alone practice for sediment trapping; they work best when used in conjunction with sediment control BMPs.
- For long channels, a series of check dams may be more effective.

Recommended Specifications

- Construction of check dams in flowing streams requires regulatory agency approval.
- When installing check dam series, the base of the upstream dam should be at the same elevation as the top of the downstream dam.



- Check dams should not be used in channels whose drainage area exceeds 10 acres.
- Check dams should have a minimum height of 3 feet.
- Center dam should be at least 6 inches lower than the channel edge.
- Check dam materials should be embedded into the sides and bottom of the channel for increased stability.

Maintenance

- Routine inspection and removal of fallen leaves and other debris that can clog the dam
- Routine inspection and repair of dam damage or erosion

DIVERSIONS AND DIVERSION DIKES

Definition/Purpose

Diversions are structures such as gutters, drains, sewers, channels, and swales that are used to collect storm water runoff and divert flow so that runoff does not contaminate or become contaminated by other water sources. Diversions are often accompanied by supporting earthen ridges (diversion dikes).

Diversion dikes are earthen levees that usually accompany a diversion, channel, ditch, or swale that is built along the perimeter of a site.

Applicability

- To redirect storm water runoff from potentially contaminated industrial sites
- To redirect runoff from low-lying areas to prevent flooding or to allow for vegetative growth to establish in these areas
- In areas where runoff from elevated areas may cause erosion
- On sloping terrains to reduce slope length and minimize soil losses

Planning Considerations

- Diversions should be designed so that runoff from areas of potential contamination are directed to appropriate treatment facilities.
- Infiltration capabilities of utilized structure materials should be evaluated to determine the potential for groundwater contamination.
- Diversions may create concentrated flows that can lead to increased erosion, so this BMP should be considered for cooperative use with other BMPs; for example, outlet protection and channel stabilization measures.
- Coordination with a sediment trapping device can significantly reduce the erosion potential of concentrated runoff that collects in the diversion channel and prevents particulates from being transferred to surface waters.
- The practice should not be used in areas where a vehicle pathway is crossed.

Recommended Specifications

- Once constructed, diversions should be immediately stabilized with vegetation, mulch, or other stabilization methods (see Surface Stabilization BMPs) along disturbed areas that drain into the diversion area.
- Diversion dike slopes should not exceed a 2:1 ratio.
- Dikes should have a 4 feet (minimum) width at the expected water level for the diversion.
- Dikes should be designed to extend a minimum distance of 0.3 feet above the expected water level.
- An outlet protection system should be incorporated.

Photo courtesy of USDA NRCS

Maintenance

- Inspection after every storm event and every two weeks until final stabilization and the establishment of vegetative cover
- Periodic monitoring to ensure that diversion or diversion dike structure is not eroding due to concentrated flow
- Diversion clearing to remove any obstructions from flow path

P

POROUS PAVEMENT

Definition

Porous pavement is a permeable pavement surface resembling traditional pavement in appearance, but structurally different in consistency. Porous pavement is made primarily of coarse bulk materials with little to no filler material so that voids are created in the surface.

Purpose

To allow for storm water runoff from the pavement to gradually infiltrate into the subsoil, promoting groundwater recharge and reducing flooding

Applicability

As surfaces for low traffic loads, such as parking lots or bike/walking trails on the tops of levees

Planning Considerations

Though initial costs are higher than traditional pavement surfaces, budget planning may indicate overall decreases in total costs due to the elimination of any need for additional land-intensive BMPs. These savings should be apparent in decreases in overall land consumption.

Recommended Specifications

- Underlying soils should have a permeability of 0.5-3 inches/hour.
- Stone reservoir layer should be level and at an appropriate depth to allow the porous pavement surface to be 2-5 feet above groundwater table.
- Incorporation of an overflow trench around the pavement perimeter can help collect excess storm water runoff during large storm events.
- Stabilization of up-slope areas (see Surface Stabilization section for full BMP lists; vegetation is most appropriate) will prevent pore clogging.

Photo courtesy of Alabama SWCC

Maintenance

- Needs to be inspected and vacuum swept regularly to avoid clogging which will decrease the effectiveness of this practice
- Maintenance of adjacent vegetation will help prevent clogging and reduce vacuum sweeping frequency

☞ TIP

One potential cause for failure is that new owners may be unaware that there is a porous pavement surface on site. Disclosing this information to future property owners will help insure the success of this BMP.

ROOFTOP RUNOFF DISPOSAL

Definition/Purpose

Rooftop runoff disposal practices involve vegetative or pond systems, installed on residential or commercial roofs, that promote storm water retention and evapotranspiration to minimize and slow roof runoff.

Applicability

- In the control of small to moderate storm events
- To increase the "green value" of a home by providing increased insulation which helps to reduce heating and cooling energy consumption
- To increase the life expectancy of the roof
- To aid in sound insulation (may be particularly useful in high traffic areas)

Planning Considerations

- Installation may require structural strengthening to support additional loads. Load calculations should take into account maintenance and support system weights in addition to the vegetation itself.
- Choice of plants can contribute significantly to installation and maintenance costs of the practice.

Recommended Specifications

Requires certified engineering design for:

- Waterproofing
- Root barrier installation
- Drainage and filter layering
- Structural strengthening

Photo courtesy of Alabama SWCC

Maintenance

- Equivalent maintenance of similar vegetation, including grooming, weeding, pruning, and watering, if necessary
- Monitoring of rooftop integrity to ensure that vegetation or water pooling is not leading to leaks in the roof
- Periodic clearing of outlets and circulation vents

SLOPE DRAINS

Definition/Purpose

Slope drain systems are made of flexible conduit that can be used to divert slope runoff to temporary alternate outlets.

Applicability

- Typically, in areas which drain no more than five acres
- In areas where stabilization needs are temporary (≤ 2 years)
- In recently graded areas until permanent drainage is installed

Planning Considerations

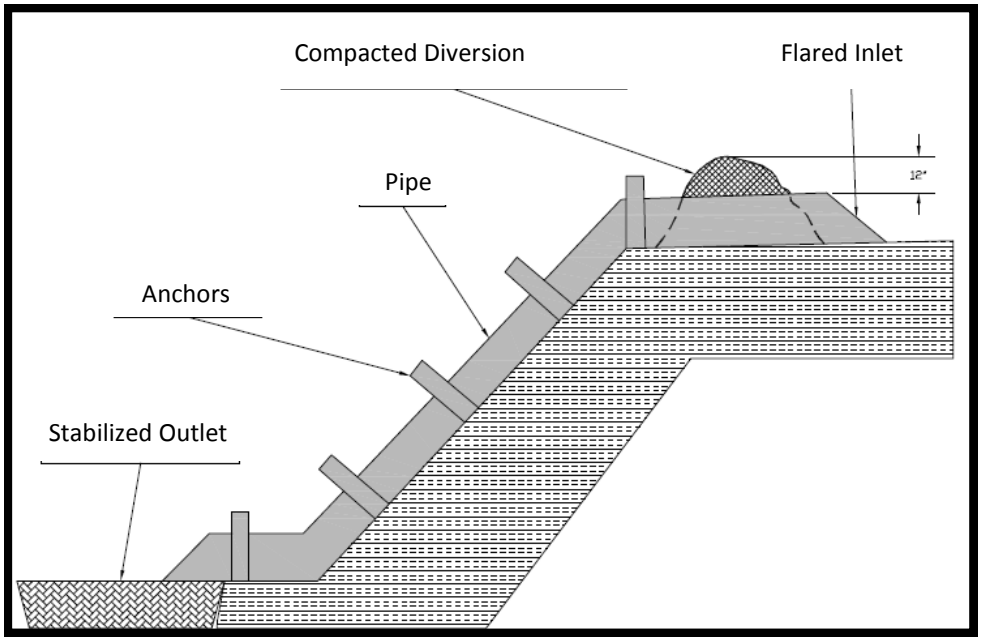
- Design of the drain, specifically pipe inlet capacity, channel capacity, and ridge height, should be adequate for drainage of the effective area.
- Drain should be constructed of heavy-duty materials suitable for specific use with this purpose.
- Permanent slope drains are often buried.

Recommended Specifications

- Anchors should be spaced a maximum of 10 feet apart.
- The pipe entrance should be flared and watertight.
- The height of the diversion should be at equal to the pipe diameter plus 0.5 feet (minimum).
- The outlet should be reinforced, and appropriate erosion control BMPs, such as outlet protection practices, should be employed.
- Some general guidelines for conduit sizing are provided on the facing page; more specific information on conduit selection is provided in Appendix C, VII (see Culverts Quick Reference Guide and/or Specific Selection Instructions).

