



Module 3

Onsite Practices

Module 3a

ESC Practices and

Minimum Standards



Principles of Erosion & Sediment Control

Let's Start with two
REMINDERS from Module 1

Principles of Erosion & Sediment Control

Sediment Control - subordinate to erosion control practices; second line of defense.

Coordination of erosion control, sediment control, & management of stormwater leaving the site is necessary for a well-integrated program!





Functions of Structural Controls

- **“Second line”** of defense against sediment loss.
- **Must be used in conjunction with vegetative controls.**
- **Must not exceed design limitations**



Functions of Structural Controls

- High life cycle costs for a project.
- Temporary controls must be removed after final stabilization.



Overview of Structural Controls



ESCH Practices

Can be tied into 1 or more MS contained in the regulations





ESCH Practices

15-16 Flumes

- Temporary Slope Drains
- Paved Flumes

17-21 Waterway & Outlet Protection

- Stormwater Conveyance Channel
- Outlet Protection
- Riprap
- Rock Check Dams
- Level Spreader

22-27 Stream Protection

- Vegetative & Structural Streambank Stabilization
- Temporary Vehicular Crossing
- Utility Stream Crossing
- Dewatering Structures
- Turbidity Curtain

28 Subsurface Drain

39 Dust Control

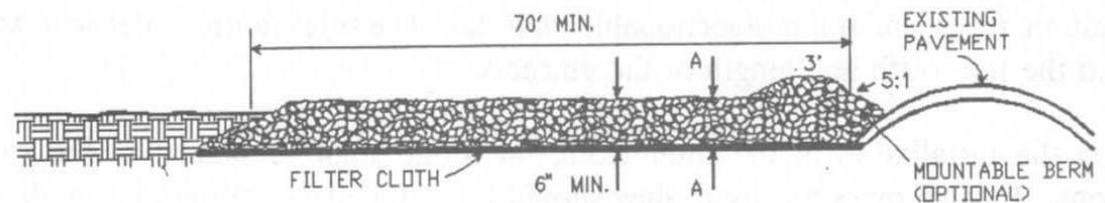


ESCH Organization

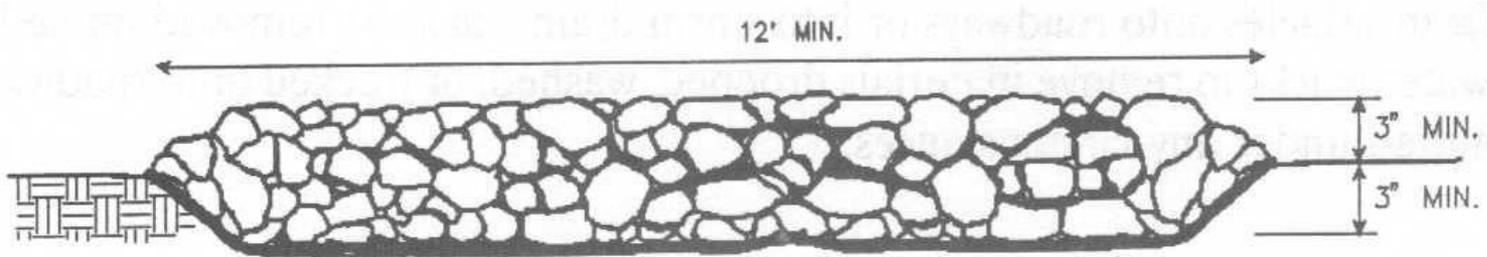
- **Definition**
- **Purpose**
- **Condition where practice applies**
- **Planning considerations**
- **Design criteria**
- **Construction specifications**
- **Maintenance**

Construction Entrance (3.02)

- Used to reduce the amount of mud transported onto paved public roads by motor vehicles or runoff.
- A stabilized stone pad with a filter fabric underliner
- Located at points of vehicular ingress and egress. Should be @ least 70 feet long*



Construction Entrance (3.02)







- Any mud that gets onto paved or public roads must be removed daily by:
- Shoveling and sweeping
- * Only then can the pavement be washed





Take home points:

- ✓ Minimize mud tracked onto paved or public surfaces
- ✓ Shovel then sweep at the end of each day
- ✓ Every LDA needs a CE

PG 3 *Construction Road Stabilization* (3.03)

- Temporary stone stabilization of access roads, subdivision streets, parking areas and other traffic areas immediately after grading
- Prevents erosion and re-grading





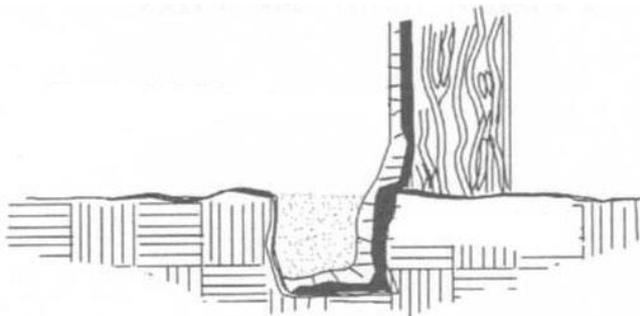


Silt Fence (3.05)

- **A temporary sediment barrier with fabric stretched across and attached to posts and entrenched**
- **Used to intercept and detain small amounts of sediment from sheet flow**
- **Decrease the velocity of sheet flows and rill erosion or small concentrated flows (1 cfs max.)**
- **Limited to 1/4 acre of drainage per 100 ft.**
- **Requires constant maintenance and clean-out**

Silt Fence (3.05)

- Should be placed on contour
- Installed as a “first step” perimeter controls in land-disturbance



4" x 4"





Clean out when sediment
is 1/2 the height of the
silt fence.





27/11/2006





Take home points:

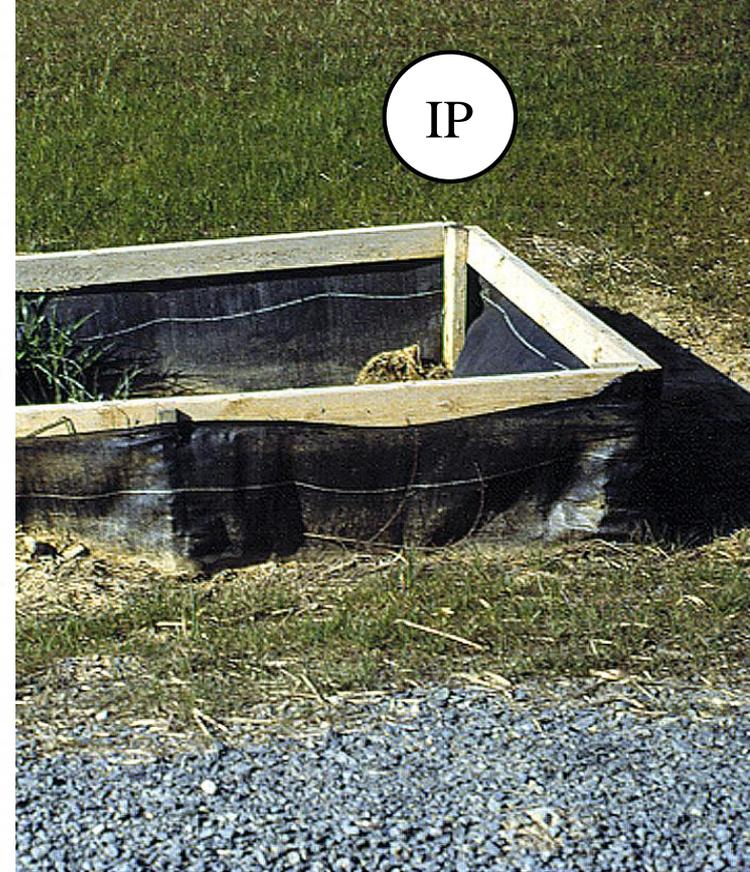
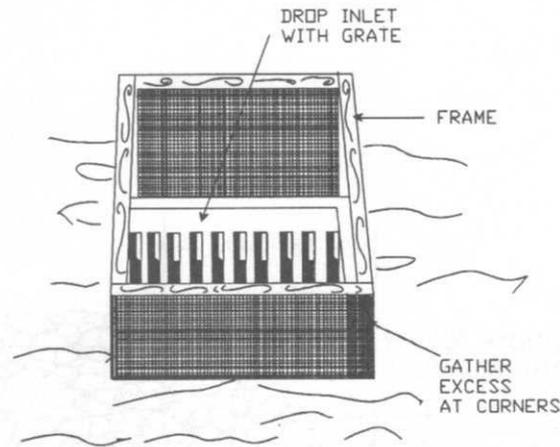
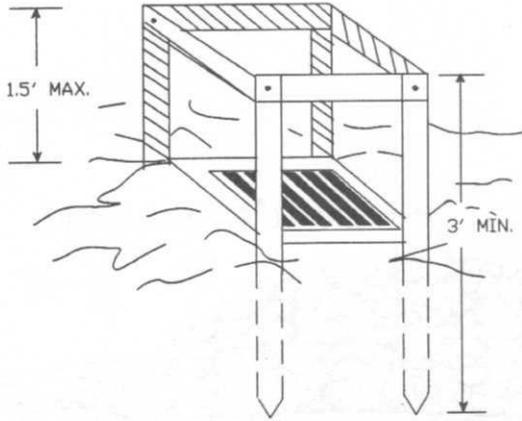
- ✓ Small drainage area & flow
- ✓ Must be installed correctly!
- ✓ Needs constant maintenance
- ✓ Design Life/cycle = 6 months
- ✓ Must be removed at end of project

Storm Drain Inlet Protection (3.07)

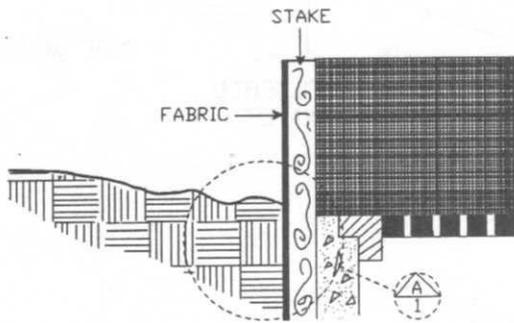
- A sediment filter or an excavated impounding area around a drop inlet or curb inlet
- Used to prevent sediment from entering storm drainage systems
- Installed prior to permanent stabilization if the system is made active
- Limited to drainage areas < 1 acre



