Module 2. Review

Some of the principles of water

1

Objectives

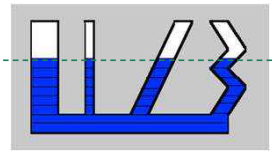
1. Water finds its own level
2. Water cannot flow through things - ex. stone
3. Drag - how flowing water is erosive
4. Curves – but water wants to flow straight
5. Mud - Standing water causes sediment to settle

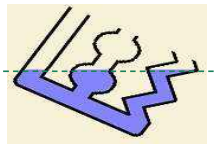
2

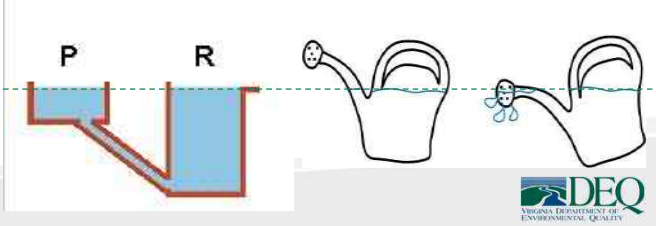
2.1 Water (or how water flows down hill and finds its own level)

3

The first property of water: It seeks its own level







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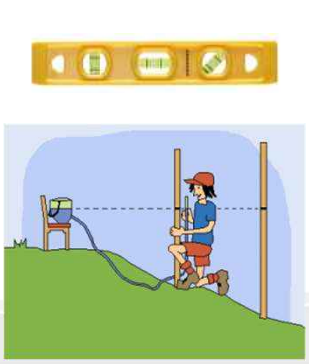
Water finds its own level



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What is "The lowest level?"

The Ocean (sea level)

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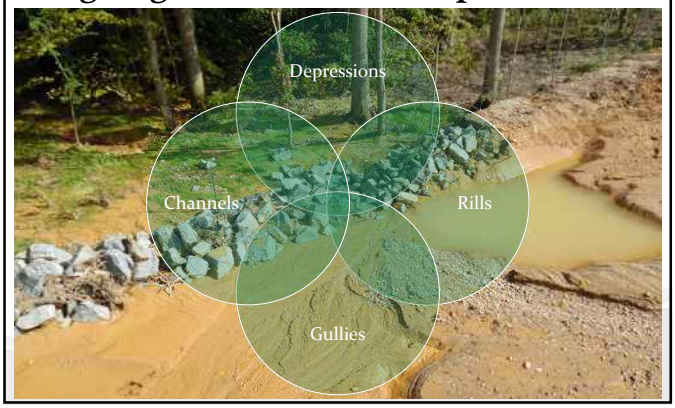
On a construction site: Water is going to find the lowest points



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On a construction site: Water is going to find the lowest points

And it will try to exit from these lowest point(s) from a construction sites with all the suspended sediments

8

MS-4 Perimeter Controls

- Silt fence, Straw bale barriers, Compost Filter Socks
  - Need to be put on contour
- Diversion
  - Need to have some slope
- Traps and basins
  - Need to be situated at the lowest point of the drainage

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Things that need to be level in ESC and SWM

- Level spreaders
- Level flow through bioretention areas
- Level flow through dry ponds

But!

- Check dams have "smiley faces"
- Sediment trap embankments have "smiley faces"

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Level Spreaders

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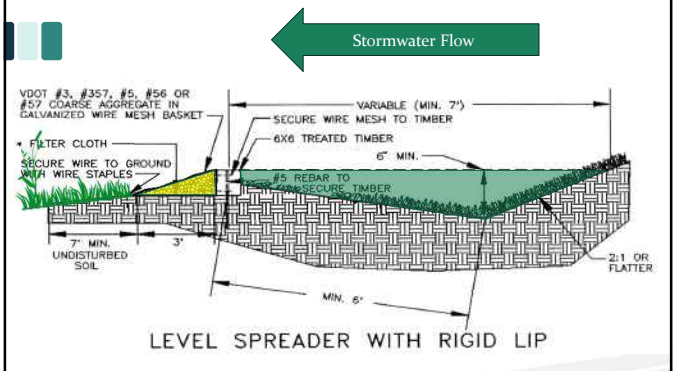

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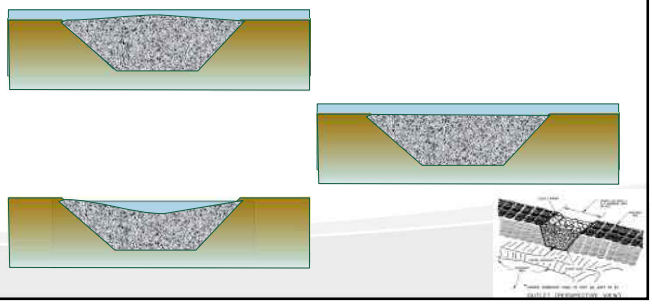
Sediment Trap Embankment and Spillway and Check Dams ➔ Where does the water go and what is more erosive?



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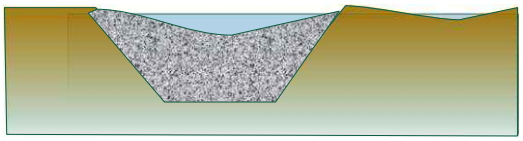
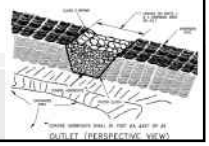
Sediment Trap Embankment and Spillway ➔ Where does the water go and what is more erodible?





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STD & SPEC 3.13 Temporary Sediment Trap

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STD & SPEC 3.13 Temporary Sediment Trap

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STD & SPEC 3.13 Temporary Sediment Trap

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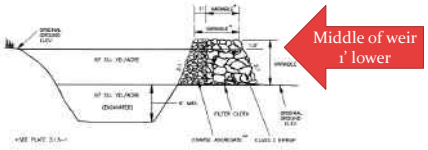
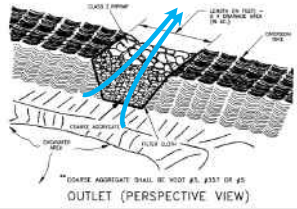
C-SCM-11 Temporary Sediment Trap





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Sediment Trap Embankment and Spillway and Check Dams

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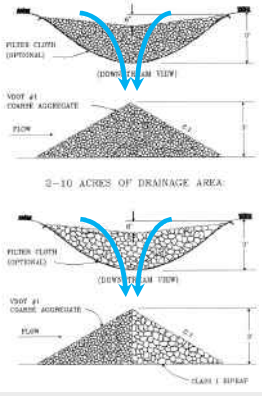
C-SCM-07 Rock Check Dams



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Level flow is also needed in SW

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Level Flow through a Bioretention Area

Unlevel filter bed concentrates water in only one area ; uneven filtering

Level filter bed -just like a bathtub - even distribution of flow across surface

23

QuickPolls – What are you seeing?

24

Poll Questions (4)

Where you inspect or review traps or basins how often are they done correctly?

- Inspections – Minimal corrections
- Inspections – More corrections than there should be
- Inspections – What traps and basins?
- Review – Spot on
- Review – At least 1-2 resubmissions needed
- Review – What plan?

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2.2 Stones (or how water cannot flow through things)

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Water does not flow through things (rock)

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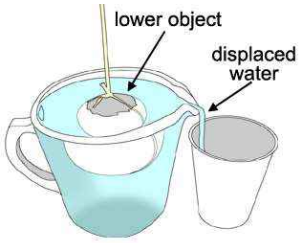
Displacement



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Displacement = Cleanout level

Few examples of maintenance requirements (sediment displaces water volume that can be captured and filtered):

- Sediment basins (1/2 wet storage)
- Sediment traps (1/2 wet storage)
- Silt fences (1/2 height of fence)
- Inlet protection
- Filtering equipment (1/3 of the capacity)

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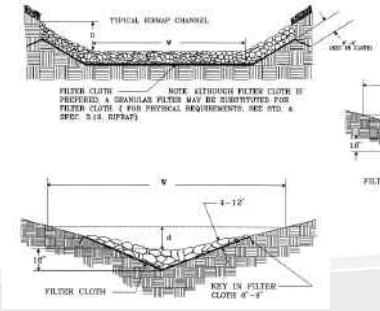
C-ECM-09 Stormwater Conveyance Channel

Use of stone in a channel

SCC



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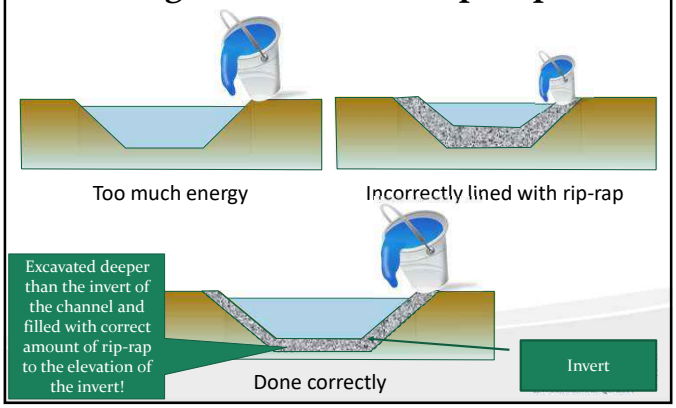
Lining Channels with Rip-Rap



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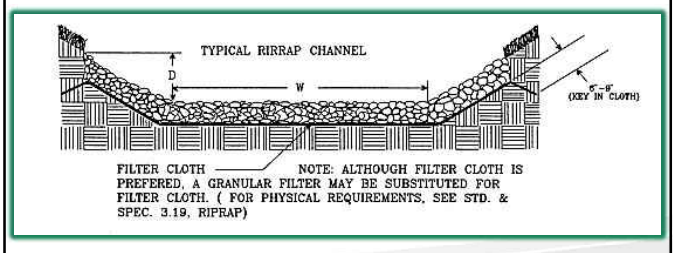
Lining Channels with Rip-Rap



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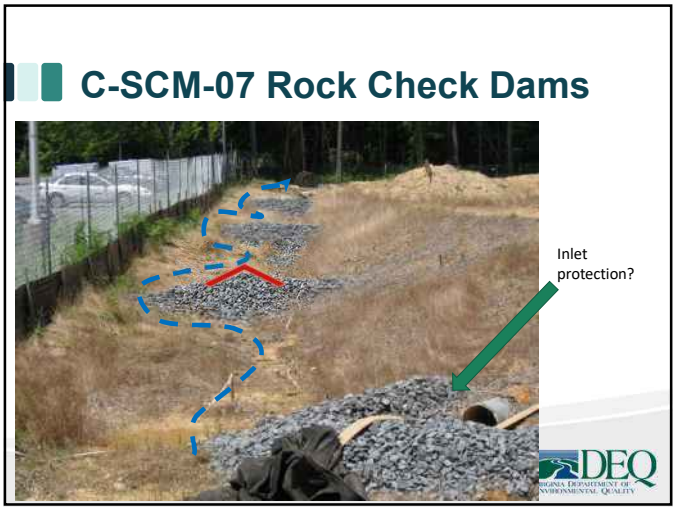

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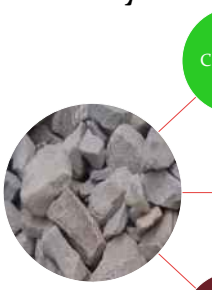
Summary: Stone in ESC



- Channels • Stability
- Check dams • Ponding/ Settling (filtering)
- Weirs • Ponding/ Settling (filtering)

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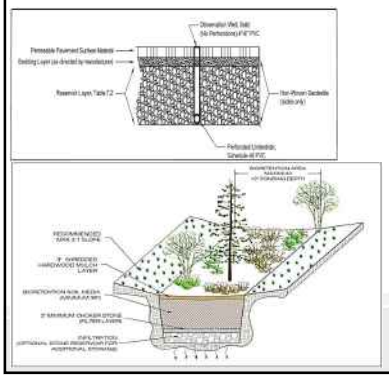
Stones in SWM – A different function



- Reservoir (+ Filtering)
  - Bioretention
  - Dry-swales
  - Permeable Pavement
  - Infiltration

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2.3 Drag (or how flowing water is erosive)

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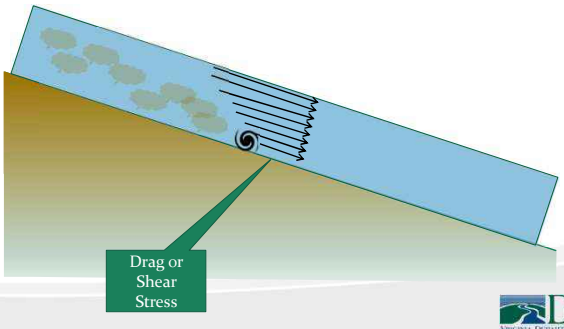
Shear Stress



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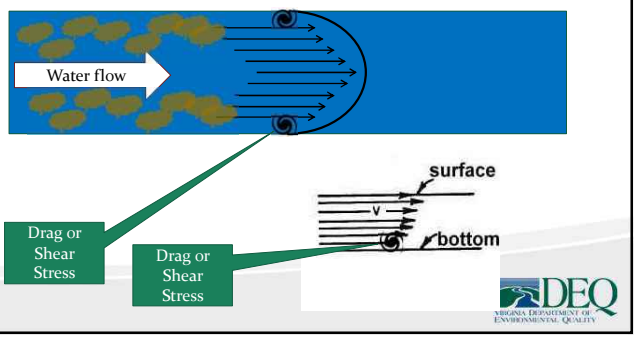
Shear Stress in Channel



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Shear Stress of water depends on the viscosity

Viscosity of water

More sediment in water

Less sediment in water

Viscosity of water

The higher the viscosity the higher the shear stress or erodibility

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Increased sediment load in runoff

Makes water abrasive ~ more erosive

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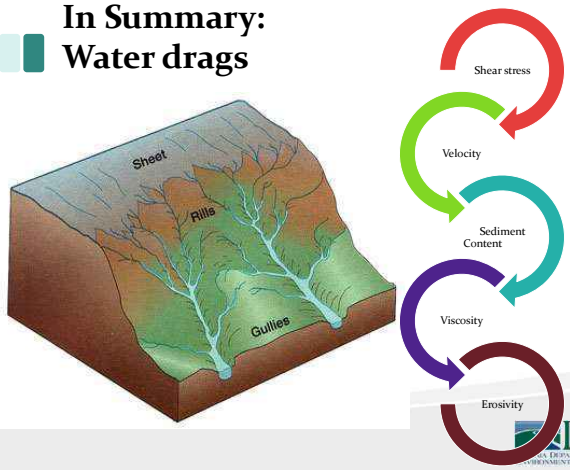
In Summary: Water drags



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Slopes and Erosion

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Slopes and Erosion

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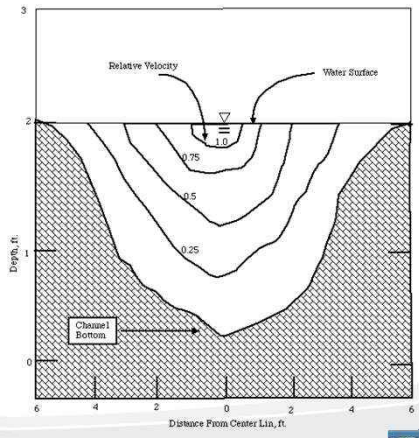
Channel flow



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Channel lining (Stormwater Handbook, 2024)

Table C-ECM-09-2 Maximum Velocities for Grass-Lined Channels

Cover Type	Slope (%)	Erosion Resistant Soils (feet/second)	Easily Eroded Soils (feet/second)
Bermudagrass	0 – 5 5 – 10	6 5	4.5 3.8
Kentucky bluegrass Reed Canarygrass Tall fescue	0 – 5 5 – 10 > 10	5 4 3	3.8 3 2.3
Grass-legume mixture	0 – 5 5 – 10	4 3	3 2.3
Red fescue	0 – 5	2.5	1.9

Sources: Virginia Department of Environmental Quality 1992; Ree 1949; Temple et al. 1987; NOVA 2007

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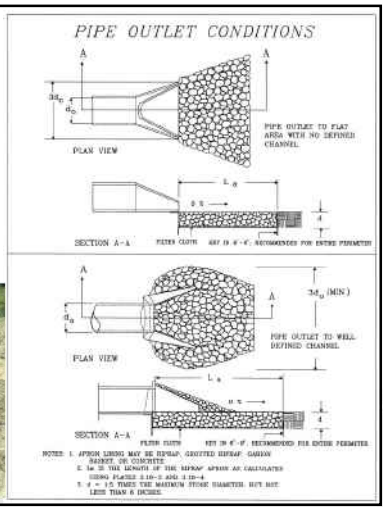
Outlet Protection

- 0% grade
- Countersunk
- Check for filter cloth
- Correct dimension
- Correct size stone



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Outlet Protection

Uncured or wet concrete poured into waters/ wetlands

NO!

52

Outlet Protection

Required to place outlet protection to drainageway

Contractor saved money on outlet protection

53

Outlet Protection

This is what happened

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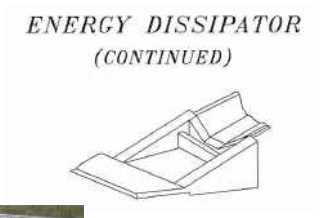
Outlet Protection (Energy dissipators)



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2.4 Curves (or how water wants to flow straight)

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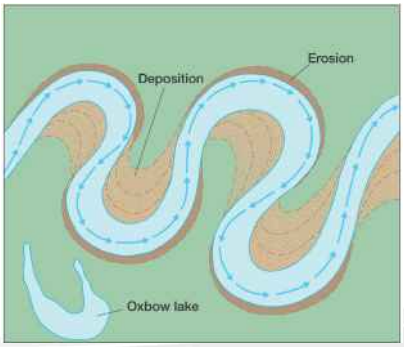
Curves in nature



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Curves in nature

58

Curves (or how water wants to flow straight)

59

Curves (or how water wants to flow straight)

60

Curves (or how water wants to flow straight)

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P-FIL-07 Sheet Flow to Vegetated Filter Strip or Conserved Open Space

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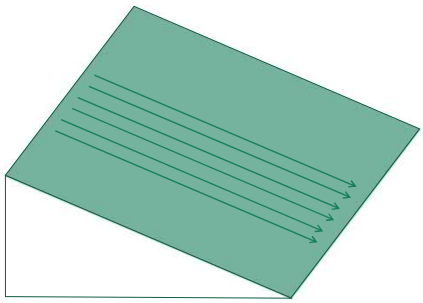
Sheet flow



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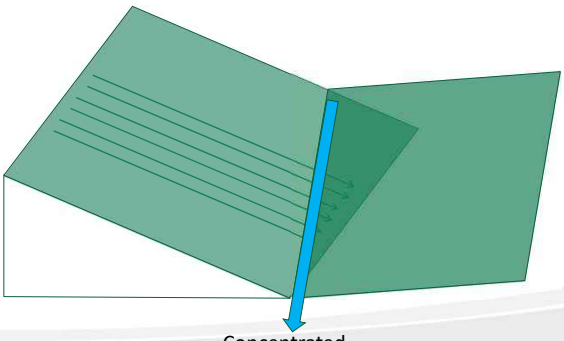
Sheet flow and grade changes



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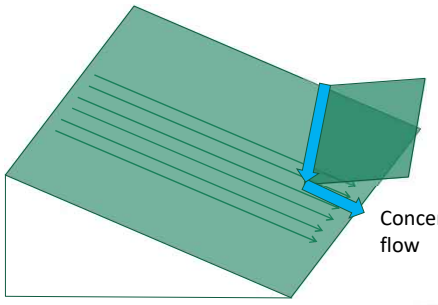
Sheet flow and grade changes



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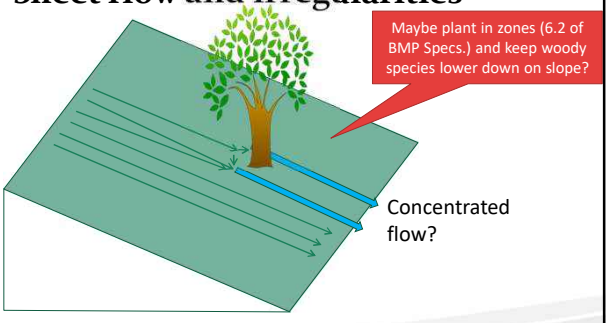
Sheet flow and irregularities



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2.5 Mud (or how standing water causes sediment to settle)

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Siltation

When water slows down sediment will drop out

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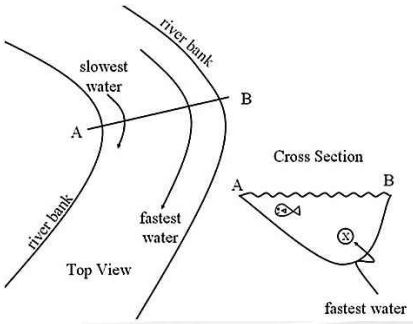
Curves in nature



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Sedimentation

Clays are very difficult to settle out

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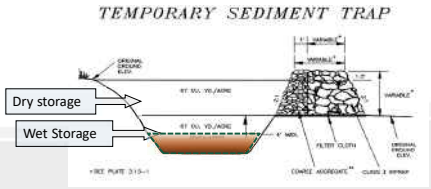
C-SCM-11 Temporary Sediment Trap

Principles:

- Wet storage for energy dissipation of water entering the trap
- Dry storage draws down in 6 hours ➔ managed by weir width
- Designed for 1" – 24 hr. storm event ➔ center of weir is emergency overflow (1' lower!)
- Displacement! ➔ cleanout when half the wet storage is filled with sediment (otherwise looses the sedimentation [1" & 6 hr.] function)



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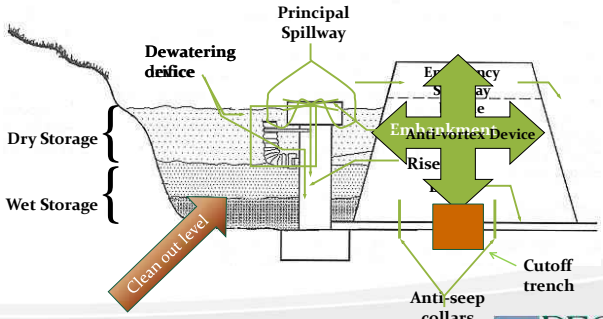
C-SCM-12 Temporary Sediment Basin



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3.14 (SB) - Temporary Sediment Basin (Hydrology)

- Wet storage for energy dissipation of water entering the basin
- Dry storage draws down in no less than 24 hours and no more than 120 hours hours ➔ managed by orifice opening
- Designed for 1" – 24 hr. storm event ➔ principle spillway handles at least the 10 year storm ➔**keep the trash rack clean!**
- Displacement! ➔ cleanout when half the wet storage is filled with sediment (otherwise looses the sedimentation [1" & 6 hr.] function)

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Ways to enhance sediment removal and settling from sediment basins

- Baffles
- Flocculants (Polyacrylamides)
- Surface withdrawal of the water (Faircloth skimmer)

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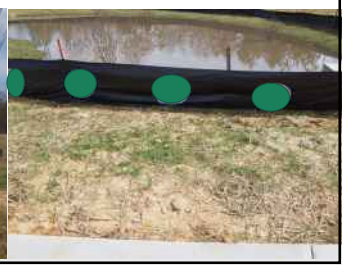
Closure/Conversion (traps and basins)

- Needs to be done when the entire site has been stabilized
- Sediment that has been removed needs to be stabilized



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Other Sediment Settling Devises

Anything that slows the water down, ponds it and promotes settling:

- Silt fence
- Straw bale barriers
- Inlet protection
- Check dams
- Forebays

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Questions?

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