Sediment Basin Design : The How To's

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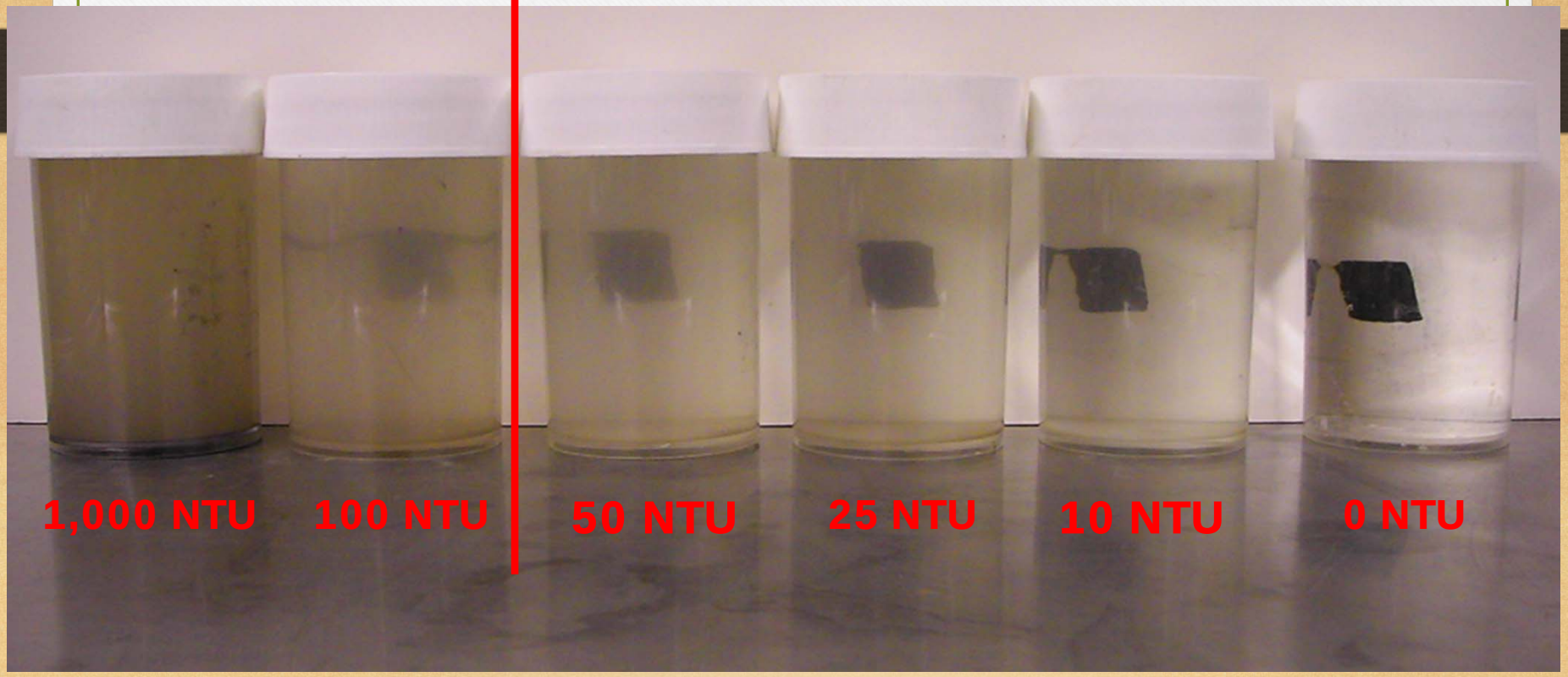
Is More Better?


MAYBE….

SC Water Quality Regulations (turbidity)

Trout waters ≤10 NTU or 10% above natural conditions
Freshwater (except for lakes) ≤50 NTU
Lakes ≤25 NTU
Shellfish harvesting waters ≤25 NTU
Class SA/SB Tidal saltwaters ≤25 NTU




Turbid water still likely…
Spillway

Problem….

- Very hard to reduce turbidity

BUT….

- we can lighten the load of sediment entering the waters

Understanding Soil!


Certainly ideal……
But the reality of it is……

Design basics

Drainage= 5-30 acres

Storage= 3600 ft^3 ac^{-1}

Shape= L=2W

Side walls= 2:1

Baffles= 3 rows minimum

Surface dewatering???

What?

Forebays = 20% of total storage

Baffles…which are now required in SC (and many other states)!

- **Reduced turbulence** – solids settle faster.
- **Reduced flow** – inflow spread across basin, reducing carrying capacity of the water.