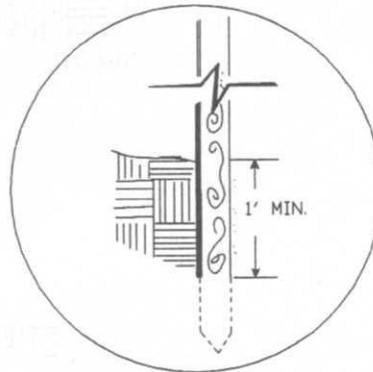
2 X 4' WOOD FRAME



IP

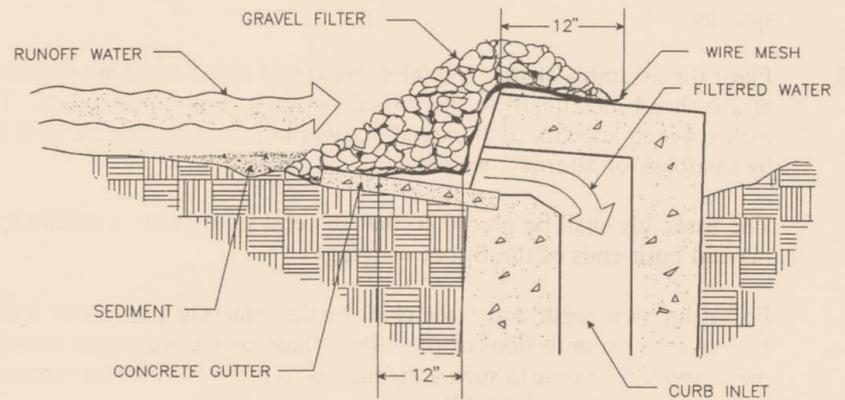
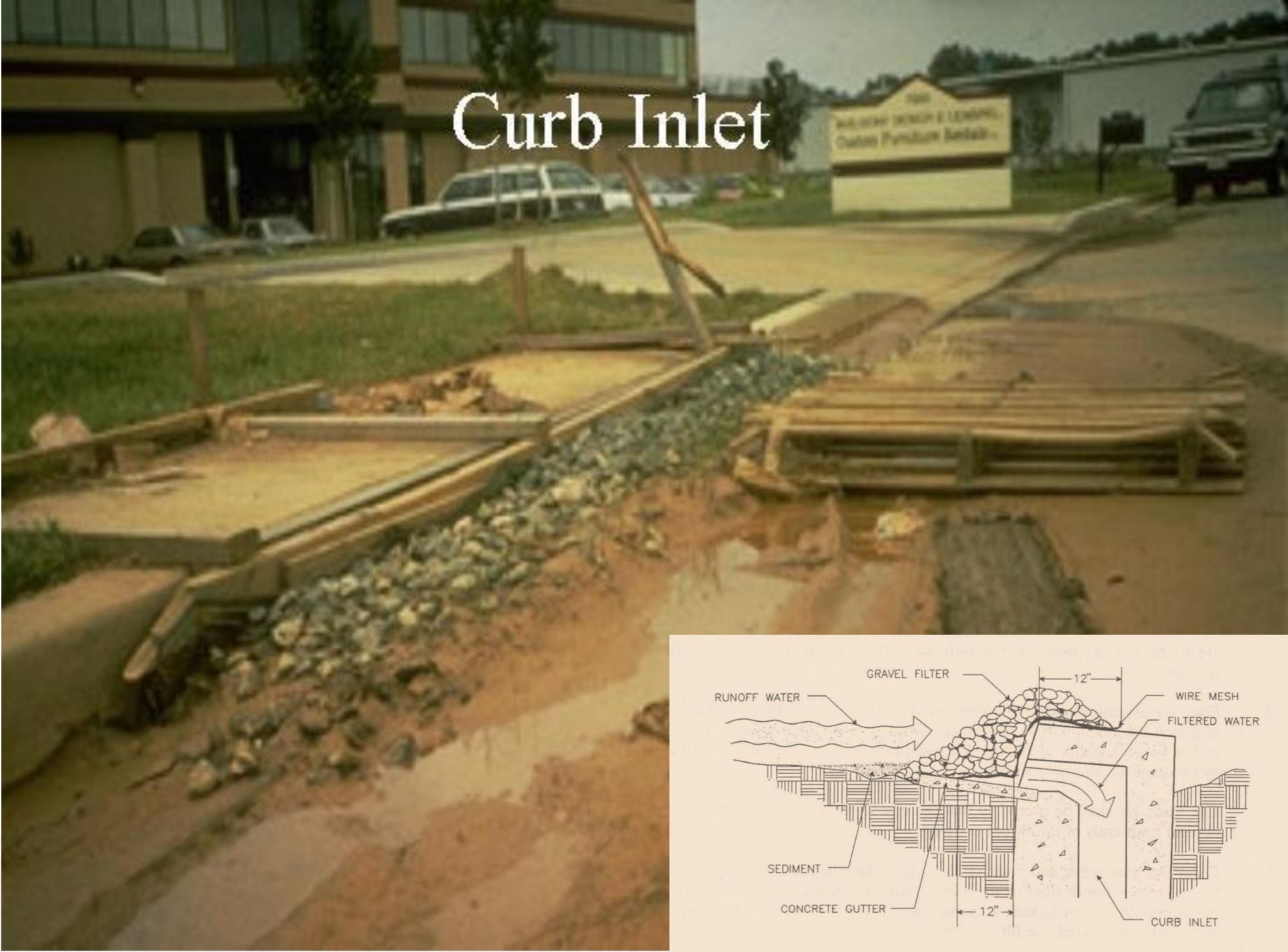


ELEVATION OF STAKE AND FABRIC ORIENTATION



DETAIL A

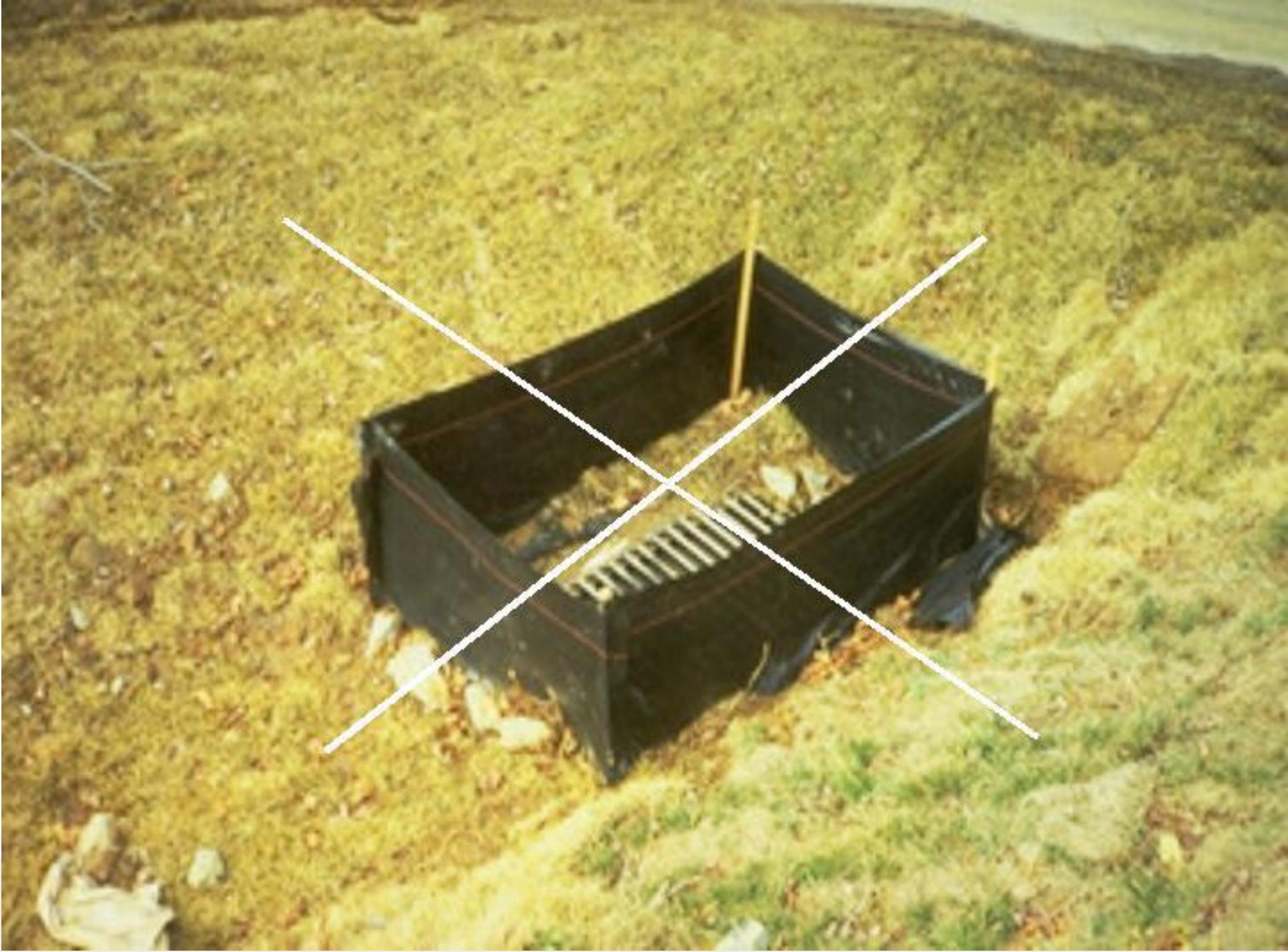
Curb Inlet

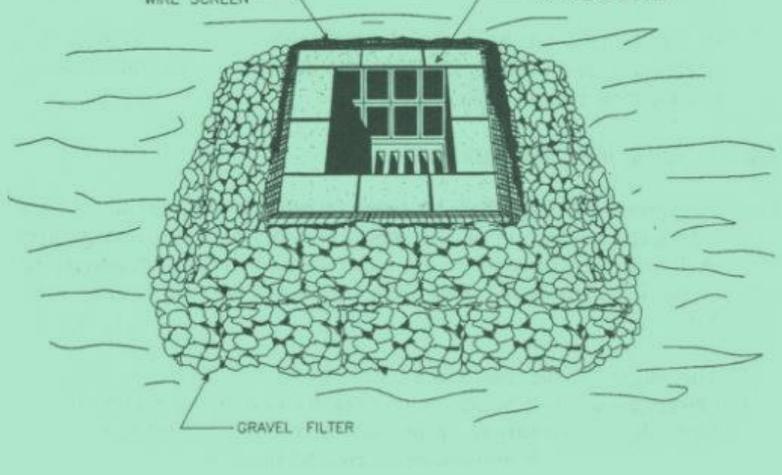












IP









Take home points:

- ✓ Keep sediment out of the storm sewer system
- ✓ Entrench 12 inches around drop inlet
- ✓ 2 x 4 frame around the top

Culvert Inlet Protection (3.08)

- To prevent sediment from entering, accumulating in and being transferred by the culvert.
- To provide erosion control at the storm sewer culvert inlets during elevation and drainage patterns change

