

DEQ Certification Class Presentations

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July 2024

Module 6

Virginia Stormwater Management Handbook

Module 6 Contents

6a. Handbook Specifications and the Minimum Standards

6b. Structural Control Practices

6c. Vegetative Control Practices

Module 6 Contents

- Construction BMP Specifications and the Minimum Standards
- Construction BMP Specifications (Chapter 7)
 - C-ECM – Erosion Control Measures
 - C-SCM – Sediment Control Measures
 - C-SSM – Surface Stabilization Measures
 - C-PCM – Perimeter Control Measures
 - C-ENV – Environmentally Sensitive Area Protection

Module 6 Contents

- Structural practices
 - C-ECM – Erosion Control Measures;
 - C-ENV – Environmentally Sensitive Area Protection;
 - C-PCM – Perimeter Control Measures;
 - C-SCM – Sediment Control Measures
 - For sediment control; *second* line of defense
- Vegetative practices
 - C-SSM – Surface Stabilization Measures
 - For erosion control, *first* line of defense

Module 6a.

Handbook Specifications and the Minimum Standards

Technical Assistance

- Sections §62.1-44.15:30 of VESMA and §62.1-44.15:52.B. of the ESC law requires the Department to:
 - Provide technical assistance and advice to
 - Conduct and supervise educational programs for VESCP and VESMP authorities
- One way the Department accomplishes this is with the Virginia Stormwater Management Handbook (VSWHB)

Construction BMPs – VSWHB CH.7

- Structural practices
 - **C-ECM** – Erosion Control Measures;
 - **C-ENV** – Environmentally Sensitive Area Protection;
 - **C-PCM** – Perimeter Control Measures;
 - **C-SCM** – Sediment Control Measures
 - For sediment control; *second* line of defense
- Vegetative practices
 - **C-SSM** – Surface Stabilization Measures
 - For erosion control, *first* line of defense

Numbering and Nomenclature

**First letter represents
the type of BMP:**

- Construction (C)
- Post-Construction (P)

**Number represents
the specific BMP
per group**



Three letters represent the primary function of the BMP:

- Erosion Control Measures (ECM)
- Perimeter Control Measures (PCM)
- Surface Stabilization Measures (SSM)
- Sediment Control Measures (SCM)
- Environmentally Sensitive Area Protection (ENV)
- Basins (BAS)
- Filtration/Infiltration (FIL)
- Conveyance (CNV)
- Support Components (SUP)

Handbook Specifications and the Minimum Standards

Soil Stabilization for Erosion Control MS-1, 2, 3, and 5

Environmentally Sensitive Area Protection (C-ENV)

C-ENV-15 Seeding, Mulching, and Soil Stabilization (Wetlands/Streams) (MS-1, 3)

Sediment Control Measures (C-SCM)

C-SCM-01 Dust Control (MS-2)

C-SCM-13 Concrete Washout Pit (MS-2)

Surface Stabilizations Measures (C-SSM)

C-SSM-01 Tree Preservation and Protection (MS-1)

C-SSM-02 Topsoiling (MS-1, 2)

C-SSM-03 Surface Roughening (MS-1, 7)

C-SSM-04 Compost Blankets (MS-1)

C-SSM-05 Soil Stabilization Blankets and Matting (MS-1, 3)

Handbook Specifications and the Minimum Standards

Soil Stabilization for Erosion Control MS-1, 2, 3, and 5 (Continued)

Surface Stabilizations Measures (C-SSM)

C-SSM-06 Sodding (MS-1, 3)

C-SSM-07 Bermudagrass and Zoysiagrass Establishment (MS-1) Note: MS-3 is not listed in the VSWHB

C-SSM-08 Trees, Shrubs, Vines, and Ground Cover (MS-1, 5, 7)

C-SSM-09 Temporary Seeding (MS-1, 2)

C-SSM-10 Permanent Seeding (MS-1, 3)

C-SSM-11 Mulching (MS-1)

Handbook Specifications and the Minimum Standards

Sediment Control MS-4 and 6

Erosion Control Measures (C-ECM)

C-ECM-01 Straw Wattles (MS-4)

C-ECM-02 Impermeable Diversion Fence (MS-4)

C-ECM-04 Temporary Diversion Dike (MS-4, 8)

C-ECM-05 Diversion (MS-4, 5, 8, 9, 19)

Environmentally Sensitive Area Protection (C-ENV)

C-ENV-10 Trenchless Silt Fence (MS-4)

C-ENV-11 Wetland Berm (MS-4)

C-ENV-12 Wetland Weir Outlet (MS-4)

C-ENV-13 Wetland Cell Sediment Trap (MS-4, 6)

Perimeter Control Measures (C-PCM)

C-PCM-01 Safety Fence (MS-4)

C-PCM-02 Straw Bale Barrier (MS-4)

C-PCM-03 Brush Barrier (MS-4)

C-PCM-04 Silt Fence (MS-4)

C-PCM-05 Compost Filter Sock (MS-4)

Handbook Specifications and the Minimum Standards

Sediment Control MS-4 and 6 (Continued)

Sediment Control Measures (C-SCM)

C-SCM-02 Construction Road Stabilization (MS-4, 17)

C-SCM-03 Temporary Stone Construction Entrance (MS-4, 17)

C-SCM-04 Inlet Protection (MS-4) Note: MS-10 is not listed in the VSWHB

C-SCM-06 Wood Chip Filter Berm (MS-4)

C-SCM-08 Rock Filter Outlet (MS-4)

C-SCM-09 Turbidity Curtain (MS-4, 12, 14)

C-SCM-10 Dewatering Structure (MS-4, 6)

Note: MS-16 is not listed in the VSWHB

C-SCM-11 Temporary Sediment Trap (MS-4, 6)

C-SCM-12 Temporary Sediment Basin (MS-4, 6, 19)

Handbook Specifications and the Minimum Standards

Slope Protection MS-7, 8, and 9

Erosion Control Measures (C-ECM)

C-ECM-03 Slope Interruption Device (MS-7)

C-ECM-04 Temporary Diversion Dike (MS-4, 8)

C-ECM-05 Diversion (MS-4, 5, 8, 9, 19)

C-ECM-06 Temporary Fill Diversion (MS-8)

C-ECM-07 Temporary Right-of-Way Diversion (MS-8)

C-ECM-08 Waterbars and Sheet Flow Breakers (MS-8)

C-ECM-09 Stormwater Conveyance Channel (MS-8)

C-ECM-10 Subsurface Drain (MS-9, 16)

C-ECM-11 Paved Flume (MS-8, 11)

C-ECM-12 Temporary Slope Drain (MS-8)

C-ECM-14 Temporary Level Spreader (MS-8, 11)

Surface Stabilizations Measures (C-SSM)

C-SSM-03 Surface Roughening (MS-1, 7)

C-SSM-08 Trees, Shrubs, Vines, and Ground Cover (MS-1, 5, 7)

Handbook Specifications and the Minimum Standards

Channels, Culverts, and Outlets MS-10 and 11

Erosion Control Measures (C-ECM)

C-ECM-05 Diversion (MS-4, 5, 8, 9, 19)

C-ECM-11 Paved Flume (MS-8, 11)

C-ECM-13 Riprap (MS-11)

C-ECM-14 Temporary Level Spreader (MS-8, 11)

C-ECM-15 Outlet Protection (MS-11)

C-ECM-16 Flexible Transition Mat (MS-11)

Environmentally Sensitive Area Protection (C-ENV)

C-ENV-07 Gabions (MS-11, 15)

Sediment Control Measures (C-SCM)

C-SCM-04 Inlet Protection (MS-4) Note:
MS-10 is not listed in the VSWHB

C-SCM-05 Culvert Inlet Protection (MS-10)

C-SCM-07 Rock Check Dams (MS-11)

Handbook Specifications and the Minimum Standards

Watercourses MS-12, 13, 14, and 15

Environmentally Sensitive Area Protection (C-ENV)

C-ENV-01 Vegetative Streambank
Stabilization (MS-15)

C-ENV-02 Structural Streambank
Stabilization (MS-15)

C-ENV-03 Temporary Vehicular Stream
Crossing (MS-13, 15)

C-ENV-04 Utility Stream Crossing
(MS-12, 14)

C-ENV-05 Cofferdam Crossing (MS-12, 14)

C-ENV-06 Stable Wetland Crossing
(MS-12, 14)

C-ENV-07 Gabions (MS-11, 15)

C-ENV-08 Pump Around Diversion
(MS-12, 14)

C-ENV-09 Overnight Channel Protection
(MS-12, 14)

C-ENV-14 Modified Turbidity Curtain for
Streams (MS-4, 12, 14)

Sediment Control Measures (C-SCM)

C-SCM-09 Turbidity Curtain (MS-4, 12, 14)

Handbook Specifications and the Minimum Standards

Underground Utilities MS-16

Erosion Control Measures (C-ECM)

C-ECM-10 Subsurface Drain (MS-9, 16)

Sediment Control Measures (C-SCM)

C-SCM-10 Dewatering Structure (MS-4, 6)

Note: MS-16 is not listed in the VSWHB

Construction Entrances MS-17

Sediment Control Measures (C-SCM)

C-SCM-02 Construction Road Stabilization (MS-4, 17)

C-SCM-03 Temporary Stone Construction Entrance (MS-4, 17)

Handbook Specifications and the Minimum Standards

C-BMP Removal MS-18

Applicable to any temporary C-BMP that is not detailed as a permanent SWM control on the approved plan.

Stormwater Quantity MS-19

Erosion Control Measures (C-ECM)

C-ECM-05 Diversion (MS-4, 5, 8, 9, 19)

Sediment Control Measures (C-SCM)

C-SCM-12 Temporary Sediment Basin (MS-4, 6, 19)

Note

- During this presentation, we do not cover every specification in chapter 7 due to time.
- You are highly encouraged to study the specifications we don't cover and become familiar with those as well.
- Please take notes and highlight your material.
- With ANY of the specs covered, pay attention to the “numbers” (maximum, minimum, how deep, how wide, etc.) as these are important things to remember or be able to find *quickly*

Note for Construction BMPs

- Take a look at the commonly used stone sizes listed in the PG- Module 6, pages 6-7
 - These will be referenced throughout this section
- Then go to Chapter 7 of the Handbook
 - The remainder of this module will use the specifications found in the Handbook

Organization of BMP Specifications

- 1.0 Definition
- 2.0 Purpose and Applicability
- 3.0 Planning and Considerations
- 4.0 Stormwater Performance Summary
- 5.0 Design Criteria
- 6.0 Construction Specifications
- 7.0 Operations and Maintenance Considerations
- Note: Some BMPs have additional sections

Module 6b.

Structural Control Practices

Erosion Control Measures (ECM)

- Prevent sheet, rill, and gully erosion
- Reduce the overland flow velocities
- Shorten the length of flow
- Divert and convey runoff safely through a site

C-ECM-01 – Straw Wattles (MS-4)



1.0 Definition

- Temporary measure of weed- and seed-free agricultural straw wrapped in biodegradable netting, tubular plastic, or similar encasing material

2.0 Purpose

- Shorten slope lengths, slow water and trap sediment

3.0 Planning

- For runoff flow < 1 cfs

C-ECM-03 – Slope Interruption Device (MS-7)



1.0 Definition

- Tubular runoff and erosion control device used for sediment filtration and slope interruption

5.0 Design Criteria

- Decrease vertical spacing as slopes steepen

Table C-ECM-03-1 Slope Interruption Device Spacing

Maximum Spacing (feet)	Slope (H:V)
10	greater 2:1
15	from 2:1 to 4:1
20	From 4:1 to 10:1
50	er than 10:1

C-ECM-04 – Temporary Diversion Dike (MS-4, 5)

1.0 Definition

- Temporary ridge of compacted soil constructed to convey clean stormwater runoff through or around a disturbed land area
- Often work as conveyance in conjunction with other ESC measures
- NOTE: BMP C-ECM-02 (Impermeable Diversion Fence) is a similar measure



3.0 Planning and Considerations



- Intended to divert overland sheet flow
- Install at top of slope to divert water away from exposed slope
- Install at base of slope to protect downstream area from sediment runoff

5.0 Design Criteria



- Max drainage area = 5 acres
- Contain runoff from 10-yr storm
- Min compacted height = 18" (including 6" freeboard)
- Minimum top width = 2'
- Must have positive grade to a stabilized outlet
- See Table C-ECM-04-1 for more information

C-ECM-05 – Diversions (MS-4, 5, 19)



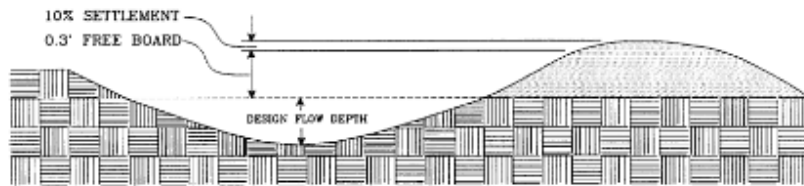
1.0 Definition

- A channel constructed across a slope with a supporting earthen ridge on the lower side

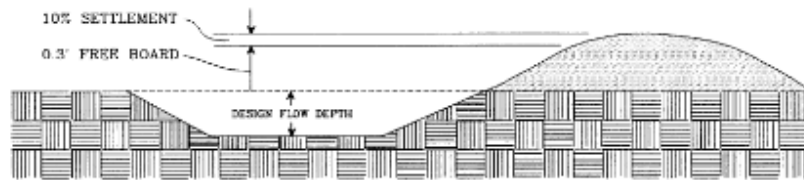
2.0 Purpose

- Reduce slope length
- Intercept and divert stormwater runoff to stabilized outlets
- Typically permanent

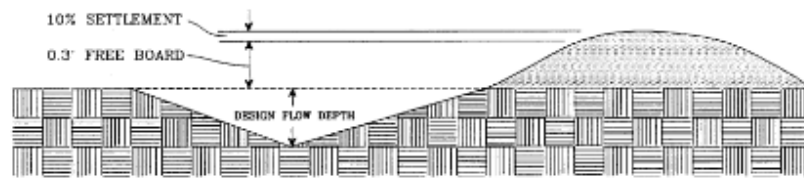
Section 5.0 Design Criteria



TYPICAL PARABOLIC DIVERSION



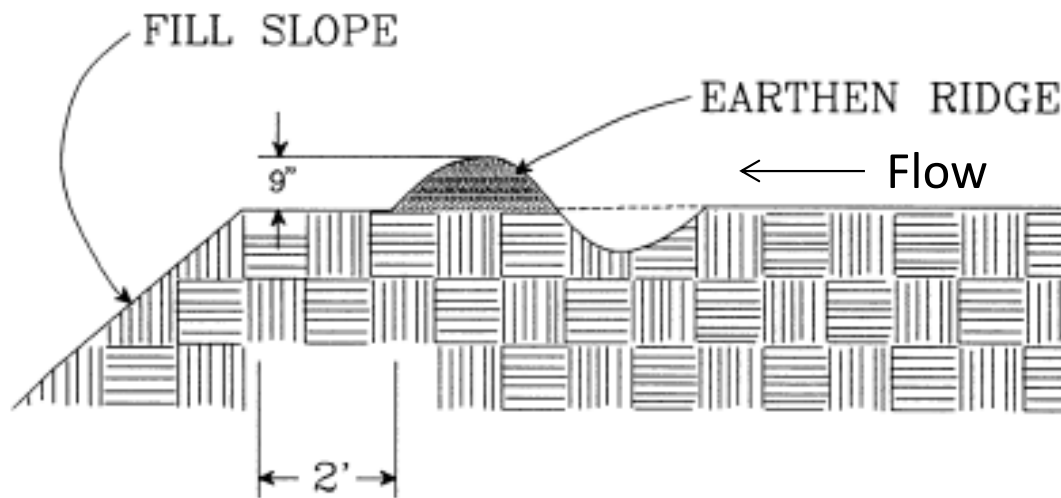
TYPICAL TRAPEZOIDAL DIVERSION



TYPICAL VEE-SHAPED DIVERSION

- Channel must carry a 10-year storm
- Three different channel shapes
- Side slopes no steeper than 2H:1V
- Minimum berm width = 4'
- Minimum freeboard = 0.3'
- Requires adequate outlet

C-ECM-06 – Temporary Fill Diversion (MS-7)



1.0 Definition

- Channel with a supporting ridge of soil on the lower side, constructed along the top of an active earth fill

5.0 Design Criteria

- Max. drainage area = 5 ac
- Minimum height 9"
- Must have positive grade to a stabilized outlet
- Located 2' back from top of slope

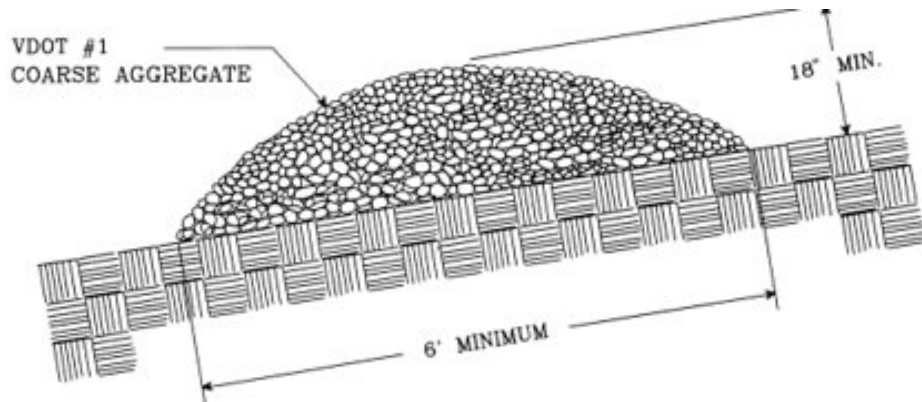
C-ECM-07 – Temporary Right-of-Way Diversion (MS-7)

1.0 Definition

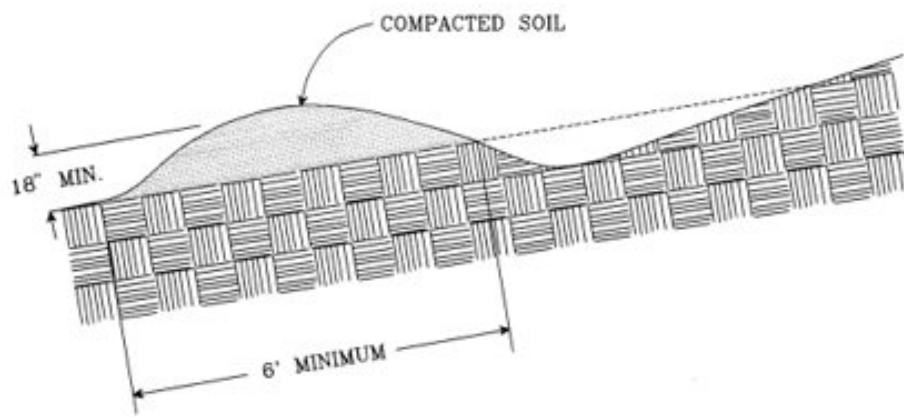
- Ridge of compacted soil, loose rock, or gravel constructed across disturbed steep slopes and similar sloping areas that is removed following construction once permanent stabilization has begun



5.0 Design Criteria



TYPICAL GRAVEL STRUCTURE



- Proper spacing is dependent on slope and soil erosivity (Table C-ECM-07-2)
- Must outfall to Outlet Protection Measure (Table C-ECM-07-3)
 - Temporary Sump with Compost Filter Sock
 - Compost Filter Sock J-Hook
 - Rock Outlet Apron

C-ECM-08 – Waterbars and Sheet Flow Breakers (MS-7)

1.0 Definition

- Shorten sheet flow length, reduce velocity, and flatten slopes within a terrain at pre-designed intervals
- Intended to remain after permanent stabilization of the site has been achieved