No Baffles...i.e. short circuiting

Open Basin- No baffles

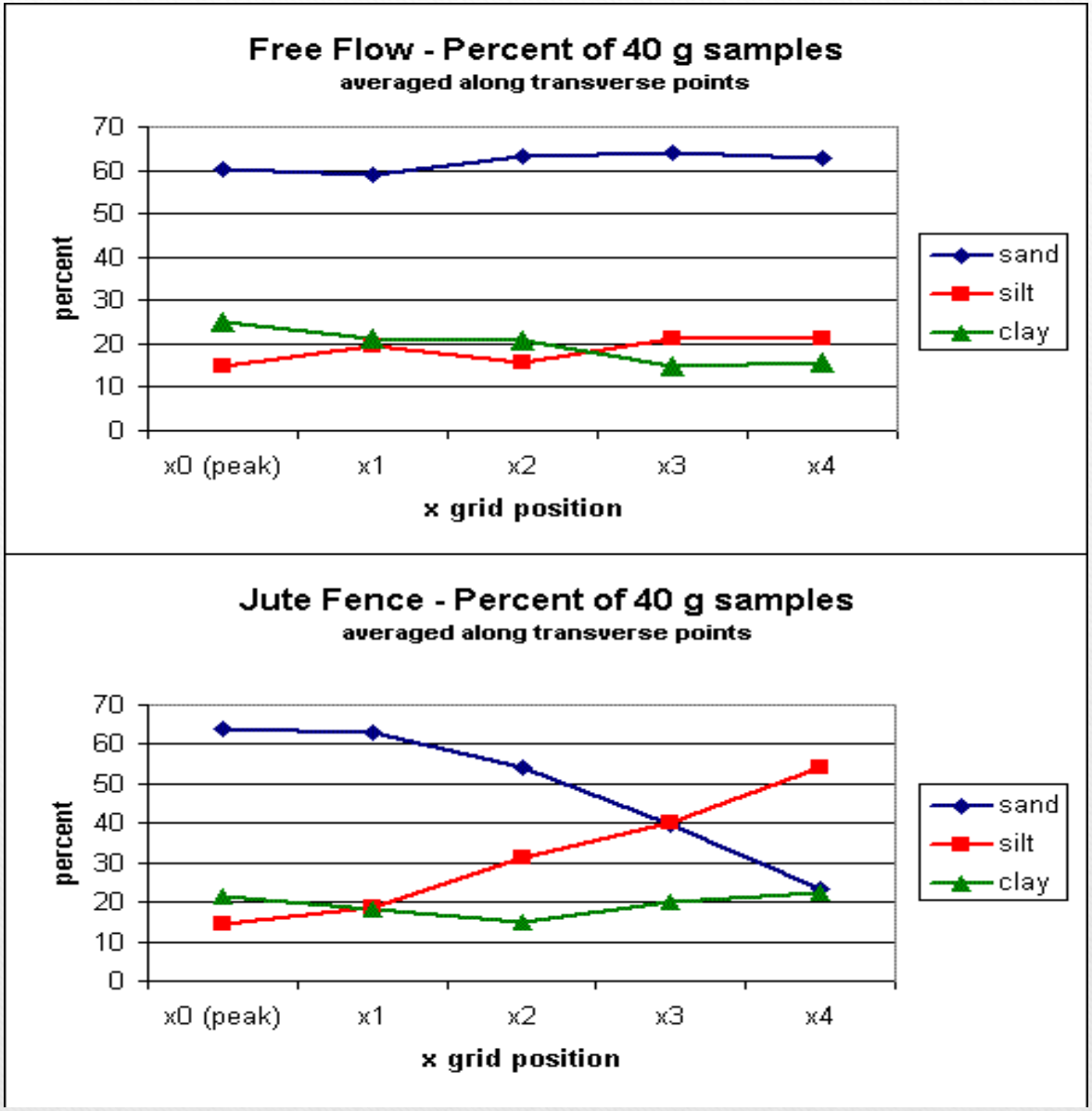
Silt Fence Baffles

Silt Fence Baffles...the end