Conduit Sizing Considerations	
Drainage Areas (Acres)	**Conduit Diameter (Inches)**
0.5	12
1.5	18
2.5	21
3.5	24
5.0	30

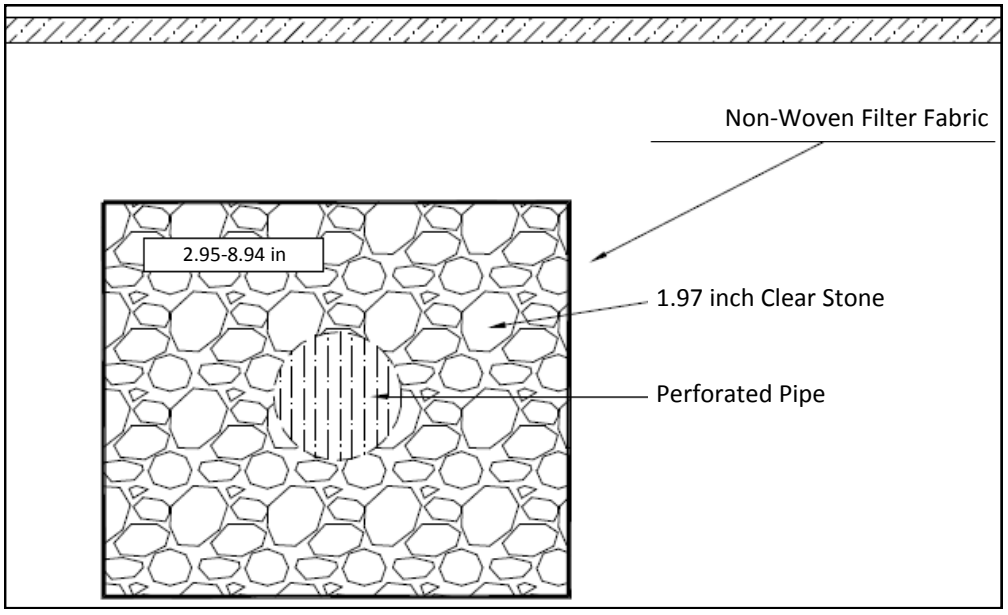
Table adapted from Alabama SWCC



Maintenance

Slope drains require routine monitoring to avoid drain inlet/outlet blocking and to ensure the effectiveness of erosion control measures at the drain outlet. Failure can lead to gully formation, erosion, and sedimentation at the outlet.

UNDERDRAIN AND STORM WATER FILTER SYSTEM



Definition/Purpose

Porous conduit, pipe, or trench that is installed below a disturbed site to collect and convey storm water runoff after following infiltration. Incorporation of filters may also be used in areas where natural soil percolation is insufficient to remove pollutants.

Applicability

- In areas where soil characteristics restrict natural infiltration and percolation
- In areas where conveyance systems will help improve infiltration and pollutant removal rates

Planning Considerations

- A thorough analysis of the soil, subsoil, and groundwater should be done prior to installation.

- Installation should be done immediately after area is prepared (trenched).
- Filling with granular material to support pipe should be done immediately following installation.

Recommended Specifications

Materials

Underdrain pipes should be made of perforated:

- Plastic:
  - CPEPSW - Single wall corrugated polyethylene (AASHTO[1] M 252, Type C)
  - PVCP - Polyvinyl chloride (AASHTO M 278)
  - CPEPDW - Double wall corrugated polyethylene pipe (AASHTO M 252, Type S)
- Steel - bituminous coated (AASHTO M 190, Type A coating) corrugated steel (AASHTO M 36, Type III). Coating thickness should be 0.03 inches (minimum) Sheet thickness should be 0.064 inches (minimum).
- Corrugated aluminum (AASHTO M 196, Type III, Alloy 3004-H34). Sheet thickness (16 gauge) should be 0.060 inches (minimum).

Installation

- Drains should have a layer (3 inches, minimum) of granular fill material below the pipe.
- Drains should be surrounded by granular materials on sides and above (minimum 1 foot fill above). See Appendix C,II for specifics on granular fill materials.
- When geotextiles are used, fabric should overlap a minimum of 6 inches at the seams.
- Underdrain outlets should be 6 inches (minimum) above the bottom of the receiving channel or ditch.

Maintenance

Periodic inspection and cleaning to ensure no blockage of outlets

[1]AASHTO=American Association of State Highway and Transportation Officials

BRUSH/FABRIC BARRIER

Definition

Brush barriers are retaining structures constructed of natural debris, such as wood/forest residue, root mats, or stones, that are stabilized with filter cloth and used to provide a sediment basin at the outlets of small drainage structures.

Purpose

To prevent or reduce transport of sediment from construction sites or disturbed areas

Applicability

- In areas that have a collection of woody debris due from fire, wind, or construction activity that can be used in barrier construction
- For small drainage areas - not suitable for high-velocity flow

Planning Considerations

- Brush barriers are most effective when natural residue is used in combination with fabric barriers which serve to hold brush material in place and increase barrier efficiency.
- Only on-site materials should be utilized for barrier construction.

Recommended Specifications

- The steepness of the slopes leading to the barrier should not exceed 2:1.
- Slopes leading to barrier should not be longer than 100 feet.
- Barrier dimensions should be at least 3 feet high and 5 feet wide.
- Debris materials with small diameters (≤ 6 inches) should not be used in barrier construction.
- Filter cloth should extend 4 inches below the brush barrier into the soil surface and 6 inches beyond the barrier on the (up-slope) drainage side.

Photo courtesy of USDA NRCS

Maintenance

These barriers are made of degradable materials and decompose over time. Due to the limited life of the barriers, supplemental brush material may need to be added as initial brush degrades. Maintenance may be necessary after storm events to remove any sediment build-up and to check for and repair any channeling that is occurring.

☞ TIP

Implementing brush/fabric barriers provides temporary storage for cleared site materials debris. However, barrier construction does require a large amount of debris to be effective. Alternative methods, such as silt fencing, may be considered if insufficient on-site material is available.

CONSTRUCTION ENTRANCES

Photo courtesy of Providence

Definition/Purpose

The implementation of gravel and filter layers to trap sediment from exiting construction vehicle and equipment before it can be transported to public roads. Typical stabilization practice is a filter cloth underneath gravel padding.

Applicability

At any construction site exit routes where mud, dust, and other debris from construction areas can be transported onto off-site paved surfaces

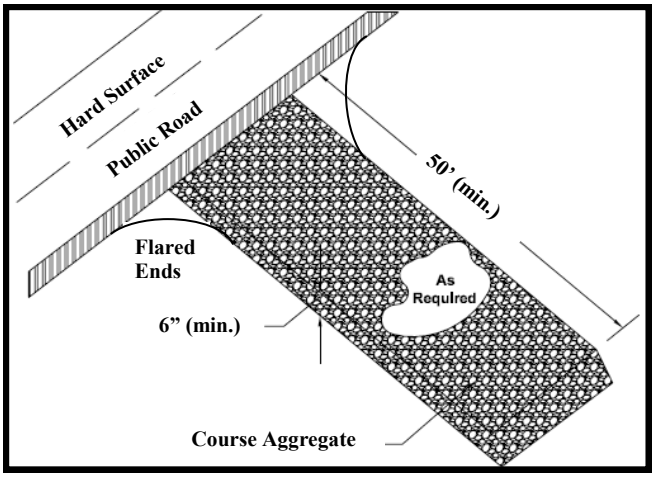
Planning Considerations

- Filter cloths should always be used as the bottom-most layer to help keep gravel from being ground into the subsoil and to prevent ground rutting.
- Additional practices, such as wash rack installation, may also be necessary if construction entrance pads are insufficient at removing debris from the vehicles tires.

- Stabilization areas should be wide enough to support any construction vehicles entering/exiting the site.
- This practice is effective only if ALL construction exit points implement this practice.

Recommended Specifications

- When exits connect directly to a paved roadway, the end of the stabilization area should be flared so that as exiting vehicles turn onto the roadway, they do not leave the stabilized area.
- Minimum recommended dimensions are 50 feet in length and 20 feet in width, but vary based on vehicle size; entranceway lengths and widths should be appropriately sized so that two vehicles may simultaneously enter/exit a site and stay in contact with the prepared entrance pad.
- Gravel layer thickness should be at least 6 inches.
- Coordination with additional BMPs may be necessary to provide bank stabilization when a construction exit crosses a ditch or channel.



Maintenance

- Regular sweeping of gravel or soil that is tracked off site
- Periodic resituating or replacement of gravel to maintain stabilization and effectiveness

FIBER ROLLS

Photo courtesy of USDA NRCS

Definition/Purpose

Fiber rolls are erosion control devices made from natural materials such as straw, flax, rice, coconut fibers, or compost that are rolled into tubes and wrapped with bio– or UV-degradable netting.

Applicability

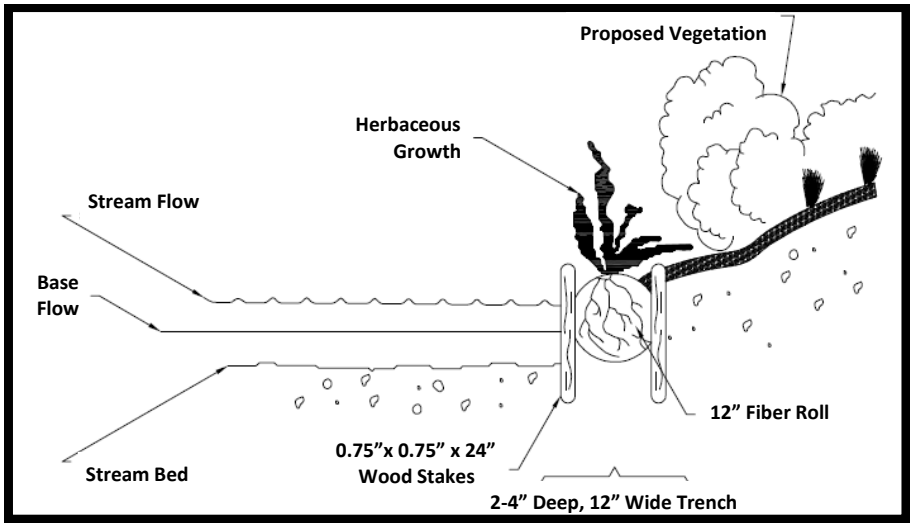
- As a complement to permanent erosion control devices to further reduce the erosion effects associated with slopes
- To reduce the velocity, filter, and distribute overland flows allowing for increased soil infiltration and reduced sediment loading of receiving water
- In areas where the goal is not to redirect flow around a barricade, but to filter out sediment and allow runoff flow-through
- In contoured installations and along site perimeters due to their moldability
- In areas where landscape, mulching, seeding, and vegetative obstructions are not desired
- As check dams in channels, ditches, or swales

Planning Considerations

- Trenching is strictly required prior to fiber roll placement.
- Fiber roll placement requires careful consideration because once rolls are saturated, they cannot be moved or relocated.
- Rolls should be designed so that the diameter is appropriately sized for slow flow. Steeper slopes require larger or multiple smaller rolls.