5.0 Design Criteria



- 4 Main Types:
 - Waterbar
 - Open-Top Culvert
 - Water Deflector
 - Broad-Based Dip
- Max. height of 18"
- Max. drainage area = 2 acres
- Max. side slopes of 2:1
- Max. 2-3% slope at outlet
- Reference C-ECM-15 to provide a stabilized outlet

C-ECM-09 – Stormwater Conveyance Channel (MS-5, 11, 19)



1.0 Definition

waterway that is shaped, sized, and lined with appropriate vegetation or structural material to safely convey stormwater runoff within or away from a developing area

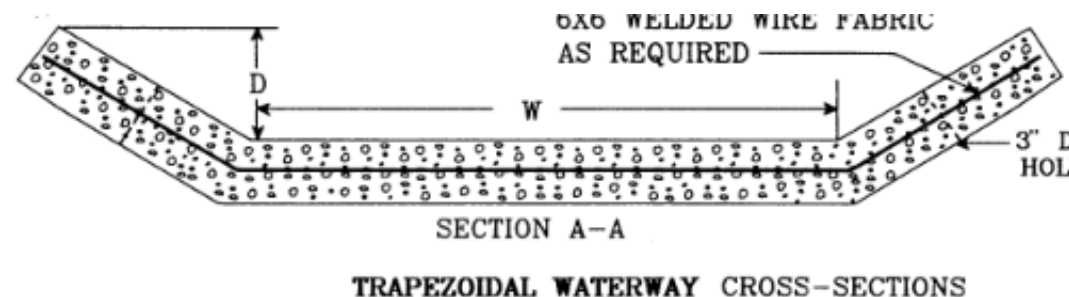
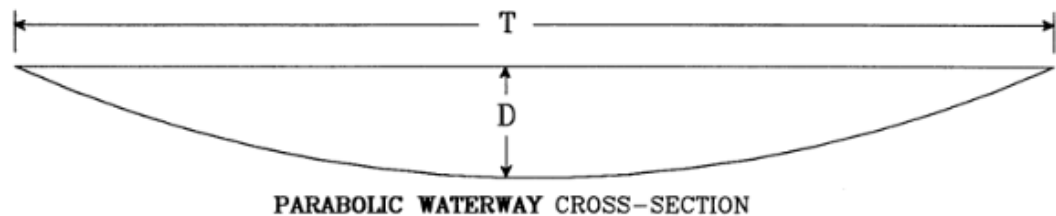
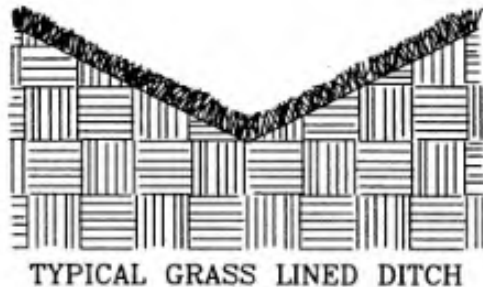
3.0 Planning and Considerations

- Grass and riprap lined are preferred
- Consider using temporary slope drains C-ECM-12 in steep slope conditions
- Do not use V-shaped channels with fabric or geotextile liners

5.0 Design Criteria

- Design based on flow rate and velocity
 - Calculate peak flow rate per Appendix A
 - Calculate velocity using Manning's Equation
- Check soil stability

5.0 Design Criteria



- Vee-shaped
 - Small quantities of water in a limited-space area
- Parabolic
 - Larger quantities of water with more available space
- Trapezoidal
 - Larger quantities of water to move at high velocities
- All must contain 10-yr flow

5.0 Design Criteria - Grass-lined Conveyance Channels



- Lower velocities only
- Type of vegetation dependent on site conditions
 - Table C-ECM-09-2
 - Permanent seeding C-SSM-10
- Blankets, check dams, or sod may be needed
 - Sodding C-SSM-06
 - Blankets and Matting C-SSM-05

6b. | C-ECM-09 — STORMWATER CONVEYANCE CHANNEL

5.0 Design Criteria – Riprap Channels



- Installed with a filter fabric underlining
 - Keyed in 6" – 9"
- Final cross-sectional elevation of receiving channel \leq elevation of the diversion or tributary flowing into it
- Install fabric and riprap in accordance with C-ECM-13

5.0 Design Criteria – Concrete-lined Channels



- Ensure there is an adequate transition section and energy dissipation
 - See Outlet Protection C-ECM-15

6.0 Construction Specifications

- Concrete sections should be at least 6' in length
- Expansion joints installed every ~~100'~~ 90'

C-ECM-12 – Temporary Slope Drain (MS-8)



1.0 Definition

- Flexible tubing or conduit extending from the top to bottom of a cut or fill slope

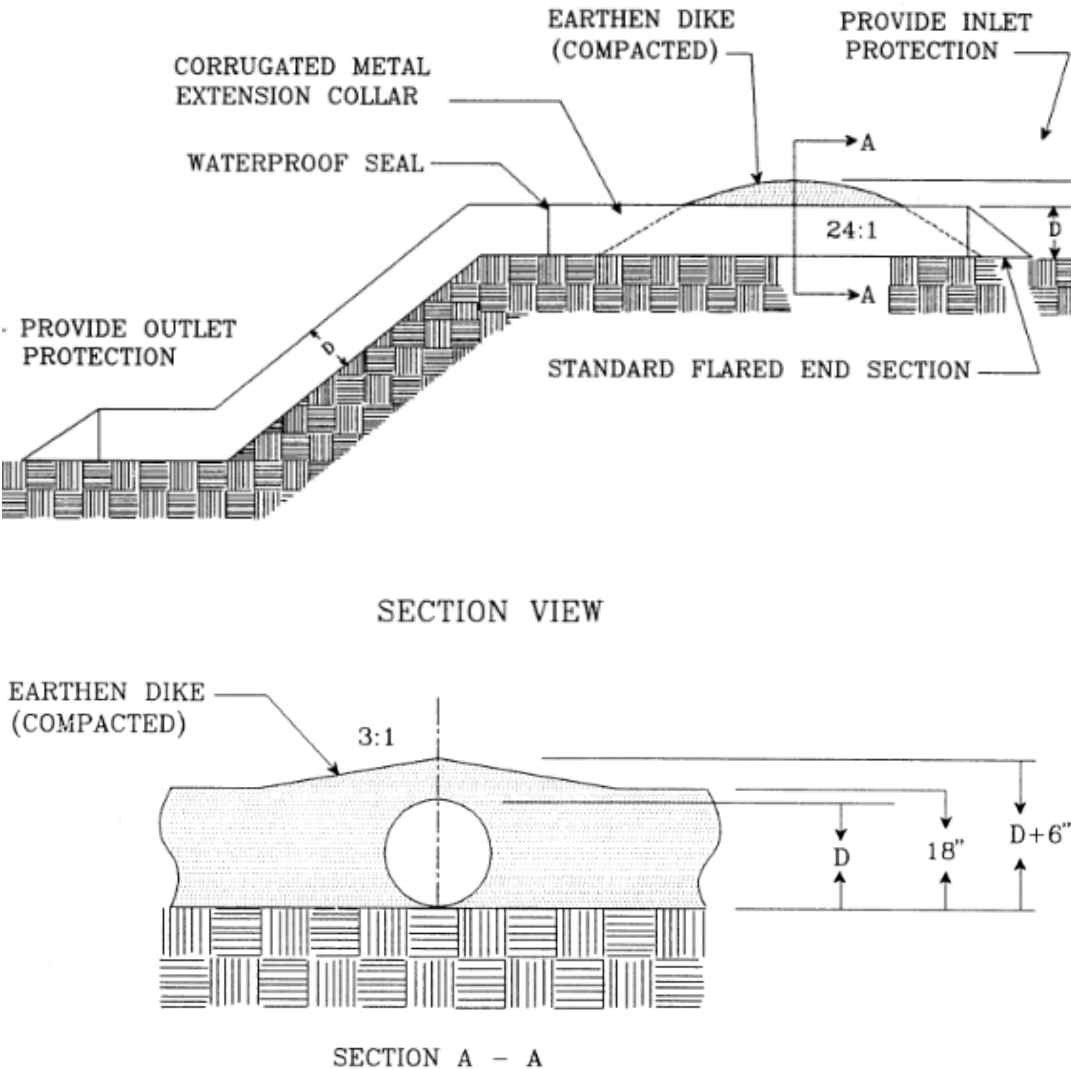
3.0 Planning & Considerations

- Protect exposed slopes while permanent drainage is installed or vegetation can be established

5.0 Design Criteria

- Make sure proper inlet and outlet protection is installed

5.0 Design Criteria



- Compacted diversion dike height = pipe diameter + 6"
- Max. drainage area = 5 acres
- Support stakes spaced at 10' intervals
- Sized according to Table C-ECM-12-2
- Inlet shall be VDOT flared-end section (Figure C-ECM-12-2)

C-ECM-13 – Riprap (MS – 7, 9, 11)



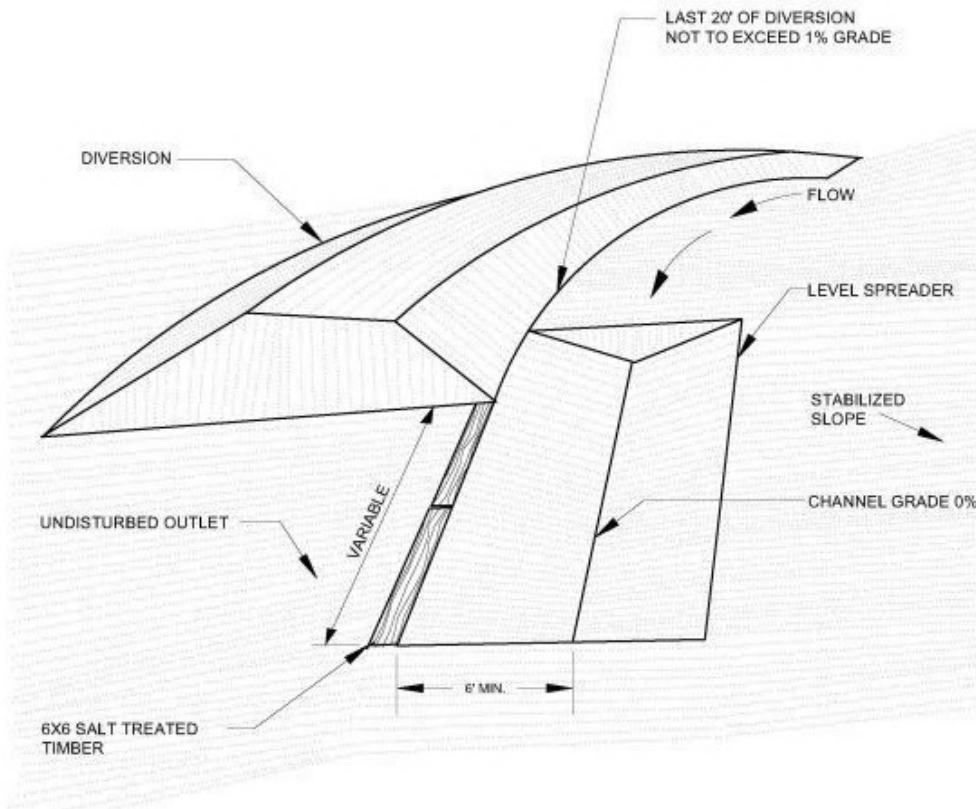
1.0 Definition

- Permanent, erosion-resistant ground cover
- Large, loose, angular stone installed with filter fabric or granular underlining

2.0 Purpose

- Purposes include:
 - Protect soil from erosion
 - Slow the velocity of runoff to enhance infiltration
 - Stabilize slopes with seepage problems

C-ECM-14 – Temporary Level Spreader (MS-11)

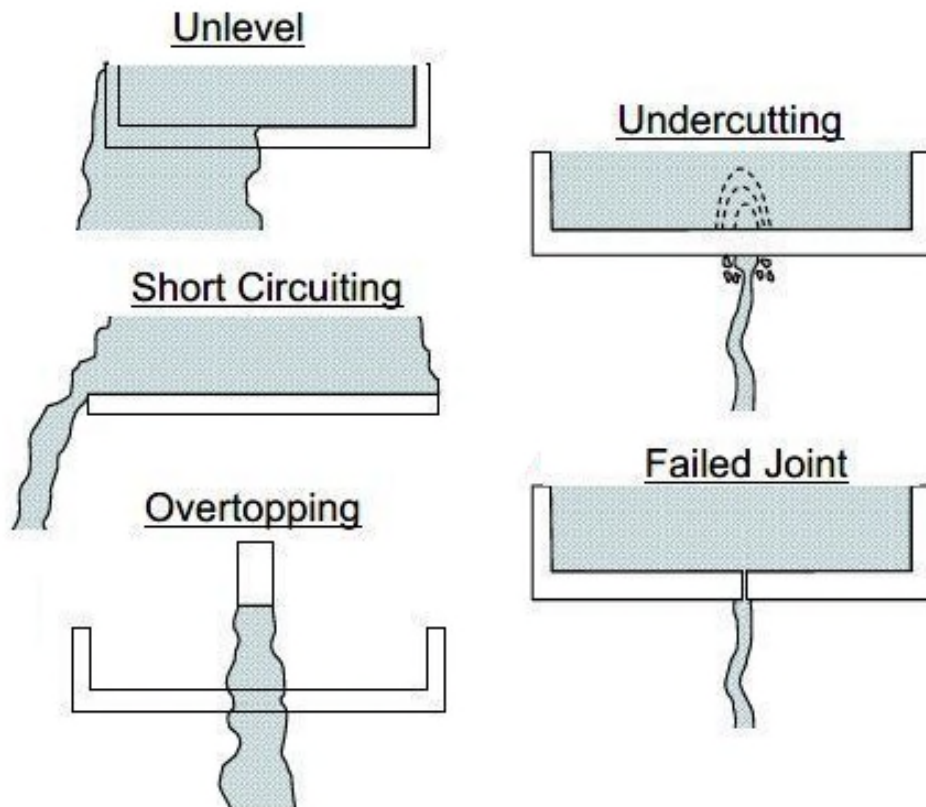


PERSPECTIVE VIEW

1.0 Definition

- Flow control measure that receives concentrated, potentially erosive inflow, and converts to a sheet flow condition by discharging across a horizontal level weir onto areas of undisturbed soil that is stabilized by existing vegetation

5.0 Design Criteria



- Vegetated spreader lips: Max design flow = 4 cfs
- Rigid spreader lips: Max design flow = 30 cfs
- Length of the spreader lip based on design flow; see Table C-ECM-14-2

6.0 Construction

- Construct level spreaders on undisturbed soil (not fill)

6b. | C-ECM-14 — TEMPORARY LEVEL SPREADER

C-ECM-15 – Outlet Protection (MS-11)

1.0 Definition

- Structurally lined aprons or other forms of energy-dissipating devices
- Placed at the outlets of pipes, curb openings, ditch turnouts, or paved channel sections
- Slow discharge velocity from the outlet to prevent an erosive condition

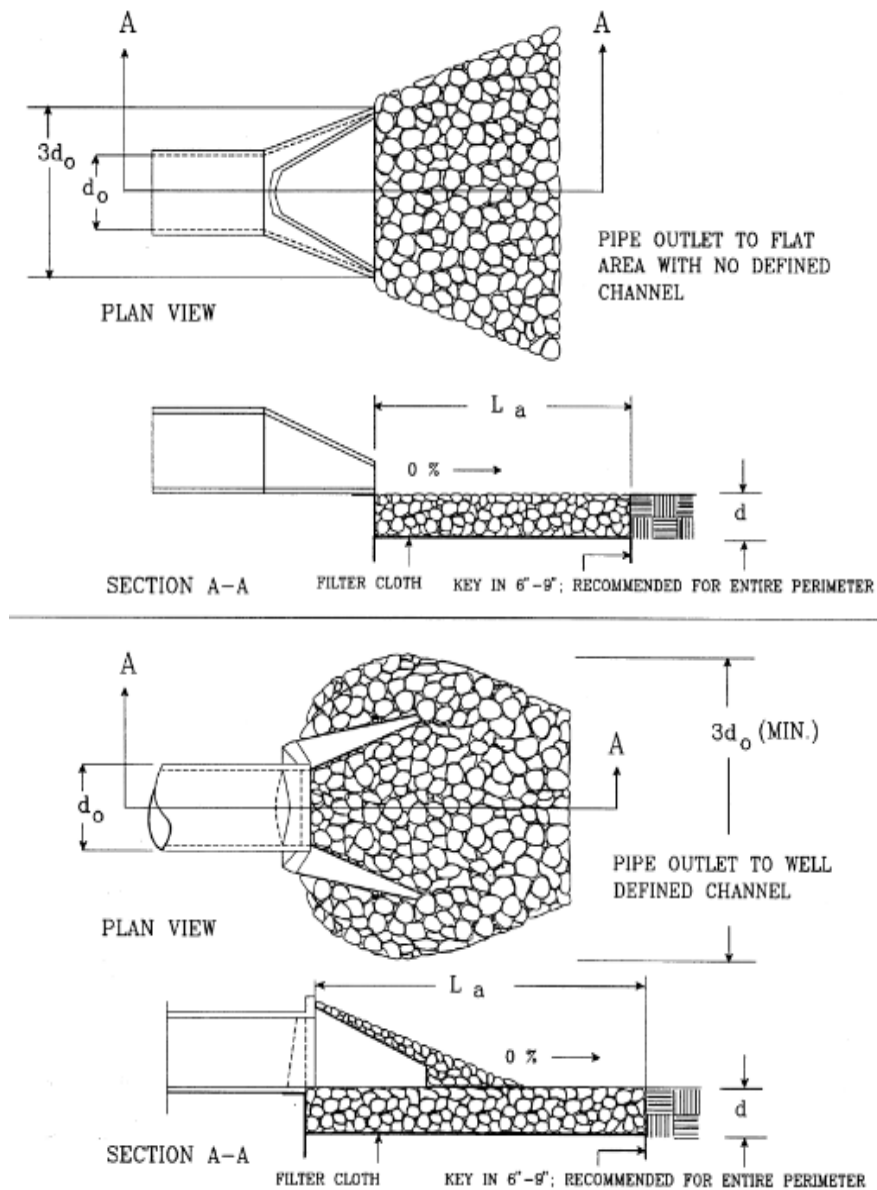


5.0 Design Criteria



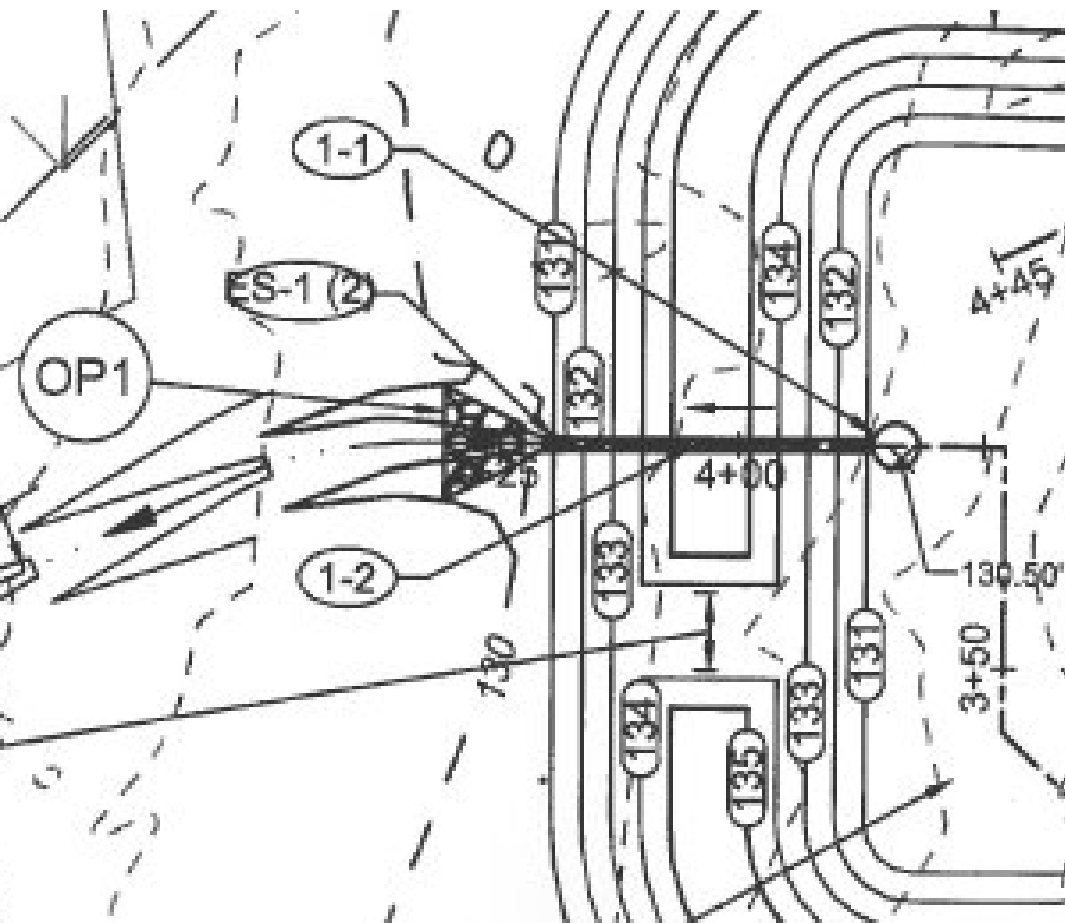
- If $<$ half the diameter of the pipe = minimum tailwater condition
- If $>$ half the diameter of the pipe = maximum tailwater condition
- Pipes that outlet to no defined channel = minimum tailwater BUT channel protection requires runoff outfalls to defined channels

5.0 Design Criteria



- Design and construct the apron with a 0% grade along its length
- Ensure no bends in the horizontal alignment of the apron
- Sized based on pipe outlet flow condition
- NOTE: C-ECM-16 (Flexible Transition Mat) is another method of Outlet Protection
- NOTE: C-ECM-13 Riprap should be referenced for stone sizing

5.0 Design Criteria



- Determine the apron length from the curves per tailwater condition
 - Min tailwater condition: Figure C-ECM-15-3
 - Max tailwater condition: Figure C-ECM-15-4
- For apron width, the upstream end = 3 x inner pipe diameter
- Apron depth = 1.5 x max stone diameter (but no less than 6")

Environmentally Sensitive Area Protection (ENV)

- Used in environmentally sensitive areas (stream corridors, wetlands, floodplains)
- Applied where disturbance in an environmentally sensitive area is necessary

C-ENV-02 – Structural Streambank Stabilization (MS-14,15)



1.0 Definition

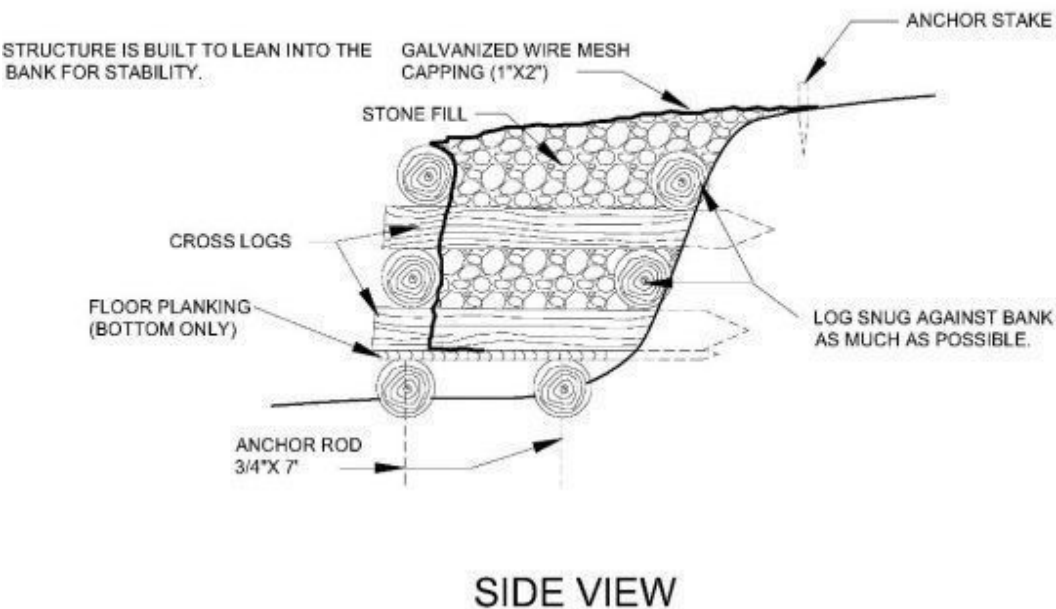
- Methods of stabilizing the banks of live streams with permanent structural measures

2.0 Purpose

- Protect streambanks from the erosive forces of flowing water
- Used where flow velocities exceed 5 fps or where Vegetative Streambank Stabilization (C-ENV-01) is insufficient

5.0 Design Criteria

LOG CRIBBING



- Start and end streambank protection at a stabilized point on the stream
- Design velocity is based on the 10-yr storm
- Work to maintain and improve habitat for fish and wildlife
- See Table C-ENV-02-1 for methods of protection and when to use them

C-ENV-03 – Temporary Vehicular Stream Crossing (MS-13, 14)



1.0 Definition

- Temporary structural span installed across a flowing watercourse for use by construction traffic
- Structures used may include bridges, round pipes, pipe arches, or oval pipes

2.0 Purpose

- Keep construction traffic from damaging channel/streambank

C-ENV-03 – Temporary Vehicular Stream Crossing

2.0 Purpose

- Drainage areas less than 1 square mile

3.0 Planning Considerations

- Prevent construction vehicles from damaging streambanks
- Constructed of non-erodible materials (MS-12)

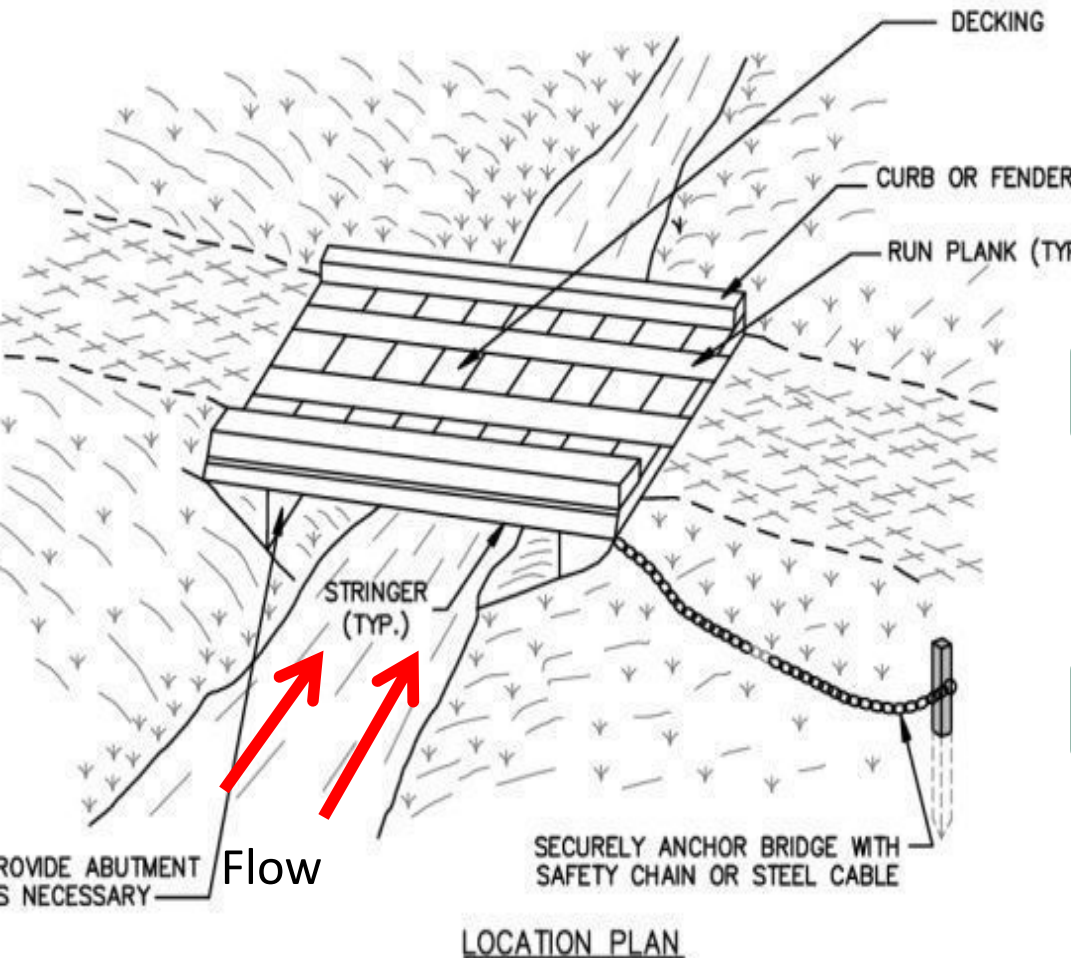
5.0 Design Criteria

- Design the crossing to be perpendicular to the stream, may vary up to 15°
- Design the centerlines of both roadway approaches to continue the crossing alignment for at least 50' from each bank

7.0 O & M Considerations

- Inspect *at least* once a week and after any rainfall

Bridge Crossing



3.0 Planning Considerations

- Preferred method for waterway crossings
 - Less disturbance
 - Remove quickly and reuse

5.0 Design Criteria

- Must be able to support construction traffic load

6.0 Construction

- Bridges must be anchored
 - Upstream is preferred

Bridge Crossing

5.0 Design Criteria

- For every 8' of channel width, a support may be constructed within the stream
- One traffic lane; minimum width = 12' and maximum width = 20'
- See Table C-ENV-03-1 for more information



Culvert Crossing



5.0 Design Criteria

- If the structure remains in place for:
 - Up to 14 days
 - Design for 2-year storm
 - 14 days - 1 year,
 - Design for 10-year storm
 - Longer than 1 year
 - Must be designed as a permanent measure by a qualified professional

Culvert Crossing

5.0 Design Criteria

- May use multiple culverts or one large culvert
- Do not use culverts $< 18"$ in diameter
- Minimum slope of the culvert = $0.25" / \text{foot}$ (2%)
- Size culverts using Table C-ENV-03-3
- See Table C-ENV-03-2 for more design information



C-ENV-04 – Utility Stream Crossing (MS-12, 14)



1.0 Definition

- Strategy for crossing small waterways when in-stream utility construction is involved

2.0 Purpose and Applicability

- Drainage area = no more than 1 square mile

3.0 Planning

- Multiple methods based on site conditions

5.0 Design Criteria



- Before fully dewatering the work area, move aquatic wildlife downstream of the lower barrier

6.0 Construction

- Multiple methods; chosen based on site conditions
 - Diversion Channel Crossing
 - Flume Pipe Crossing
 - Cofferdam Utility Crossing
 - Dam and Pump Bypass Crossing

C-ENV-05 – Cofferdam Crossing (MS-12, 14)

1.0 Definition

- Temporary structure within a waterbody designed to provide a dry work area for construction and to contain disturbed soil and/or suspended sediments
- Used with a Pump Around Diversion (C-ENV-08) and/or Turbidity Curtain (C-SCM-09 or C-ENV-14)



C-ENV-07 – Gabions (MS - 11, 14, 15)



1.0 Definition

- Rectangular baskets fabricated from a hexagonal mesh of heavily galvanized steel wire filled with rock material

2.0 Purpose and Applicability

- Slows the velocity of concentrated runoff and stabilize slopes
- Can be used to maintain stability and to protect streambanks and beds

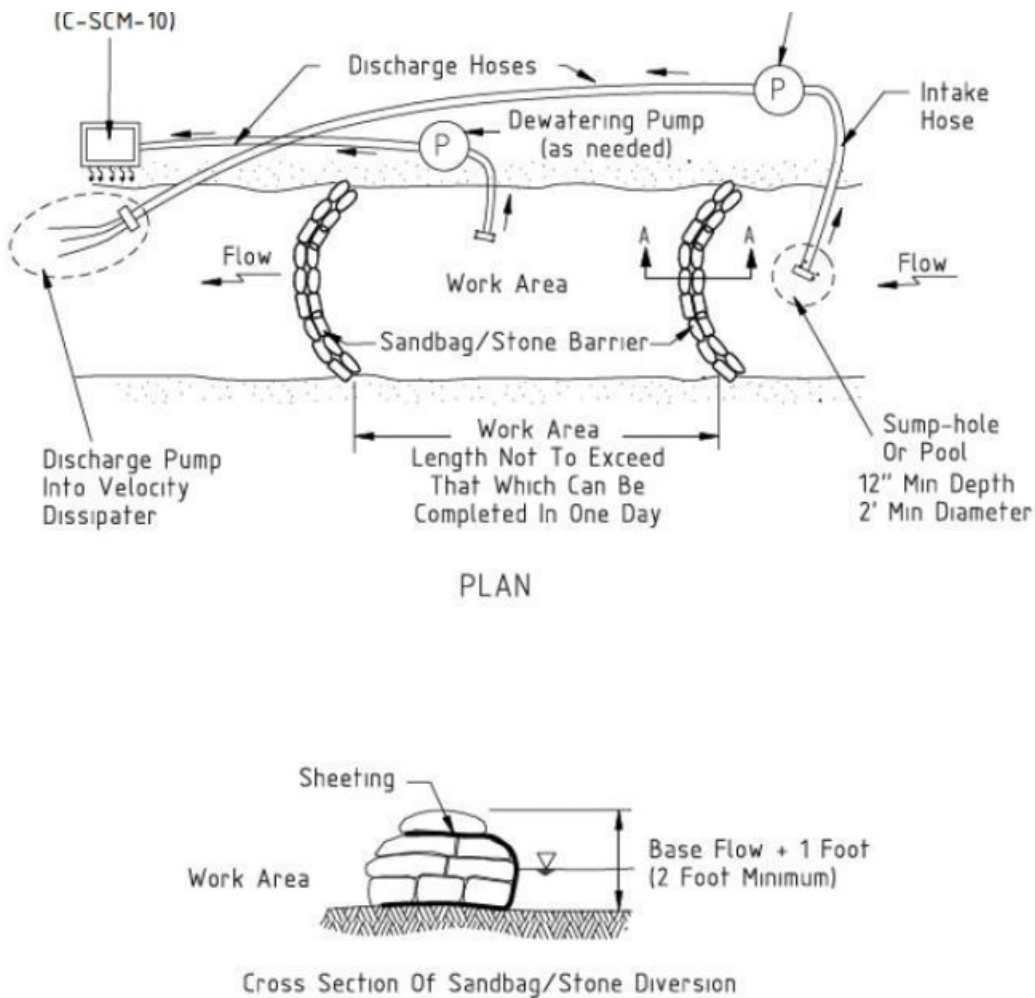
C-ENV-08 – Pump Around Diversion (MS - 12, 14)



1.0 Definition

- Dewatering practice used for temporarily pumping flow around segments of a stream channel during construction; the practice involves installing a temporary pump-around system and instream barriers to divert flow around sections or reaches of the stream

5.0 Design Criteria



- Calculate total dynamic head to select the appropriate pump
- Use a pump with a capacity greater than that required
- For barriers installed and removed each day:
 - Normal base flow depth + 1' freeboard
- For barriers with continuous pumps:
 - 2-yr storm + 1' freeboard

Perimeter Control Measures (PCM)

- Intercept sheet flow from slopes
- Remove sediment and other contaminants through:
 - Ponding
 - Settling
 - Physical filtration
- Prevent contaminants from leaving the site

C-PCM-01 – Safety Fence (MS-4)



1.0 Definition

- Protective barrier installed to prevent access to a land-disturbing activity or erosion control measure

2.0 Purpose and Applicability

- Also used to delineate limits of environmentally sensitive areas to be undisturbed or protected

5.0 Design Criteria



- Minimum height:
 - Plastic fencing = 5'
 - Metal fencing = 6'

7.0 O&M Considerations

- Any necessary repairs must be made immediately
- NOTE: C-ENV-10 (Trenchless Silt Fence) may be used in many similar instances, such as Tree Protection

C-PCM-02 – Straw Bale Barrier (MS-4) 1.0 Definition

Temporary barrier made of anchored straw, used to intercept sediment-laden runoff from small drainage areas



C-PCM-04 – Silt Fence (MS-4)



1.0 Definition

- Silt fence (and its derivatives wire-supported (reinforced) and super silt fence) is a temporary sediment barrier consisting of a synthetic filter fabric entrenched and stretched across and attached to supporting posts

5.0 Design Criteria



- Place 5'-7' beyond the base of a slope of 7% or greater
- Check slope lengths in Table C-PCM-04-2

5.0 Design Criteria

Table C-PCM-04-2 Maximum Slope Length (feet) Above Fence

Slope (%)	Standard (18 inches High) Silt Fence	Reinforced (30 inches High) Silt Fence	Super (33 inches High) Silt Fence
2 (or less)	100	500	1000
5	100	250	550
10	50	150	325
15	35	100	215
20	25	70	175
25	20	55	135
30	15	45	100
35	15	40	85
40	15	35	75
45	10	30	60
50	10	25	50

6.0 Construction Specifications



- Height above ground:
 - 18" MIN
 - 34" MAX
- Where joints overlap, a wrap at least 6" of fabric around the stake
- 4" deep and 4" wide trench on upslope side (8" of fabric in trench)
- Fabric installed on the upslope side of the stakes

Other Silt Fence Types



- Derivatives of silt fence include:
 - Wire-supported (reinforced) - standard-strength filter fabric with wire reinforcement
 - Super silt fence - filter fabric over galvanized chain link fencing with aluminum poles set $\leq 10'$ apart

C-PCM-05 – Compost Filter Sock (MS – 4)



1.0 Definition

- Temporary sediment control practice consisting of a biodegradable or photodegradable mesh tube filled with a coarse compost media to filter sediment and other pollutants associated with construction and prevent their migration offsite

5.0 Design Criteria



- Place parallel to the contour with ends extending 8' at a 45° angle
- Max drainage area = ½ acre per 100 linear feet

Maximum Slope Lengths Above Compost Filter Sock							
Diameter (inches)	Slope (%)						
	2	5	10	20	25	33	50
	Length (feet)						
8	378	264	177	91	64	29	--
12	586	256	137	73	60	47	32
18	718	321	174	95	78	61	42
24	956	436	240	133	110	86	60
32	1,277	605	344	195	163	130	93

Sediment Control Measures (SCM)

- Prevent sediment from leaving the site
- Capture or filter sediment particles

C-SCM-01 – Dust Control

1.0 Definition

- Reduction of movement of dust on the ground surface and in the air during land disturbance, demolition, and construction

3.0 Planning Consideration

- Limit amount of soil disturbance at any one time
- During drought, use other control methods than water



C-SCM-01 – Dust Control

6.0 Construction Specifications

- Dust control measures:
 - *Vegetative cover* - areas of no construction traffic
 - *Mulch* - fast & effective; not in traffic areas - use binders to tack
 - *Tillage* - emergency measure to bring clods to surface
 - *Irrigation* - keep surface wet
 - *Spray-on adhesives* - organics - derivatives of pine tar and vegetable gum

C-SCM-02 – Construction Road Stabilization (MS-4, 17)



1.0 Definition

- Stabilization of temporary construction access routes, onsite vehicle transportation routes, and construction parking areas

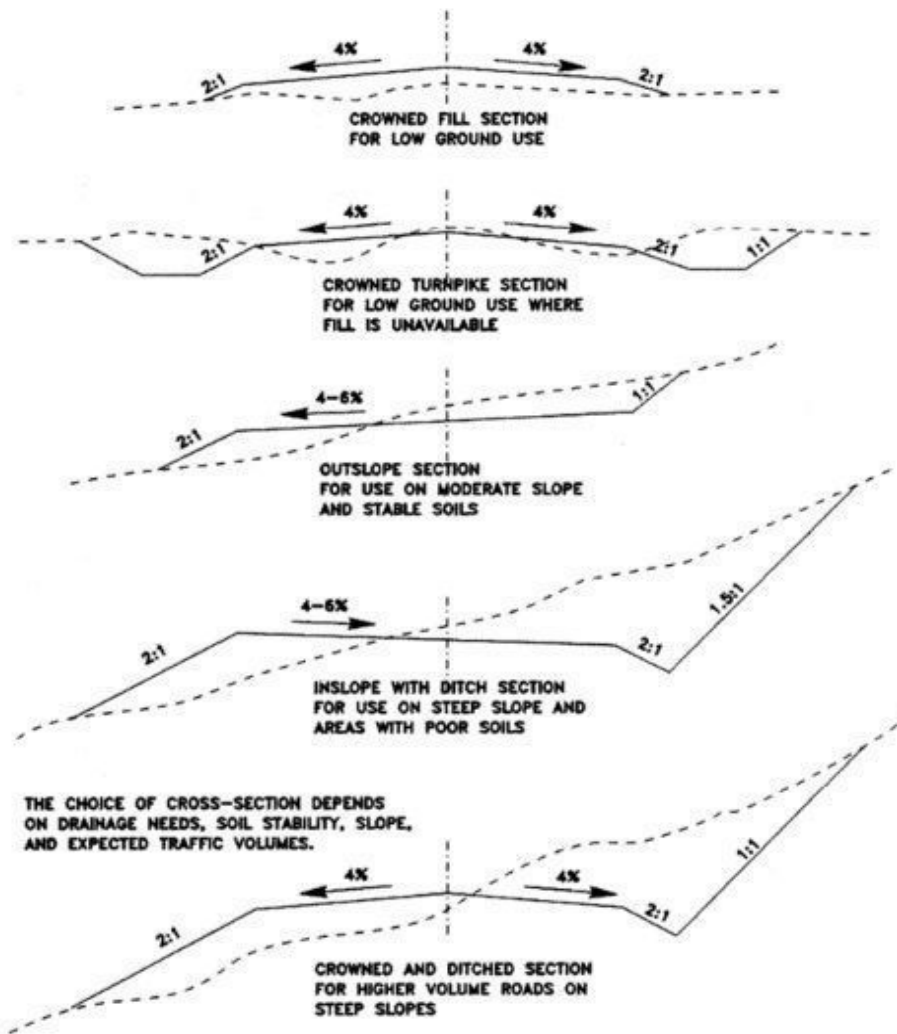
2.0 Purpose and Applicability

- Temporary stabilization of access roads, parking areas, etc.
- Reduces erosion between initial grading and final stabilization



5.0 Design Criteria

TYPES OF ROAD CROSS-SECTIONS



- 14' = 1 way; 20' = 2 way
- 6" of VDOT #1 coarse aggregate
- Five typical road cross-sections:
 - Crowned fill
 - Crowned turnpike
 - Outslope
 - Inslope with ditch
 - Crowned and ditched

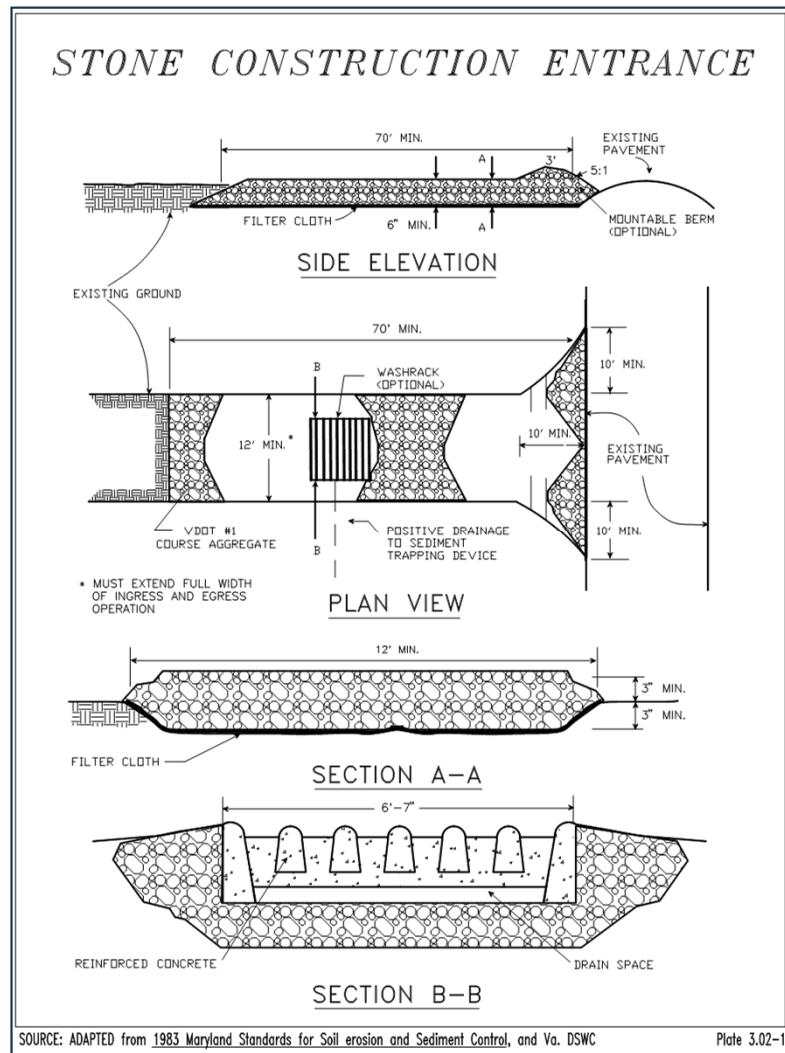
C-SCM-03 – Construction Entrance (MS-4, 17)



1.0 Definition

- Pad with a fabric filter liner underneath the stone located at points of vehicular ingress and egress on a construction site
- Several types of track-out controls that minimize the amount of sediment leaving or being tracked out from the construction site attached to vehicles

5.0 Design Criteria



- VDOT #1, #2, OR #3 coarse aggregate (1.5"-3.5" stone)
- At least 6" of aggregate
- Excavated 3"
- Filter cloth (geotextile) liner
- Minimum 12' wide & 70' long

5.0 Design Criteria



- If a wash rack is used, wash water must drain to a settling area or sediment removal device
- NOTE: C-SCM-02 Construction Road Stabilization is a similar BMP that is beneficial for use throughout a site especially larger sites

C-SCM-04 – Inlet Protection (MS-4, 10)



1.0 Definition

- Sediment filter or an excavated impounding area around a storm drain inlet or curb inlet

2.0 Purpose and Applicability

- Prevents sediment from entering storm drain system prior to permanent stabilization

5.0 Design Criteria

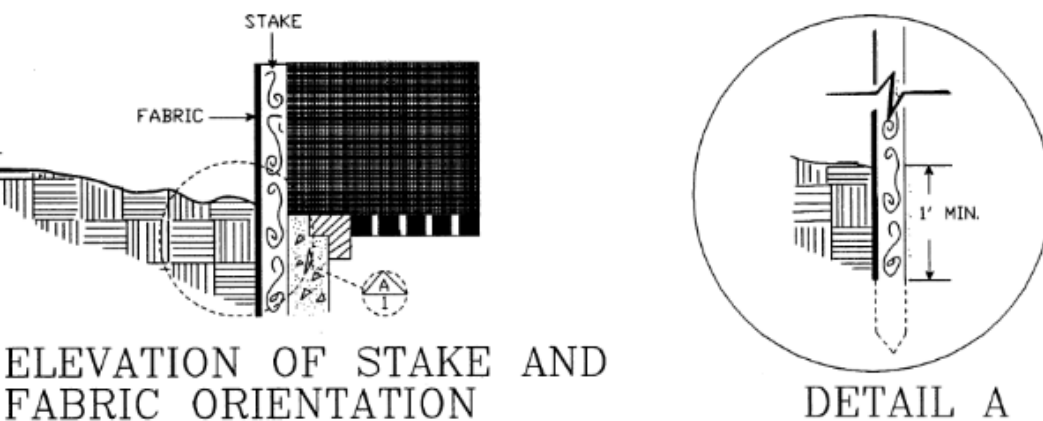
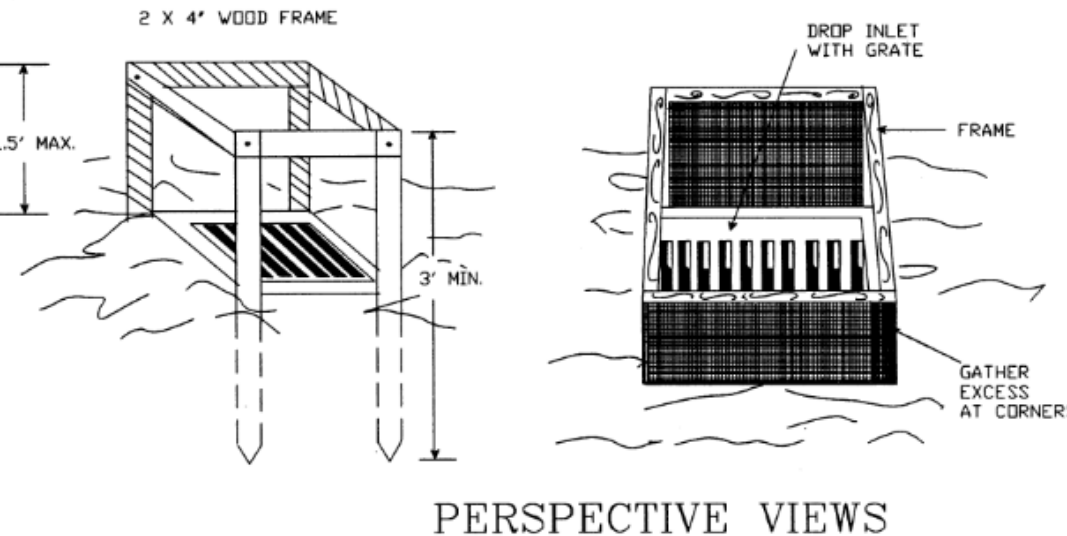


- Max. drainage area = 1 acre
- Should not create excessive ponding on the site
- Filter fabric can be used with larger, coarse aggregate, but the fabric may clog quickly, requiring more maintenance

Silt Fence Drop Inlet Protection

6.0 Construction Specs

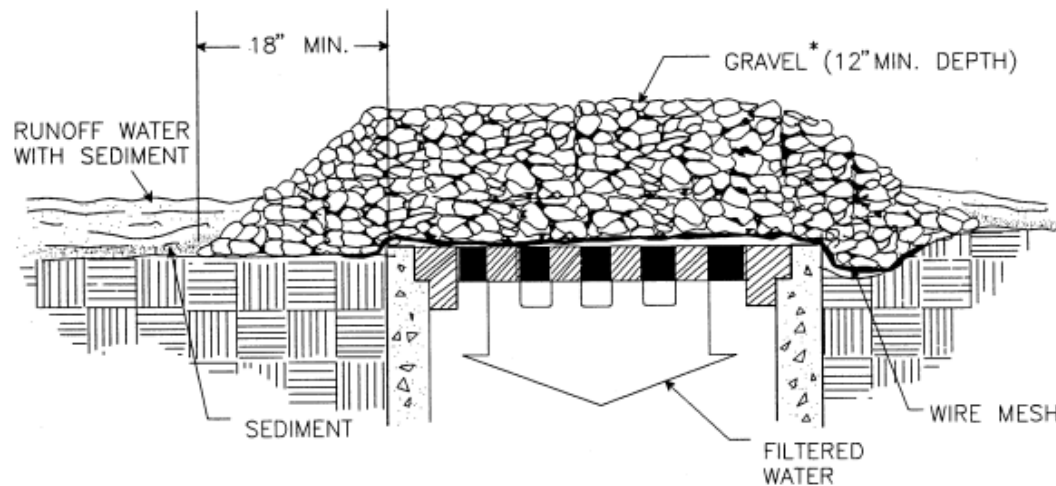
- Use 2"x4" stakes for vertical and horizontal
- Space vertical 2"x4"s 3 feet apart
- Entrench fabric 12 inches around inlet
- Overlap fabric to next stake
- Backfill and compact



Gravel and Wire Mesh Drop Inlet Protection

6.0 Construction Specs

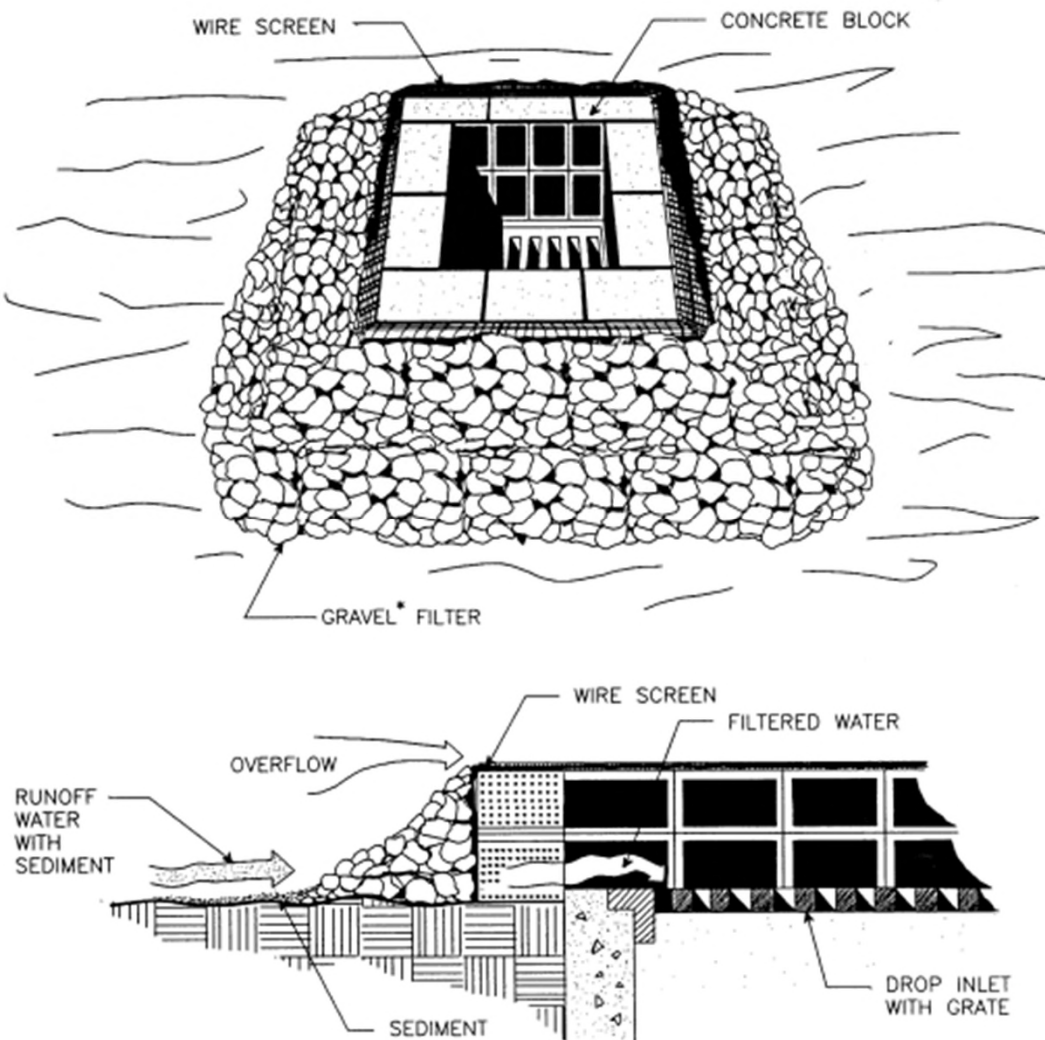
- ½" wire mesh over inlet, minimum 1' beyond each side of inlet
- Coarse aggregate placed over the wire
- Depth of stone shall be at least 12", extend 18" on all sides



Block & Gravel Drop Inlet Protection

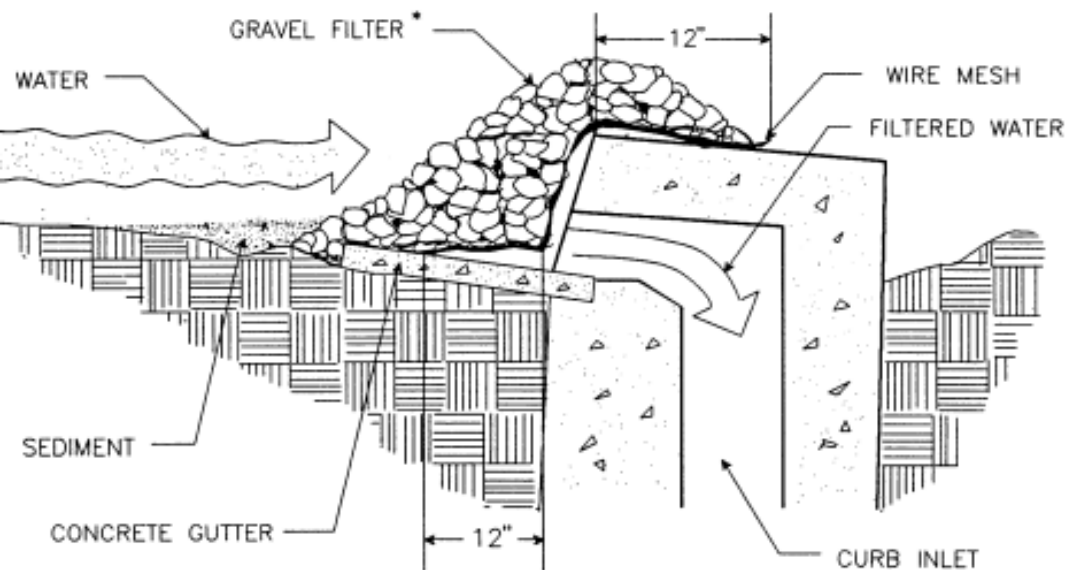
6.0 Construction Specs

- 4", 8", or 12" concrete blocks placed on sides
- Minimum 12" high, maximum 24" high
- ½" wire mesh between concrete blocks and #3, 357, or 5 stone



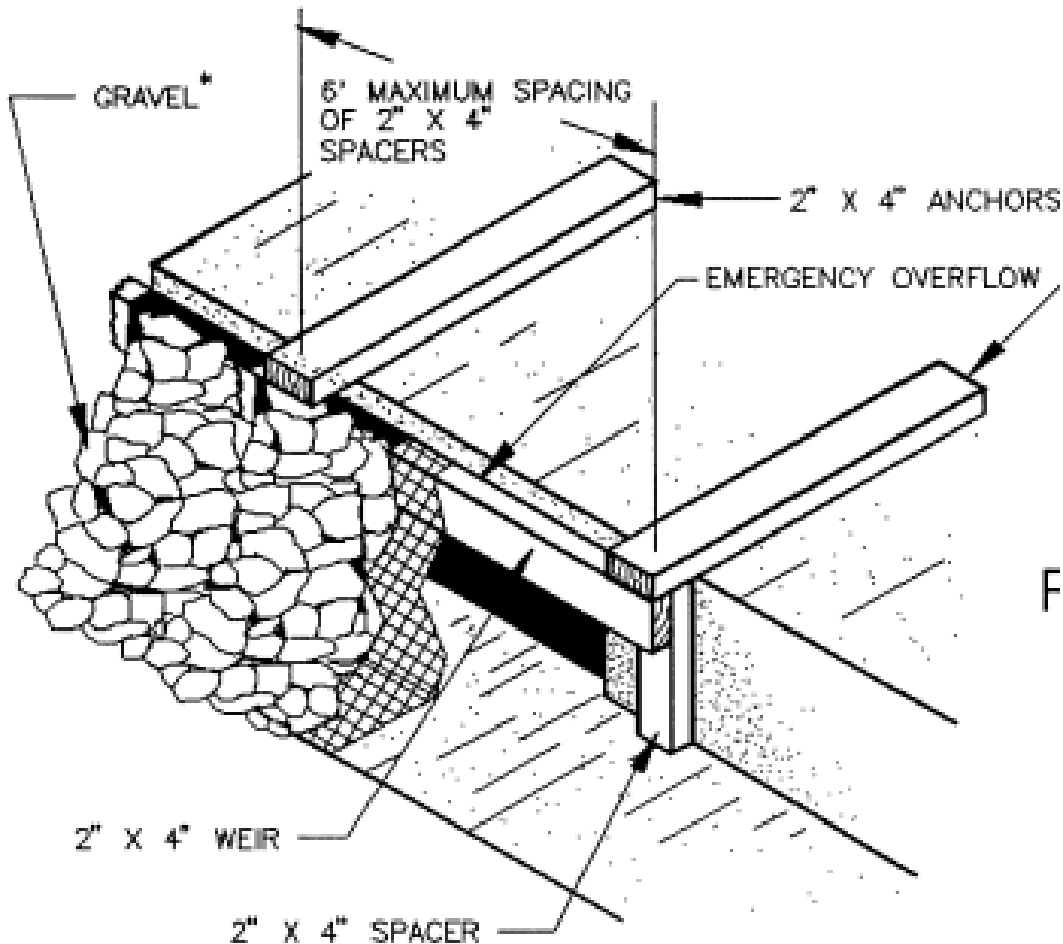
Gravel Curb Inlet Protection

6.0 Construction Specs



- ½" wire mesh
 - Extend 12" over top
 - 12" in gutter pan
- Pile stone against wire to cover inlet opening
 - #3, 357, or 5 stone
- Move and replace stone once clogged

Wooden Weir Curb Inlet Protection



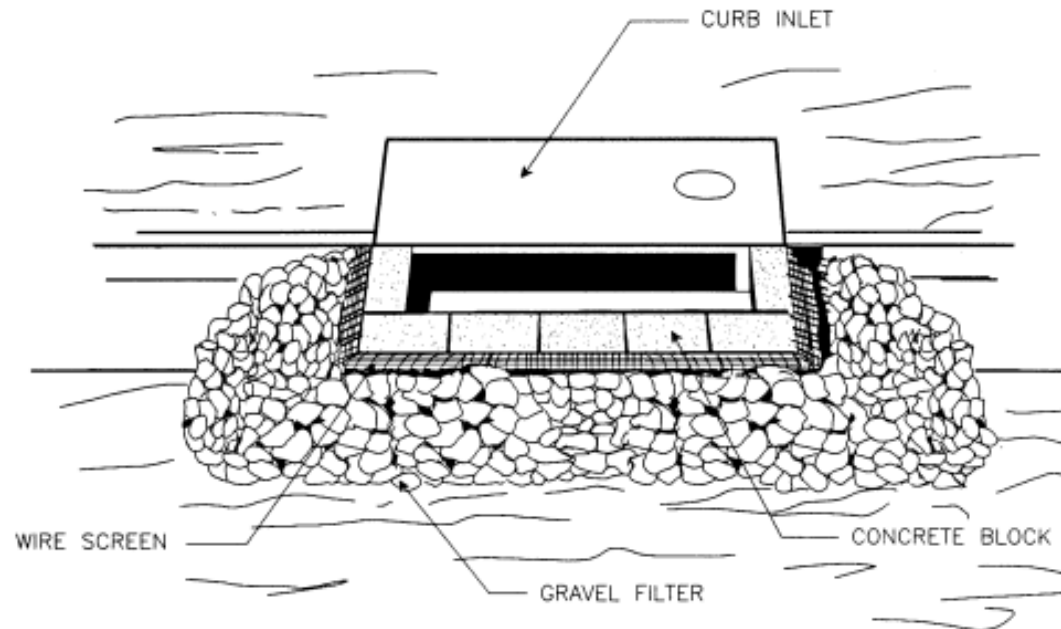
6.0 Construction

- Attach wire mesh to 2"x4" wooden weir
 - 30" deep
 - Inlet opening plus 4'
- Use 2"x4" anchors and spacers
- Place 2"x4" across inlet and nail together
- Weighted support on top of inlet

Block and Gravel Curb Inlet Protection

6.0 Construction Specs

- Concrete blocks placed on sides across front of inlet and against the spacer blocks
- ½" wire mesh placed over outside of blocks
- Wire covered with #3, 357, or 5 stone



Other Inlet Protection Devices

Make sure the operator has the manufacturers' specs on how to properly install and maintain these products!



C-SCM-05 – Culvert Inlet Protection (MS-10)



1.0 Definition

- Sediment filter located at the inlets of culverts

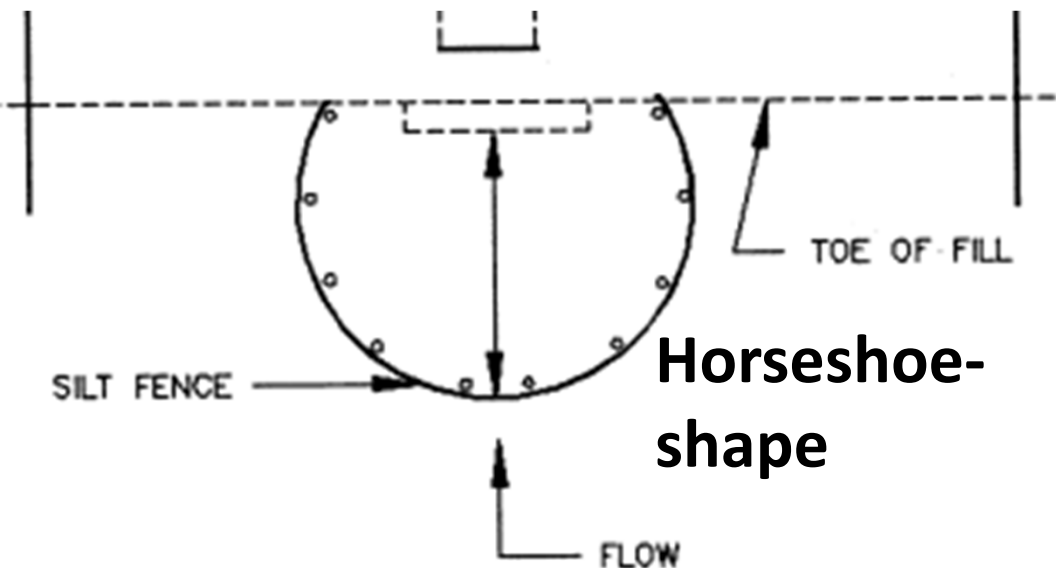
2.0 Purpose and Applicability

- Prevents sediment from disturbed area above the culvert from entering, accumulating in, and being transported by a drainage system

Silt Fence Culvert Inlet Protection

5.0 Design Criteria

- Expected useful life span is 3 months
- No more than 1 acre of drainage
- Minimum of 16" 18" high
- Maximum of 34" high
- Stakes spaced 3' apart
- Fence placed 6' away from culvert opening



Silt Fence Culvert Inlet Protection

6.0 Construction Spec.

- If silt fence cannot be installed properly or high velocity is expected, use a stone combination
 - #3, 357, or 5 stone
 - Backed by riprap
- Compost filter sock or straw wattles may be used in lieu of a silt fence



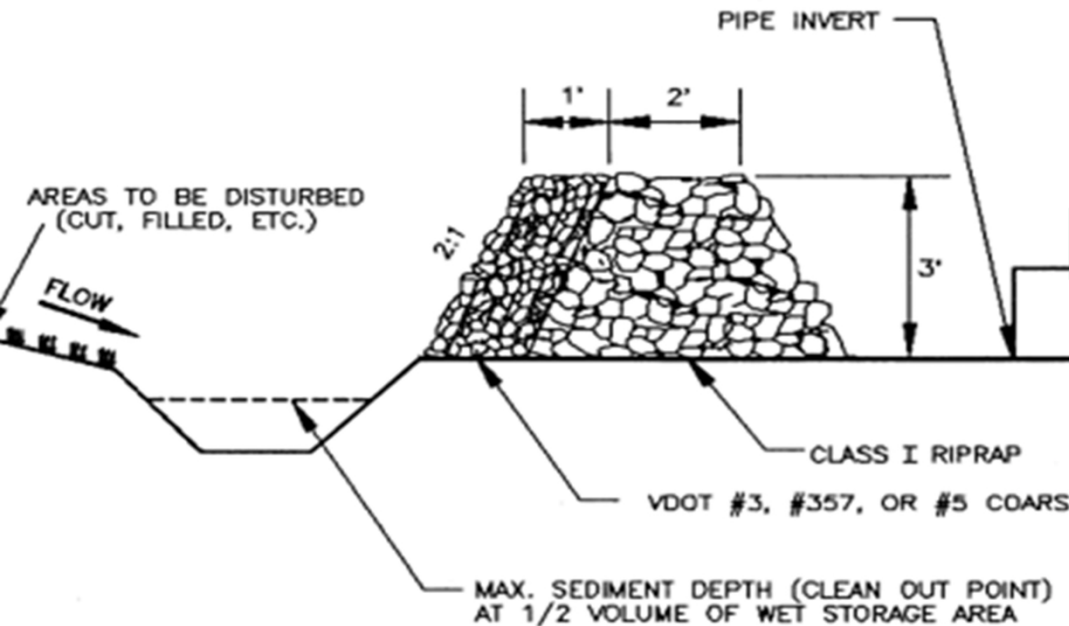
Sediment Trap Culvert Inlet Protection

5.0 Design Criteria

- Lifespan = 18 months
- Less than 3 acres drainage

6.0 Construction

- Horseshoe-shape around the inlet
- Toe of riprap no closer than 24" from opening
- Align runoff storage requirements with C-SCM-11 (Temp Sediment Trap)



C-SCM-07 – Rock Check Dams (MS-11)



1.0 Definition

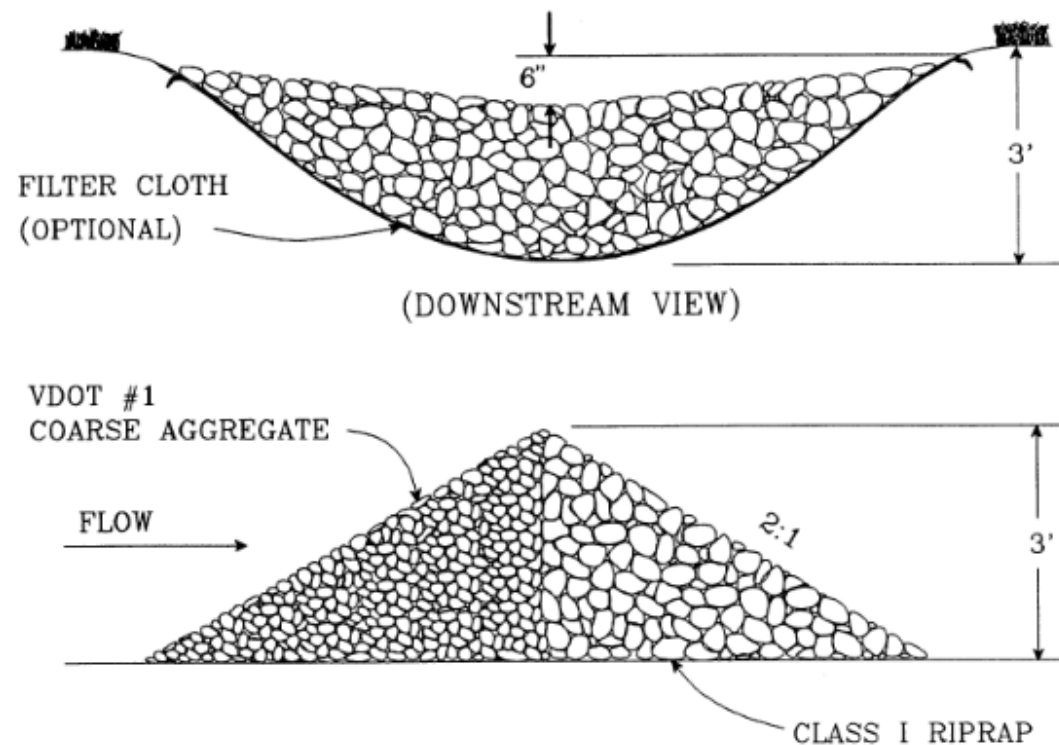
- Small temporary stone dams constructed across a swale, channel, or drainage ditch

2.0 Purpose and Applicability

- Minimize erosion by reducing velocity in a ditch or swale
- Traps sediment by ponding stormwater runoff
- Can be used while grass lining is being established

5.0 Design Criteria

2-10 ACRES OF DRAINAGE AREA:

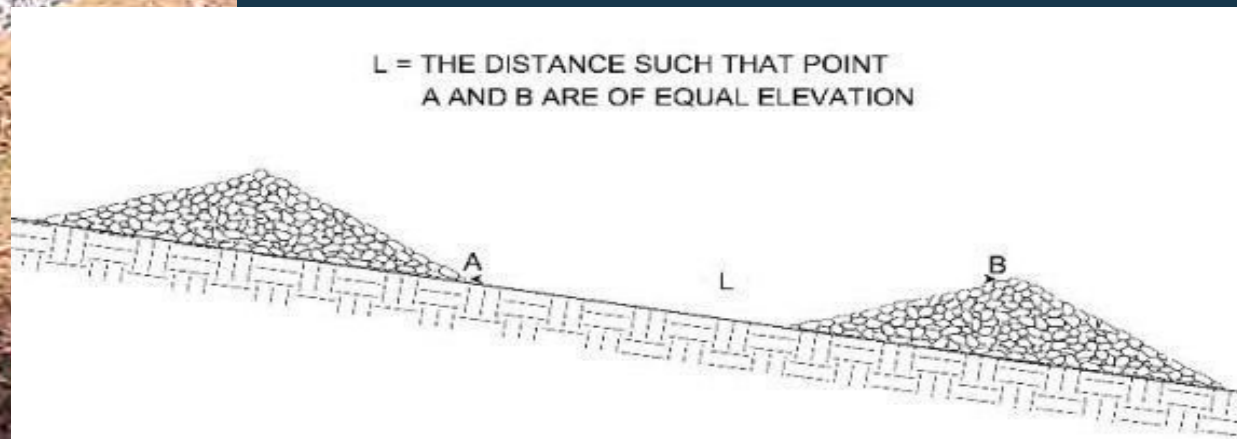


- Two stone sizes, depending on drainage area
 - Up to 2 acres – #1 stone
 - 2-10 acres – #1 backed by riprap
- Max height = 2' at center of channel/swale
- Center must be at least 6" lower than outer edges
- Filter fabric may be used, refer to Riprap (C-ECM-13)

5.0 Design Criteria



- Space such that the toe of the upstream dam is at the same elevation as the top of the downstream dam
- Based on proposed slope



C-SCM-08 – Rock Filter Outlet (MS-4)



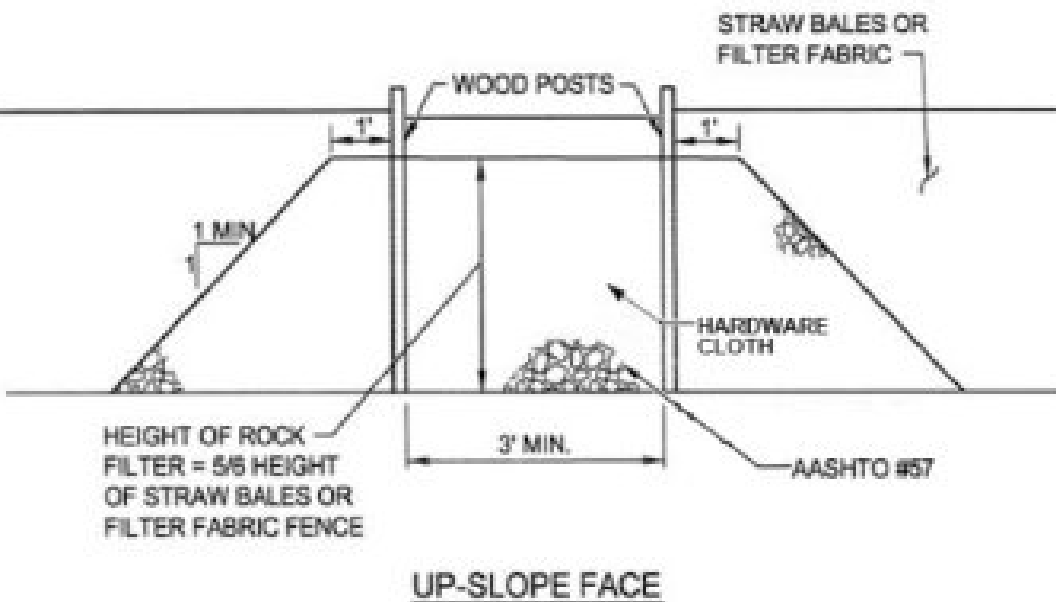
1.0 Definition

- A berm constructed of riprap and stone aggregate where unanticipated concentrated flow to a perimeter control has caused the perimeter control to fail

2.0 Purpose and Applicability

- Only use where a sediment trap may not be warranted

5.0 Design Criteria



- Ensure coarse aggregate layer is installed on the *upslope side* of the riprap
- Provide 1' of rock on either side of the opening in the fabric before tapering down
- Minimum top width is 1'
- Max drainage area of 0.25 acres

C-SCM-09 – Turbidity Curtain (MS-4, 12, 14)



1.0 Definition

- A floating geotextile material that minimizes sediment transport from a disturbed area adjacent to or within a body of water

2.0 Purpose and Applicability

- Used to provide sediment protection when working along the edge of water
- Can be used in tidal and non-tidal water
- NOTE: C-ENV-14 (Modified Turbidity Curtain for Streams) may be preferred in situations

5.0 Design Criteria



5.0 Design Criteria

- Three configurations based on current (Table C-SCM-09-3)
- Avoid excessive number of joints in the curtain, aim for 50' to 100' between joints

6.0 Construction

- Must be securely anchored into the shoreline
- Attach anchor lines to flotation device, not bottom of curtain

C-SCM-10 – Dewatering Structure (MS-16)

1.0 Definition

- A temporary settling filtering device

2.0 Purpose and Applicability

- Provide settling and filtering of sediment-laden water for discharging

5.0 Design Criteria

- Storage capacity (cu. ft.) should = $16 \times$ pump discharge capacity (GPM)
- Effluent pumped across a well-vegetated area (at least 75') or through silt fence



Straw Bale/Silt Fence Pit



5.0 Design Criteria

- Filter fabric may help reduce scour and reduce inclusion of soil from within the structure

6.0 Construction

- Ensure settlement of at least 6 hours
- Excavate at least 3' below the base of the perimeter measures (straw or SF)

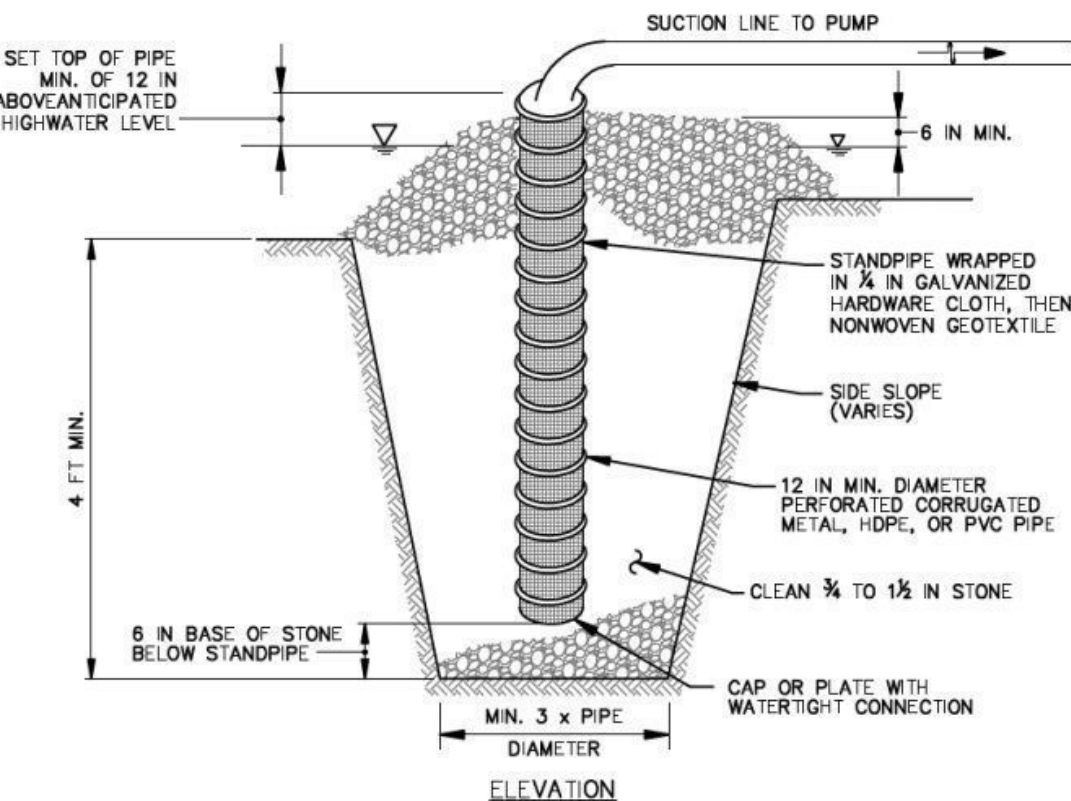
Portable Sediment Tank



6.0 Construction

- Minimum depth = 2'
- Locate for easy cleanout and disposal of sediment
- Ensure tank allows for emergency flow over the top
- Cleanout sediment at $\frac{1}{3}$ of the tank's capacity

Other Dewatering Structures



- Other dewatering structures include:
 - Pumped Water Filter Bag - Geotextile bag water is pumped into and through
 - Sump Pit - Perforated pipe wrapped in filter fabrics and attached to a pump
 - Filter Box - Box with porous bottom and 12" of #3 stone
- See Table C-SCM-10-2

C-SCM-11 – Temporary Sediment Trap (MS-4, 6)



1.0 Definition

- Temporary ponding basin formed by constructing an embankment, often earthen or composed of compost filter sock, with a stone outlet

2.0 Purpose

- Drainage areas less than 3 ac
- Sediment settles out in pond
- Max. lifespan = 18 months

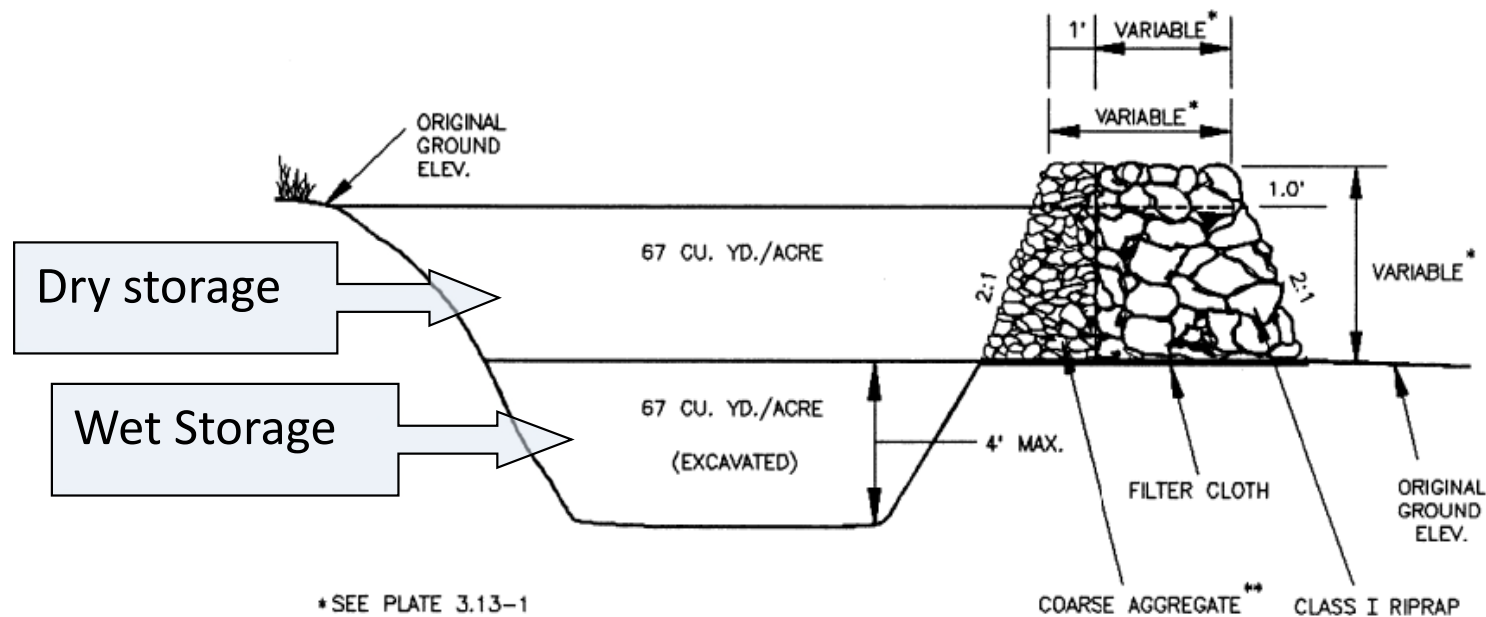
3.0 Planning and Considerations



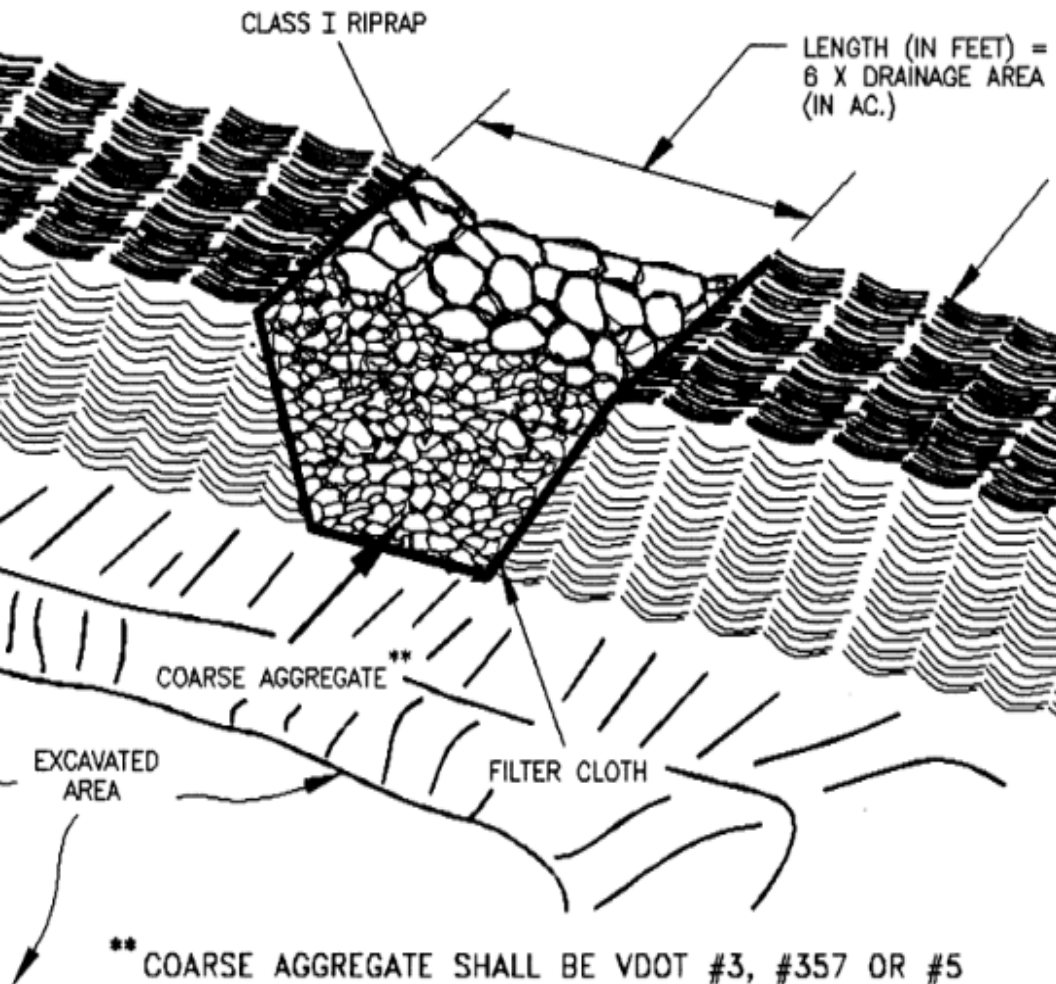
- Place traps where existing drainage divides naturally send runoff
- Consider variations in the design to ensure that storage requirements are met
- Avoid locating traps on steep or unstable slopes
- Avoid placing where they will impede construction activity

5.0 Design Criteria

- Must have a storage capacity of 134 cubic yards per acre of **drainage** area
- Storage volume = 50% wet; 50% dry
- 2:1 length to width ratio
- See Table C-SSM-11-1 for more information



5.0 Design Criteria



- Excavation:
 - Side slopes no steeper than 1:1
 - Max excavated depth of wet storage = 4 feet
- Reference Table C-SSM-11-1 for more design information

5.0 Design Criteria

- Embankment:

- Max height = 5' from base of stone outlet

Table C-SCM-11-2 Minimum Top Width Required for Sediment Trap Embankments According to Height of Embankment		
Embankment Height (ft)	Outlet Crest Height (ft)	Minimum Embankment Top Width (ft)
1.5	0.5	2.0
2.0	1.0	2.0
2.5	1.5	2.5
3.0	2.0	2.5
3.5	2.5	3.0
4.0	3.0	3.0
4.5	3.5	4.0
5.0	4.0	4.5

5.0 Design Criteria

Three types of outlet designs:

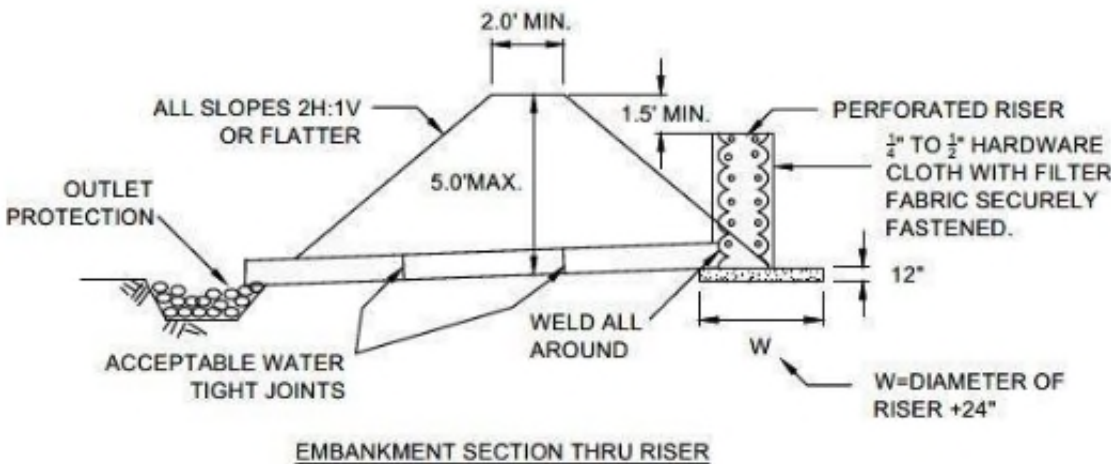


- Stone outlet
 - Low point in basin
 - 1' below embankment
 - Smaller stone used to provide filtering
 - Larger stone (rip-rap) used to provide outlet stability
 - Filter cloth under stones
 - Length = 6 x drainage area

5.0 Design Criteria

Three types of outlet designs:

- Pipe outlet
 - Riser at least 1.5' below top of the embankment
 - No holes or perforations within 6" of the top of the pipe
 - Ensure riser is wrapped in cloth



5.0 Design Criteria

Three types of outlet designs:

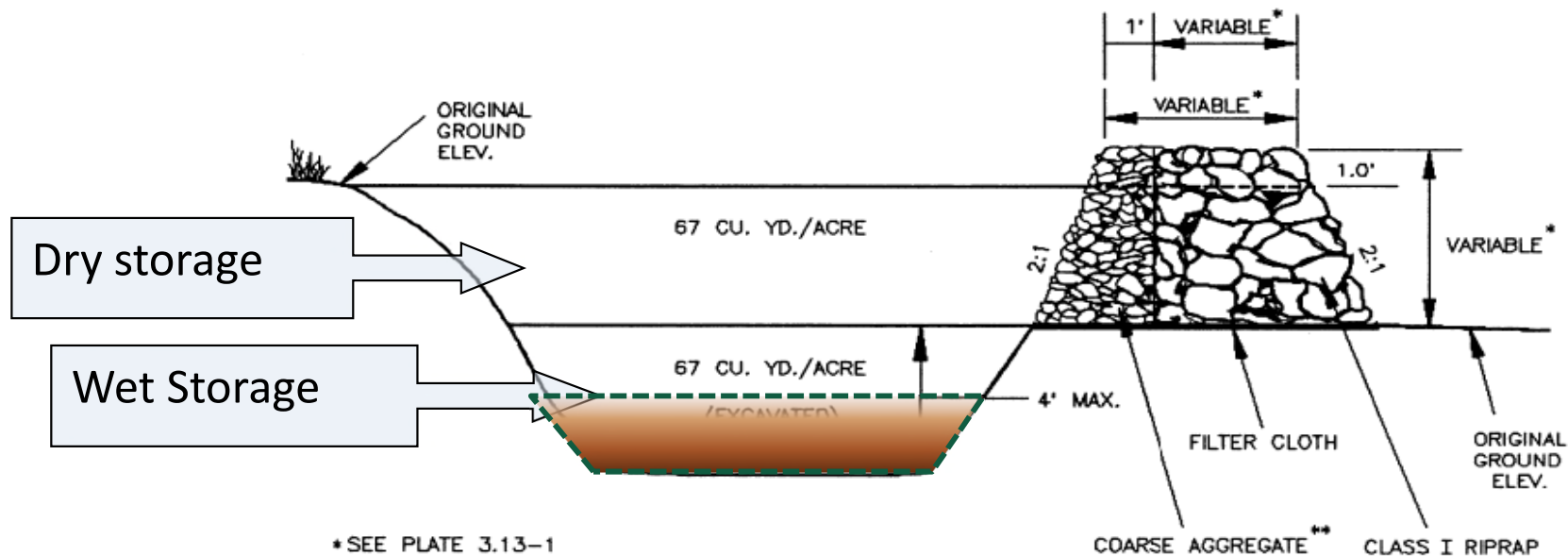


- Compost Filter Sock outlet
 - Small socks (8", 12", 18") stacked above larger filter socks (18", 24", 32") to form a berm
 - Min height = 3'

7.0 Operations and Maintenance

- Must be cleaned out when sediment reaches half of the wet storage volume
- Make sure outlet is not clogged or damaged

TEMPORARY SEDIMENT TRAP



C-SCM-12 – Temporary Sediment Basin (MS-4, 6, 19)



1.0 Definition

- A temporary barrier or dam with a controlled stormwater release structure formed by constructing an embankment of compacted soil across a drainageway

2.0 Purpose and Applicability

- Drainage area = 3 to 100 acres
- Max lifespan = 18 months

3.0 Planning and Considerations



- Locate basins to intercept the largest possible amount of runoff from the site
- Low points and natural drainageways below disturbed areas are optimal locations
- May be used in conjunction with drainage dikes and ditches to help transport sediment to the basin

3.0 Planning and Considerations

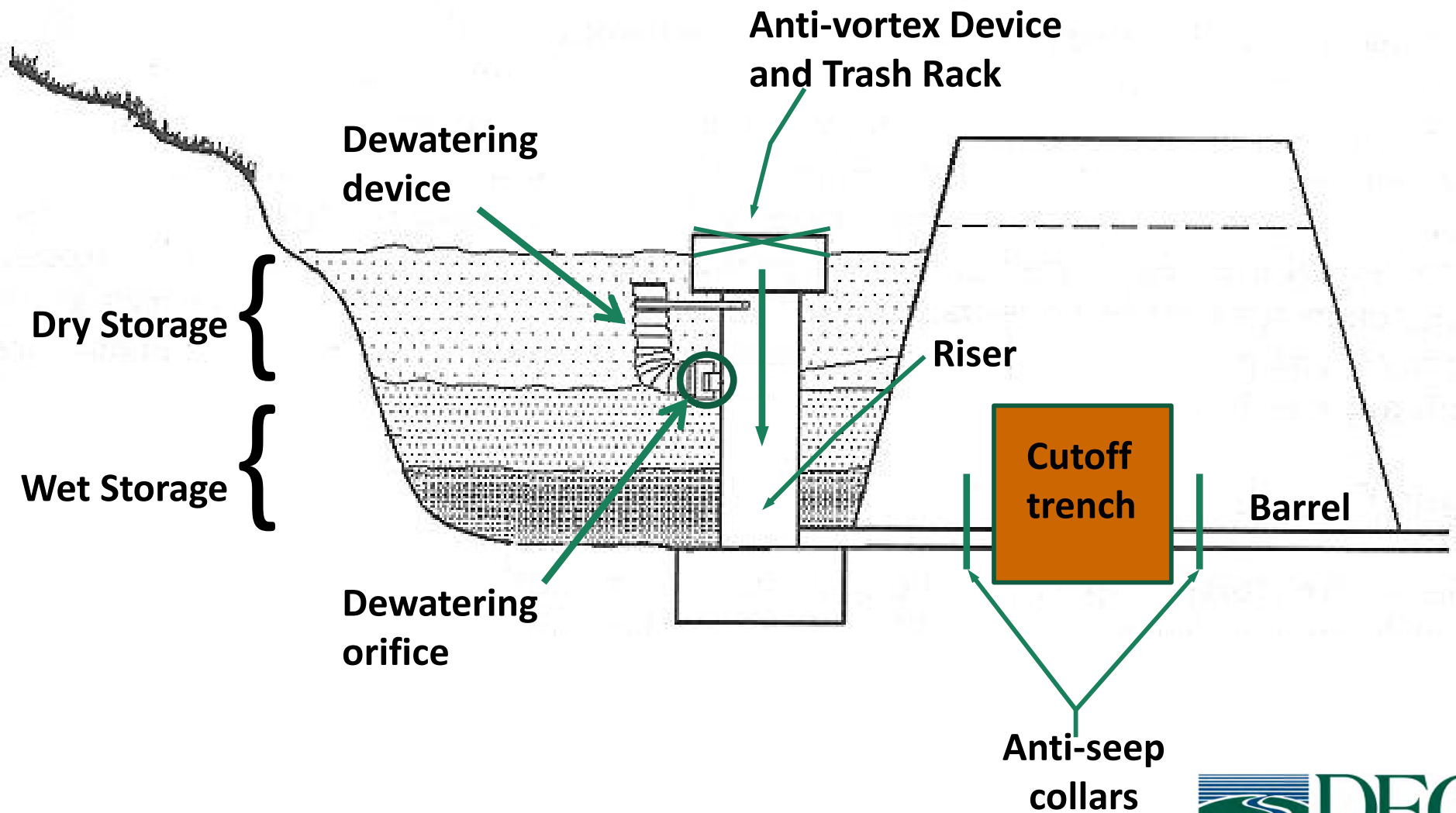


- Do not locate basins in a live stream or where its failure would have negative impacts on habitats or daily life
- Ponds formed using a low dam across a natural swale are generally preferred to excavated ponds
- Avoid placing where they will impede construction activity

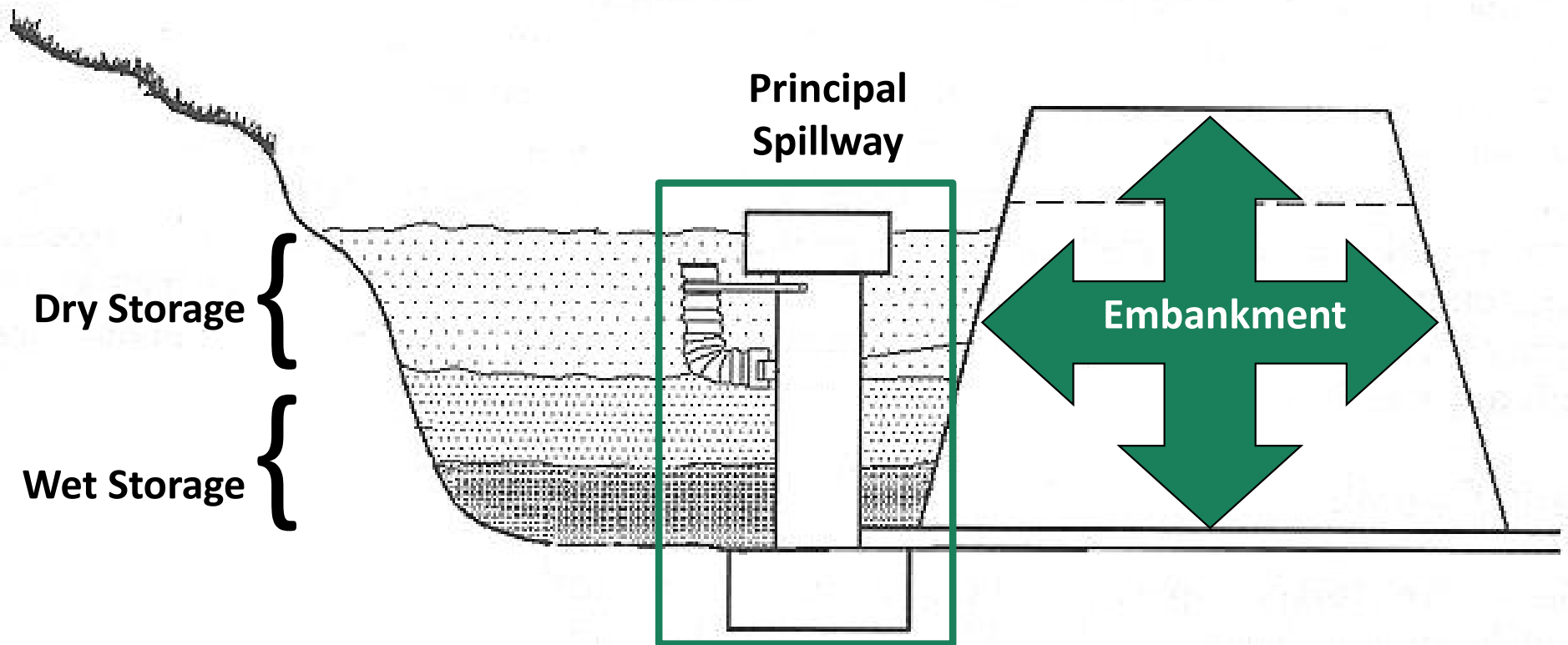
5.0 Design Criteria

- Must maintain permanent pool of water
- Storage capacity of at least 134 cubic yards per acre of total contributing drainage area
 - Half of the design volume (67 cu yds) will be dry storage, half wet storage
- Must not dewater in less than 24 hours, nor take longer than 120 hours
- Sediment Cleanout Level = 34 cubic yards/acre ($\frac{1}{2}$ the wet storage volume)

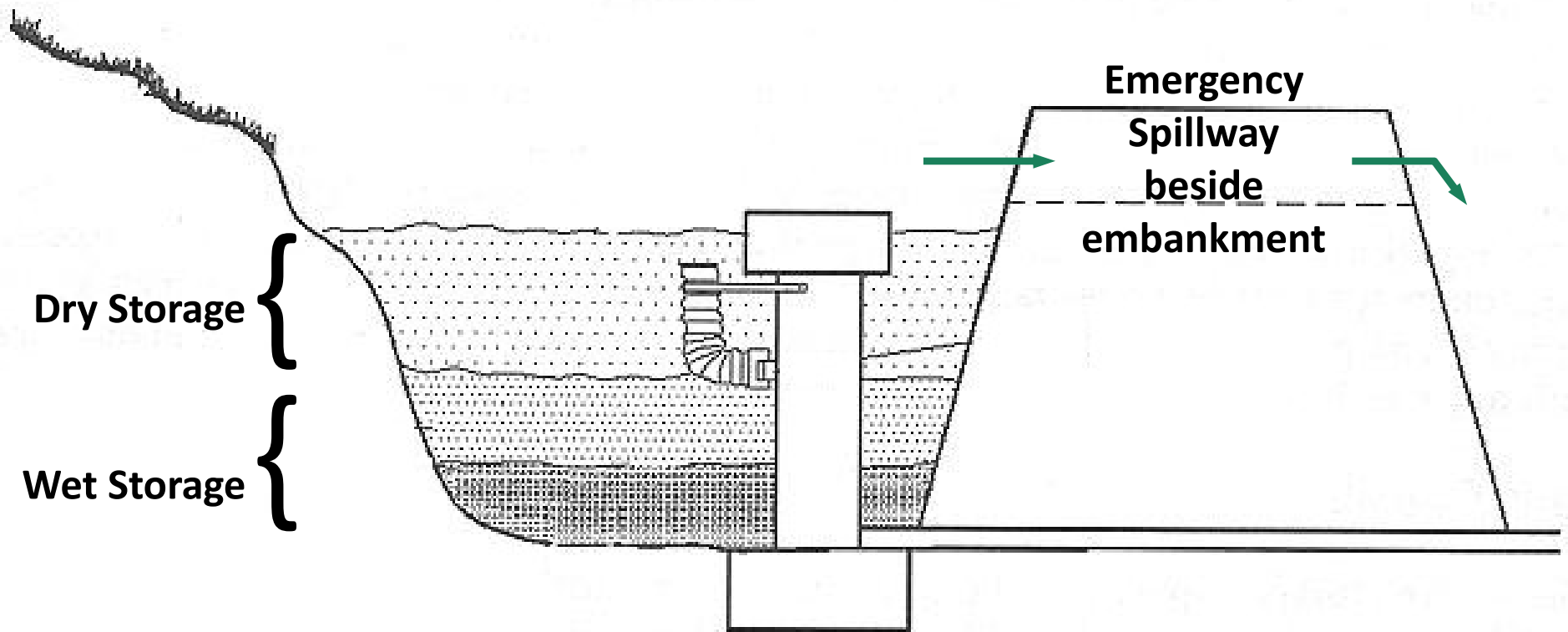
5.0 Design Criteria



5.0 Design Criteria



5.0 Design Criteria



5.0 Design Criteria

Minimum diameter of riser = 15"

Principal spillway must be at least 1' below the emergency spillway

Anti-vortex device and trash rack attached to top

Dewatering device attached to riser

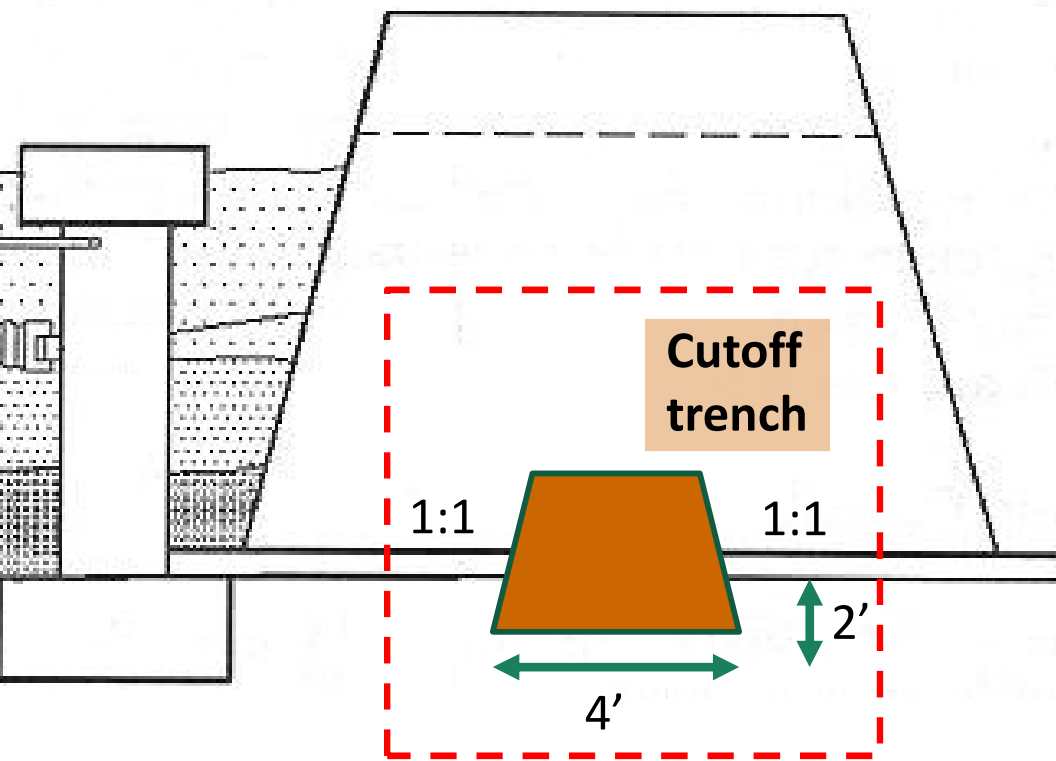
The base of the riser shall be anchored by either concrete or steel plate (see approved plan for details)

The barrel shall have a watertight connection to the riser and shall have outlet protection

5.0 Design Criteria

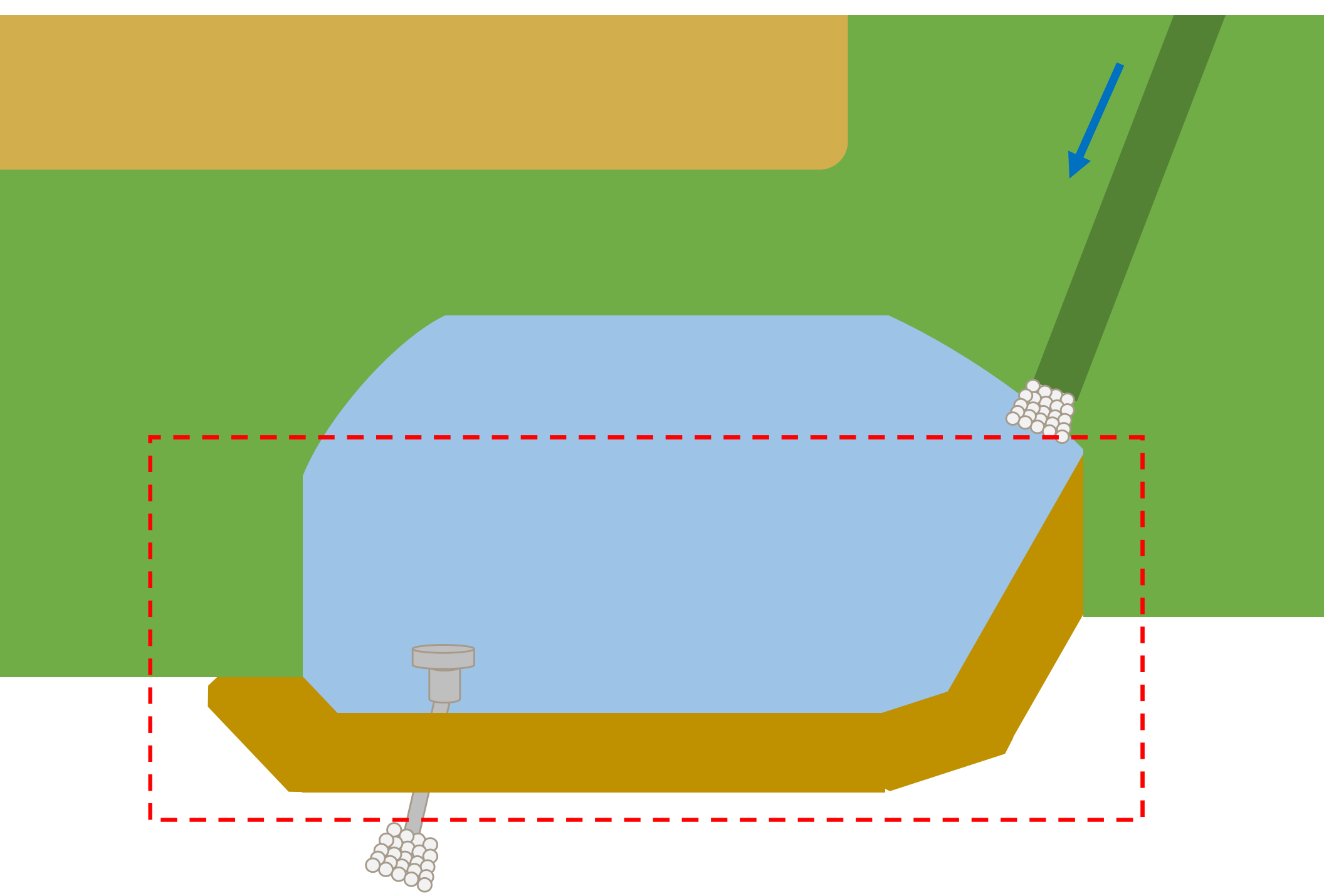
- Anti-seep collars control seepage along the barrel pipe
 - May or may not be required. Check approved plan
 - Generally required when the settled height of the embankment exceeds 10' OR the embankment has a low silt-clay content
 - Compaction around these are critical (95%)
 - Shall be watertight

6.0 Construction Specifications

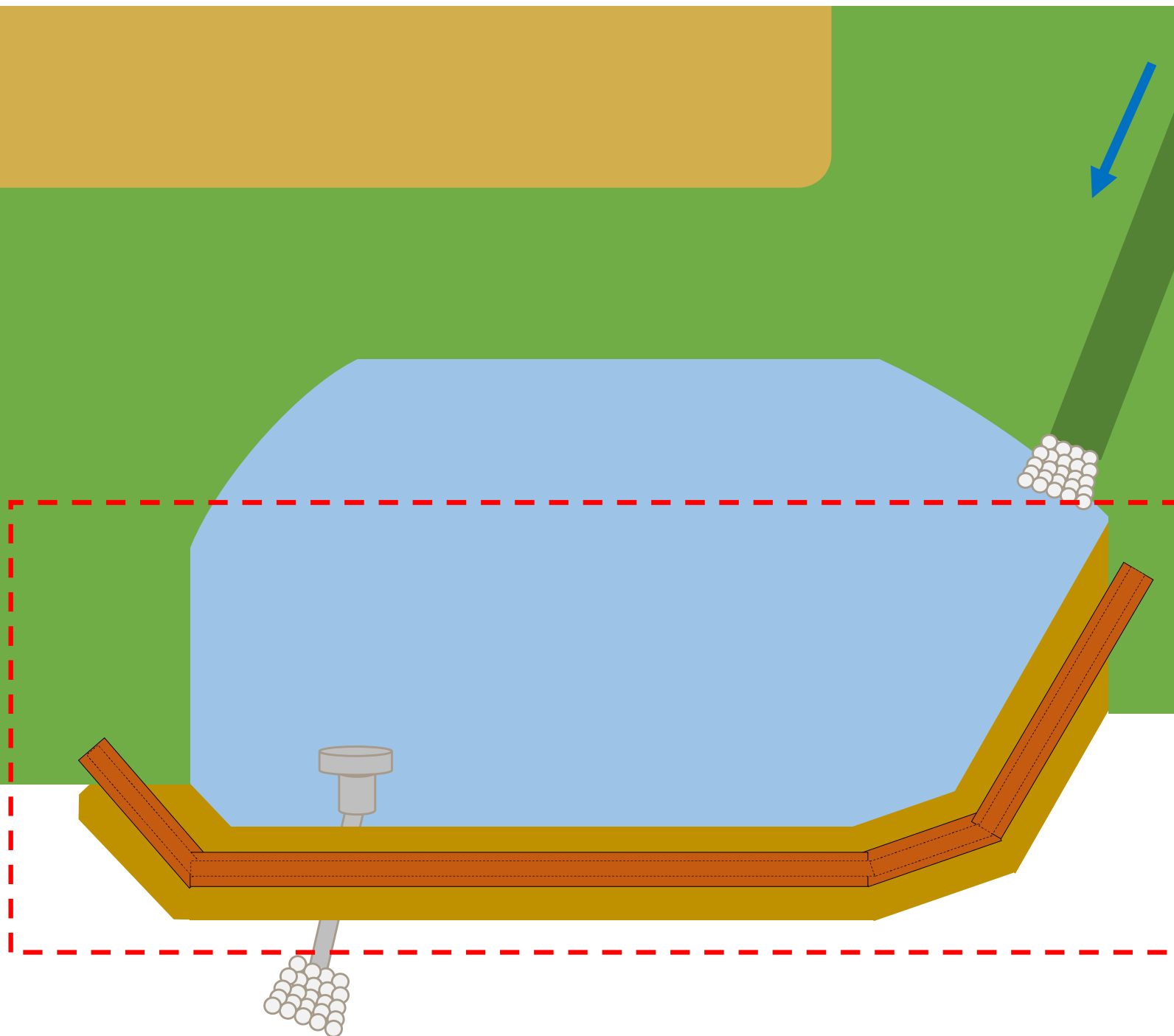


Cutoff Trench:

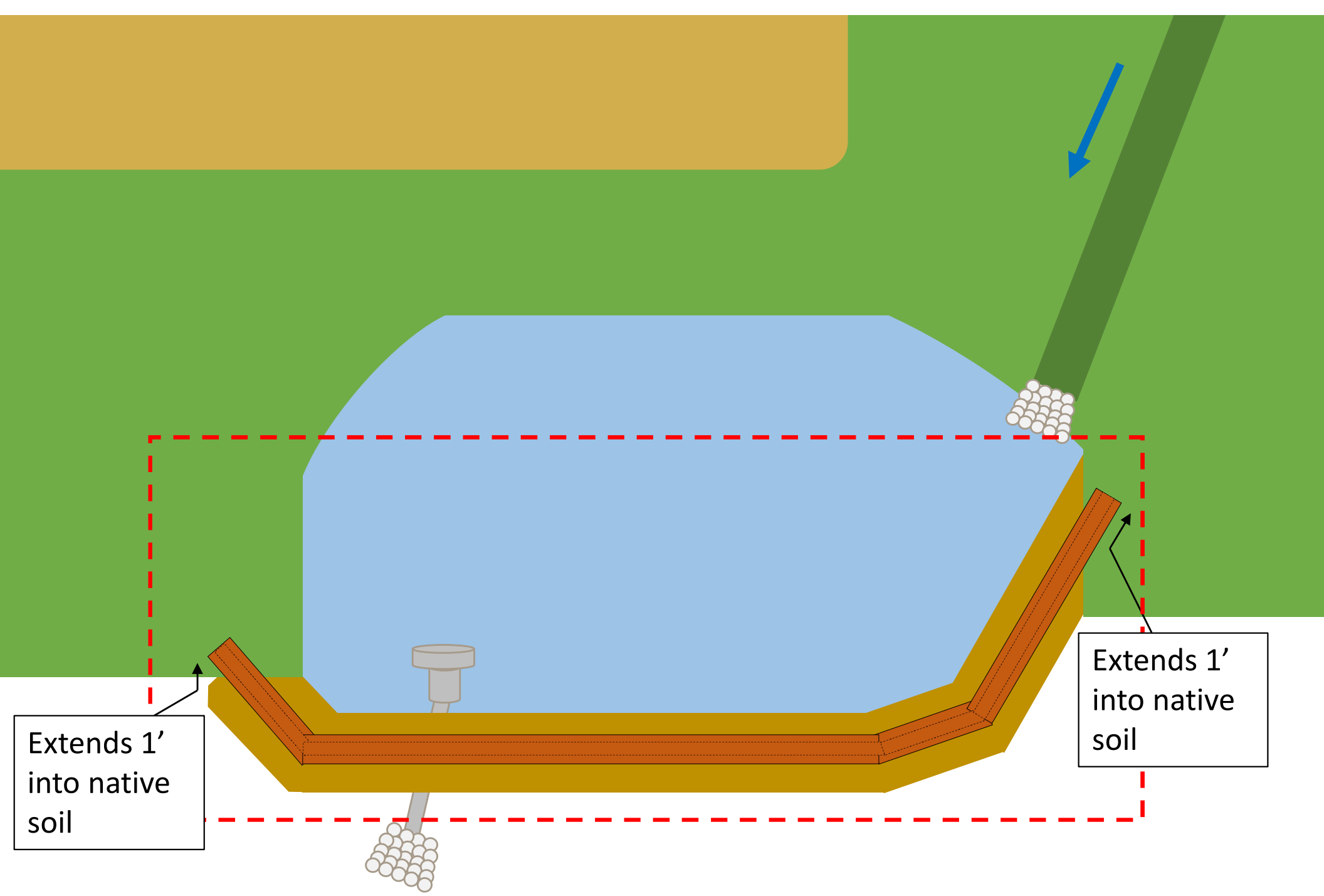
- Shall extend 1' into stable soil and up both abutments to the riser crest elevation
- Minimum depth 2' into native soil
- Minimum 4' bottom width
- Side slopes no steeper than 1:1



6b. | C-SCM-12 — TEMPORARY SEDIMENT BASIN



6b. | C-SCM-12 — TEMPORARY SEDIMENT BASIN



6b. | C-SCM-12 — TEMPORARY SEDIMENT BASIN

5.0 Design Criteria - Embankments

- For embankments of less than 10 feet:
 - Minimum top width of 6 feet
 - Maximum side slopes of 2H:1V or flatter
- For embankments 10 to 14 feet in height:
 - Minimum top width of 8 feet
 - Maximum side slopes of 2.5H:1V or flatter
- For 15-foot embankments:
 - Minimum top width of 10 feet
 - Maximum of 2.5H:1V side slopes

5.0 Design Criteria - Embankments

- Constructed in 6” lifts, using clean soil with no roots or rocks (Section 6.0)
- Fill material needs to be clean and approved
 - Free of roots, rocks, and other objectionable materials
 - Achieve a compaction of 95%
 - Placed in 6” layers/lifts over the entire length

Sediment Basin Examples



6b. | C-SCM-12 — TEMPORARY SEDIMENT BASIN

C-SCM-13 – Concrete Washout Pit

1.0 Definition

- Temporary excavated or above-ground lined constructed pit or a prefabricated or fabricated container
- Concrete truck mixers and equipment can be washed after their loads have been discharged
- Prevent highly alkaline runoff from entering storm drainage systems or leaching into soil



Module 6c.

Vegetative Practices

Surface Stabilization Measures (SSM)

- Protect disturbed soil from surface runoff
- Both temporary covering and permanent vegetative cover
- Often part of the final landscape

C-SSM-01 – Tree Preservation & Protection (MS-1)

1.0 Definition

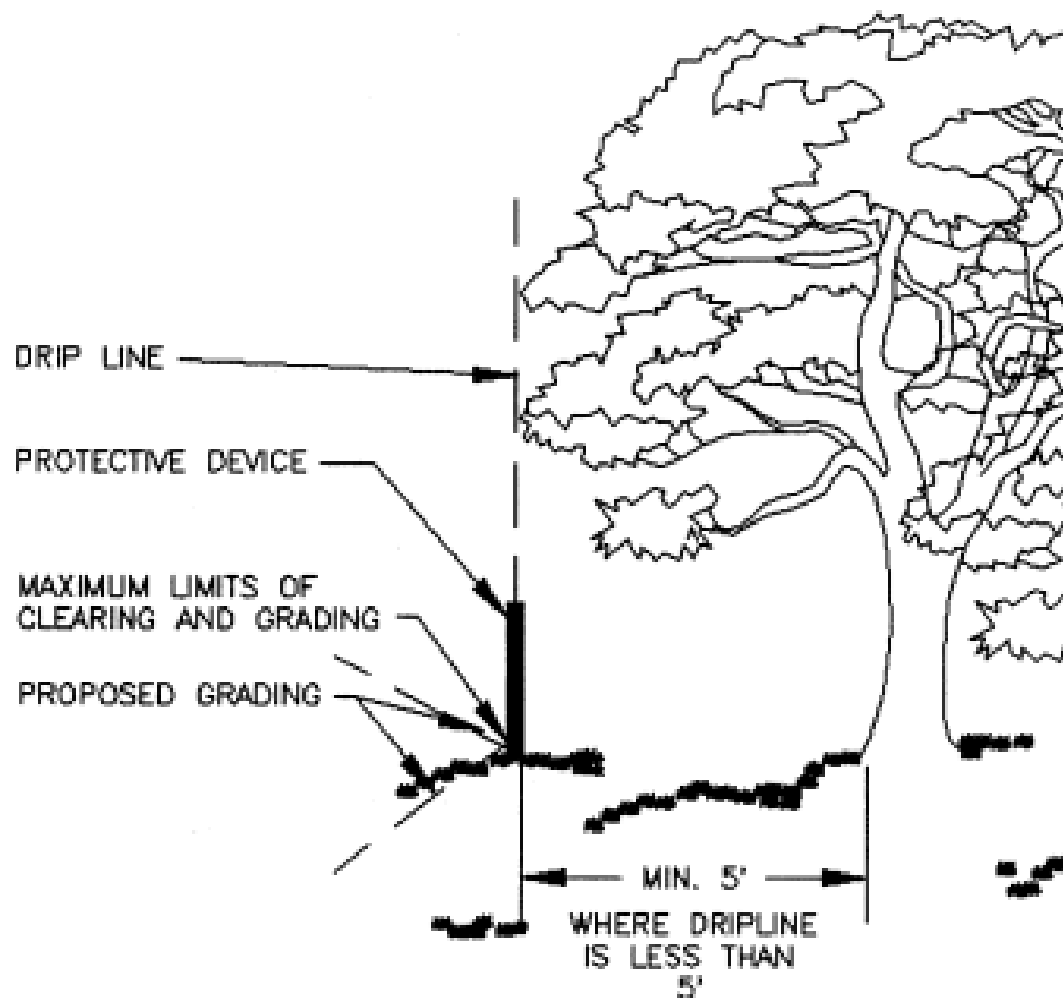
- The protection of desirable trees from mechanical and other types of injury during land disturbance and construction

2.0 Purpose

- Ensure the survival of desirable trees and their root zones



3.0 Planning and Considerations



- Newly planted trees take ~20-30 years to provide full benefits, existing trees do not require this wait

6.0 Construction

- Material storage and vehicle parking must be located away from trees
- Install at edge of drip line but no closer than 5'

C-SSM-02– Topsoiling (MS-1, 2)

1.0 Definition

- The A and E horizons of the existing mineral soil profile. Well humified litter layer (O horizon) material may also be included but not fresh or partially decomposed litter
- *As a BMP:* entails preserving and using the surface layer of undisturbed soil, often enriched in organic matter, to obtain a more desirable planting and growth medium and enhance final site stabilization



5.0 Design Criteria

- Topsoil should be tested to meet requirements
 - At least 1.5% by weight OM
 - $6.0 \leq \text{pH} \leq 7.5$
 - Soluble salts ≤ 500 ppm
- Consists of 3 processes:
 - Stripping
 - Stockpiling
 - Reapplying

6.0 Construction

- Avoid applying when soil is frozen or wet

6.0 Construction Specifications



- Ensure subsoil is loosened to provide a good bond between the subsoil and topsoil
- Verify topsoil is spread to a minimum depth of 2" on 3:1 or steeper slopes and 4" on flatter slopes

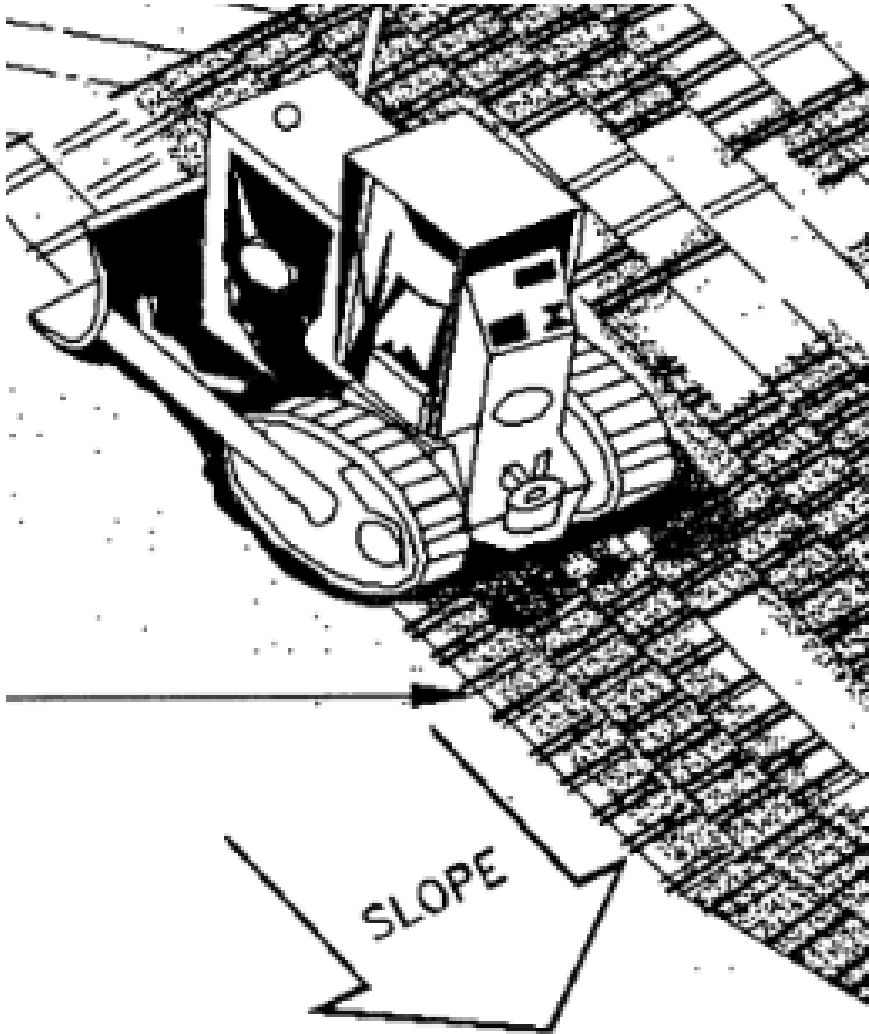
C-SSM-03 – Surface Roughening (MS-1, 7)



1.0 Definition

- Practice of providing a rough soil surface with *horizontal* depressions to reduce runoff velocity, increase infiltration, aid the establishment of vegetation, and reduce erosion
- Methods include stair stepping, grooving, and tracking

3.0 Planning and Considerations



- When selecting a method, consider:
 - Slope steepness
 - Mowing requirements
 - Is the slope cut or fill?
- Avoid excessive compaction of the soil surface

C-SSM-04 – Compost Blankets (MS –1)



1.0 Definition

- A layer of loosely applied composted material placed on the soil in disturbed areas to reduce stormwater runoff and erosion

6.0 Construction Spec.

- Ensure all large rocks, stumps, roots, and obstructions are clear
- Blankets should be installed with:
 - 10' overlap into vegetated area
 - At least 3' over shoulder of slope

C-SSM-05 – Blankets & Matting (MS-1, 3)



1.0 Definition

- A form of protective blanket or soil stabilization matting on a prepared planting area of a steep slope, channel, or shoreline

2.0 Purpose and Applicability

- Provide a microclimate that protects young vegetation and promotes its establishment
- Raise the maximum permissible velocity of grass in channelized areas

Treatment 1 - Protective Blanket



- Degradable
 - Plastic netting with organic material woven throughout
 - Jute mesh
- Should not have flow velocities greater than 4 feet per second

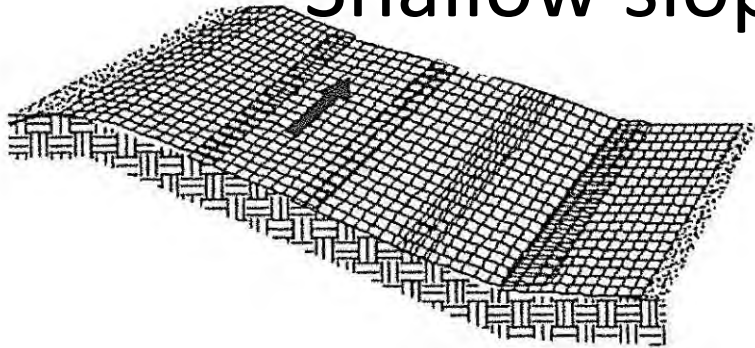
Treatment 2 - Stabilization Matting



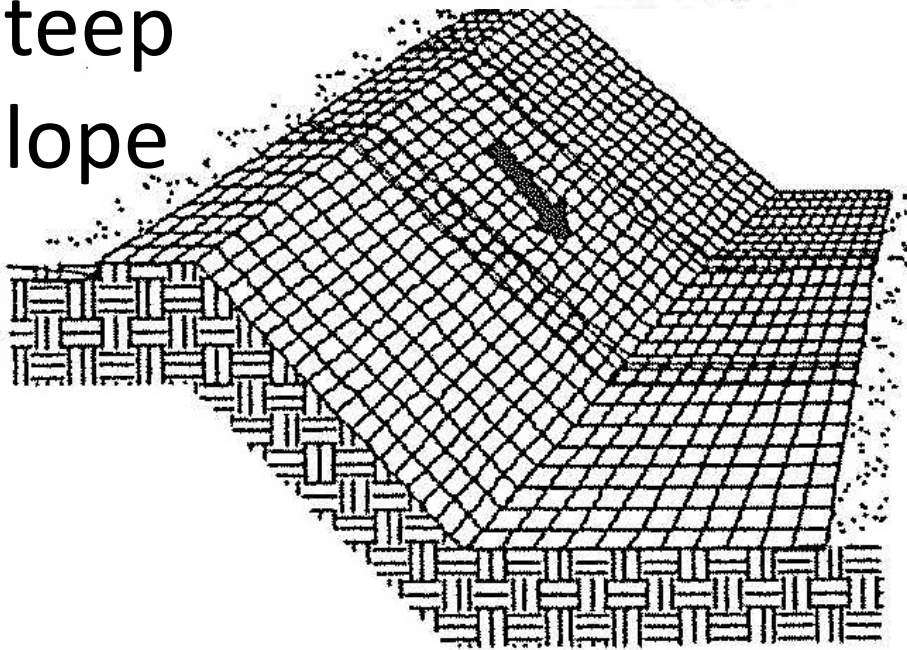
- Non-degradable plastic structures
- Should not have flow velocities greater than 10 feet per second

3.0 Planning and Considerations

Shallow slope



Steep slope



- Applied to supplement nature's erosion control system – vegetation
- Provide a safe, natural conveyance for high-velocity stormwater runoff while vegetation is being established

C-SSM-06 – Sodding (MS-1, 3)

1.0 Definition

- Permanent stabilization of areas by laying a continuous cover of grass sod over exposed soils

2.0 Purpose and Applicability

- Sodding is used to:
 - Prevent erosion and damage from sediment and runoff by stabilizing the soil surface
 - Reduce the production of dust and mud associated with bare soil surfaces
 - Stabilize drainageways where concentrated overland flow will occur
 - Serve as a filtering device for sediments before achieving permanent stabilization
 - Establish permanent turf immediately

2.0 Purpose and Applicability



- Locations particularly suited to stabilization with sod are:
 - Waterways carrying intermittent flow
 - Areas around drop inlets or in grassed swales
 - Steep slopes (up to 2H:1V if not mowed, 3H:1V if mowed)
 - Residential or commercial lawns where quick use and/or aesthetics are factors

5.0 Design Criteria



5.0 Design Criteria

- Select plant species based on region, availability, and intended use
- Refer to Table C-SSM-06-2 when selecting type of sod

6.0 Construction Specifications

- Determine lime and fertilizer requirements using soil tests
- Clear and smooth soil surface before laying sod

C-SSM-09 – Temporary Seeding (MS-1, 2)



1.0 Definition

- The establishment of a temporary vegetative cover on disturbed areas by seeding with appropriate rapidly growing annual plants

2.0 Purpose and Applicability

- Stabilize disturbed areas that will not be brought to final grade for over 14 days
- Reduce damage downstream and protect bare soils while permanent vegetation (or other erosion control measures) can be established

6.0 Construction Specifications



- Make sure the seed used is appropriate for the time of year
 - Tables C-SSM-09-3 and C-SSM-09-4

7.0 O&M Considerations

- Make sure the area is mulched after seeding

C-SSM-10 – Permanent Seeding (MS-1, 3)

1.0 Definition

- Permanent seeding is the establishment of perennial vegetative cover on disturbed areas by planting seed
- NOTE: Spec C-SSM-07 (Bermuda and Zoysia Grass Establishment) can be applied under this specification



3.0 Planning and Considerations



- Depends on:
 - Physiographic region
 - Soils
 - Land use
 - Planting season

7.0 O&M Considerations

- Plant information and uses
Table C-SSM-10-4
- Recommendations for seed mixtures (Tables C-SSM-10-6 through C-SSM-10-8)

6.0 Construction Specifications



- Soil depth shall be at least 12" to bedrock or other impermeable layer
- Check for a soil test and if recommendations for the pH and nutrient content have been made
- Make sure the soil does not contain large amounts of rocks, woody materials, or construction debris

C-SSM-11 – Mulching (MS-1)



1.0 Definition

- Mulching is the application of a protective blanket of straw or other plant residues/materials to the soil surface during the establishment of temporary and permanent seeding.
- Similar applications to C-SSM-04 Compost Blanket

5.0 Design Criteria



- Consider slope, soil, and water availability when selecting mulch

6.0 Construction Specs

- #1 choice of mulch with seeding applications is straw – applied at 1.5 – 2 tons/acre
 - Must be anchored
- Other organic mulches: Table C-SSM-11-1

Q&A



Any Questions?