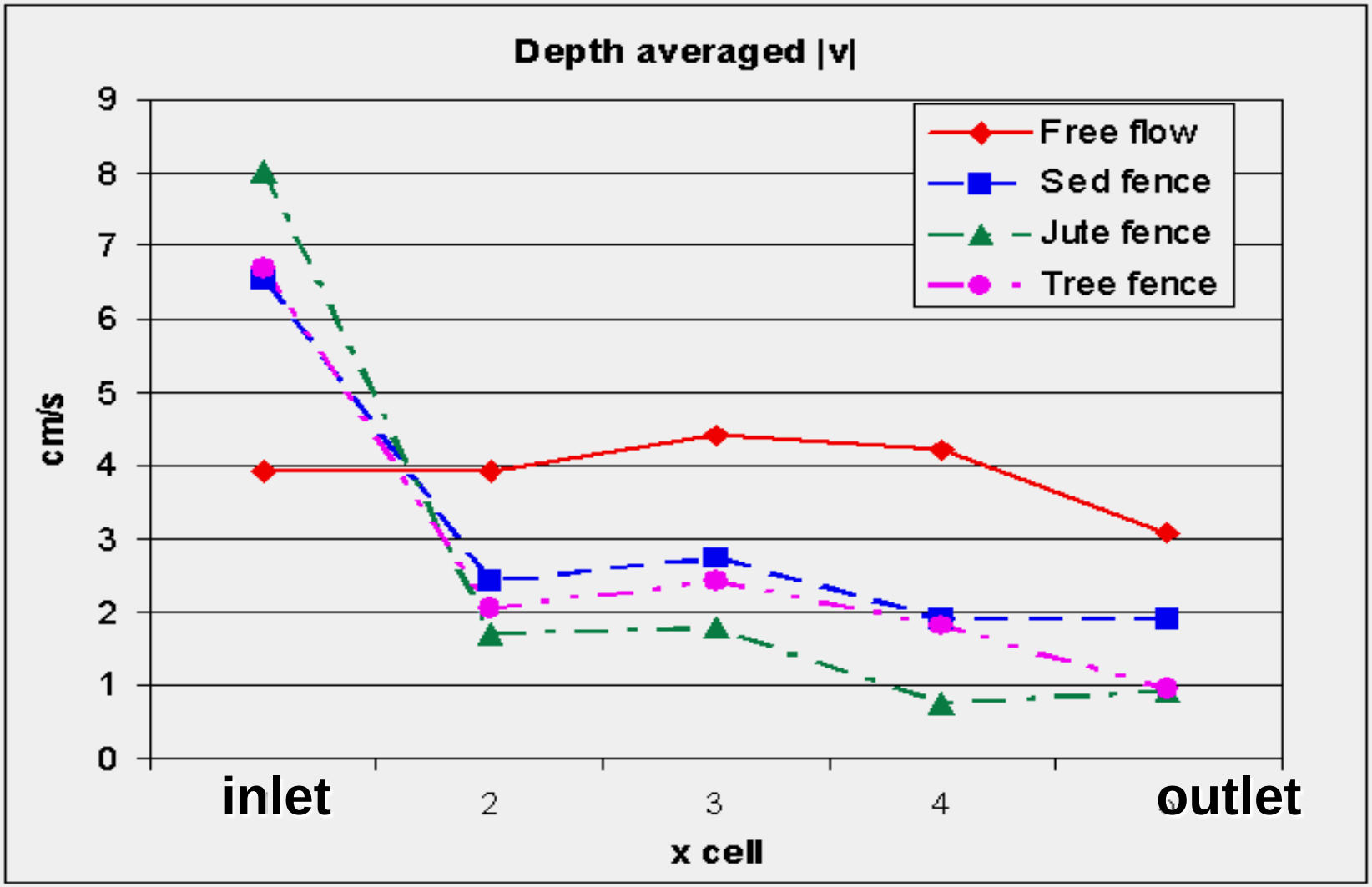
Porous Baffles and after...

Measuring Baffle Effects

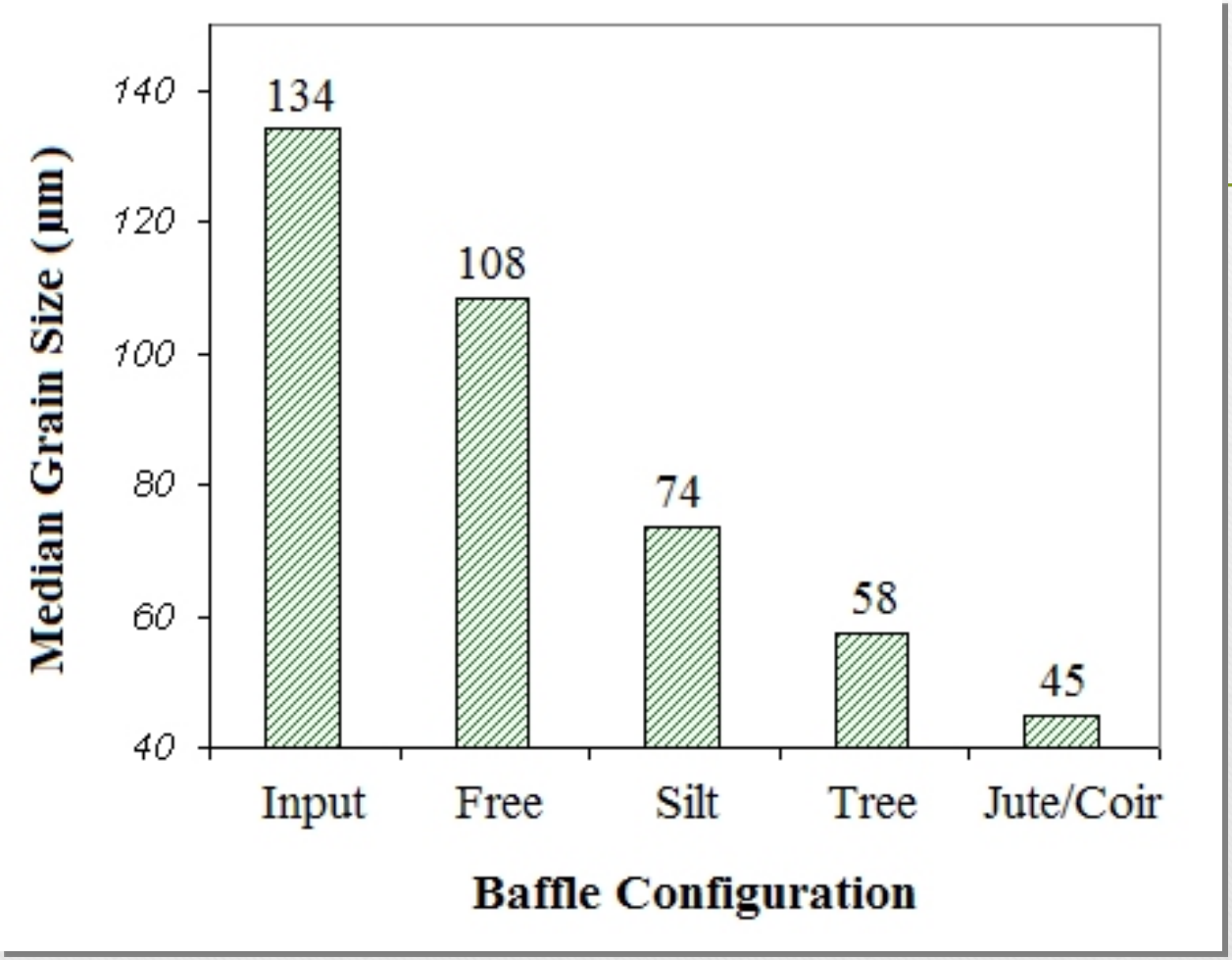
Effects of Baffles: Particle Distribution