Recommended Specifications

- Trenches for fiber rolls should be 2-4 inches (minimum) deep with a width equal to roll diameter.
- Rolls should be staked at each end and every 4 feet (minimum) along the length of the roll. Stakes should be of nominal size 0.75x0.75 inch with a minimum length of 24 inches.



Maintenance

Fiber rolls have an anticipated life expectancy of three to five years before degradation and thus have very low maintenance requirements. However, replacement or repair may be necessary if the roll had become split or has begun to unravel or slump.

FLOATING TURBIDITY BARRIER

Photo courtesy of Alabama SWCC

Definition

Turbidity barriers are temporary silt barriers made from weighted filter fabric extending down from buoyant tubes.

Purpose

To reduce sediment transportation to or within bodies of water

Applicability

- In waterways that are adjacent to construction sites
- Around waterways that are subject to sediment loading from adjacent up-slope lands
- In low flow conditions (≤ 5 ft/sec)

☞ TIP

Floating turbidity barriers are good practices if sediment release to or sediment generation within a water body is unavoidable. However, this should be considered a cleanup practice. Every effort should first be made to avoid releasing sediment into a water body.

Planning Considerations

> **☞ TIP**
>
> Should NOT be installed perpendicular to current flow

- Turbidity barriers should not be used in high energy areas without permits.
- Tubes should be adequately visible and marked for distinction.
- Barrier fabric permeability should be based on sediment particle size, but should be able to handle the anticipated water volume and not restrict flow.

Recommended Specifications

- Care should be taken when weighting the curtain. Tidal movement of changes in flow velocities may affect the volume of water the barrier is handling. The curtain should be weighted to maintain buoyancy in the channel without collapsing into the channel (low tide/low flow conditions) or being captured in a flow stream (high tide/high flow conditions).
- Particles should be allowed to settle for 6-12 hours (minimum) before barrier removal.
- Barrier use is limited to depths of 10-12 feet (maximum).

Maintenance

- Periodic inspection of mesh and anchors to check for tearing or damage and removal of any marine growth
- Frequent inspection to check for snagging or slack due to changes in hydrology
- Inspection of buoys for damage and degradation of visibility

BMPs
Sediment Control

P

GRASSED SWALES

Definition/Purpose

Grassed swales are vegetated, open-channels that are used to treat and attenuate storm water runoff for a specific water volume by reducing runoff velocity, providing filtration, and facilitating subsoil infiltration.

Applicability

- Under low erosion conditions - small drainage, low-flow rate (≤ 5 ft/s) areas
- Should not be used in direct sediment loading conditions

Planning Considerations

- Swales should not have sharp turns or significant slope variations.
- Wet swales may contribute to mosquito breeding.
- Dry swales are superior to wet swales in terms of groundwater recharge.
- Proper slope design is essential to swale pollutant removal benefits.
- To prevent direct sediment loading, cooperative BMPs, such as vegetative buffers/filter strips, should be considered (see Sediment Control).

☞ TIP

- Use native vegetation. This will result in lower installation and maintenance costs.
- Coordination with additional BMPs is encouraged. These BMPs can be found in this section as well as under "Sediment Control."

Recommended Specifications

- Swales should have a maximum (bottom) width of 15 feet unless a support system is incorporated. Examples of support systems include riprap lining, check dams, subsurface drainage or other flow control BMPs.
- Grass height should be maintained at 3-4 inches.
- If there is an established (base) flow in the swale, an additional flow control BMP should be used in coordination. Please see above examples.
- Swale outlet should utilize erosion control measures.
- Additional temporary BMPs (see Surface Stabilization) should be used until vegetation is established.

Photo courtesy of Providence

Maintenance

- Periodic inspection for erosion of channel walls and outlets
- Litter and debris removal

GRAVEL BAG AND SANDBAG BERM

Definition

Gravel and sand bag berms are constructed of gravel or sand filled bags that are placed on flat stream beds to intercept sheet flow and divert runoff.

Purpose

To prevent erosion and filter runoff

Applicability

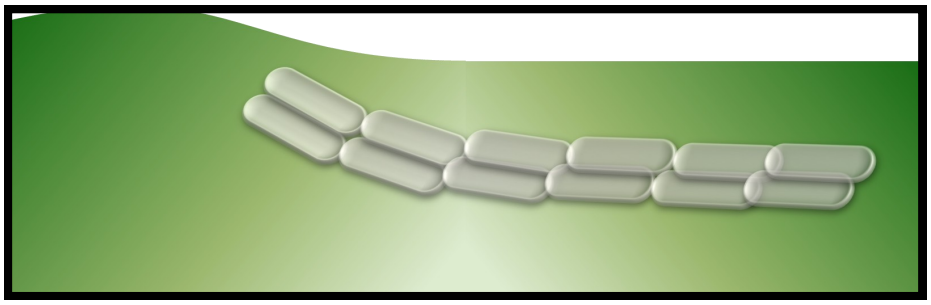
- Lining the bottoms of level contour streambeds of moderately concentrated flow channels (such as ditches or swales)
- Along the sides of ditches and channels
- Along site perimeters
- Parallel to roadways to reduce sediment transport to road surfaces
- As temporary channel crossings

Planning Considerations

- Bag installation and removal are time and labor intensive.
- Gravel bags are less of a containment issue in failure than sandbags, but both are susceptible to rupture and spillage.
- Gravel bags have a limited drainage area of five acres.
- Bag materials selection is important. Burlap should not be used for sandbags.

Recommended Specifications

- This is not intended as a stand-alone BMP. This practice should be used in conjunction with other sediment control practices.
- Plastic (polyethylene) bags are reusable. Burlap may not be reused.
- Sand bags should be filled ½ to ⅔ full.
- Gravel bags should contain gravel that is 4 to 8 inches in diameter.
- Bags should be staggered at the seams with the top of each bag tucked under itself.



Maintenance

Gravel and sandbags have limited durability and may need to be monitored and replaced. Maintenance requirements are greater for both in concentrated flow areas.

BMPs
Sediment Control

RIPARIAN BUFFER

Photo courtesy of USDA NRCS

Definition

A riparian buffer is an area of restricted development along a shoreline, wetland, or stream. These buffer zones are usually composed of both grass and deeply rooted vegetation such as trees and shrubs.

Purpose

To provide physical protection of a water body or wetland from disturbance by slowing runoff velocity and aiding in bank erosion prevention through the use of a combination of various plant systems

Applicability

- Areas where waterway ecosystems and habitats need to be conserved
- In areas where restricted use will provide storm water and flood control management benefits

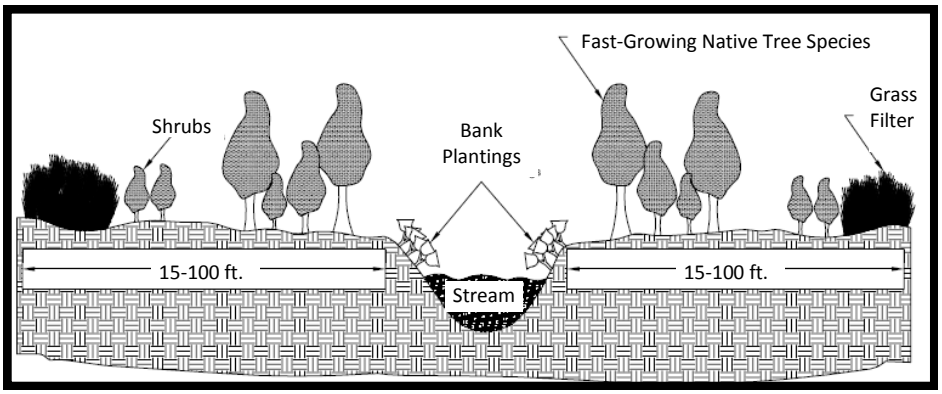
- In the prevention of waterway pollution from sediments and other contaminants

Planning Considerations

To avoid ineffective channel flow through the buffer, these areas should be designed to have storm water capture areas such as depressions, grass filters, or filter strips.

Recommended Specifications

- When able, protect native trees, shrubs, and other vegetative ground cover by planning construction activities around riparian zones.
- If establishing new vegetation, be sure to chose a variety of native plant species.
- Buffer zones should have a width of at least 15-20 feet on both sides of the waterway; ideal widths are 25-100 feet on each side.
- Buffer zone widths should be increased to treat sheet flow that is coming off of slopes.



Maintenance

Occasional inspection is necessary to ensure that environmental conditions or neighboring land use is not overloading the buffer area.