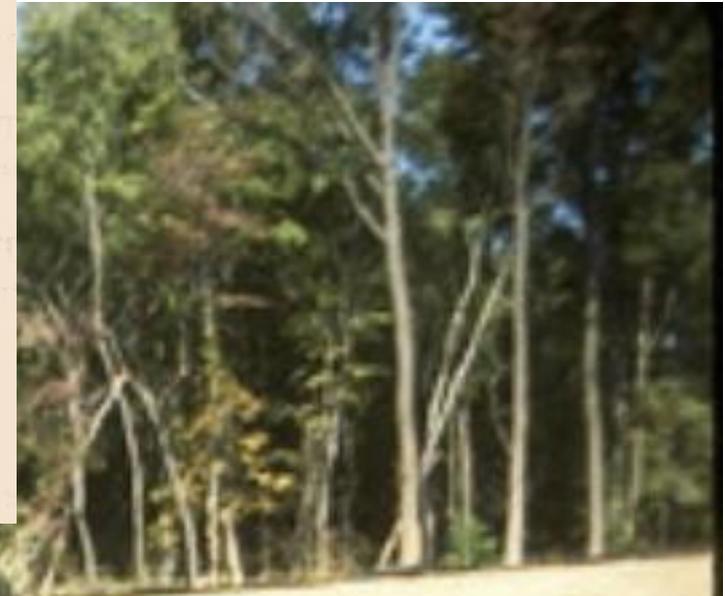
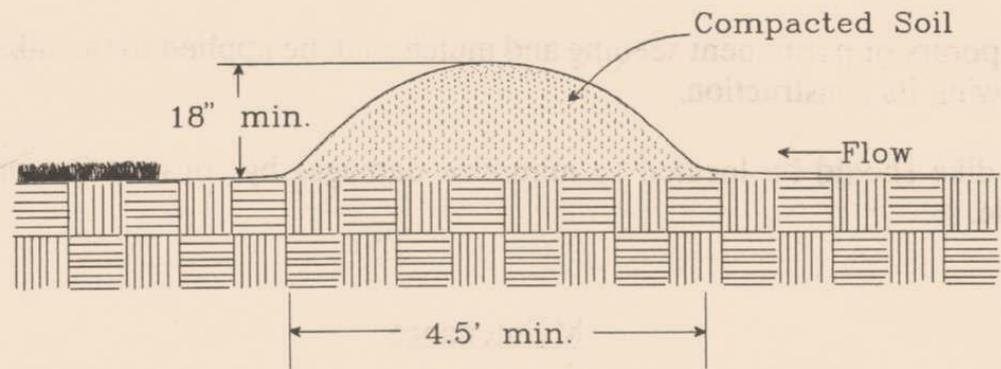






Temporary Diversion Dike (3.09)

- **A temporary ridge of compacted soil to divert storm runoff from upslope drainage areas away from unprotected disturbed areas and slopes**
- **Stabilize immediately after construction**
- **Needs to drain to a stabilized outlet or divert to sediment-trapping structure**
- **Maximum life - 18 months**
- **Maximum drainage area - 5 acres**



Purpose: to divert runoff or shorten overland flow

Maximums: 5 acre drainage area



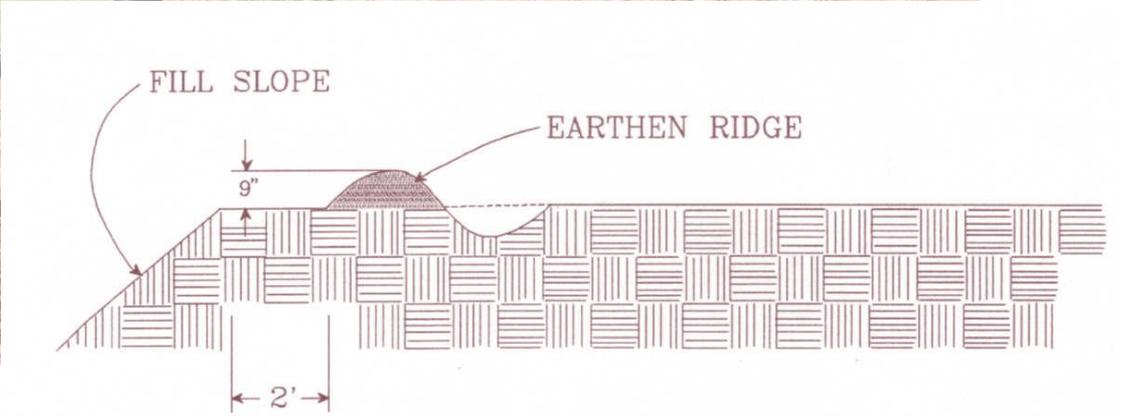
Take home points:

- ✓ Use these to divert runoff on your site, if you have problems with concentrated runoff
- ✓ Stabilize immediately so they don't become an erosion problem



Temporary Fill Diversion (3.10)

- **A channel with a supporting ridge of soil on the lower side**
- **Constructed along the top of an active earth fill at the end of each day**
- **To divert storm runoff away from the unprotected slope of the fill**
- **To a stabilized outlet or sediment-trapping facility**
- **Maximum effective life is one week**

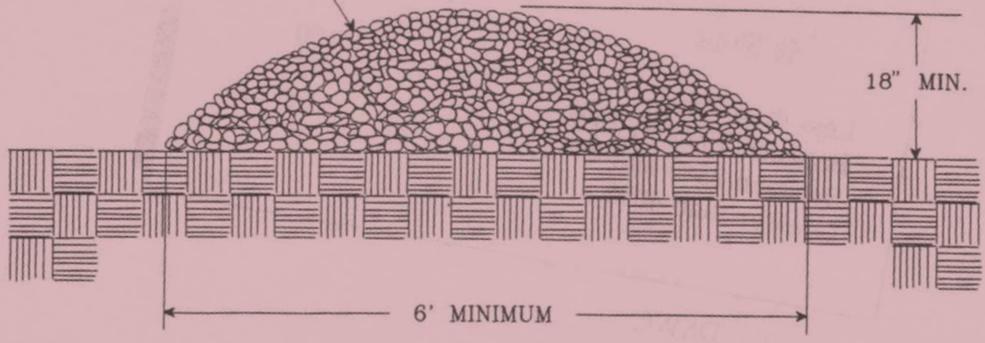




Right-of-Way Diversion (3.11)

- **A ridge of compacted soil or loose rock or gravel constructed across disturbed rights-of-way and similar sloping areas**
- **To shorten the flow length within a sloping right-of-way (Speed Bump)**
- **Reducing the erosion potential by diverting storm runoff to a stabilized outlet.**
- **Gravel structures where vehicles travel**

VDOT #1
COARSE AGGREGATE





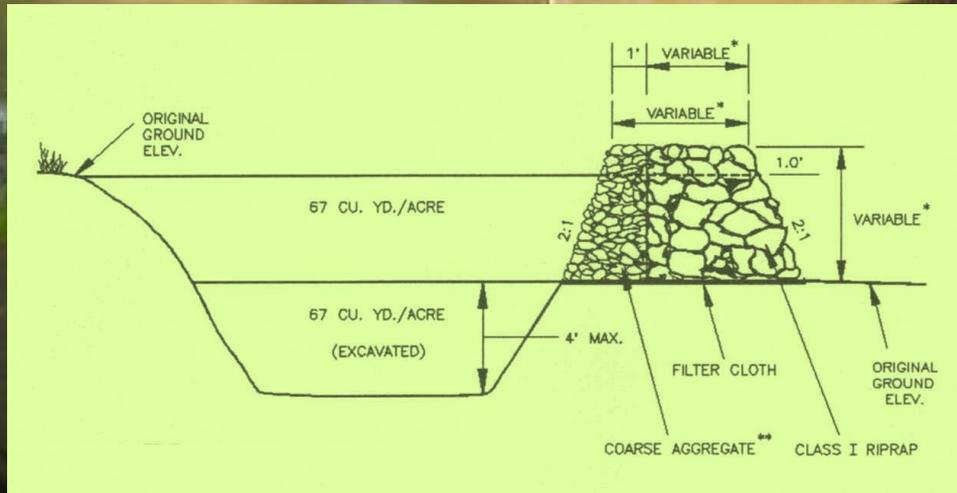
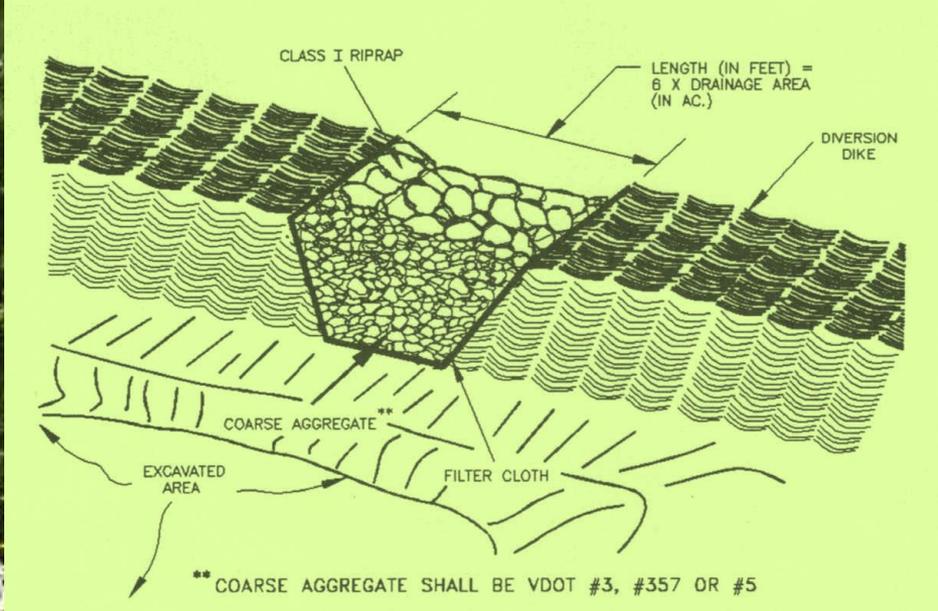
Take home points:

- ✓ Use these to slow down runoff on your site when you have those long grades or problems with concentrated runoff
- ✓ Can save a lot of re-grading



Temporary Sediment Trap (3.13)

- A ponding area formed by constructing an earthen embankment with a stone outlet across a drainage swale
- Used to detain sediment-laden runoff from small disturbed areas long enough to allow most of the suspended solids to settle out
- Stabilize immediately after construction
- Maximum drainage area - **less than 3 acres**
- Max effective life – 18 months