Effects of Baffles: Velocity



Effects of Baffles: Grain Capture



Arrangement to handle flows from all directions!

Installation Important…

Porous Baffles

- **Problems**
  - Baffles not anchored to side walls of basin
  - Incorrect baffle material too thin

Porous Baffles

- **Problems**
  - Lack of anchoring to the basin bottom
  - Lack of maintenance

Quiz! Porous baffles – which is wrong?

1. Improve sediment retention by spreading the flow across the basin cross-section
2. Work by filtering the sediment out from muddy water
3. Should be installed to a height to prevent any overtopping
4. Need to have porosity <50%

What do baffles NOT do?

A. Backs up inflow to create pool

B. Spreads incoming water across width of basin

C. Filter sediment

D. Increase frequency of maintenance

Surface Outlets

Surface Outlets

- Perforated Riser

Surface Outlet (Skimmer)

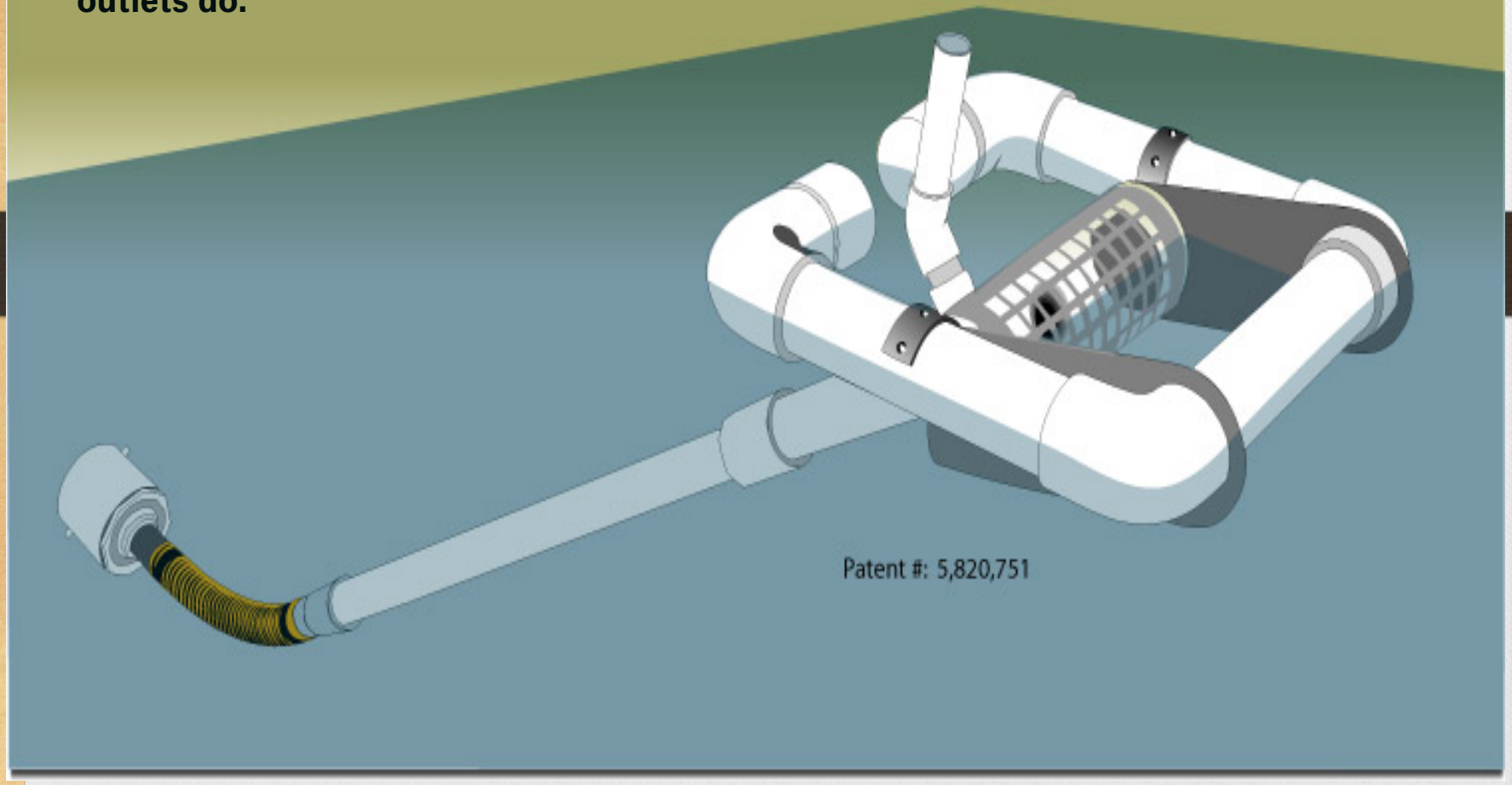
Skimmer Spillway (Emergency)