RIPRAP LINING IN CHANNELS

Photo courtesy of USDA NRCS

Definition/Purpose

This practice involves the use of heavy unsupported or grouted rocks to line the sides or bottoms of channels for structural support, to stabilize storm drains, to protect erodible soils, and to stabilize culvert outlets.

Applicability

- In areas that need additional resistance to channel degradation
- Areas where channel flow leads to erosion of channel (banks, bottom, slope) soil

Planning Considerations

- Grading should always be done prior to riprap installation.
- Riprap must be used with a geotextile underlayer.

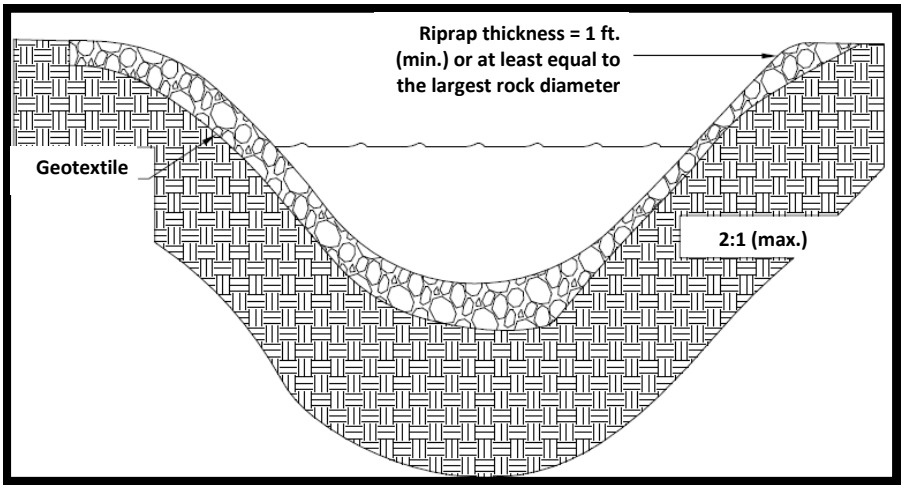
☞ TIP

Concrete channel lining is never encouraged. However, concrete lining may be considered in instances where riprap structure is consistently compromised due to region-specific challenges or wildlife interference (*i.e.* burrowing rodents)

- Rock riprap use is limited by channel flow velocity. Extreme flows may cause dislodging of placed stones. In these cases, riprap may be grouted.
- Riprap stones should be appropriately sized for flow conditions (see Appendix C,V).

Recommended Specifications

- When grouting riprap, grout mixture should consist of 1 part Portland Cement to 3 parts sand, mixed thoroughly in water.
- When grouting riprap, stones should be placed first followed by grout pouring. Grout should be poured to a minimum depth of 6 inches.
- Riprap should not be used on steep (≥ 2:1) slopes.
- Riprap layer thickness should be equal to at least the largest rock diameter.
- Stones should be carefully placed on well-graded slopes with minimal voids between rocks and with a constant thickness.



Maintenance

- Annual inspection to monitor potential rock or soil displacement or concrete lining erosion
- Annual drift checks, when riprap is used in high flow channels, to monitor riprap depth and distribution

ROCK FILTER BERM

Photo courtesy of Alabama SWCC

Definition/Purpose

A rock filter berm is a temporary gravel, stone, or crushed rock ridge that filters, redirects, and reduces the velocity of storm water runoff releasing the runoff as sheet flow.

Applicability

- On low-grade (<10%) slopes in vehicle paths
- On low-grade (<10%) slopes that are subject to frequent erosion

Planning Considerations

- Rock choices and overall berm design should consider the grade of the slope and the hydrologic, hydraulic, topographic, and sediment characteristics of the treatment area.
- Berm spacing depends on the steepness of the slope. The greater the slope, the closer the berms.
- Berms are difficult to remove.

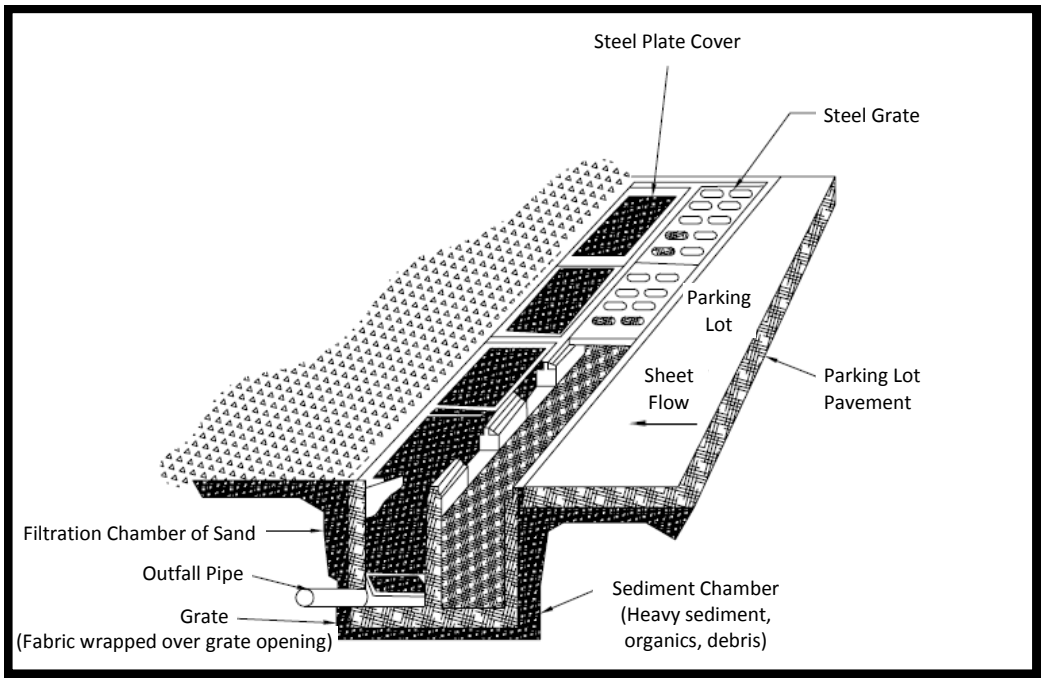
Recommended Specifications

- Rock dams are suitable for drainage areas ≤5 acres.
- Dams require space considerations for water that is ponded at the berm.
- Rock filter berms act as a runoff filter, and should not be used as a diversion method.
- Maximum height of the dam should not exceed 12 inches.
- Please see Page 69 ('Sediment Basin and Rock Dams') for additional information and design specifics.

Maintenance

- Regular maintenance is required to clear any debris that may cause filter clogging.
- Regular inspection is necessary to remove sediment build-up on the berm or to check for berm deterioration.

SAND FILTER SYSTEM



Definition/Purpose

This practice involves filter systems composed of sand layers that allows storm water to percolate through, facilitating the pollutant filtration.

Applicability

- In the treatment of flows from heavily contaminated areas (such as high TSS levels)
- In the treatment of peak runoff discharges
- In crowded urban areas (aboveground sand filter systems have small footprints, and many sand filter systems are installed underground and consume no space)

Planning Considerations

- Sand filter systems need to have trash screens or grated inlets to trap sediment and other materials removed during filtration.
- Size and placement of the system may be important in the planning stage if aesthetics are a concern.

Recommended Specifications

- Filter systems should have two chambers: one to settle large particulates and another to filter finer particles and pollutants.
- Surface filters can treat drainage areas up to 5 acres; underground filters can treat areas up to 2 acres.
- Filter systems can be used with slope steepness up to 6% but are not intended for use with flat surfaces.
- There should be a 2 feet (minimum) separation between the filter and groundwater table.

Maintenance

- Monthly inspection and collection of trash and other debris from the trash screens
- Monthly clearing of inlets and outlets
- Monthly inspection for erosion and leaks
- Annual checking and cleaning of filter
- Annual checking and clearing of flow paths

T/P

SEDIMENT BASINS AND ROCK DAMS

Definition

Sediment basins are excavated or natural depressions that are associated with earthen embankments or rock/gravel damming structures that retain and slowly drain runoff water.