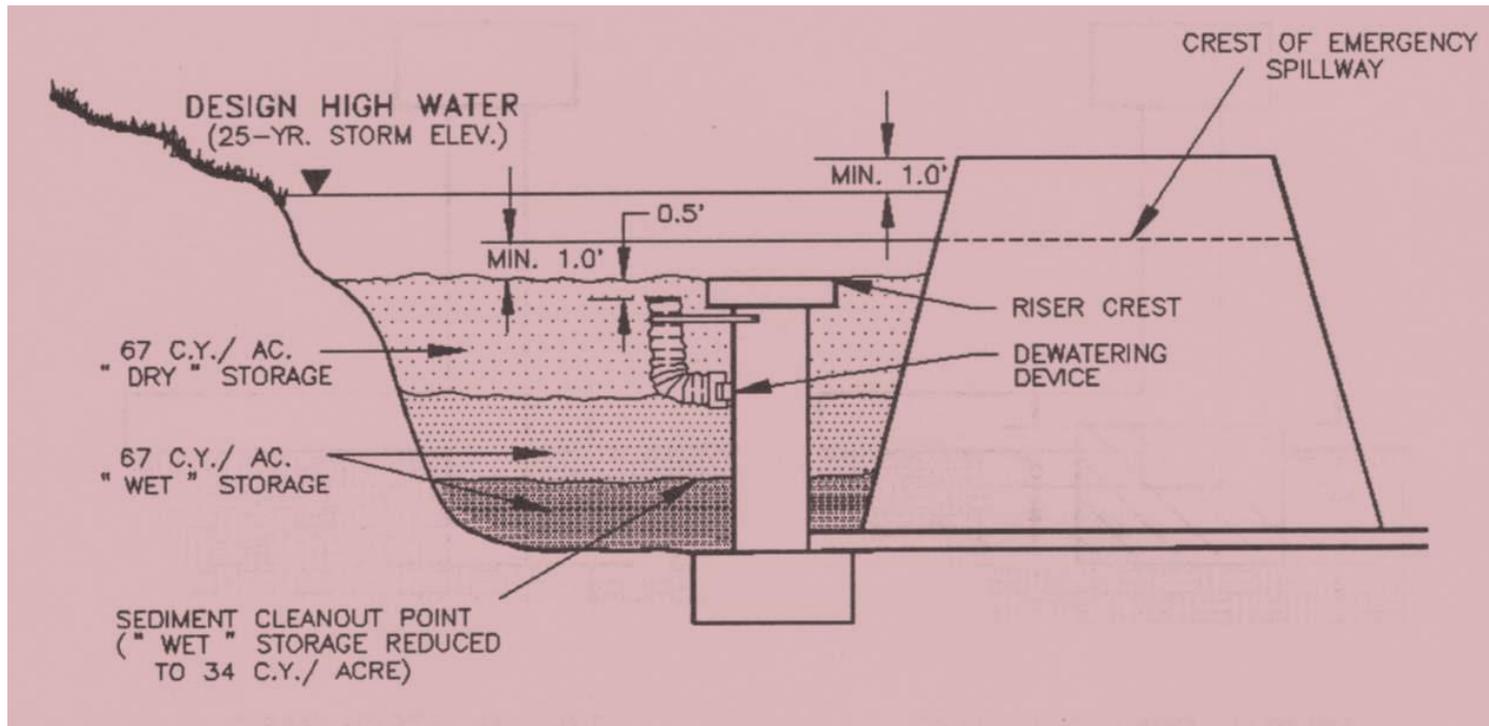
Take home points:

- ✓ Stabilize immediately
- ✓ Mark the clean out level
- ✓ Filter fabric under the stone is a must!
- ✓ Inspect after storm events for scour around the stone or embankment

Temporary Sediment Basin (3.14)

- A temporary barrier or dam with a stormwater release controlled structure
- Constructed of an embankment of compacted soil across a drainage way
- Used to detain sediment-laden runoff from disturbed areas long enough for most of the sediment to settle
- Required for drainage areas 3 acres and greater

Temporary Sediment Basin (3.14)



Sediment Basin

Earth Dike

Inflow Protection

Principal
Spillway



Riser/barrel assembly





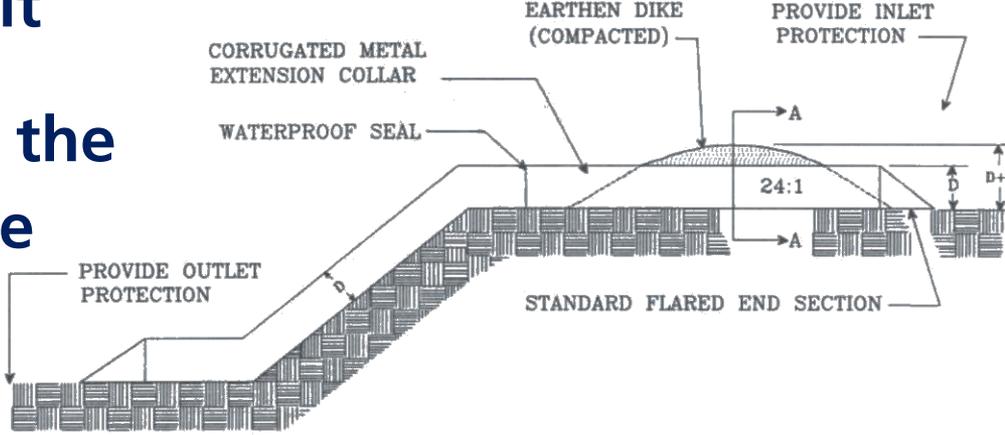


Take home points:

- ✓ **Construct as a first step and stabilize immediately**
- ✓ **Block off low flow orifice if structure will be converted to a SWM basin**
- ✓ **Don't over-excavate!**
- ✓ **Engineered structure.**

Temporary Slope Drain (3.15)

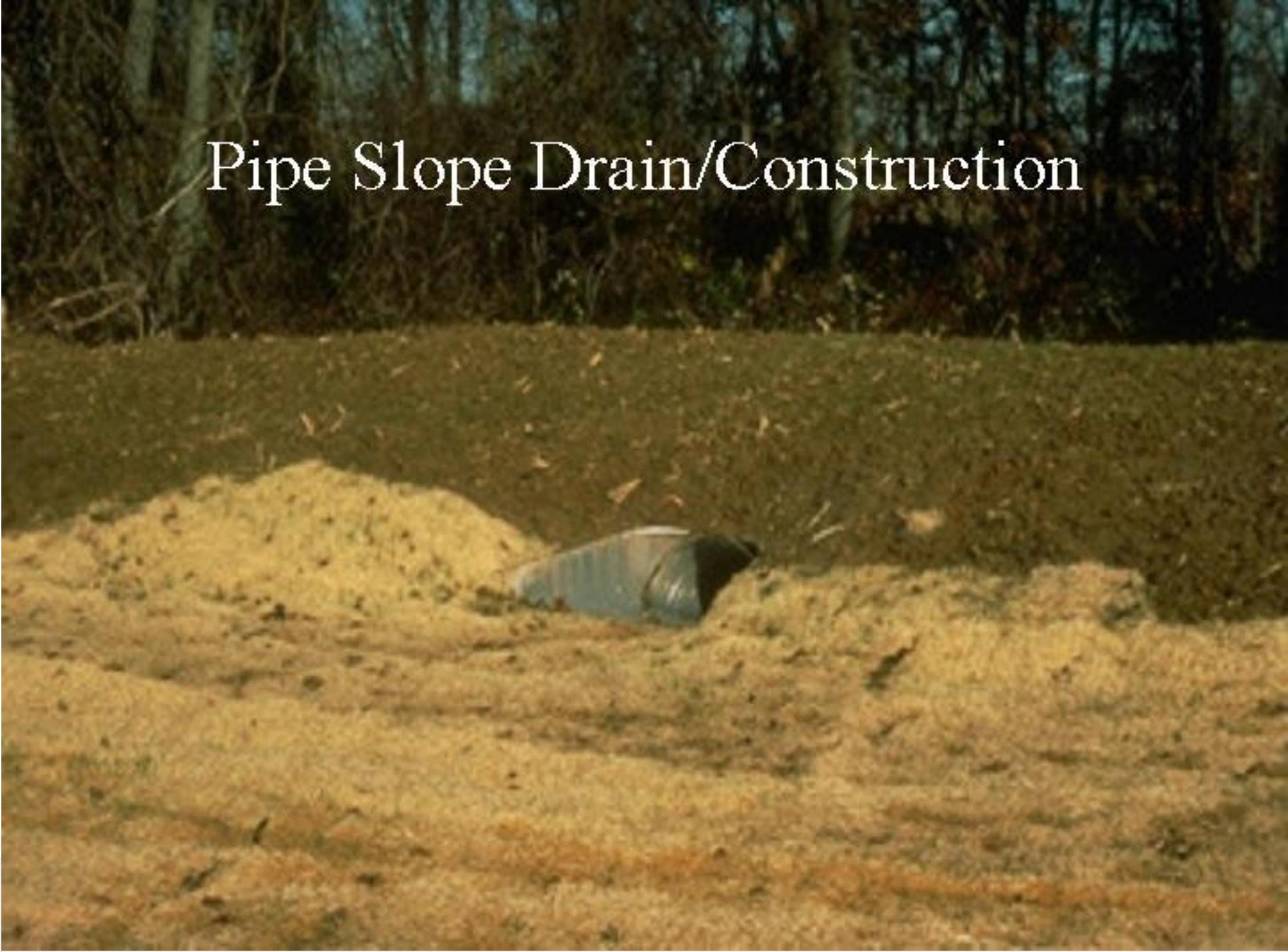
- A flexible tubing or conduit
- Extending from the top to the bottom of a cut or fill slope
- To temporarily conduct concentrated stormwater runoff safely down the face of a cut or fill slope
- Without causing erosion on or below the slope





Purpose: to safely convey runoff down the face of a steep slope

Pipe Slope Drain/Construction





Take home points:

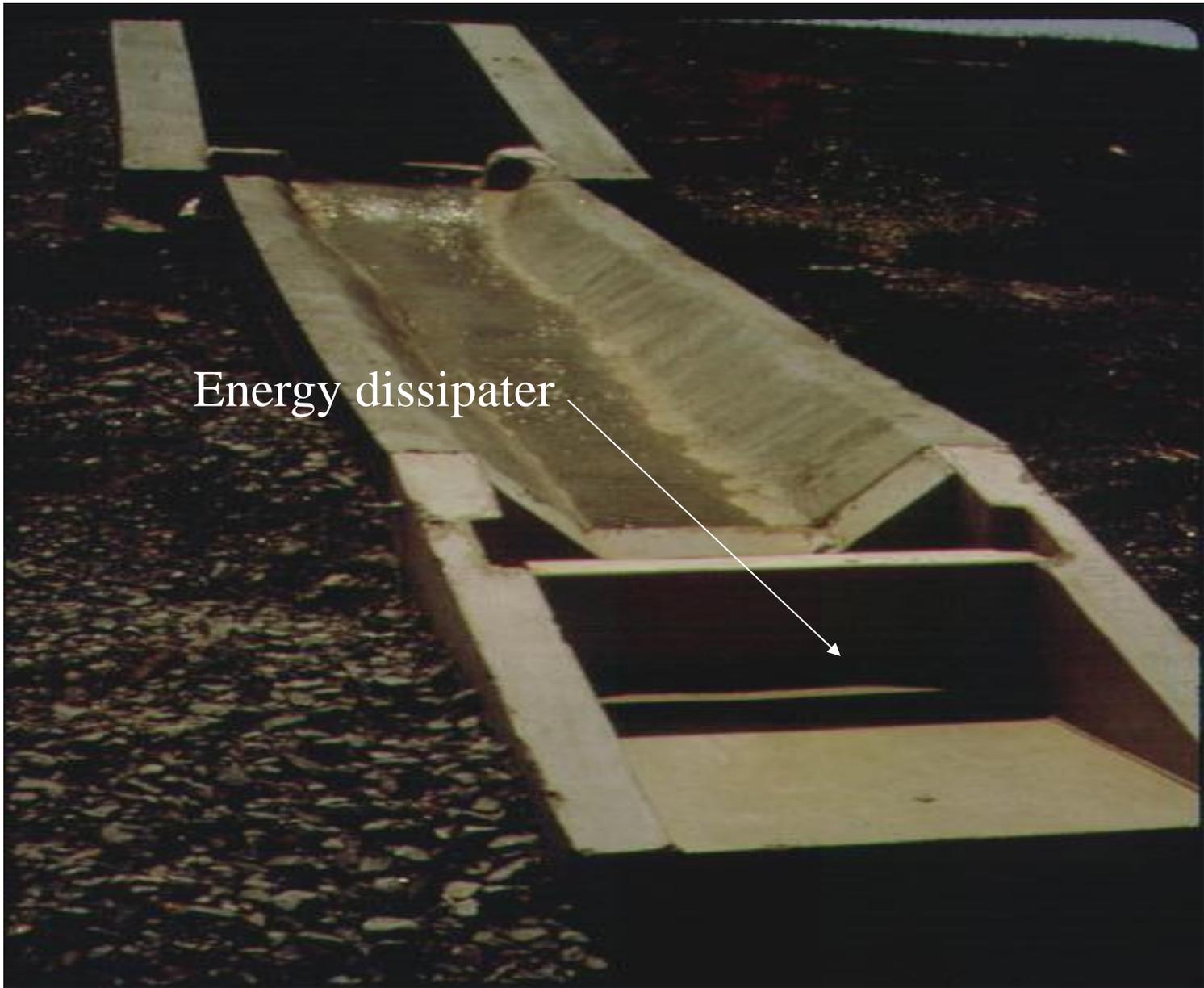
- ✓ Saves re-grading an unprotected slope
- ✓ Keep an eye at the inlet of the pipe...that's where they fail the most
- ✓ Must have outlet protection installed & inspected