Skimmer Basin Functions

- Skimmer backs up inflow to create pool
- Pool acts to slow flow and drop sediment
- Basin dewaters primarily over emergency spillway!
- Skimmer dewaters basin once inflow ceases.
  - Allows sediment to dry between storms
  - Reduces standing water (liability, mosquitoes)

Faircloth Skimmer

The Faircloth Skimmer floats on the surface of the sediment basin, releasing the cleanest water in the basin instead of draining from the bottom as conventional outlets do.



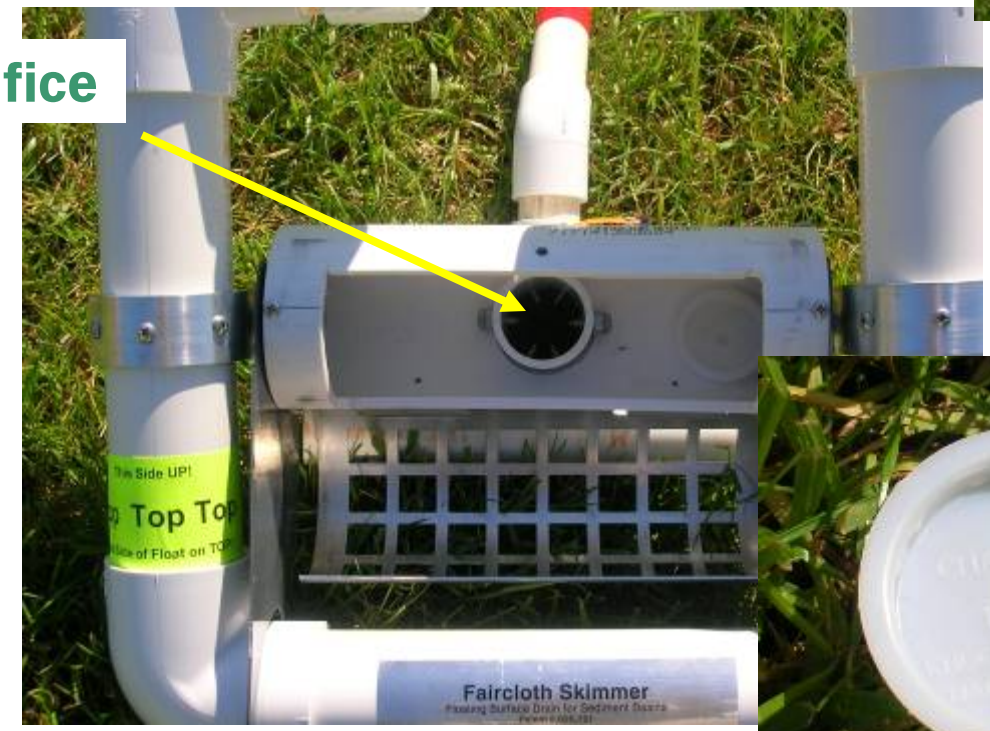
Skimmer

- Minimum barrel diameter = 4 inches
- Ensure orifice/plug are sized per plan

  -Example: 3-inch skimmer orifice with 2.5-inch plug

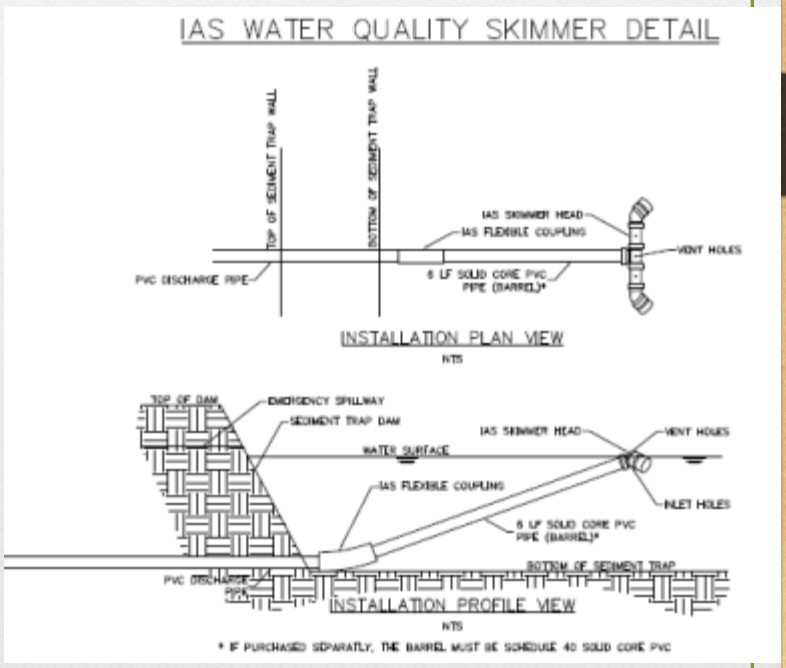
  -Contractor must insert “knock out plug” with 2.5 inch hole drilled in it into the 3 inch orifice

Orifice



Knock out plug

- **IAS Skimmer**
  - The skimmer dewaters based on four holes that are sized by the manufacturer to dewater the basin that is designed for.
  - Do Not relocate the skimmer to a new basin unless the manufacturer confirms its dewatering flow rate will match the new basin size.



•**Erosion Supply Skimmer**

- This model has an orifice plate located adjacent to the inlet of the skimmer.
- Orifice plate shall be sized according to the basin that it has been installed in to insure proper dewatering rates.

- **Pro-Drain 70 Surface Dewatering Device**

- It utilizes a slotted inlet with adjustable sleeve to control dewatering rates.
- Adjust the sleeve as directed by the manufacturers instructions to insure proper dewatering rate.

The "*Marlee Float* "™ Skimmer

- Made of HDPE pipe, polyethylene float and stainless steel fittings
- UV Resistant and virtually indestructible
- Fabricated to be part of the permanent outlet structure
- No moving parts
- Shielded weir prevents clogging

- Unique design traps floatables in basin and increases sediment trapping efficiency
- Three models to choose from with simple, cost effective conversion kits allow weir size to be easily changed
- Ships pre-assembled – Simple 5-minute Installation

Simple skimmer basin

DISCHARGE CAPACITIES (in Cu. Ft.) FOR THE *Faircloth Skimmer®*

Size to Dewater 24-48 hrs

Skimmer size	1.5"	2"	2.5"	3"	4"	5"	6"	8"
24 hours	1,728	3,283	6,234	9,774	20,109	32,832	51,840	97,978
2 day	3,456	6,566	12,468	19,548	40,218	65,664	103,680	195,956
3 day	5,184	9,849	18,702	29,322	60,327	98,496	155,520	293,934
4 day	6,912	13,132	24,936	39,096	80,436	131,328	207,360	391,912
5 day	8,640	16,415	31,170	48,870	100,545	164,160	259,200	489,890
6 day	10,368	19,698	37,404	58,644	120,654	196,992	311,040	587,868
7 day	12,096	22,981	43,638	68,418	140,763	229,824	362,880	685,846

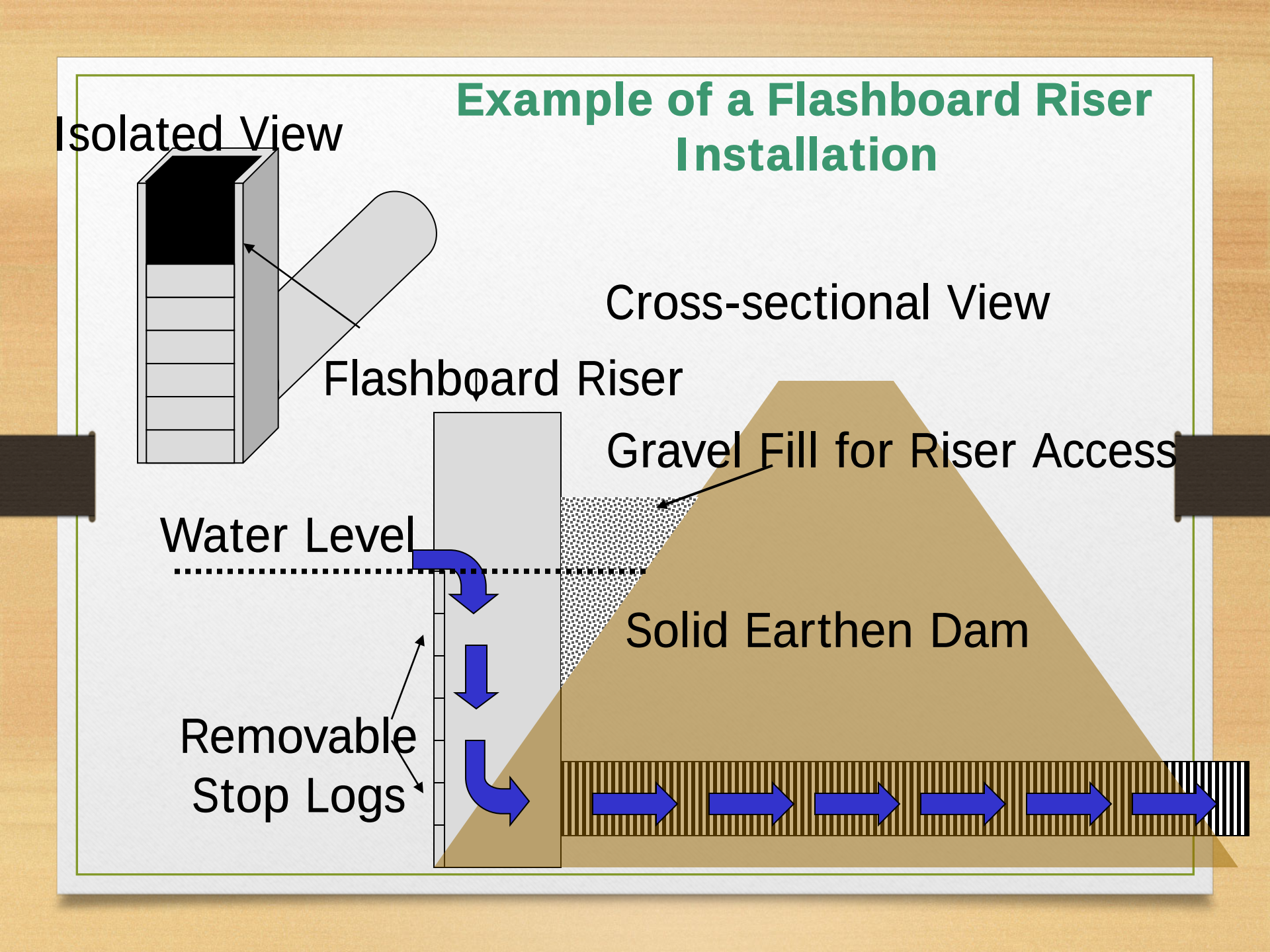
Which Is Not Functional?

…or a more complicated installation

Flashboard Riser Outlet

- Adjustable standing pool
- Can empty for sediment removal
- Manually remove boards gradually to lower water level and replace before next storm

Example of a Flashboard Riser Installation



Improvement from Surface Outlet/Porous Baffles

- May increase sediment capture from 60% to 90%.
- This will increase maintenance needs.
- Turbidity will still be an issue


Stabilize inlets
and sidewalls


Can you guess what might happen?

This is just a bad idea....

Quiz! Guess how much soil was lost…

1. 1/2 ton (1,000 lbs)
2. 1 ton
3. 3 tons
4. 4 tons


Maintenance!!!!!

Two Chamber Basin Design (essentially a forebay)

Maximum Sediment Control

- Forebay
- Baffles
- Skimmer + Emergency Spillway

Design of the device

- Vertical walls?
- Storage capacity?
- Surface outlet?
- Baffles?
- Maintained?

Some Research….

- All basins were on NCDOT projects
- Basin designed varied
- Either 10-yr or 25-yr sizing
- Many different soil types and total rainfall

Standard 10-year Trap

37% Efficiency

Standard Trap with 1 meter storage

76% / 36% Efficiency

Standard Traps/Basins

45% / 36% Efficiency

46% Efficiency

Skimmer Basin with Porous Baffles

99.8% Efficiency

Conclusions!

- Increased surface area and volume will decrease the total load of sediment leaving the basin/trap

Conclusions cont'd.

- Baffles reduce the velocity of water entering the basin/trap creating time for the heavy soil particles to fall out of the suspension.

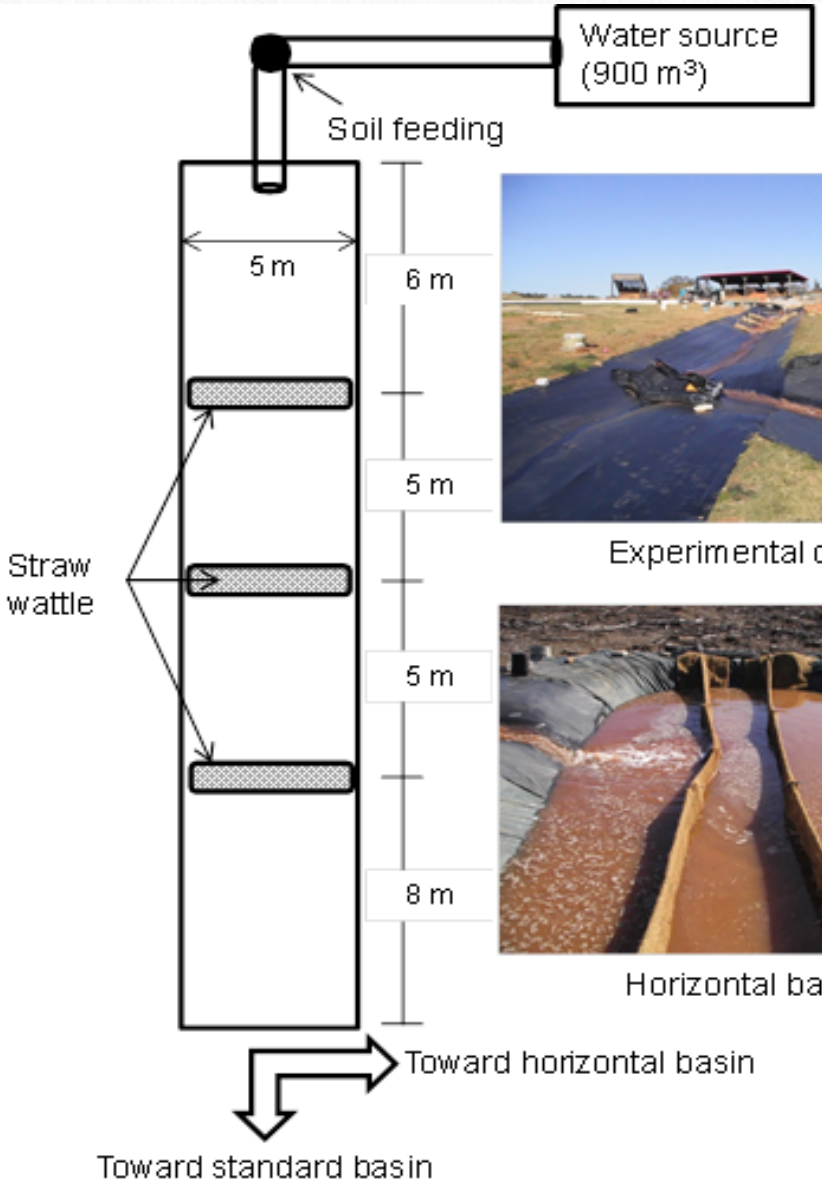
- Vertical walls should be avoided because they fail, producing sediment within the basins/traps and diminishing the effective volume of the device.

Conclusions cont'd.

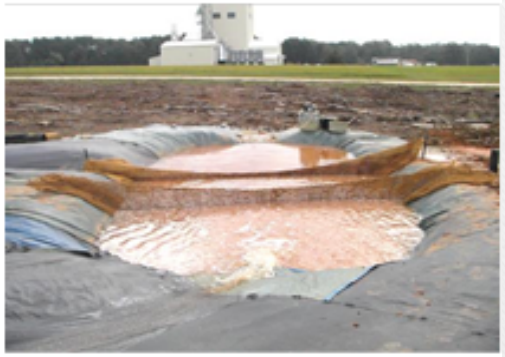
- Surface outlets decrease the total amount of sediment leaving the basin/trap by dewatering from the top of the water column.

- MORE IS BETTER!

Something to Chew on…. from NCSU

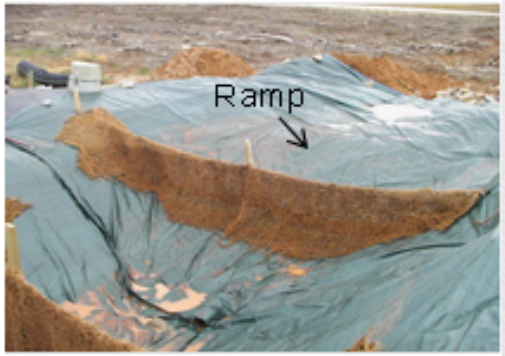


Experimental ditch



Standard basin

Horizontal basin



Standard basin with ramp

Table 3. The effects of ditch PAM treatment and basin configuration on turbidity and TSS concentration (mean ± std. error).Within a column, values followed by different letters are significantly different (P < 0.05).

		Turbidity (NTU)		TSS (mg L^{-1})	
PAM	Basin	Ditch exit	Basin exit	Ditch exit	Basin exit
None	Horizontal	268 ± 25 a	197 ± 27 a	995 ± 79 a	125 ± 3 b
None	Ramp	262 ± 24 a	162 ± 19 a	1121 ± 122 a	195 ± 14 a
None	Standard	271 ± 21 a	234 ± 22 a	1258 ± 107 a	239 ± 30 a
PAM	Horizontal	96 ± 20 b	30 ± 5 b	943 ± 84 a	49 ± 5 c
PAM	Ramp	98 ± 14 b	23 ± 4 b	1078 ± 80 a	84 ± 7 bc
PAM	Standard	78 ± 18 b	34 ± 5 b	1228 ± 78 a	91 ± 13 bc