Purpose

To capture and detain storm water runoff to promote sediment settling and runoff velocity reduction

Applicability

- In the drainage of (5-10 acres) when used alone
- In the drainage of up to 100 acres when sediment basins are used in combination with an earthen dam
- In the drainage of up to 50 acres when sediment basins are used in combination with a rock dam (rock dams are used when earthen embankments are difficult to construct or when riprap is readily available)
- As either a temporary (≤3 years) or permanent (>3 years) practice

Planning Considerations

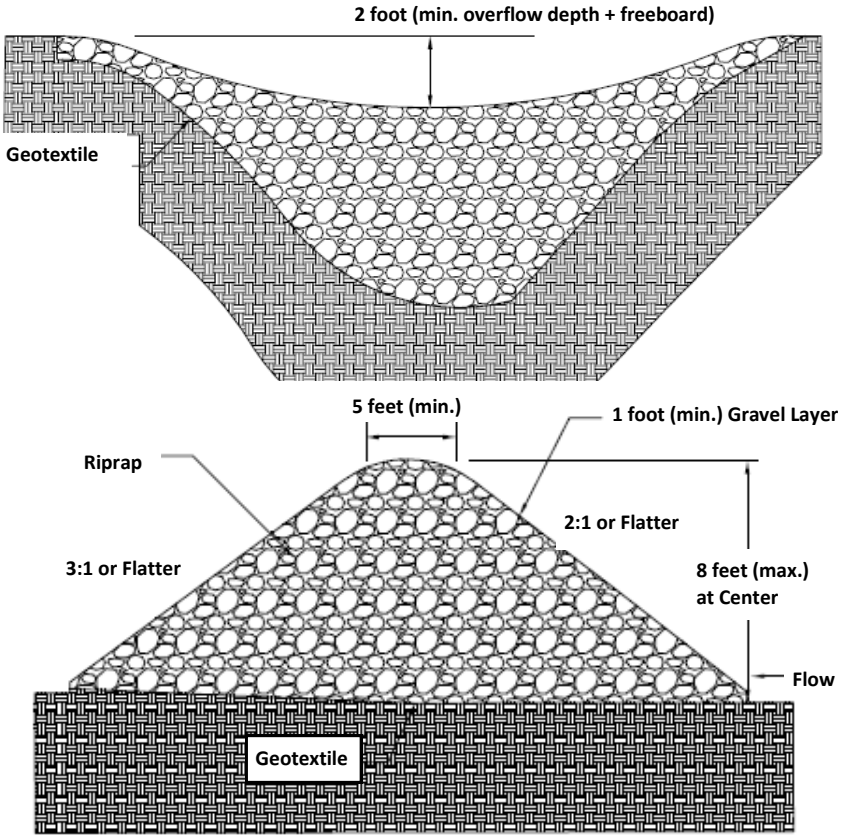
- Sediment basins-dam combinations should NOT be used in areas where basin overflow or dam failure would devastate life or property.
- The effectiveness of this practice is dependent upon particulate size and the capacity of the basin to handle the influx flow rate.

☞ TIP

Professional engineering design is recommended for sediment basin/rock dam construction. If this practice is meant to be permanent, then professional engineering design is required.

Recommended Specifications

- Basin/dam construction should be done prior to grading.
- Rock dams should be no greater than 8 feet high and have a minimum top width of 5 feet.
- Rock dams should have slopes no greater than 2:1 on the basin side and no greater than 3:1 on the outlet side of the dam.
- On the basin side of the dam, a minimum of 1 foot of gravel should be used to cover the dam from top to bottom to slow drainage.



Maintenance

- Routine inspection
- Removal of debris
- Sediment removal if sediment basin reaches 50% capacity

BMPs
Sediment Control

SILT FENCE

Photo courtesy of USDA NRCS

Definition/Purpose

Silt fences are composed of filter fabric stretched between regularly-spaced anchoring posts to temporarily control sediment transport in or around a site.

Applicability

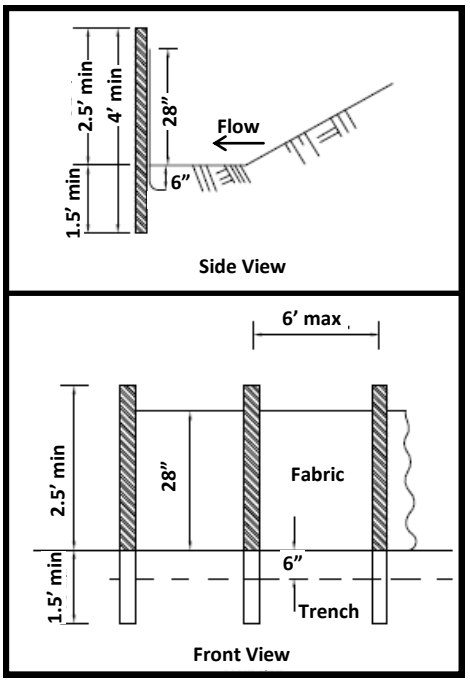
In areas where there will be temporary soil disturbance and the expected runoff volume and concentrations are relatively low

Planning Considerations

- Silt fences should not be installed over any waterways, so considerations should be made to avoid streams and ditches.
- Fence design should account for the uphill sediment pools that may form as fabric pores become clogged.

Recommended Specifications

- Wooden stakes should be at least 5 feet long and have a minimum diameter of 2 inches (hard woods for example, Oak) or 4 inches (soft woods for example, Pine).
- Stakes should extend 16 -34 inches above ground height and be uniformly anchored a maximum of 10 feet apart (standard strength fabric); maximum of 6 feet apart (extra-strength fabric).
- Fence fabric should be continuous. If this is not possible, then fabric should have a minimum overlap of 6 inches at stakes
- Filter fabrics should be fully entrenched between stake posts.
- Synthetic material fabric requirements are shown in the table below, (information provided courtesy of USEPA).



Property	Requirements
Filtering Efficiency	Minimum 75-85%; highly dependent on local conditions
Tensile strength at max (20%) elongation	Standard strength: Minimum 30 lb/linear inch Extra strength: Minimum 50 lb/linear inch
Ultraviolet radiation	Minimum 90%
Slurry flow rate	Minimum 0.3 gal/sqf t/min

Maintenance

Periodic inspection of filter fabric to check for deterioration and gapping. High wind exposure areas may require more frequent inspection. Immediate repair or replacement should be done. Maximum life expectancy is 6 months.

T/P

STORM DRAIN INLET PROTECTION

Photo courtesy of Alabama SWCC

Definition/Purpose

This practice involves excavation or inlet barrier measures that are designed to prevent soil debris from entering storm drain drop inlets. These measures include inlet perimeter excavation, installation of fabric barriers at the inlet, installation of gravel or concrete barriers at the inlet, or temporary sandbag barriers at the inlet.

Applicability

Around inlets that receive relatively clean, sediment-free runoff from small (<1 acre) drainage areas

☞ TIP

As a temporary practice, these measures are ineffective as standalone sediment and pollution control practices. Consideration should be given to other BMPs as a coordinated form of coastal wetland protection.

Planning Considerations

- For temporary protection, materials such as straw bales or fabric barriers can be used; for permanent protection, block inlets or sodding can be placed around drain inlets.
- This practice should be put into place prior to grading.

Recommended Specifications

Method	Practice Specific Recommendations
Perimeter Excavation	• Excavation depth: 1 ft (min.); 2 ft (max.) • Excavation volume: 35 yd^3 /acre (min.) • Excavated slopes: 2:1 ratio (max.)
Fabric Barrier Inlet Protection	• Stake placement: 3 ft apart (max.) • Fabric extension: 1 ft (min.) below soil surface 1.5 ft (max.) above soil surface
Gravel/Concrete Barriers	• Block height: 1 ft (min); 2 ft (max.) • Block extension: 2 inch (min.) below soil surface • Mortar required • 1/2” wire mesh should be used over block openings • Gravel should be placed along outside of blocks
Sod Inlet Protection	• Sod extension: 4 ft (min.) from inlet; all directions • Slope: 4:1 (max.) for sodded area • Sod should be placed in staggered arrangement

Maintenance

- Frequent cleaning to prevent clogging of the water intake and subsequent erosion of unprotected areas
- Repair and replacement of temporary material structures as necessary after storm events

STRAW BALE SEDIMENT TRAP

Photo courtesy of Alabama SWCC

Definition/Purpose

Straw bale sediment trapping is the implementation of straw or hay bales as check dams, perimeter controls, or as inlet/outlet protectors.

Applicability

- To filter sediments in storm water runoff for small (<5 acres) drainage areas
- To trap sediment in runoff before it can be introduced to receiving waters or drainage systems
- To slow concentrated runoff velocity
- For short-term (<3 months) sediment trapping

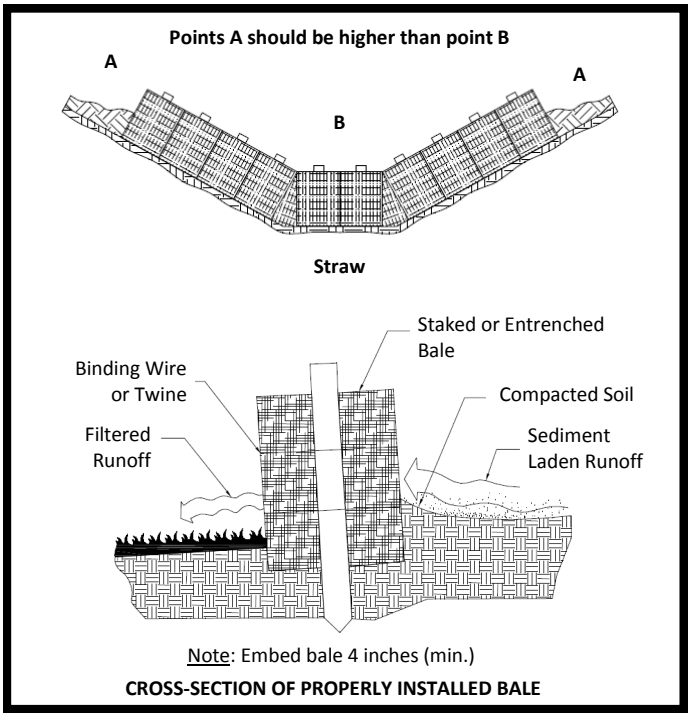
Planning Considerations

- Straw bales have very low filtration and flow rates so it can be easy for runoff to overtop.

- This practice is ineffective for large storms events.
- Bales need to be stacked down even for low-flow, small storm events.
- Bales cannot be used in channels, streams, or ditches.
- Straw bales require careful handling to avoid breaking bindings.

Recommended Specifications

- Each bale should be secured with two stakes (hardwood or rebar; minimum length = 36 inches).
- Bale size recommendation is 14 inches x 18 inches x 36 inches (minimum).