Paved Flume (3.16)

- **A permanent paved channel constructed on a slope**
- **To conduct stormwater runoff safely down the face of a slope**
- **Without causing erosion problems on or below the slope.**





Energy dissipater

Stormwater Conveyance Channel

(3.17)

- A permanent, designed waterway, shaped, sized, and lined with appropriate vegetation or structural lining
- Used to safely convey stormwater runoff from a 10 year storm to a receiving channel without damage from erosion.
- Needs outlet protection if it empties into a natural stream to prevent erosion

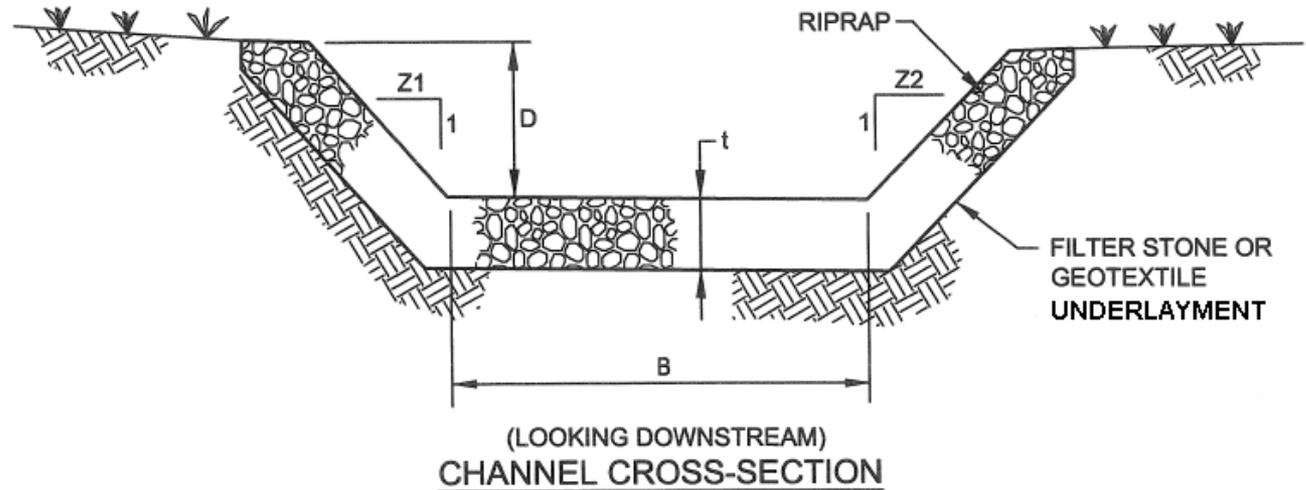




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Riprap Channels

STANDARD CONSTRUCTION DETAIL #6-3
Riprap Channel



- Take home points:
- Make sure the correct stone size is installed
- Make sure the proper channel cross sections are achieved



Gabion Lined Channel





Take home points:

- ✓ **Make sure they are built to the proper cross section**
- ✓ **Stabilize immediately to prevent erosion or transport of sediment**



Outlet Protection (3.18)



- Placed at the outlet of pipe or paved channel to reduce erosion and under-cutting from scouring at stormwater outlets
- Apron must be constructed with no slope along its length (0% grade)



Photo by: Jim Collins, DFM Development LLC









Take home points:

- ✓ **Constructed at zero grade (flat)**
- ✓ **Excavate, place the filter fabric, then the rock**
- ✓ **Check for sediment build up**

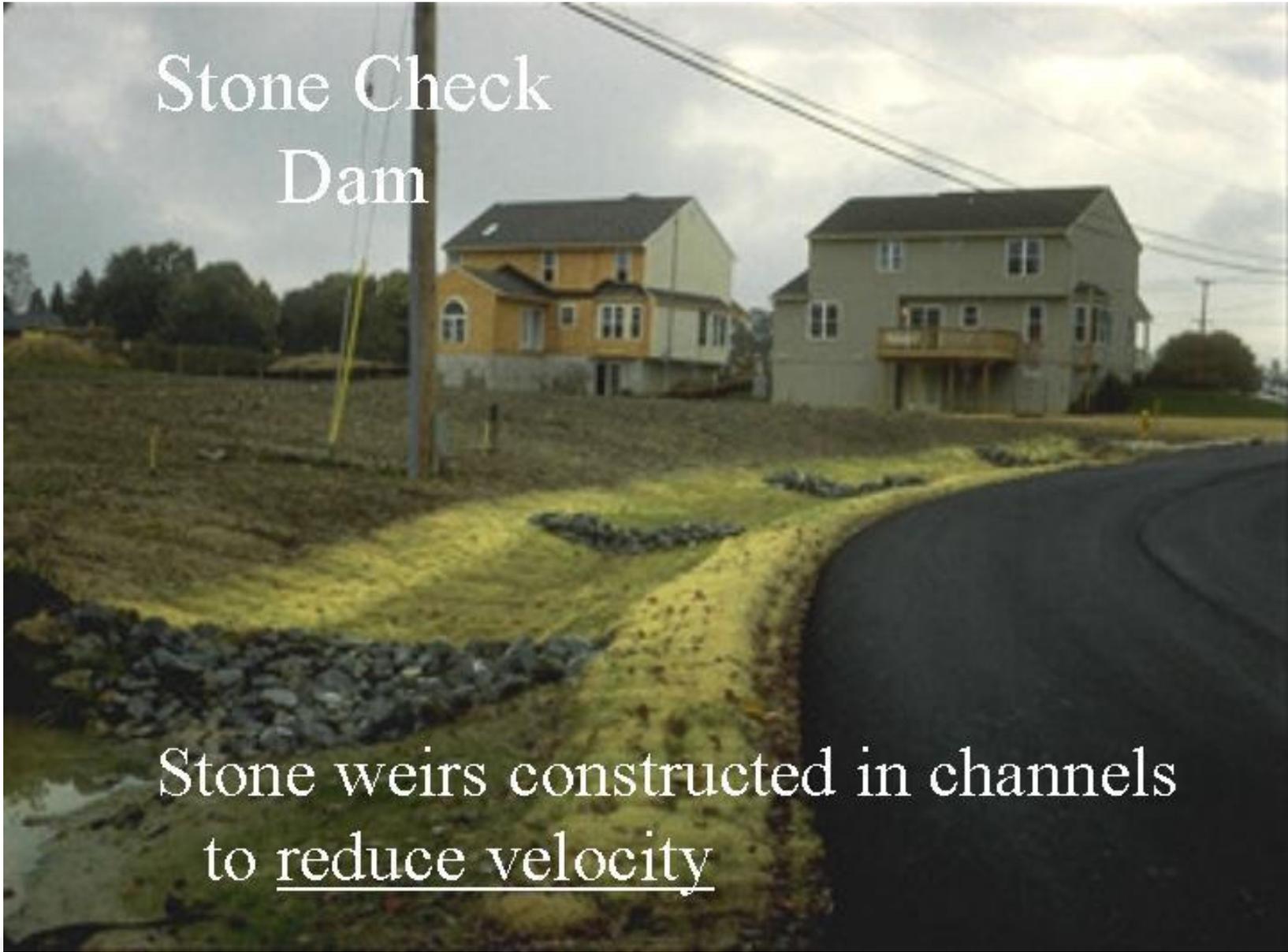


Rock Check Dam (3.20)

- **Small temporary stone dams constructed across a swale or drainage ditch**
- **To reduce the velocity of concentrated stormwater flows and erosion of the swale or ditch**
- **This practice may also traps sediment by ponding of the stormwater runoff**
- **Not to be used in a live stream**



Stone Check Dam



Stone weirs constructed in channels
to reduce velocity

Dewatering Structure (3.26)

- A temporary settling and filter device for water being pumped from trenches, basins, traps or other areas which contains sediment laden water
- May be constructed of straw bales and filter fabric, portable boxes or tanks
- Must be sized according to pump capacity in cfs









Don't undersize these!
Must be removed when de-watering is complete



Turbidity Curtain (3.27)

- **A floating geo-textile material which minimizes sediment transport from a disturbed area adjacent to or within a body of water**
- **Used in non-tidal and tidal watercourses**
- **Keeps sediment limited to a confined area until it settles out**
- **Should not be installed across channel flows**





Take home points:

- ✓ Do you have those other permits or clearances for working in a watercourse?



Vegetative Vs. Structural Controls



- *Vegetative Controls = erosion prevention*
- *Less \$ than structural practices*
- *Structural Controls = sediment trapping & erosion control*
- *More expensive*



Benefits of Vegetation

- **Good vegetative cover is about 90-99% effective**
- **Protects against raindrop impact**
- **Slows runoff velocity & filters sediment**
- **Roots bind the soil surface & enhance filtration**
- **Increased organic matter improves soil structure**
- **3 X less expensive than structural controls**

Preservation of Existing Vegetation

- Minimize cost of development
- Native vegetation (Spec 3.37 = trees)
- Buffers
- Does not disturb soil and promotes infiltration



ESCH Vegetative Control Practices

29-30 Seedbed Preparation

- Surface roughening
- Top soiling

31-34 Vegetation Establishment

- Temporary seeding
- Permanent seeding
- Sodding
- Bermuda and zoysiagrass establishment

35-36 Mulches

- Mulching
- Soil stabilization, blankets and matting

37-38 Other Vegetative Controls

- Trees, shrubs, vines and ground covers
- Tree preservation and protection

39 Dust control

Topsoil Stockpiles (3.30)





Topsoil Stripping and Stockpiling

- Stockpiles must be stabilized in accordance with MS2
- Stockpiles off-site must be inspected as well



TS – Temporary Seeding (3.31)



Used for:

- Compliance with MS-1
- Compliance with MS-5
- A nurse crop to bridge to an optimal time for permanent seeding

Temporary Seeding

- Determine if denuded areas will remain dormant for longer than 14 days (MS-1)
- Make sure the area is mulched after seeding
- Make sure the seed used is appropriate for the time of year





Take home points:

- ✓ Can save money on ongoing maintenance of ESC structures
- ✓ If there's no erosion, there's no what??

Sediment!



Plant Selection

MS-1 Permanent or **temporary** soil stabilization shall be applied to denuded areas within **seven** days after final grade is reached on any portion of the site.

Temporary soil stabilization shall be applied within seven days to denuded areas that may not be at final grade but will remain dormant for longer than **14** days.

Permanent stabilization shall be applied to areas that are to be left dormant for more than one year.

Permanent Seeding (3.32)

Used for:

- Compliance with MS-1 and MS-3

Need:

- Good growing medium/soil
- Good plant material





Permanent Seeding (cont)

MS-3 A **permanent** vegetative cover shall be established on denuded areas not otherwise permanently stabilized.

Permanent vegetation shall not be considered established until a ground cover is achieved that is uniform, mature enough to survive and will inhibit erosion.



Final Stabilization (1)

(9VAC25-880-1)

Means one of the following situations has occurred:

1. All soil disturbing activities at the site have been completed and a permanent vegetative cover has been established on denuded areas not otherwise permanently stabilized. Permanent vegetation shall not be considered established until a ground cover is achieved that is uniform (e.g., evenly distributed), mature enough to survive, and will inhibit erosion.



Final Stabilization (2)

(9VAC25-880-1)

2. For individual lots in residential construction, final stabilization can occur by either:
 - a. The homebuilder completing final stabilization as specified in subdivision 1 of this definition; or
 - b. The homebuilder establishing temporary soil stabilization, including perimeter controls for an individual lot prior to occupation of the home by the homeowner, and informing the homeowner of the need for, and benefits of, final stabilization



Take home points:

- ✓ **Make sure vegetation is proper for you area is specified on the ESC plan**
- ✓ **Make sure the seed (which has specific germination rates and seed purity) is used w/out substitution.**



Oh..just one more thing about
vegetation...



Seed early...Seed often!

3.33 - Installation of Sod (SO)

- Sod is laid in staggered rows
- Sod is tightly butted against each other
- Sod installed on steep slopes is anchored



Sod Installation Considerations

- Soil should be slightly irrigated if sodding occurs during very dry or hot weather
- Sod is installed within 36 hours of harvesting
- Sod is unrolled to provide soil contact



3.35 (MU) – Mulching

- Protect the soil from raindrop impacts, thus reducing erosion
- Provide a favorable microclimate for seed germination and plant establishment

#1 choice of mulch is straw –
applied at 2 tons/acre
Fiber mulch – applied at 500-750
lbs/acre over straw mulch
Other organic mulches: Table
3.35-A









Take home points:

- ✓ **Mulch protects the soil from raindrop impact**
- ✓ **Provides protection from heat and cold to seed**
- ✓ **Make sure the proper amount is applied**

Nets and Mats

- Treatment 1 and 2
- ex. Jute, Excelsior, etc.
- Need good contact with soil
- Must be anchored
- Use in channels and on slopes



Dust Control

- *Most common method to control is spray water.*
- *Phased clearing/grading can significantly reduce dust.*
- *Additional options include other temporary stabilization.*





Summary/Tables

- Page 13 – 15 of the Participant Guide includes a comparison of ESC Specifications w/ Minimum Standards

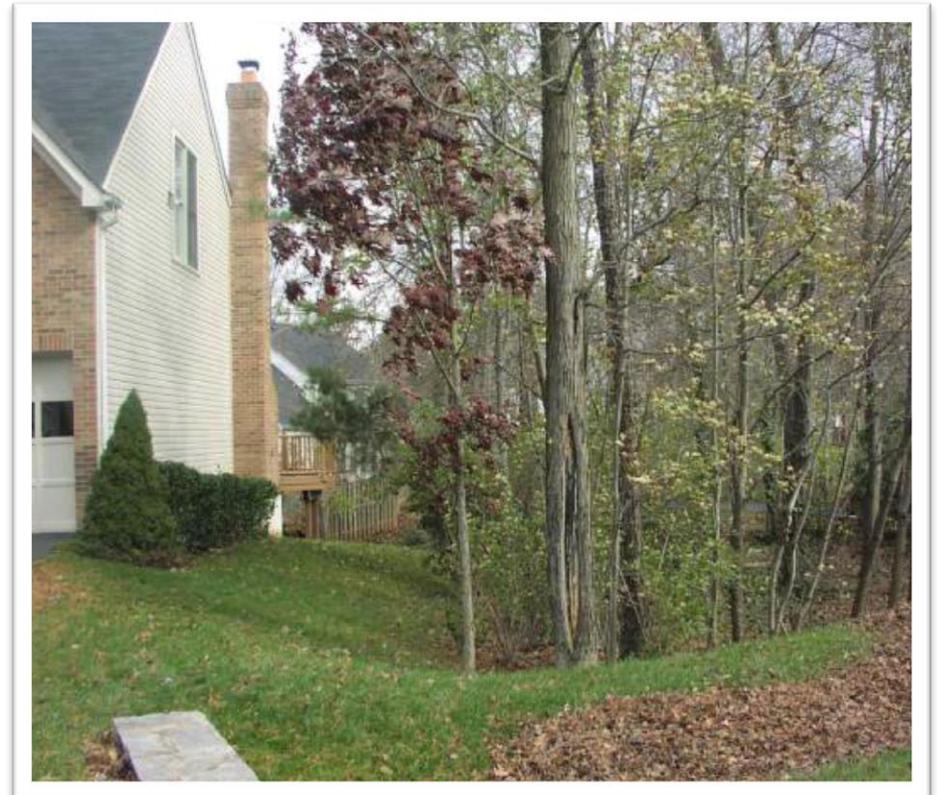


3b.

SWM Best Management Practices Overview

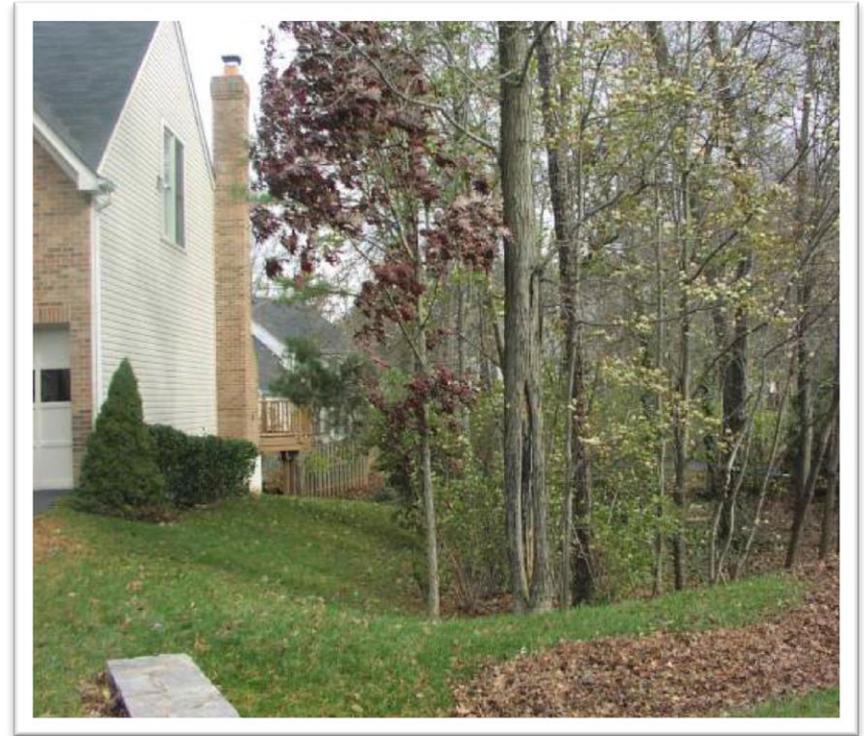


**DESIGN
SPECIFICATION
No. 1 ROOFTOP
(IMPERVIOUS
SURFACE)
DISCONNECTION**



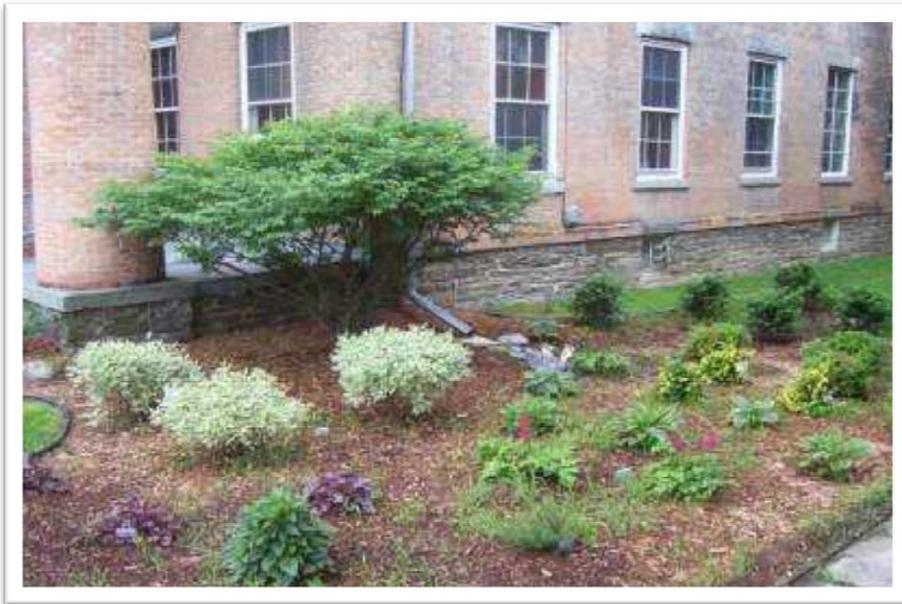
Two disconnection types allowed:

1. Simple
2. Alternative



Type 1. Simple Disconnection

Rooftops and/or on-lot impervious surfaces are directed to pervious areas

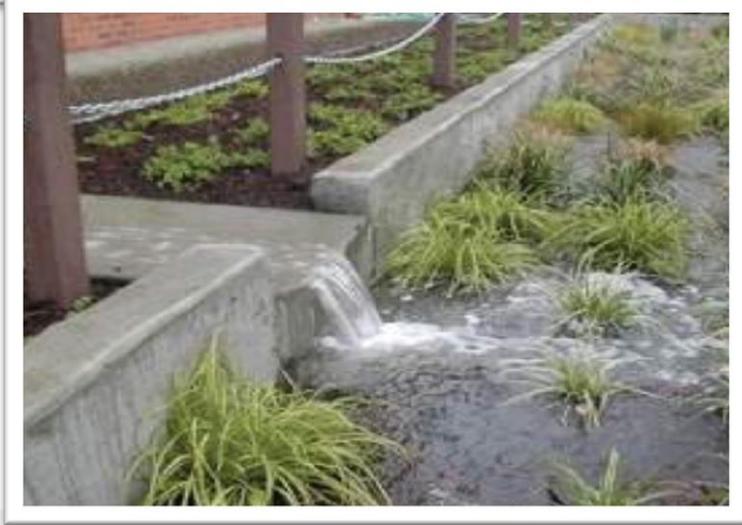




Type 2. Alternative Disconnection

- Compost Amended Filter Path
{Specification #4}
- Dry Well (Micro-Infiltration)
{Specification #8}
- Rain Garden (Micro-Bioretenention)
{Specification #9}
- Rain Tank, Rainwater Harvesting
{Specification #6}

PG 16 Type 2. Alternative Disconnection





Take home points:

- ✓ Check the plan for location of BMP
- ✓ Soil compaction and sediment are enemies!