Maintenance

Need to be checked frequently to ensure bales are not rotting, falling apart, and are remaining immobilized

WATER QUALITY INLETS

Definition/Purpose

Water quality inlets are underground storm water retention systems that have one or more chambers for settled sediment collection.

Applicability

- As an alternative to wet detention ponds, especially when available land space is a consideration
- Highly effective in the removal of both large, bulky particles and finer particles (multi-chamber system) but less effective in the removal of heavy metals and organics
- Suitable for use in small (<1 acre) drainage areas in most urban applications

Planning Considerations

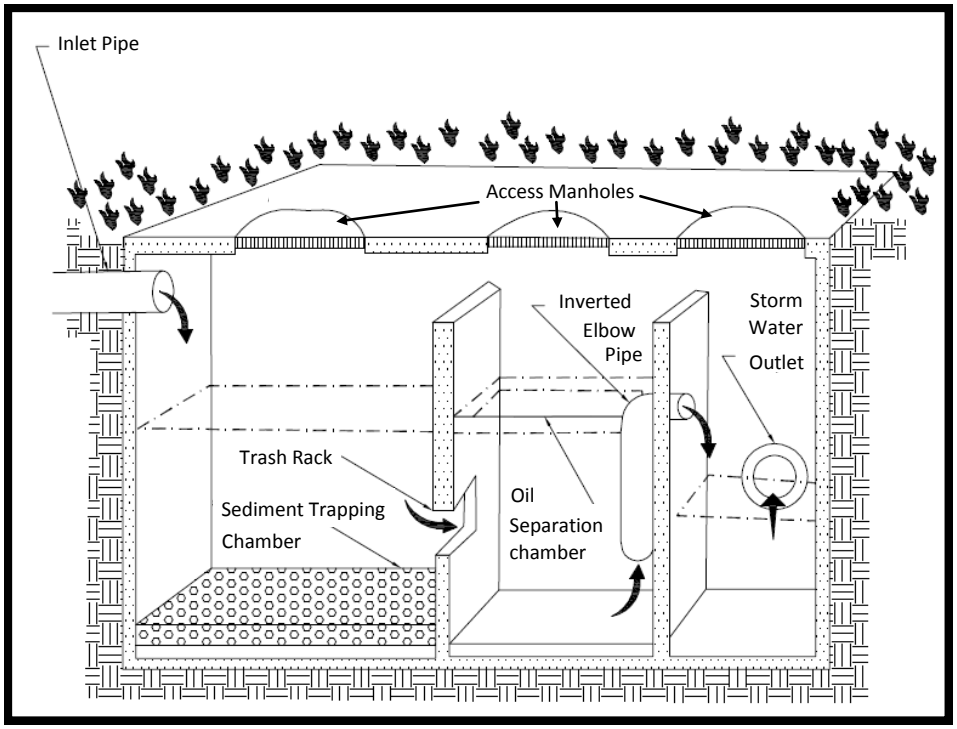
- Cannot be relied on for large storm events so additional backup BMPs are needed
- Different filter bed media are available: sand, soil, peat, compost, and others, with sand being the most common
- May be less effective in environments where freeze conditions are common

TIP

Need to be properly labeled to distinguish these storm water treatment systems from septic treatment systems.

Recommended Specifications

- Typically, the minimum vertical distance between the inflow and outflow points should be at least 5 feet
- For sand filter beds, the minimum sand depth should be inches



Maintenance

- Quarterly cleaning of residual matter in chambers is required, but may not be possible due to the design of the inlet structure. New systems should be designed for accessibility to do both emergency and routine repairs
- Annual removal and replacement of the top 3-4 inches of sand or other filter medium is required.

WET DETENTION PONDS

Photo courtesy of City of High Point Stormwater Services Division

Definition

Wet detention ponds are basins which collect and retain storm water runoff.

> **TIP**
>
> Detention ponds are used to catch and hold water, but have an outlet to allow for controlled outflow. By comparison, retention ponds maintain all water permanently (except evaporation losses) on site. In most cases, retention ponds may be substituted. However, they are generally more costly and have more significant maintenance requirements.

Purpose

To achieve sediment removal through the settling of particulates and pollutant and nutrient uptake

Applicability

In humid and moderate environments where conditions are favorable for sustaining a permanent pool

Planning Considerations

- Installation location should be carefully considered to avoid loss of forests or wetlands.
- Wet ponds can be designed to provide flood water storage and act as a flood control measure.

Recommended Specifications

- Wet ponds are compatible with large (25+ acres) drainage areas.
- Ponds can support runoff from slopes up to 15% (maximum).
- Pond bottoms should not intersect groundwater table.
- Incorporation of a sediment forebay (typically 10% of pond size) at design implementation can decrease future maintenance needs on larger pool area.
- Increasing pond length to width ratio, 1.5:1 (minimum), will help increase pond water treatment potential.
- More detailed information on a variety of other design variations that are available can be found through USEPA website (see page iii).

Maintenance

- Semi-annual inspection to ensure that biological activity is balanced
- Annual inspection and debris removal from pond inlets, pool, and forebay
- Occasional inspection for sediment build-up

Appendix A:
BMP Quick Reference Listings

BMP Category Color Coding
Site Preparation & Maintenance
Surface Stabilization
Runoff Conveyance
Sediment Control

Management Area Addressing
NEW DEVELOPMENT
Site Preparation & Maintenance
Surface Stabilization
Runoff Conveyance
Sediment Control
WATERSHED PROTECTION
Surface Stabilization
Sediment Control
SITE DEVELOPMENT
Site Preparation & Maintenance
Surface Stabilization
Runoff Conveyance
Sediment Control
CONSTRUCTION SITE EROSION AND SEDIMENT CONTROL
Site Preparation & Maintenance
Surface Stabilization
Runoff Conveyance
Sediment Control
CONSTRUCTION SITE CHEMICAL CONTROL
Site Preparation & Maintenance
EXISTING DEVELOPMENT
Site Preparation & Maintenance
Surface Stabilization
Runoff Conveyance
Sediment Control

Suggested BMP	Suggested Meeting Management Area
Brush/Fabric Barrier	Sediment transport control
Channel Lining	Channel/bank/shoreline erosion control
Check Dam	Erosion control
Chemical Control	Contamination control
Chemical Stabilization	Soil stabilization, erosion control
Construction Entrances	Sediment transport control
Diversion	Ground/surface water contamination control
Diversion Dike	Contamination control, sediment transport control
Drain Protection	Sediment transport control, erosion control
Dry/Wet Detention Ponds	Flood control, channel protection, sediment filtration
Dust Control	Dust generation/dust transport control, sediment control
Erosion Control Blanket	Soil stabilization, erosion control
Fiber Rolls	Sediment transport control, erosion control
Floating Turbidity Barrier	Sediment transport control
Good Housekeeping	Erosion control, sediment control
Grassed Swales	Flood control, channel protection, sediment filtration
Gravel/Sandbag Berm	Sediment transport control, erosion control
Mulching	Soil stabilization, erosion control
Outlet Protection	Erosion control, downstream erosion control
Porous Pavement	Sediment trapping
Preservation of Vegetation	Soil stabilization, erosion control
Riparian Buffer	Bank/shoreline protection, contamination control
Rooftop Runoff Disposal	Runoff reduction
Sediment Basin	Sediment transport control, sediment filtration
Seeding	Soil stabilization, erosion control
Silt Fence	Sediment transport control
Slope Drains	Erosion control
Sodding	Soil/channel/swale stabilization, erosion control
Straw Bale Sediment Trap	Erosion and sediment control
Street Sweeping	Contamination control, sediment transport control
Temporary Vegetation	Immediate sediment transport control, erosion control
Temp. Stream Crossing	Bank stabilization, sediment transport control
Top Soiling	Soil stabilization
Underdrain/Filter Systems	Sediment filtration, groundwater recharge
Vegetated Filter Strips	Sediment control, sediment filtration
Vegetated Ground Covers	Soil stabilization, erosion control

Appendix B
Recommended Improvement Examples

OUTLET PROTECTION

GOOD

BAD

Appendix B
Recommended Improvement Examples

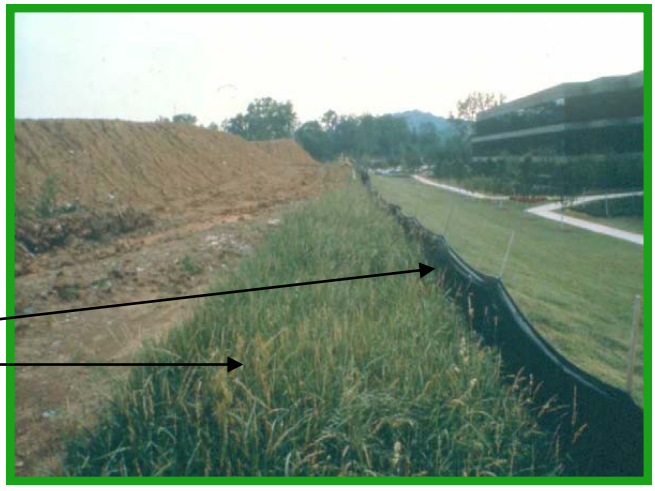
Using more than one BMP in conjunction can lead to superior erosion control, pollution prevention, and stabilization. Examples are provided below.

Example 1

Combination of multiple BMPs has resulted in a well maintained pond. BMPs in use:
Wet detention pond +
Rock dam +
Outlet protection

Example 2

Combination of multiple BMPs results in excellent sediment control and slope runoff filtration. BMPs in use:
Silt fence +
Vegetated filter strip



Appendix C
Material Specifications

I. FERTILIZER

Approved Fertilizer Compositions and Application Rates:
(Nitrogen-Phosphoric Acid-Soluble Potash, N-P-K)

Approved Type	Pounds per Acre	Kilograms per Hectare
8-8-8	1000	1120
12-12-12	667	748
13-13-13	615	689
16-16-16	500	560

Table adapted from LDOTD Standard Specifications, 2006

II. GRANULAR MATERIAL

Sizing:

Maximum Diameter, inches (mm)	U.S. Standard Sieve No.	Percentage of Granular Material
0.5 (12.7)	----	100
0.0787 (2)	# 10	75-100
0.0029 (0.075)	# 200	0-10

Table adapted from LDOTD Standard Specifications, 2006

Appendix C
Material Specifications

Tillage Requirements	
Slope	**Tillage Depth (min.)**
0-3:1	4 in
3:1-1:1	2 in
1:1-∞	none

III. SEEDING

A. Preparative Requirements:
- Soil testing
- Tillage
- Debris/weed removal

B. Specific Requirements (Table adapted from LDOTD Standard Specifications, 2006)

Type[7]	Seed Mixture[1]	Pounds/ Acre	Kilograms/ Hectare	Soil Area[2]	Planting Dates	Establishment Period[6]
A	Hulled Bermuda	30	34	1,2,3,4,5	Mar.-Sep.	Mar.-Dec.
B	Hulled Bermuda Crimson Clover[3]	20 25	22 23	1,2,3,5	Feb.-Mar.	Feb.-Jan.
C	Kentucky 31 Fescue Unhulled Bermuda	25 20	28 22	1,2,3,4,5	Sep.-Feb.	Sep.-May
D[7b]	Unhulled Bermuda Crimson Clover[3]	20 40	22 45	1,2,3,4,5	Sep.-Feb.	Sep.-May
E[7c]	Pensacola Bahia[4]	25	28	1,2,3,5	Mar.-Sep.	Mar.-Dec.
F	Ball Clover Unhulled Bermuda	25 20	28 22	1,2,3,4,5	Feb.-Mar.	Feb.-Jun.
G	Vetch (Common) Unhulled Bermuda	40 20	45 22	1,2,3,4,5	Sep.-Oct.	Sep.-Jan.
H	N/A in Coastal Zone	N/A	N/A	N/A	N/A	N/A
I	Annual Rye	30	34	1,2,3,4,5	Sep.-Jan.[5]	Sep.-Apr.

[1]Only Hulled Bermuda or Unhulled Bermuda are permitted in rest areas.

[2]Corresponding soil areas: 1- Alluvial soils of Mississippi/Red River bottoms
2– Mississippi terraces and loessial hill soils
3– Coastal plain soils
4– Coastal prairie soils
5– Ouchita River bottom

[3]Inoculated prior to planting with proper bacteria culture

[4]Type E requires Roadside Development Specialist approval

[5]Annual Rye should not be planted before September 20 and may be planted as late as January 15

[6]Vegetation is considered established when at least 85% of the seeded area is covered with grass stems and there are not voids over 4 sq ft.

[7]For all seed varieties, the min. percentage of pure live seed is at least 80%/max. percentage weed seed at most 1%

[7b]78% (min. percentage pure live seed) for Crimson Clover

[7c]2% (max. percentage weed seed) for Pensacola Bahia

Appendix C
Material Specifications

IV. GEOTEXTILE FABRICS

A. General Requirements:

- Minimum composition of 85% (weight/weight) polyolefin, polyester, or polyamide
- Minimum roll overlap of 18 inches
- Roll sewing: polyester or Kevlar thread, "J" or "Butterfly" seam, two-thread chain stitch
- Must be covered within 7 days of placement (see relevant overlay BMP structures, below)

B. Specific Requirements		Class						
Property	Test Method	A	B	C	D	S	F	G
AOS, Metric Sieve, µm, Max.	ASTM D 4751	300	300	300	212	600	850	850
Grab Tensile, N, Min.	ASTM D 4632	330	400	580	800	800	400	400
% Elongation @ Failure, Min.	ASTM D 4632	—	—	50	50	—	—	—
% Elongation @ 200 N, Max.	ASTM D 4632	—	—	—	—	—	—	50
Burst Strength, N, Min.	ASTM D 3787	440	620	930	1290	1390	—	—
Puncture, N, Min.	ASTM D 4833	110	130	180	330	330	—	—
Trapezoid Tear Strength, N, Min.	ASTM D 4533	110	130	180	220	220	—	—
Permittivity, $Sec.^{-1}$, Min.	ASTM D 4491	1.0	1.0	1.0	1.0	0.2	0.01	0.01
Grab Tensile Strength Retained after Weathering 150 h, UVA lamps, % Min.	ASTM D 4632 ASTM G 154	70	70	70	70	70	—	—
Grab Tensile Strength Retained after Weathering 50 h, UVA lamps, % Min.	ASTM D 4632 ASTM G 154	—	—	—	—	—	70	70

Table copied from LDOTD Standard Specifications, 2006

C. Relevant BMPs	Fabric Class Required
Riprap	D
Silt Fencing	F or G
Soil Stabilization (Construction Entrances)	C, D, or S
Underdrains	A, B, C, or D

Appendix C
Material Specifications

V. RIPRAP

A. General Requirements
- Sturdy, holds up to exposure to Louisiana environmental elements
- Reasonably pure, free from foreign materials
- Minimum solid weight = 155 lb/cu^3
- No dimension should be less than 1/3 the largest dimension for individual stones
- Requires geotextile fabric base

B. Specific Requirements

Riprap Class [Avg. Stone, lb (kg)]	Spherical Diameter [Avg. Stone, ft (mm)]	Percent of Stone Smaller Than Average
30 (15)	0.74 (255)	15-50
55 (25)	0.88 (270)	15-50
130 (60)	1.17 (360)	15-50
250 (115)	1.46 (455)	15-50
440 (200)	1.76 (535)	14-50
1000 (455)	2.31 (705)	10-50

Table adapted from LDOTD Standard Specifications, 2006

VI. SOD

Approved Sod Species:

Field Grown	Bermuda
	Carpet
	Centipede
Nursery Grown	Common Bermuda*
	Nomow Bermuda
	St. Augustine
	Tiffway Bermuda

(* only sod approved for use within 30 ft of paved shoulders)

Appendix C
Material Specifications

VII. CULVERTS - QUICK REFERENCE GUIDE/GENERAL INSTRUCTIONS

A. Preparation
- Area around where the culvert is to be placed should be excavated to a width of 18 in (min.) on all sides.
- The compacted earth below the culvert should have a thickness of at least ½ of the culvert diameter (8 in, min.) of compacted earth above the culvert.
- Unstable soil or rock bases should be removed and replaced prior to culvert installation.
- Culvert installation should begin at the downstream end.

B. Culvert selection—see chart on facing page

C. Installation
- Each end of the culvert should extend 1 ft (min.) beyond the slope/fill material.
- Culvert should be placed with a 1%-2% downgrade slope.
- Culvert should be angled 30°-45° in the direction of water flow.
- Riprap or other outlet protection measures should be used at outflow end of culvert.
- Soil replaced and compacted above the culvert should be equal to half of the culvert diameter (min.).

VIII. CULVERTS - SPECIFIC SELECTION GUIDELINES

A. Determine the drainage area (in acres):
The Louisiana Department of Natural Resources (LDNR) maintains a Strategic Online Natural Resources Information System (SONRIS) that can be used to retrieve acreage information and perform drainage calculations. The site provides interactive, geographically oriented, versatile map capabilities with relevant tutorials on map use. The site can be accessed at: http://sonris-www.dnr.state.la.us/www_root/sonris_portal_1.htm.

B. Determine the drainage runoff in cubic feet per second (cfs):
See Table **A** on page 91.

C. Determine the size of pipe/culvert required:
See Tables **B** and **C** on page 92. To use these tables, look under the length of pipe that is needed to span a slope or roadway (also allowing for a 1-5 ft extension on either side) for the drainage runoff value from **A**. Go down the chart until you find a number that is equal to or greater than the value from **A**. Go Across the chart to find the correct pipe diameter and recommended gauge.

(Tables **A**, **B**, and **C** adapted from "Best Management Practices for Hydromodification Activities," Louisiana Department of Environmental Quality)

Appendix C
Material Specifications

Slope rows: Flat / Moderate / Steep. Culvert Diameter (in.)