**DESIGN
SPECIFICATION No. 2
SHEET FLOW TO A
VEGETATED FILTER
STRIP OR
CONSERVED OPEN
SPACE**





Two Types of Filter Strips

- 1) Conserved open space
- 2) Designed vegetated filter strips



Remember...

- Stormwater **must** enter as sheet flow
 - Inflow from pipe or channel requires an engineered level spreader



Conserved Open Space

- Outside limits of disturbance
- Marked on all construction drawings
- Protected by signage and erosion controls





DESIGN SPECIFICATION

No. 3

GRASS CHANNELS





Grass Channel Design Guidance

- Bottom width of channel should be between 4 to 8 feet wide
- Channel side-slopes should be 3:1 or flatter
- Maximum total contributing drainage area to any individual grass channel is 5 acres



Take home points:

- ✓ Typically built as a last step
- ✓ Keep sediment out and divert water away during construction



DESIGN SPECIFICATION

No. 4

Soil Compost
Amendment





Standard Landscape Development Practices

**Should meet the general criteria set forth by the
U.S. Composting Seal of Testing Assurance
(STA) program.**



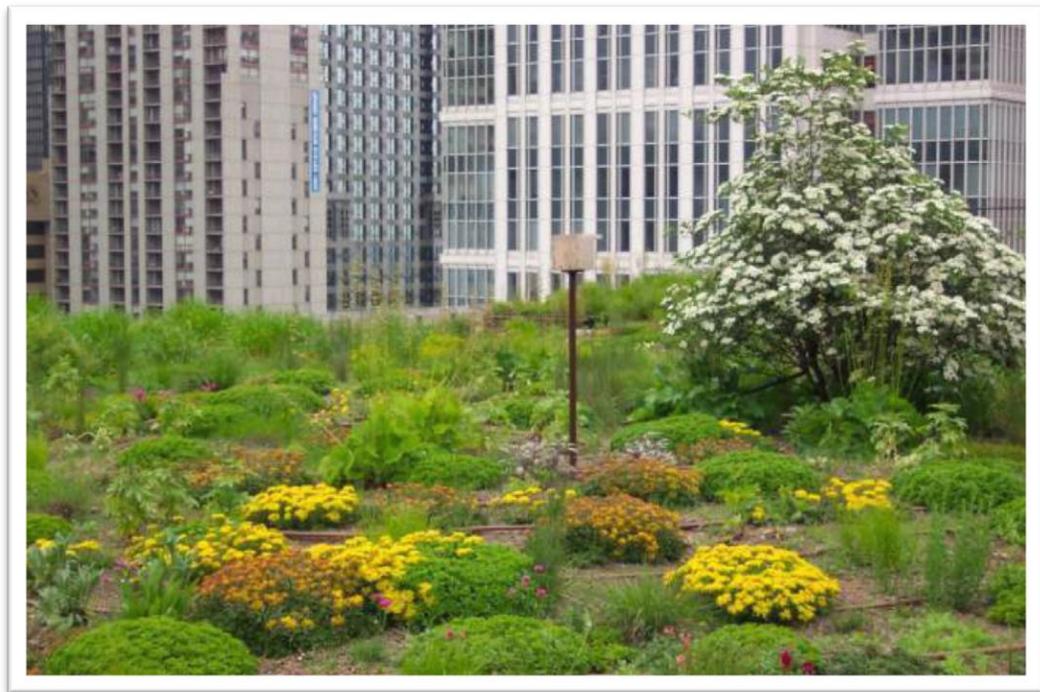
Applications

1. Reduce Runoff Volume From Pervious Areas
2. Enhance Performance of Impervious Disconnection
3. Enhance Performance of Other Runoff Reduction Practices
4. Part of a Reforestation Plan



DESIGN SPECIFICATION

No. 5 Vegetated Roof



Vegetated Roof

Vegetated roofs capture and temporarily store stormwater runoff in the growing media before it is conveyed into the storm drain system

- *Intensive* vegetated roofs = deeper growing media layer (6 inches to 4 feet thick)
- *Extensive* systems = much shallower growing media (2 to 6 inches).



Take home points:

- ✓ Usually specialized construction





DESIGN SPECIFICATION

No. 6 Rainwater Harvesting





Rainwater Harvesting

- Rainwater harvesting systems intercept, divert, store and release rainfall for future non-potable uses:
 - Flushing of toilets and urinals
 - Landscape irrigation
 - Exterior washing
 - Fire suppression (sprinkler) systems



Secondary practices can include:

- **Rooftop Disconnection**
 - (Design Specification No. 1)
- **Grass Channel**
 - (Design Specification No. 3)
- **Micro-Bioretenention or rain garden**
 - (Design Specification No. 9)



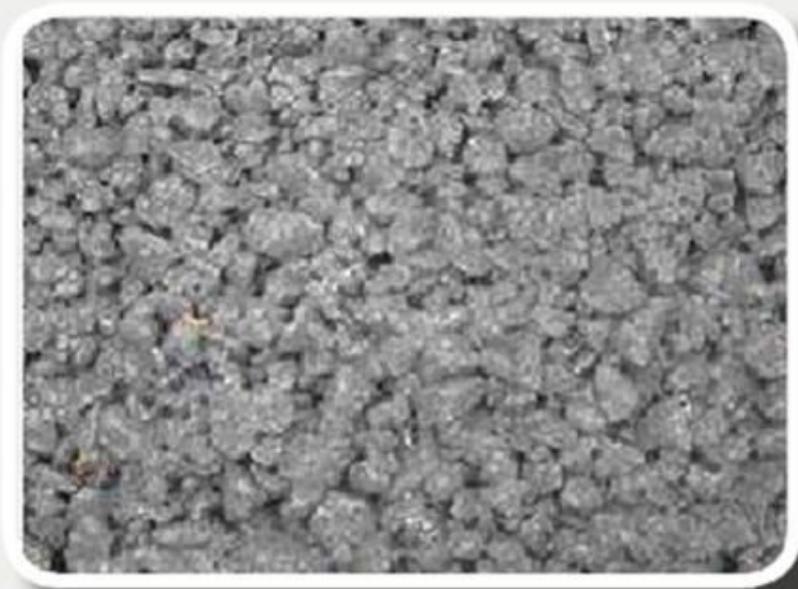
DESIGN SPECIFICATION

No. 7 Permeable Pavement





Permeable Pavement



Pervious Concrete (PC)



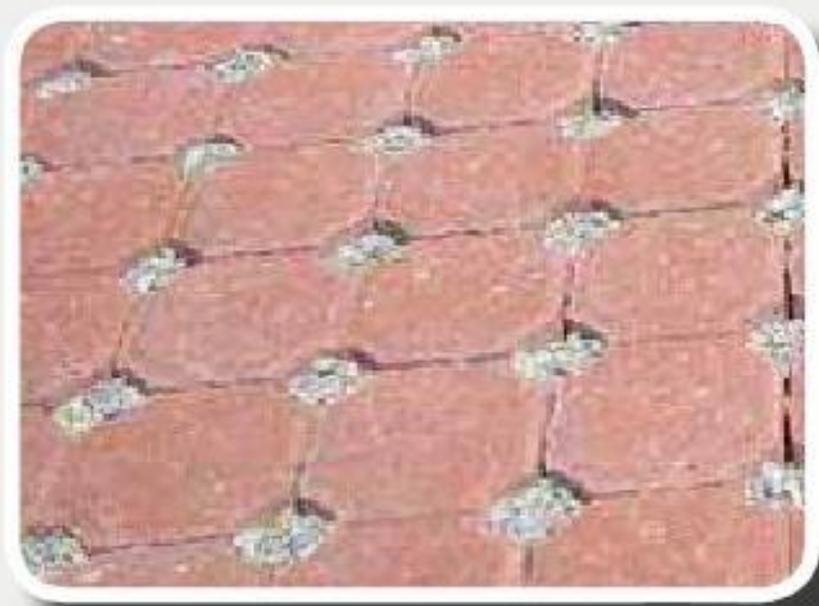
Permeable Pavement



Porous Asphalt (PA)



Permeable Pavement



Permeable Interlocking Concrete Pavers (PICP)



Permeable Pavement



Concrete Grid Pavers



Permeable Pavement



**Plastic Reinforced
Grid Pavers**



**Other:
XeriPave; Flexi Pave**



Take home points:

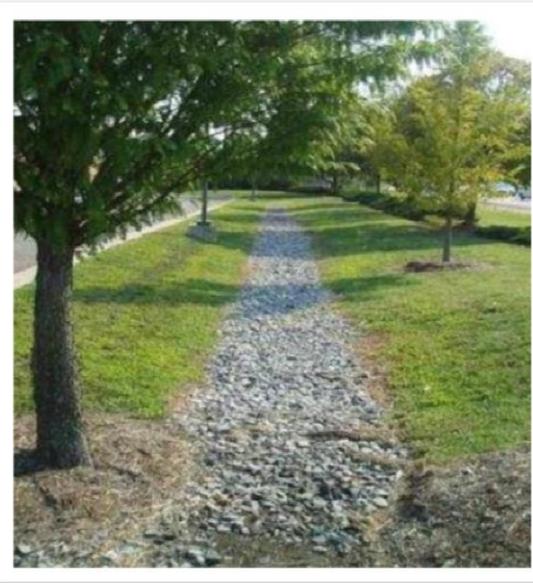
- ✓ Usually specialized construction



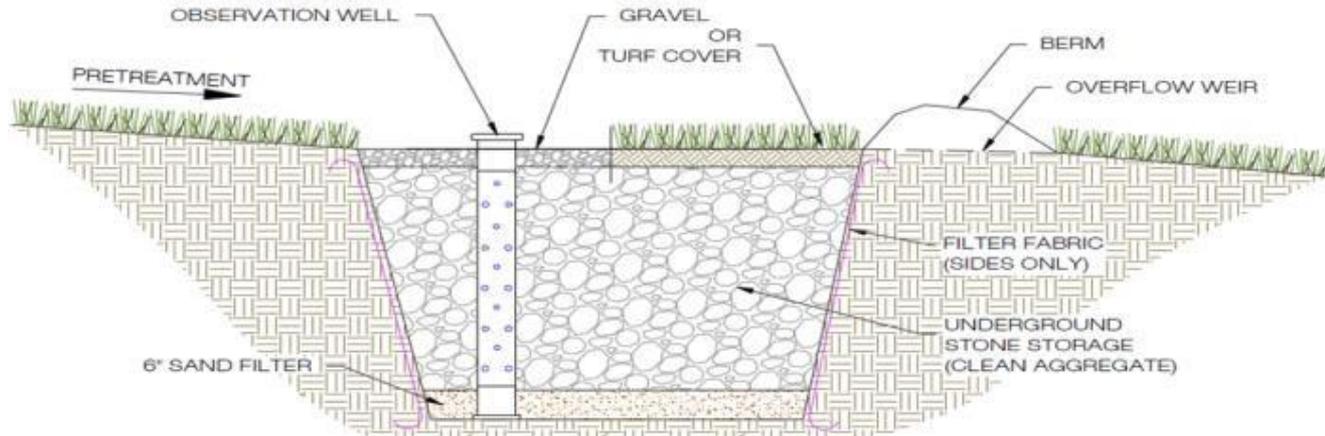


DESIGN SPECIFICATION

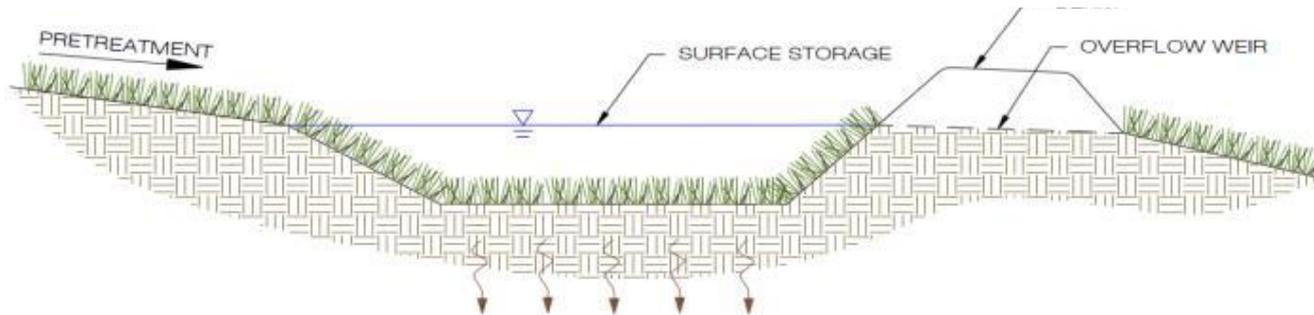
No. 8 Infiltration Practices



Types of Infiltration Practices

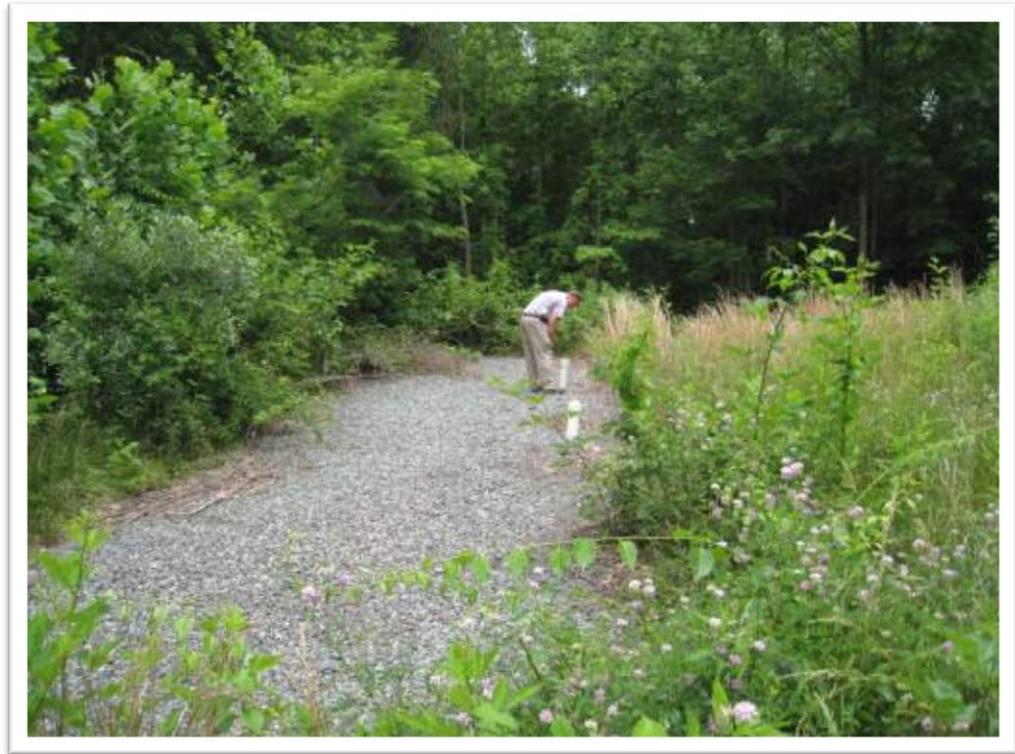


Infiltration Trench



Infiltration Basin

Infiltration Trench



Infiltration Basin



Source: epa.gov



Infiltration Practices

- Multiple pretreatment mechanisms used to trap sediment and organic matter before reaching practice
 - **Infiltration should not be used at stormwater hotspots** (e.g., vehicle fueling & maintenance, landscape maintenance)



Take home points:

- ✓ Check the plan for BMP location
- ✓ Soil compaction and sediment are enemies!



DESIGN SPECIFICATION

No. 9 Bioretention & No. 10 Dry Swale





Applications/Types



Bioretention



Dry Swale(Spec #10)



Urban Bioretention



Residential Rain Garden

Micro Scale Applications



- Drainage Area = 250 to 2,500 square feet (Mostly impervious)



Typical Scale Applications



Basin Scale: Bioretention Basins



- Impervious Area Treated = Up to 5 acres & 2.5 acres of impervious

Linear Applications: Dry Swale





Take home points:

- ✓ If there is a co-located temporary ESC control, don't over excavate
- ✓ Soil compaction and sediment are enemies!

BMP: # 11 – Wet swales

- Wet swales can provide runoff filtering and treatment
- Are a cross between a wetland and a swale
- The saturated soil and wetland vegetation provide an ideal environment for gravitational settling, biological uptake, and microbial activity.
- Typically less than 6 inches deep





DESIGN SPECIFICATION No. 12 Filtering Practices





Filtering Practices

- Treat stormwater runoff from small, highly impervious sites
- Specialized treatment at designated stormwater hotspots

Types of Filters

Quite the range of system configurations and filter media:

- Surface Sand Filter
- Pocket Sand Filter
- Organic Filter
- Perimeter Sand Filter
- Underground Sand Filter





Types of Filters





DESIGN SPECIFICATION

No. 13

Constructed Wetlands





Constructed Wetlands





DESIGN SPECIFICATION

**No. 14: Wet
Pond &**

**No. 15:
Extended
Detention Pond**





Wet Ponds & ED Ponds

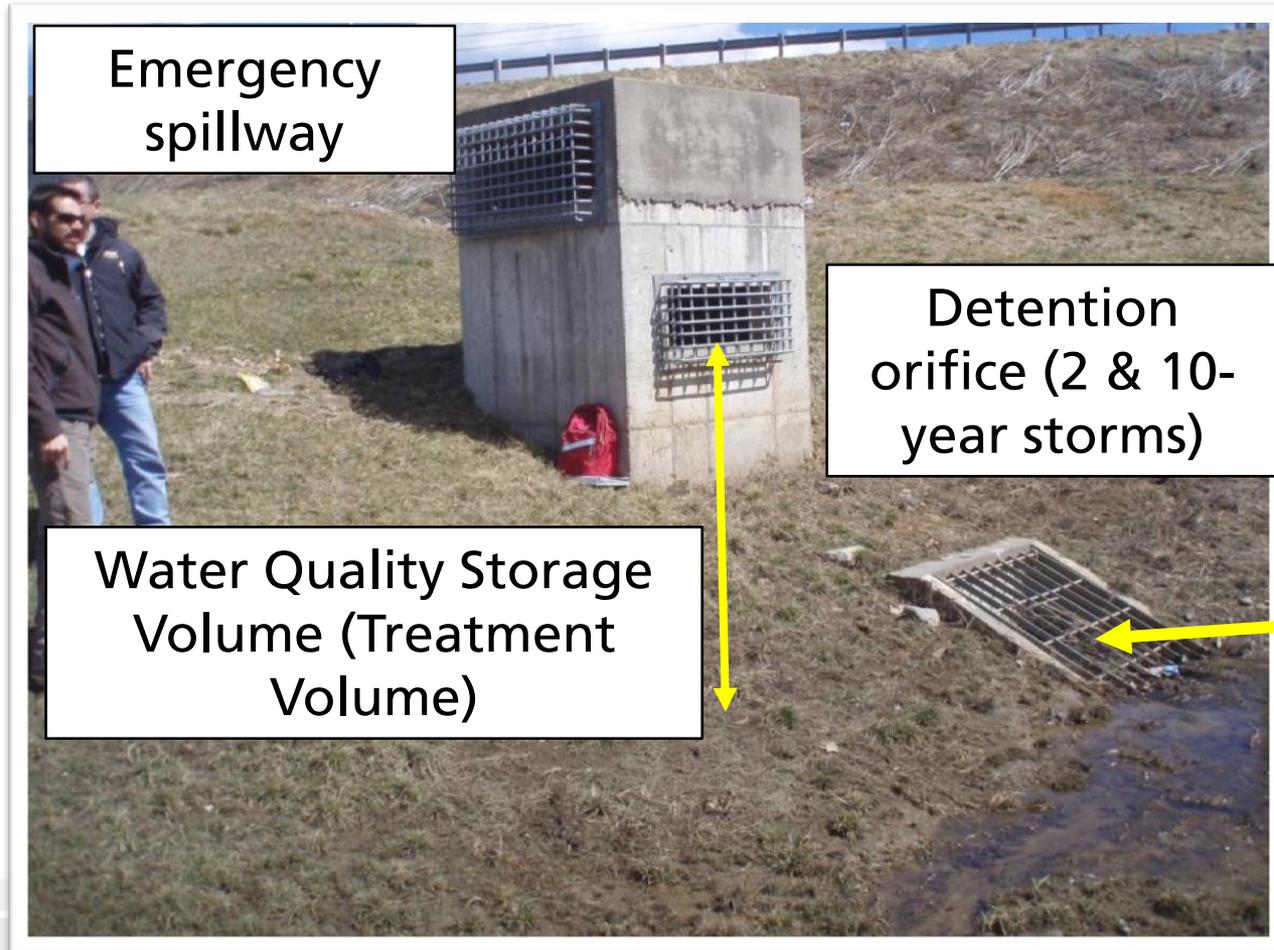
Wet Pond

- Permanent pool
- Incoming water displaces pool water

ED Pond

- Ponds only short time after storm
- Incoming water pools temporarily to allow settling

ED Pond (typical)



ED Pond (typical)



Wet Pond (typical)



Enemy of Stormwater Mgmt BMP

What do we do to keep the enemy at bay?



- Maintenance
- Minimize the
- Install each
- Follow the established construction sequence;
- Coordinate installation with the PE

END OF MODULE 3



QUESTIONS?