Acres Drained	Light Soils (example sands)			Moderate Soils (example loams)			Heavy Soils (example clays)		
	Flat	Moderate	Steep	Flat	Moderate	Steep	Flat	Moderate	Steep
	(0-5 %)	(5-15%)	(15+%)	(0-5 %)	(5-15%)	(15+%)	(0-5 %)	(5-15%)	(15+%)
5	18	18	18	18	18	21	21	21	24
10	18	18	18	21	24	27	27	27	36
20	18	18	18	24	27	36	36	36	42
30	18	18	18	27	30	36	36	42	48
40	18	18	18	27	36	42	42	48	
50	18	18	18	30	36	48	48	48	
75	18	21	21	36	42				
100	21	21	24	36	48				
150	21	24	24	42					
200	24	30	30	48					
250	27	30	30						
300	30	36	36						
350	30	36	42						
400	36	36	42						

Table adapted from LDEQ Forestry BMP Guide, 2001

Appendix C
Material Specifications

A. Drainage Runoff in Cubic Feet per Second

Acres	Marsh, Range & Woodland Areas	Rice Areas	Improved Pasture Areas	Coastal Cultivated Areas	Industrial and Municipal Flat Areas	Maximum for Hill Areas	Industrial and Municipal Hill Areas
2	0.12	0.28	0.37	0.55	0.69	1.61	1.91
4	0.22	0.49	0.66	0.98	1.22	2.86	3.41
6	0.31	0.69	0.92	1.38	1.71	4.01	4.78
8	0.39	0.88	1.17	1.75	2.18	5.10	6.07
10	0.47	1.05	1.41	2.11	2.63	6.14	7.31
15	0.66	1.48	1.97	2.96	3.68	8.61	10.25
20	0.84	1.90	2.51	3.75	4.70	10.94	13.20
30	1.20	2.63	3.50	5.30	6.55	15.33	18.30
40	1.50	3.34	4.50	6.70	8.33	19.50	23.21
50	1.80	4.03	5.40	8.06	10.03	23.50	27.96
60	2.10	4.70	6.30	9.40	11.70	27.33	32.54
70	2.40	5.33	7.11	10.70	13.30	31.10	37.00
80	2.70	5.96	7.95	11.93	14.84	34.73	41.40
90	2.92	6.60	8.80	13.20	16.40	38.31	45.63
100	3.20	7.20	9.60	14.40	17.90	41.83	49.81
120	3.70	8.40	11.20	16.72	20.81	48.70	57.99
140	4.22	9.51	12.70	19.02	23.80	55.40	65.94
160	4.72	10.63	14.20	21.26	26.50	61.90	73.70
180	5.21	11.73	15.63	23.50	29.20	68.30	81.30
200	5.70	12.80	17.10	25.60	31.90	74.54	88.80
220	6.20	13.90	18.50	27.72	34.50	80.70	96.10
240	6.62	14.90	19.90	29.80	37.09	86.77	103.33
260	7.08	15.93	21.24	31.86	39.65	92.75	110.46
280	7.53	16.94	22.59	33.89	42.17	98.66	117.49
300	7.97	17.94	23.93	35.89	44.67	104.50	124.45
350	9.07	20.41	27.21	40.82	50.80	118.83	141.51
400	10.13	22.81	30.42	45.62	56.80	132.81	158.17
450	11.18	25.16	33.55	50.33	62.63	146.51	174.47
500	12.21	27.47	36.63	54.94	68.38	159.96	190.49
550	13.22	29.74	39.66	59.79	74.03	173.18	206.23
600	14.21	31.98	42.64	63.96	79.60	186.21	221.74

Appendix C
Material Specifications

B. Size requirements for corrugated metal pipes flowing full under 0.2 of a foot head

Length of Pipe/Culvert Needed (ft)						Pipe Diameter (in)	Equivalent Pipe Arch (in)	Minimum Recommended Gauge
10	20	30	40	50	60			
1.6	1.4	1.3	1.2	1.1	1.0	12	--	16
2.7	2.4	2.2	2.0	1.9	1.7	15	17x18	16
4.0	3.6	3.3	3.1	2.9	2.7	18	21x15	16
5.5	5	4.7	4.4	4.2	3.9	21	24x18	16
7.3	6.8	6.3	6.0	5.7	5.4	24	28x20	14
11.6	11.0	10.4	9.9	9.5	9.1	30	35x24	14
17.0	16.2	15.5	14.9	14.3	13.8	36	42x29	12
23.4	22.4	21.6	20.9	20.2	19.6	42	29x33	12
30.7	29.7	28.7	27.9	27.1	26.4	48	57x38	12
39.1	37.9	36.9	35.9	35.0	34.2	54	64x43	12
48.5	47.2	46.0	44.9	43.9	43.0	60	71x47	10

C. Size requirements for concrete, PVC, or smooth steel pipes flowing under 0.2 of a foot head

Length of Pipe/Culvert Needed (ft)						Pipe Diameter (in)
10	20	30	40	50	60	
1.8	1.7	1.6	1.5	1.4	1.3	12
2.9	2.7	2.6	2.4	2.3	2.2	15
4.2	4.0	3.8	3.7	3.5	3.4	18
5.8	5.6	5.4	5.2	5.0	4.3	21
7.7	7.4	7.1	6.9	6.7	6.5	24
12.1	11.8	11.4	11.2	10.9	10.6	30
17.5	17.1	16.8	16.4	16.1	15.8	36
24.0	23.5	23.1	22.7	22.3	22.0	42
31.4	30.9	30.4	30.0	29.6	29.1	48
39.8	39.3	38.8	38.3	37.8	37.3	54
49.2	48.7	48.1	47.6	47.0	46.5	60

GLOSSARY

Apron - An area of non-erosive material designed to prevent erosion at the outlet ends of culverts, pipes, and other drainage devices

Berm - A sloped wall or embankment that separates a ditch from a bank

Best Management Practice - Educational and procedural activities that can resolve or reduce specific water quality resource problems if followed and implemented according to their established guidelines

Compaction - The compression of soil to decrease the overall void volume

Contaminant - Any substance that is introduced into a water body in which it does not belong and has the potential to adversely affect the quality of the water

Culvert - An enclosed concrete, metal, or plastic conduit that is used to transport water

Dam - A barrier designed to contain the flow of water for storage or for diversion purposes, to prevent erosion, or to retain soil, sediment, and other particulate debris

Detention - Storm water management through the temporary holding and controlled release of runoff

Dike - An embankment to confine or control water, often built along the banks of waterways to prevent flooding, a levee

Discharge - The volume of water transported per unit time, rate of water flow

Diversion - A channel with a supporting ridge on the lower side constructed at the top, across, or at the bottom of a slope for the purpose of controlling surface runoff

Diversion Dike - An embankment used to divert surface runoff

Embankment - A man-made angled deposit of soil, rock, or other structural material used to control or exclude water from an area, a dam

Erosion - The wearing away of land by water, wind, ice, gravity, or other environmental forces

Fertilizer - Any organic or inorganic material that is added to soils to supply elements that enhance vegetative growth

Filter fabric - A woven or non-woven, water-permeable material that is used in erosion and sediment control practices to trap sediment or prevent the movement of fine soil particles

Geotextile - A permeable textile of synthetic fibers

GLOSSARY

Gully - A deep ditch or hollow formed from the erosive forces of running water

Hydraulic - Activated or powered by fluids

Hydrocarbons - Hydrogen and carbon-based compounds (including oil and grease by-products)

Hydrology - The science of the behavior of water in the atmosphere, on the surface of the earth, and underground

Infiltration - The gradual downward flow of water from the surface through soil to groundwater and water table reserves

Mulch - A natural (plant residue) or synthetic layer of materials used to cover soil surfaces to conserve moisture, stabilize soils, and minimize temperature fluctuations

Nonpoint source pollution - Pollution that initiates from indirect, diffuse origins and does not result from singular, discernible conveyances

Outlet - The point of water disposal from a bayou, canal, channel, ditch, lake, river, or drain

Pathogens - Organisms and materials that can cause disease

Pesticides - Chemicals that are used to control or eliminate animals, insects, or undesirable vegetative growth

pH - A numerical representation of the concentration of hydrogen (H+) ions in a solution. pH ranges are from 0 (acidic) to 14 (alkaline) with 7 being neutral

Pollutant - Any substance that is introduced into water that adversely affects the quality of the water body. Any substance in overabundance can be considered a pollutant. Common water pollutants are sediment, solids, agricultural and industrial waste, metals, sewage, and biological and chemical materials

Receiving water - Any body of water into which runoff or effluent flow is discharged

Retention - The permanent storage of storm water

Riparian - Of, on, or pertaining to the banks of a water body

Runoff - Storm water that does not evaporate or infiltrate and flows from the land surface into surface waters

Scour - The clearing and digging action of flowing water, especially the downward erosion of the banks and beds of waterways

GLOSSARY

Sediment - Particulate material, both mineral and organic, that is in suspension, being transported, or has been moved from its site of origin by air, water, gravity, or ice

Sedimentation - The deposition, by settling, of a suspended material

Slope - The degrees of deviation of a surface from the horizontal, measured as a numerical ratio or as a percent. In ratio form, the first number represents horizontal distance, and the second number represents the vertical distance (ex. 2:1)

Sod - A surface layer of turf grass (including roots and surface soil) harvested in blocks or rolls

Soil - The unconsolidated mineral and organic growth material on the immediate surface of the earth that serves as a natural medium for vegetative growth

Stabilization - Treatments to minimize deterioration of surfaces due to erosive or other environmental forces

Subsoil - The layers of soil directly beneath the uppermost (topsoil) layer, typically provides structure and holds moisture but is devoid of any organic matter

Subsurface drain - A pervious backfilled trench usually containing stone and perforated pipe for intercepting groundwater

Surface runoff - see Runoff

Swale - An elongated depression in the land surface that is at least seasonally wet, is usually heavily vegetated, and is normally without flowing water

Topsoil - see Soil

Turbidity - A qualitative measurement of water quality. Suspended solids that have not settled out contribute to the overall cloudiness (turbidity) of the water

Urban storm water - Runoff from developed and undeveloped urban areas that is discharged into coastal receiving waters

Water quality - A term used to describe the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose