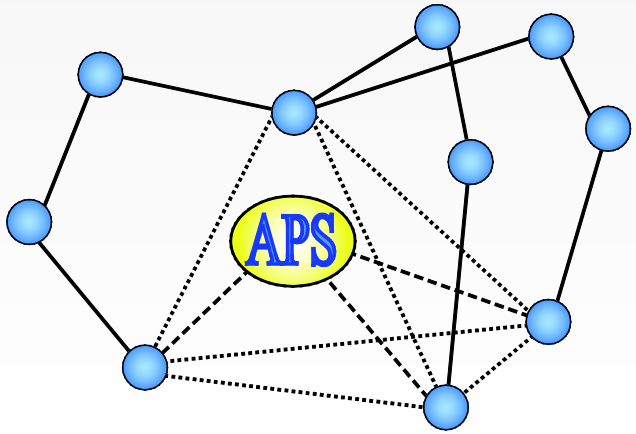
Anionic Polyacrylamide: An Innovative and Effective Tool for Stormwater Management and Improved Water Quality



Applied Polymer Systems, Inc.

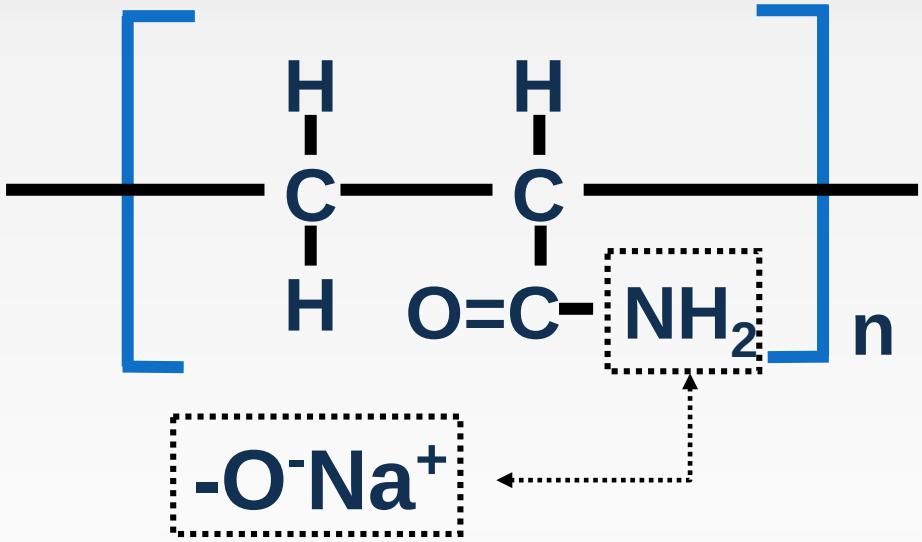
2019 Ohio Stormwater Conference

Sharonville, Ohio

Kyla Iwinski-Wood, PhD

Anionic Polyacrylamide (PAM)

- PAM is a polymer of acrylamide (AMD) monomers
- Erosion PAMs are 12 to 24 Mg/mole & >150,000 chained monomers/molecule
- Erosion PAMs have <0.05% unreacted AMD

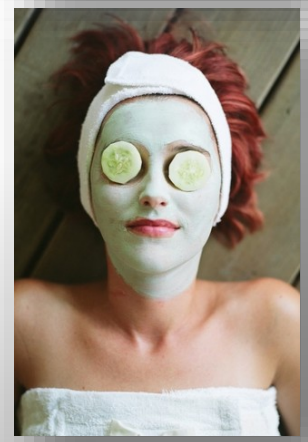


Polyacrylamide Uses

- Potable water treatment
- Waste water treatment
  - *Industrial*
  - *Municipal*
- Food industry
  - *Juice and sugar liquor clarifier*
- Soil conditioner
- Animal feed thickener
- Cosmetics
- Mining and drilling
- Mineral processing
- Pulp and paper production

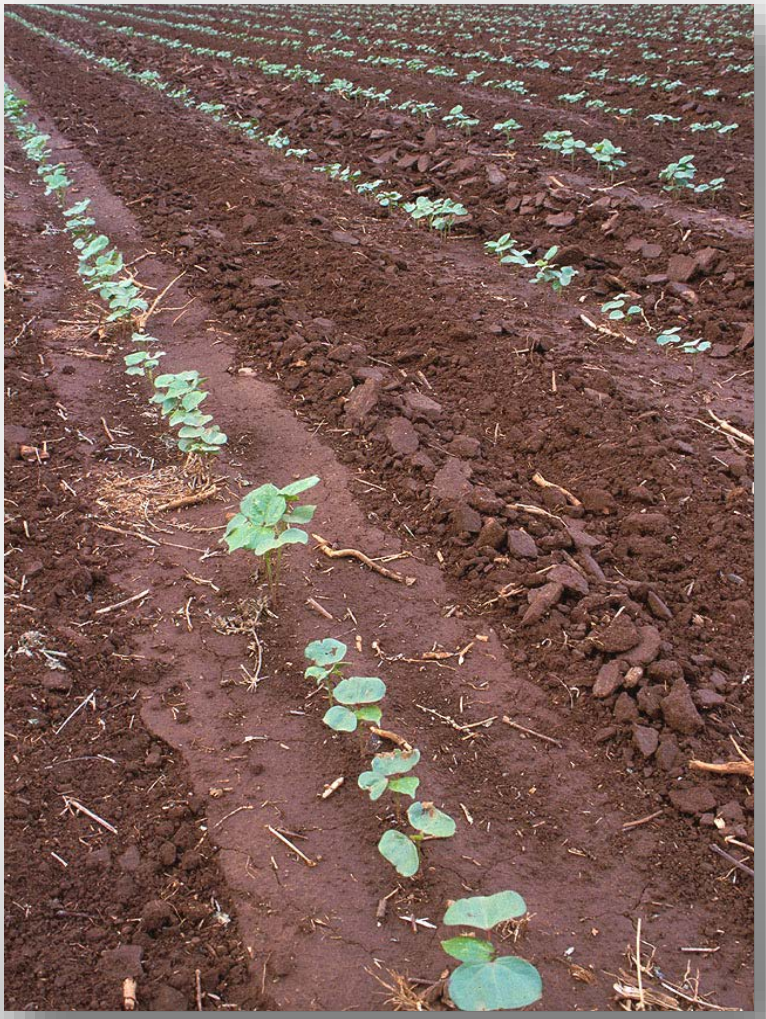







Polyacrylamide for Erosion Control

- **First used by USDA to:**
- Decrease agricultural erosion
  - *Sediment*
  - *Nutrients*
  - *Microbes*
- Increase soil infiltration
- Improve crop yield



Not Just for Erosion Control – Multiple Form and Uses

- Powder/ Granular Form
- Liquid Emulsion Form
- Block/ Gel Log Form

PAM for Water Treatment

- Flocculates excess
  - *Sediment*
  - *Nutrients*
  - *Metals*
- Decreases settling pond size or eliminates need
- Helps meet discharge requirements

Erosion and Stormwater Impacts

- Flooding
- Navigation
- Habitat Disruption
  - Temperature
  - Spawning
  - Feeding
- Pollutant Transport
  - Nutrients
  - Bacteria
- Direct Impacts to Aquatic Organisms
  - Clogged gills

Considerations for PAM Selection

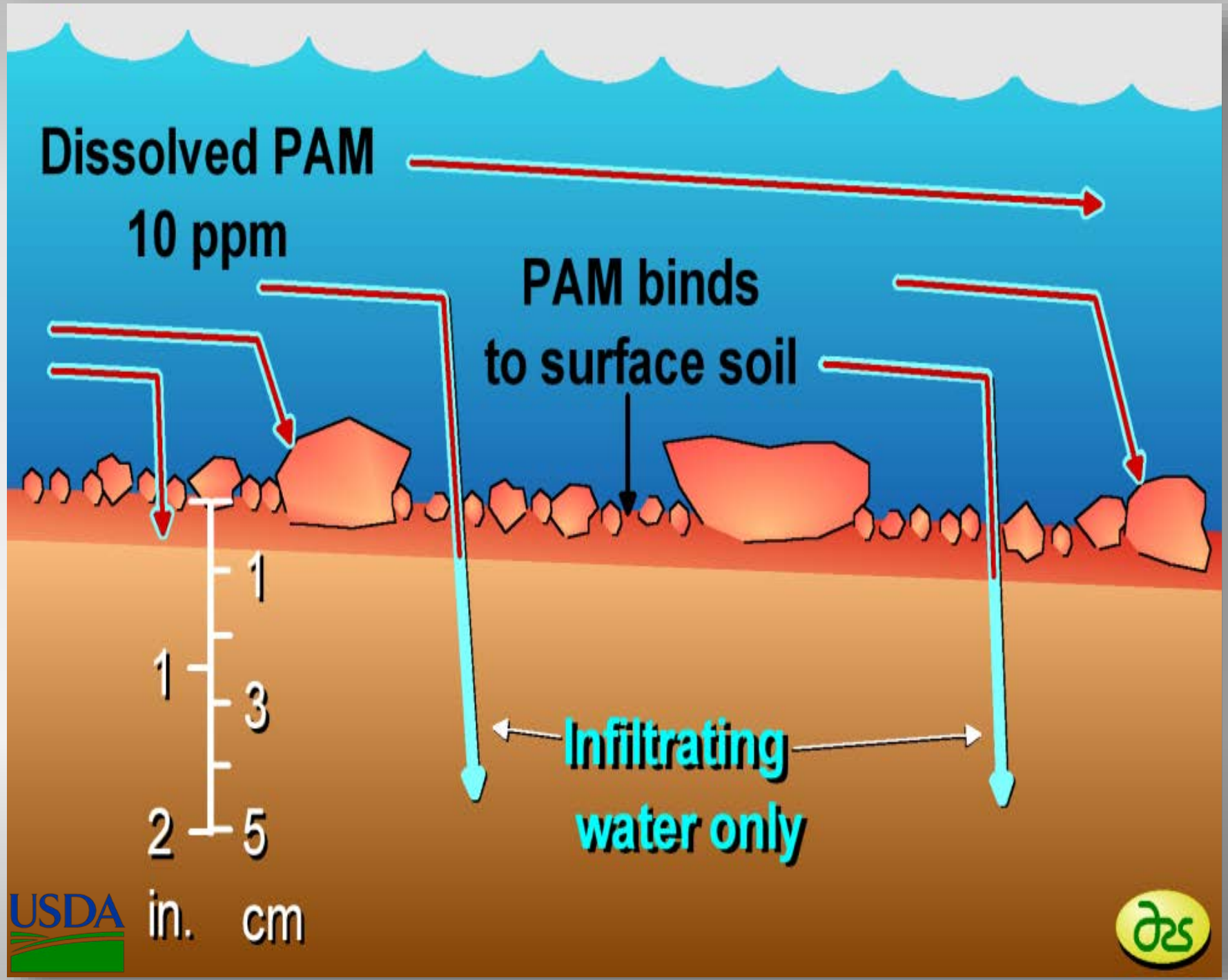
- 1. Toxicity
  - *PAM charge*
  - *WET Testing*
- 2. Performance

Ceriodaphnia dubia (Water flea)

Polymer Enhanced BMP (PEBMPs)

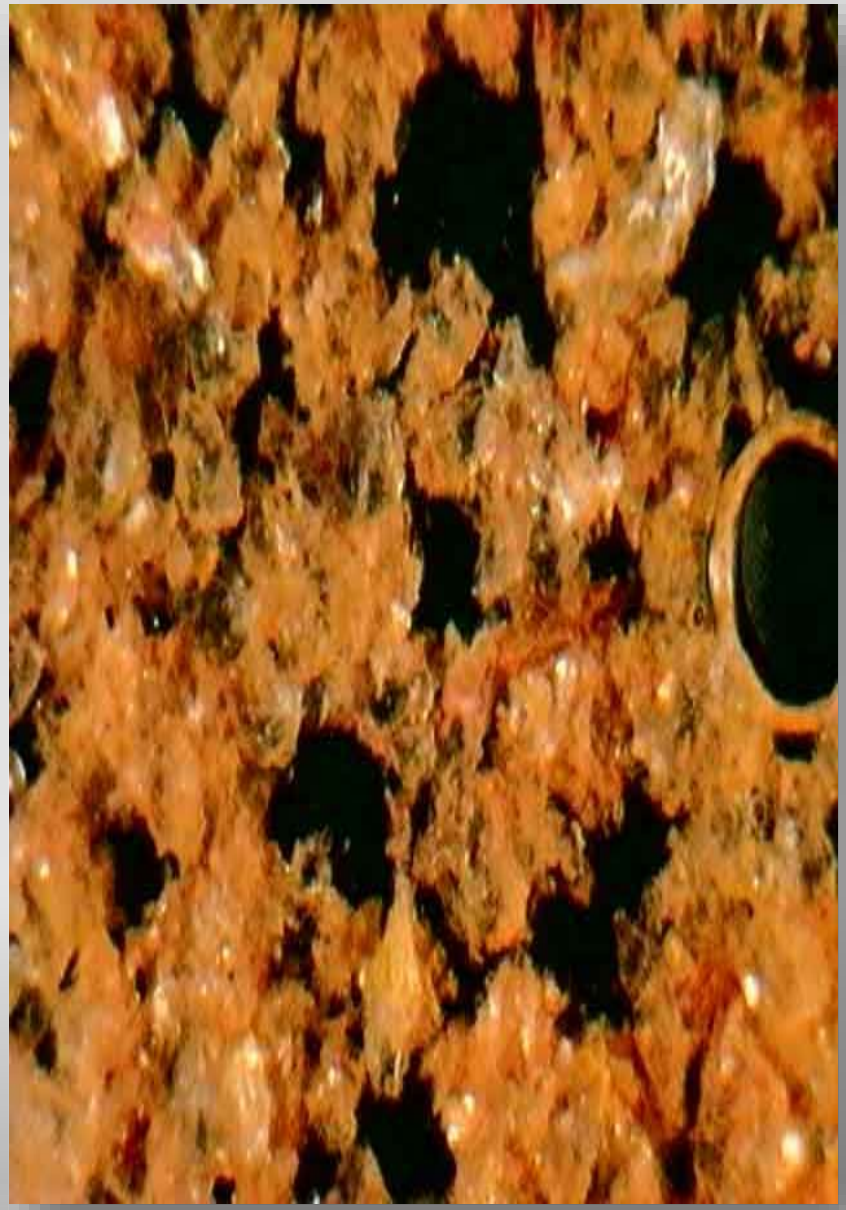
1. Soil Stabilization (Highway 98 Case Study)
2. Sediment Retention Barriers (SRBs), Rock Checks, and Waddles
3. Water Clarification (Mixing and Dewatering Systems)
4. Dredging (Kentucky Lake Case Study)
5. Demucking
6. Pond and Lake Management (Hillman Lake Case Study)
7. Treatment Train Case Studies
    - *Anna River Culvert Replacement*
    - *Salmon Trout River Bridge Construction*

1. Soil Stabilization

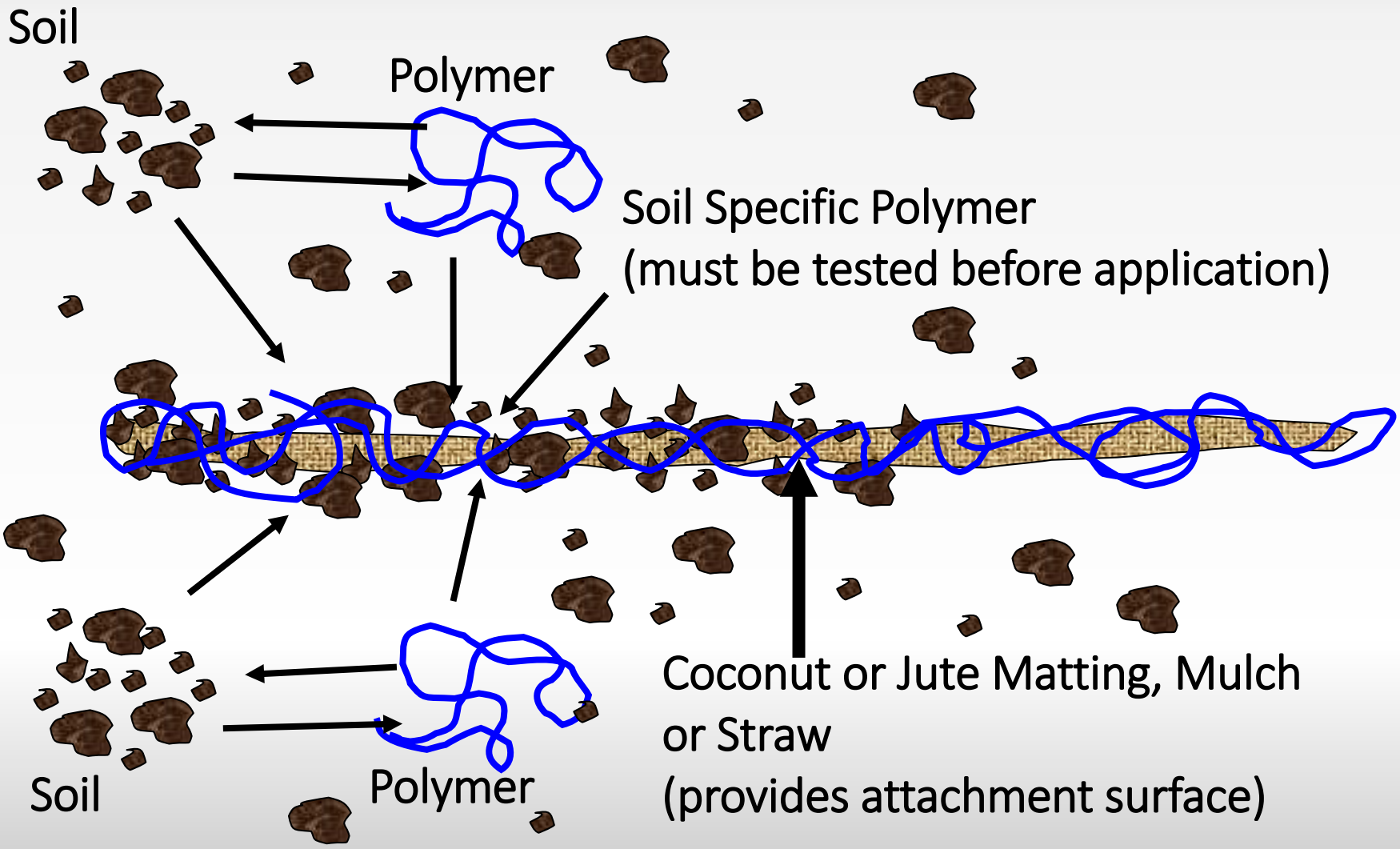

Dissolved PAM
10 ppm
PAM binds
to surface soil
1
1
3
2
5
in.
cm
Infiltrating
water only
USDA

Untreated Soil

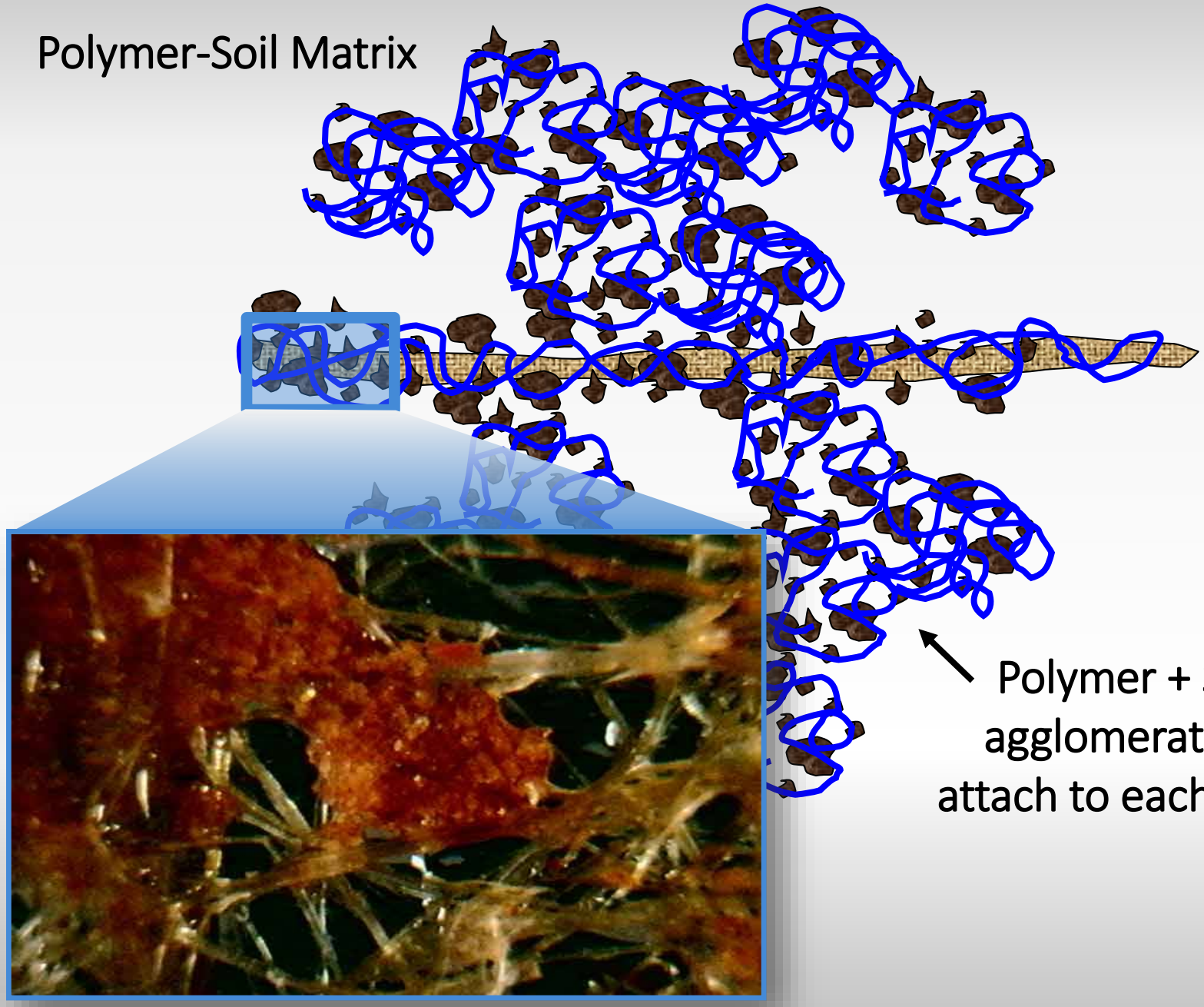
Treated Soil



Polymer Enhanced Soft Armoring

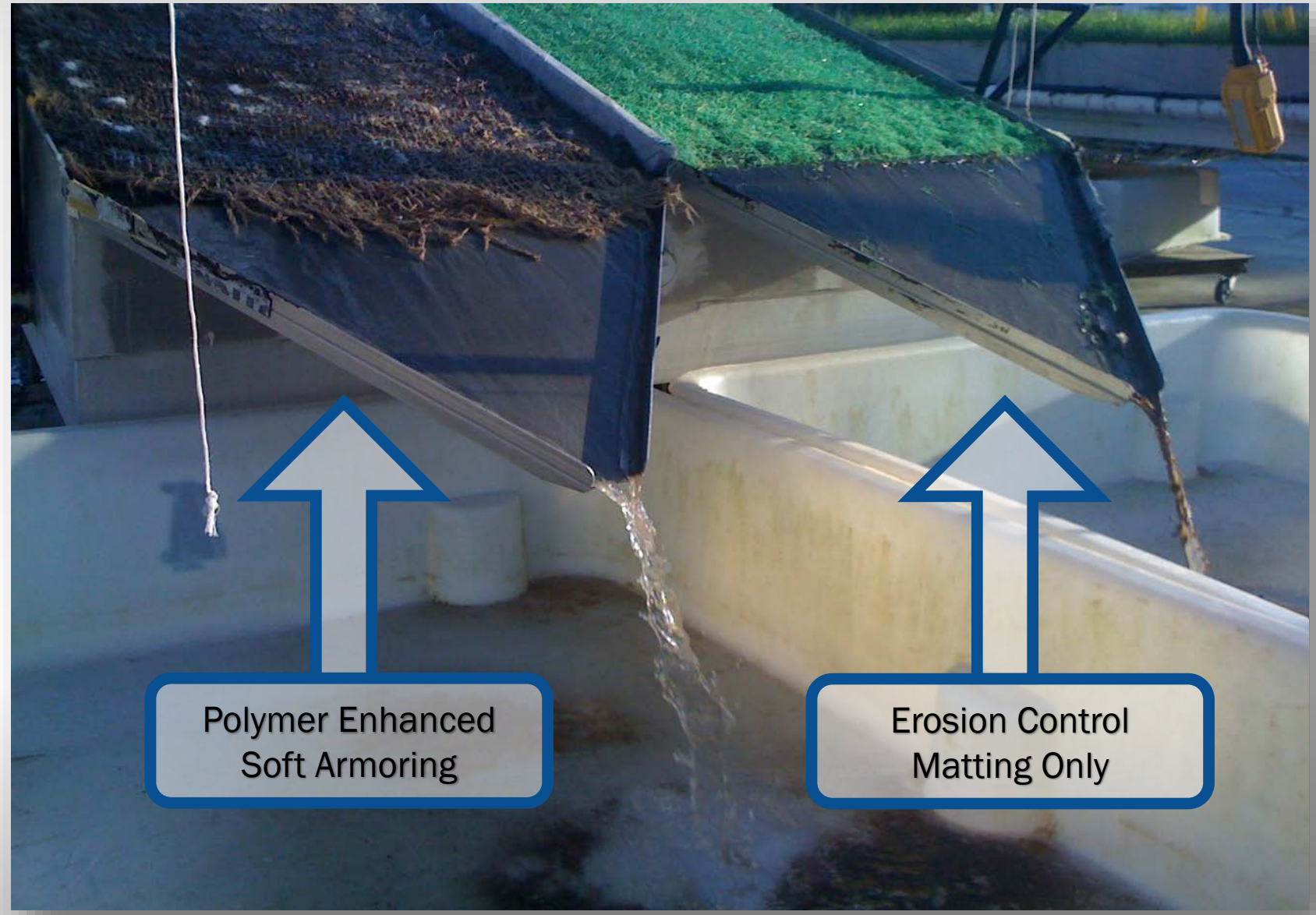


Polymer-Soil Matrix



Polymer + Soil agglomerations attach to each other

Soft Armoring: UCF Rainfall Simulator



Polyacrylamide + Seed Application

- Powder and Emulsion
- Dry Spread
- Hydroseed

Case Study: Florida Highway 98 Beach Sand Stabilization

Highway 98 Damage by Hurricane Dennis

(Carabelle to Eastpoint)

Highway 98 First Repair

Erosion after initial repair
(Category 1 hurricane)

Effective erosion control BMP for beach sand exposed to high wind and wave action was sought…

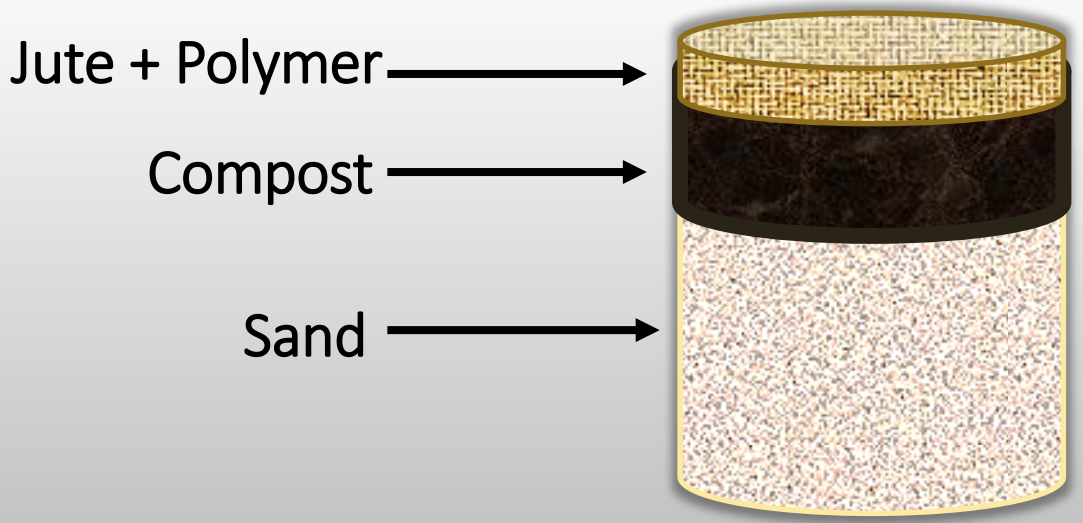
Polymer Enhanced Soft Armoring

1. Grade
2. Organic compost layer

3. Jute matting rolled over the organic layer

(Attachment media for polymer, sand and soil)

- 14 miles of matting
- Site specific polymer was selected
- Applied on top of matting at 50 pounds/acre



- Sod placed over polymer enhanced BMP

Sod

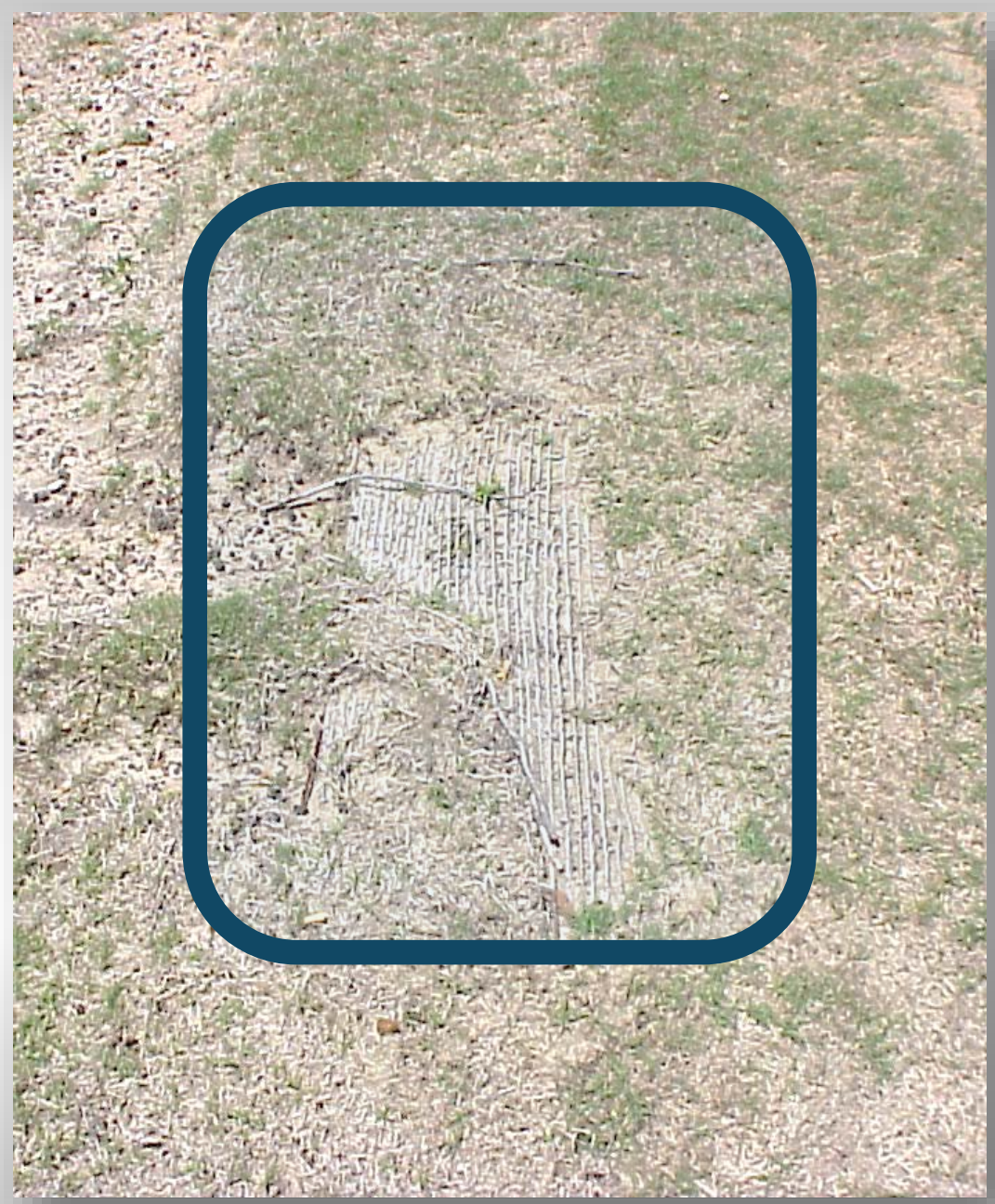
Jute & Polymer

Compost

Sand

No erosion 1 year after installation even following exposure to a tropical depression and category 1 hurricane

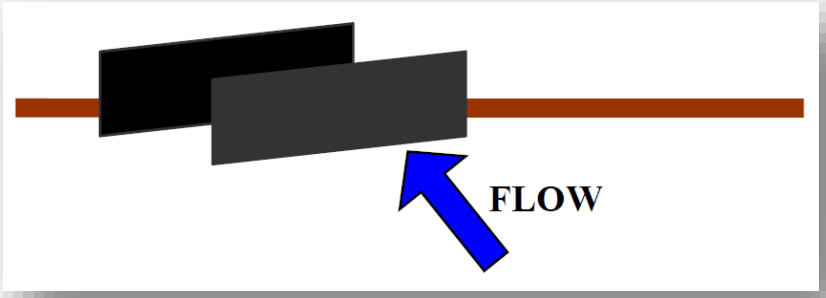
- Sod failed in some areas
- Polymer Soft Armoring remained

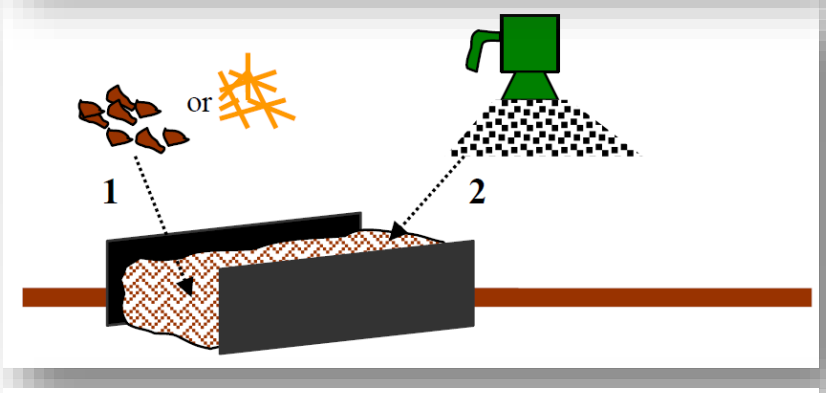


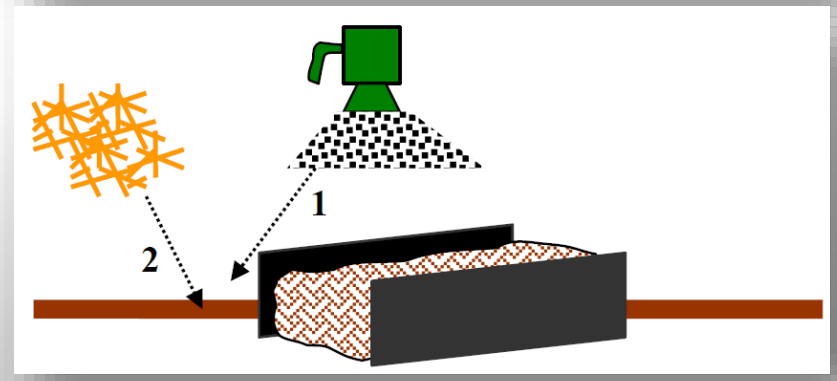
2. Sediment Retention Barriers (SRBs) and Rock Checks

Sediment Retention Barriers (SRBs)

- "Last line of defense" against erosion
- Two layers of silt fence
- Straw or mulch between silt fence
- Site specific Silt Stop Powder® applied between silt fences
- Straw and PAM applied to downflow area

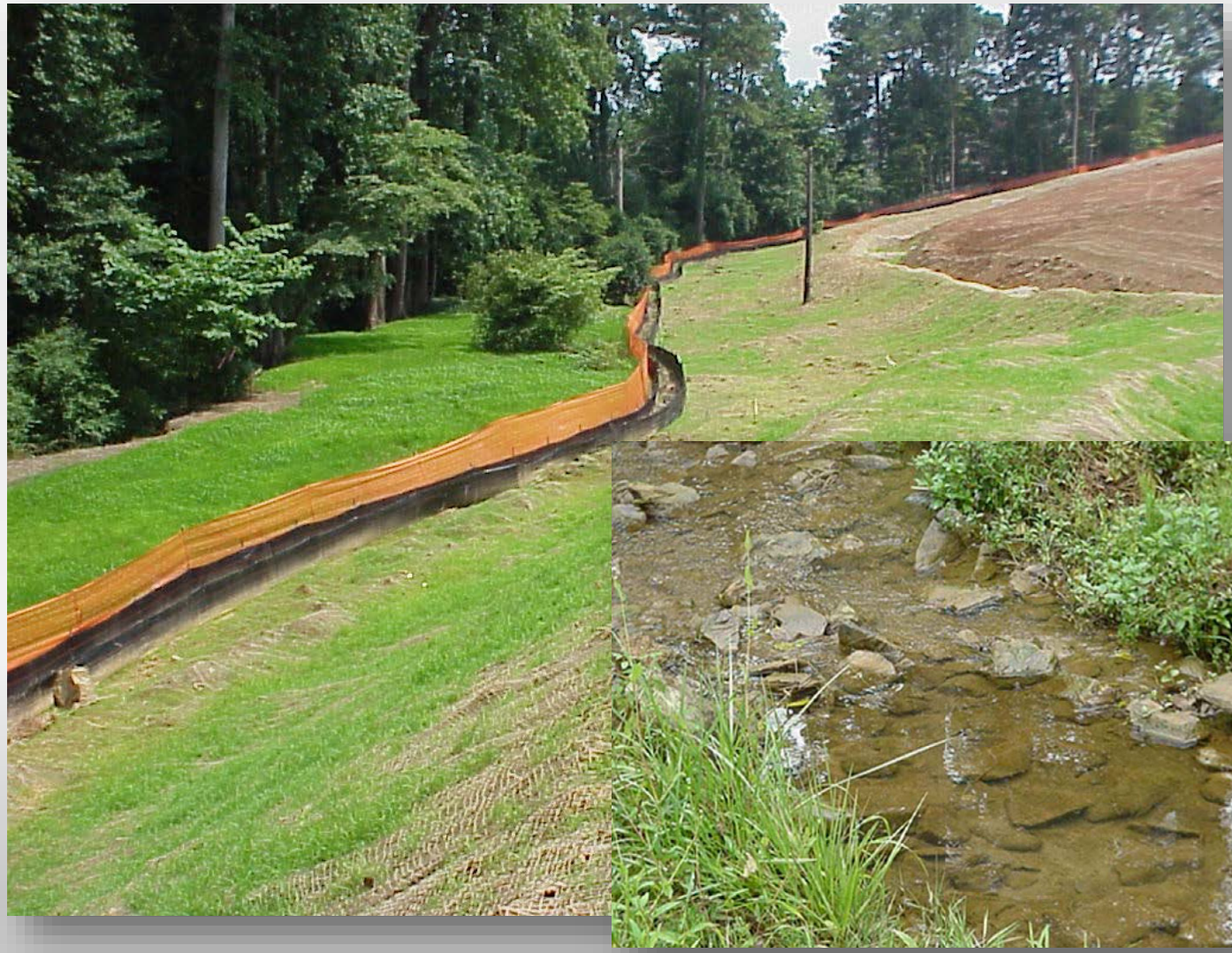




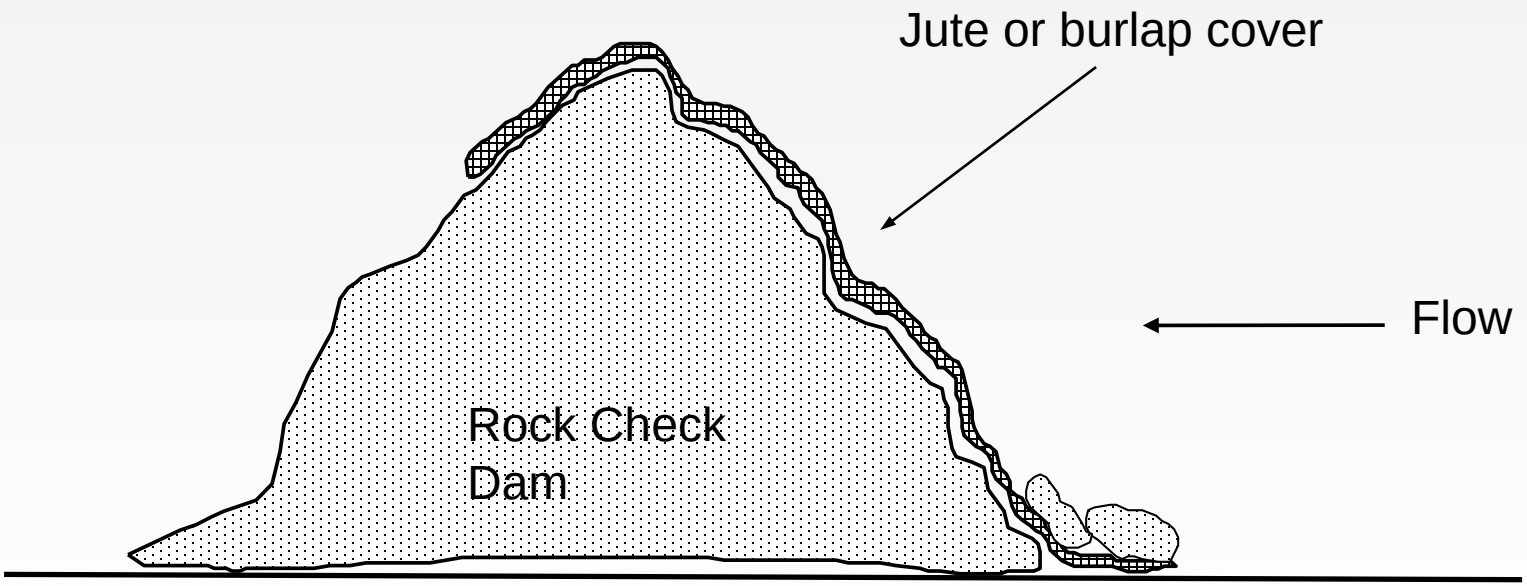


Sediment Retention Barriers (SRBs)

Sediment Retention Barriers (SRBs) in a treatment train



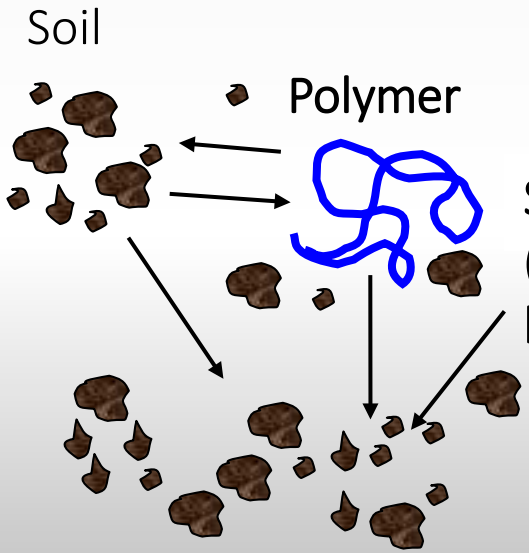
Silt Stop® Enhanced Rock Checks



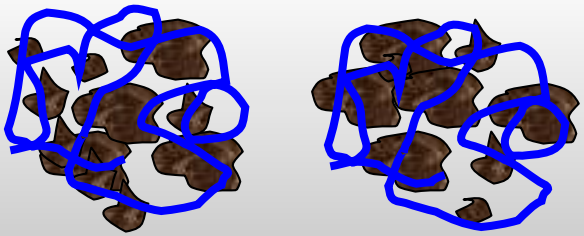
- Apply the correct, soil specific polymer to the matting

Silt Stop® Enhanced Rock Check

3. Water Clarification: Mixing and Dewatering Systems

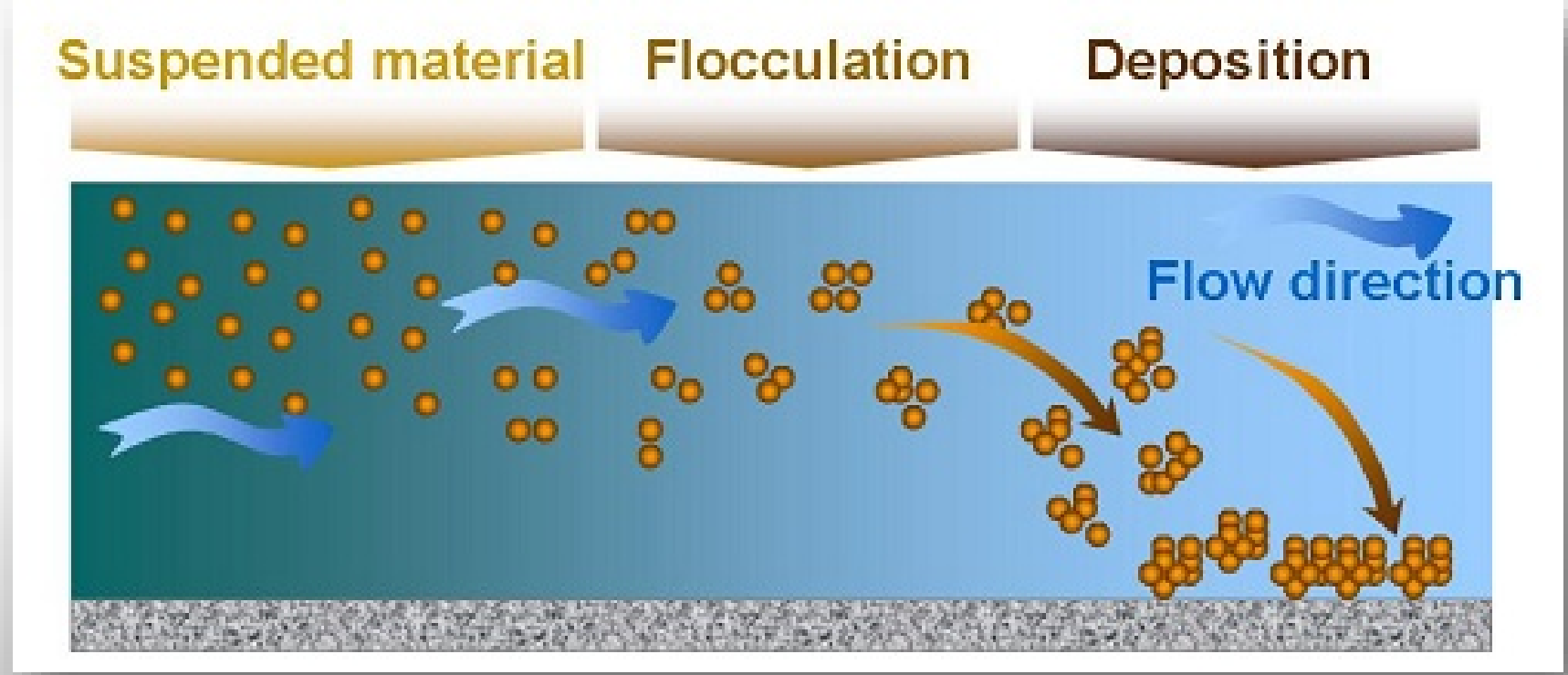


Polymer + Soil matrix forms an agglomeration



Water Clarification- Flocculation

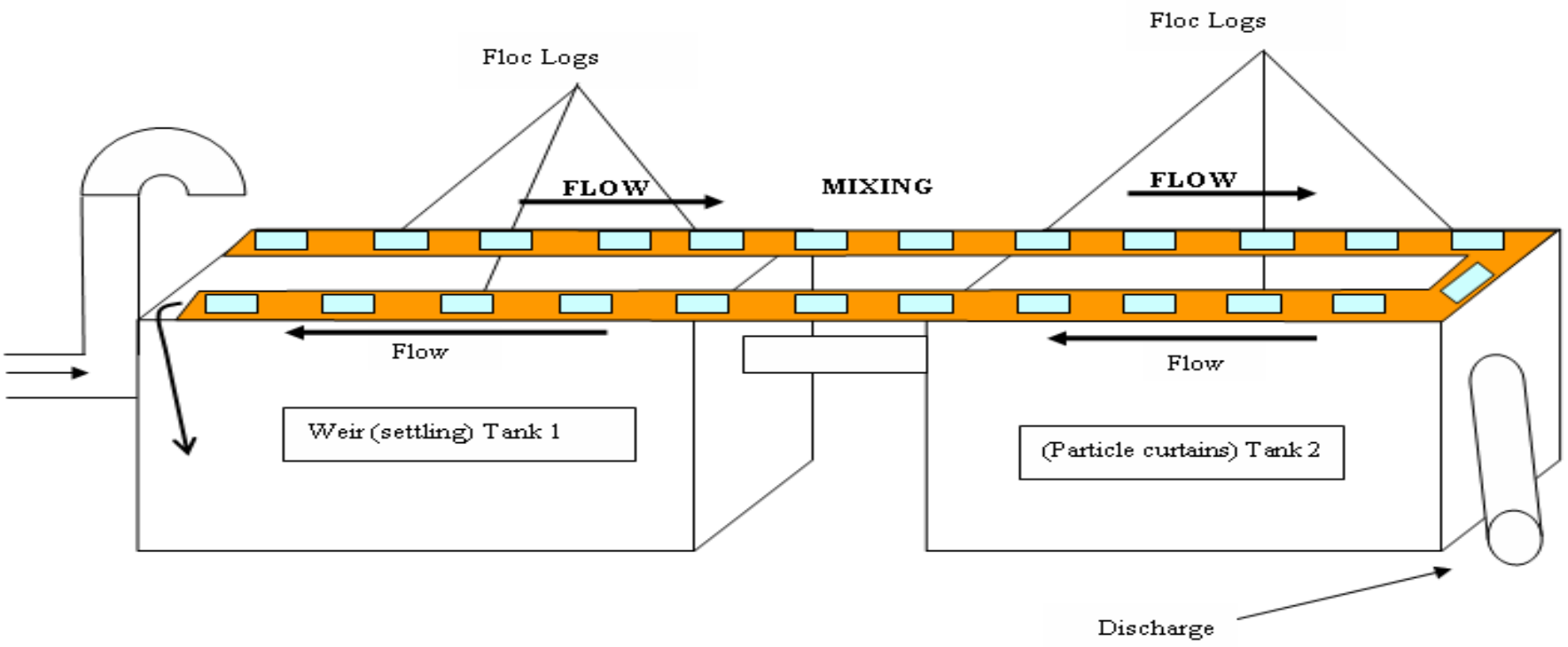
- Flocculation is where a chemical agent (flocculant) decreases turbidity by binding suspended particles together, forming a larger heavier “floc” that then settles
- www.epa.gov/npdes/stormwater/menuofbmps

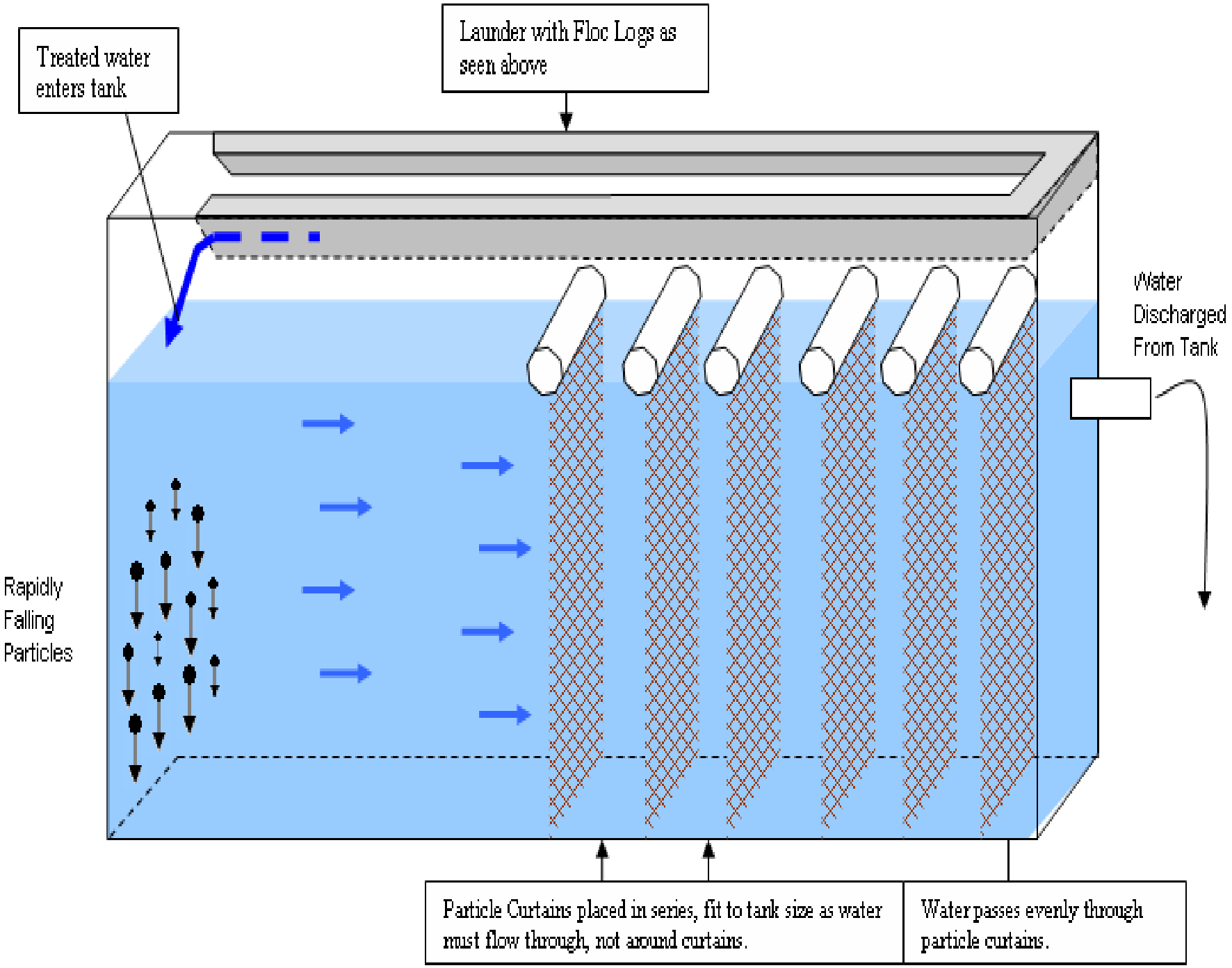


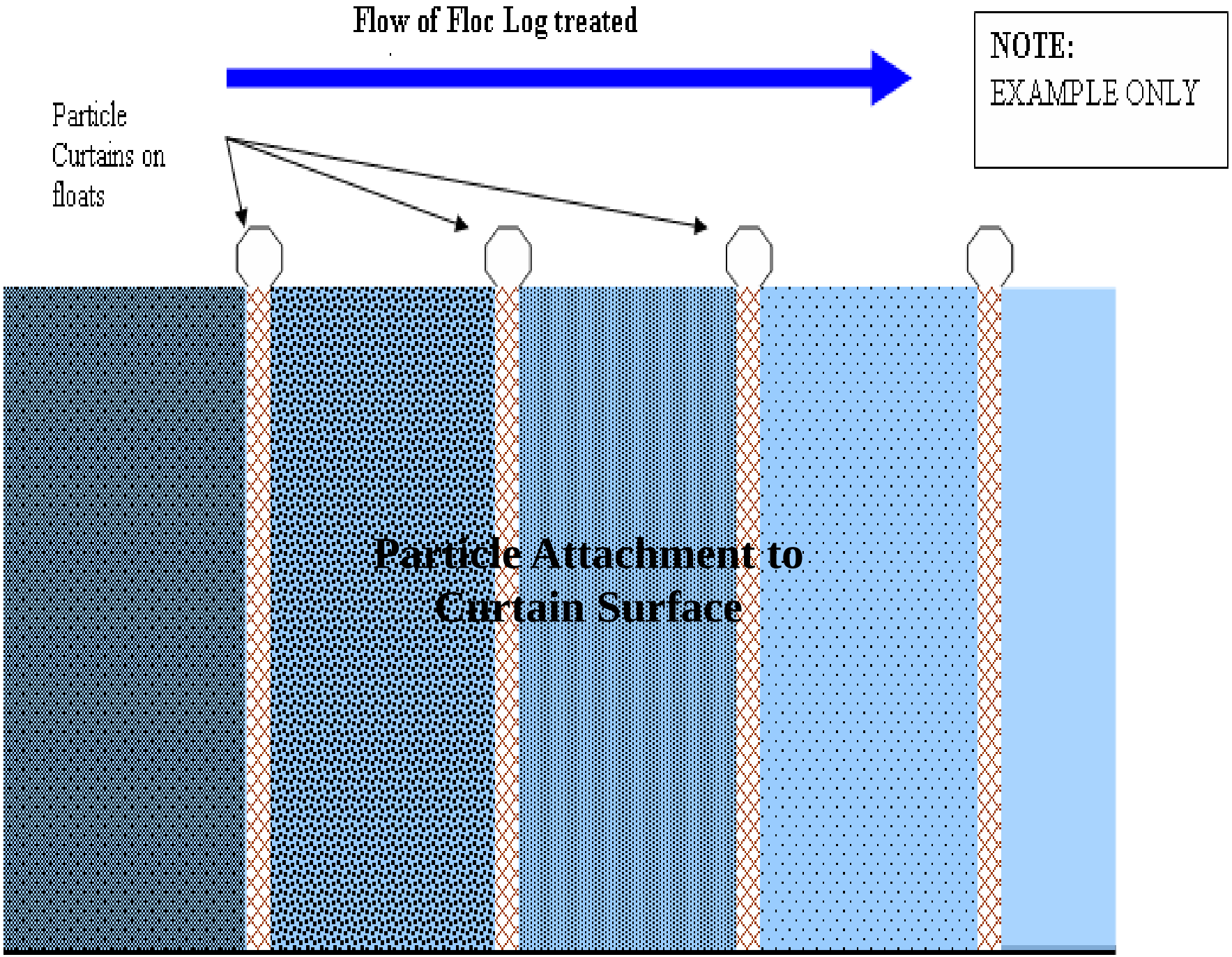
Dewatering/treatment ditches using polymer logs

Baffle Grids and Mixing Chambers

Tank Systems – Water Clarification and Particle Catchment


Floc Logs
Floc Logs
FLOW
MIXING
FLOW
Flow
Flow
Weir (settling) Tank 1
(Particle curtains) Tank 2
Discharge

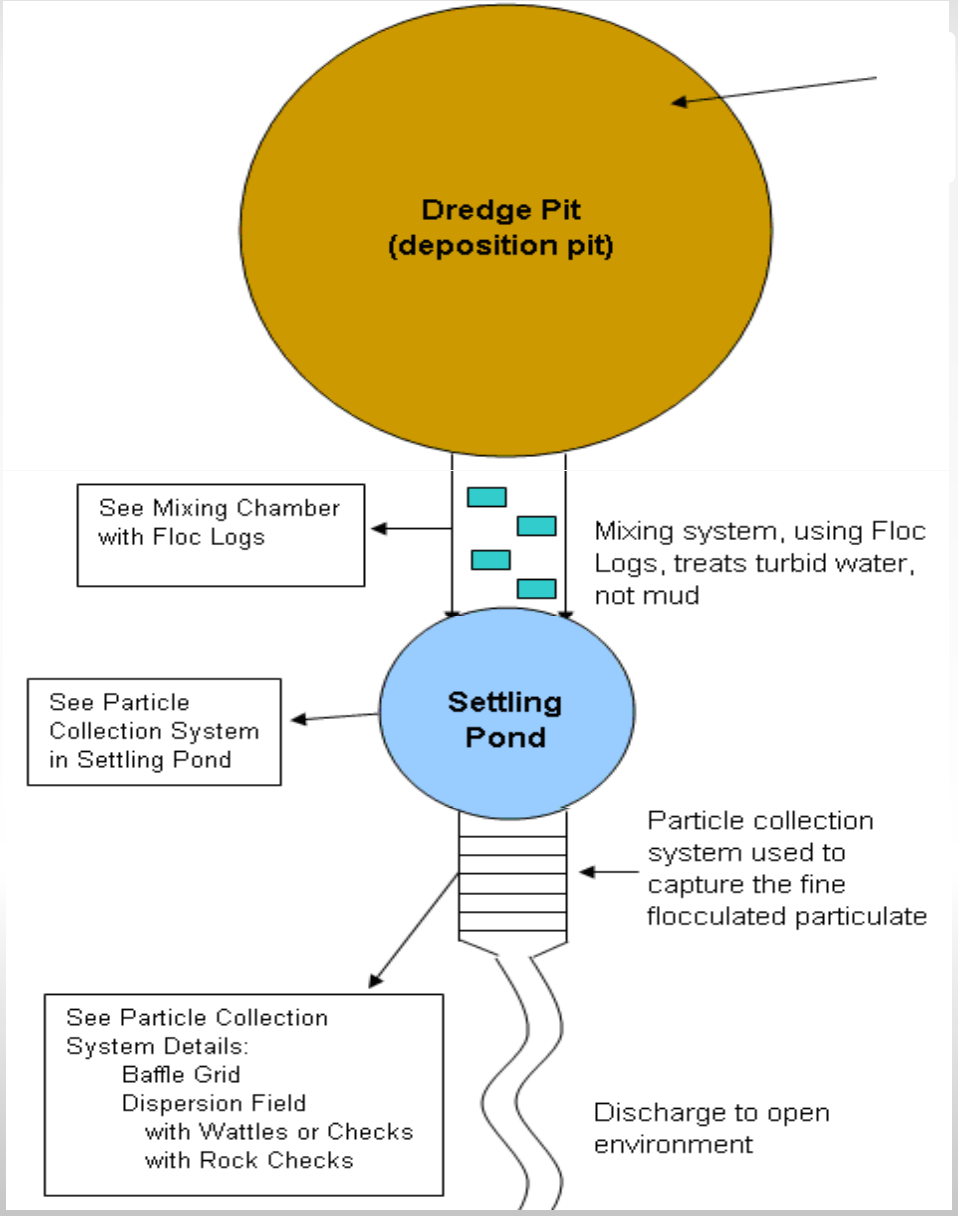

Treated water enters tank
Launder with Floc Logs as seen above
Water Discharged From Tank
Rapidly Falling Particles
Particle Curtains placed in series, fit to tank size as water must flow through, not around curtains.
Water passes evenly through particle curtains.


Flow of Floc Log treated
NOTE:
EXAMPLE ONLY
Particle
Curtains on
floats
Particle Attachment to
Curtain Surface

4. Dredging

Basic rules for dredging with PAM

- Bulk sediment is settled out before treatment (<4% solids)
- **Adequate mixing is key**
- Incorporate a settling pond
- A particle collection system for fines is optimal



Case Study: Kentucky Lake Dredging with Floc Logs®

Kentucky Lake Project
(Henry County, TN)
Tennessee Valley Authority (TVA)

Kentucky Lake

- Largest man-made lake in eastern US
- Primary use = flood protection
- Siltation in coves can decrease capacity and depth
- Homeowner in cove planned to dredge and remove 450,000 m^3 of accumulated sediment

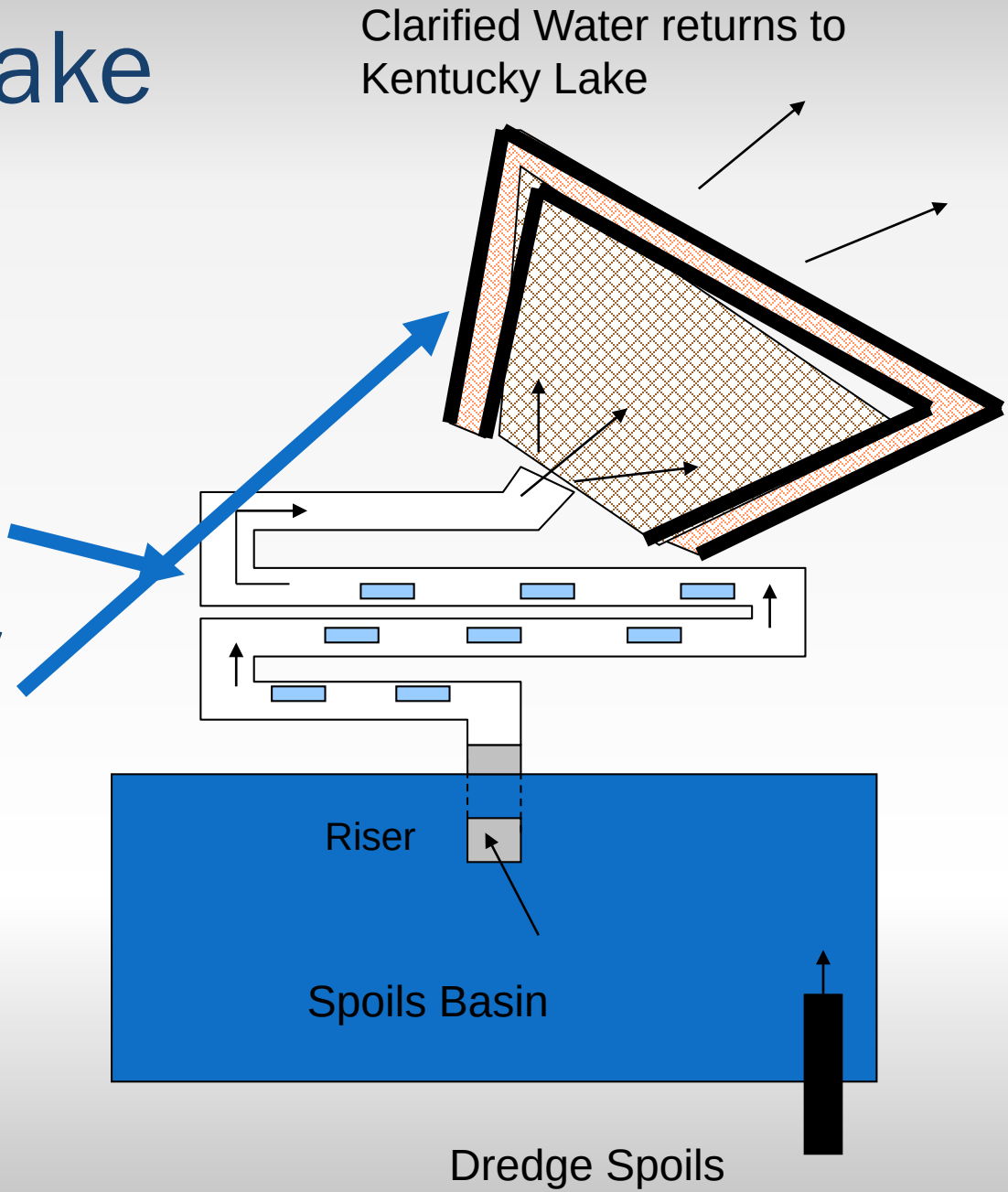
Kentucky Lake

- Dredge spoils sent to settling pond
- Excess water discharged over land through forested area owned by TVA
- Discharged back in lake
- Project shut down due to erosion and sediment loads returning to lake
- Polymer enhanced system utilized to solve erosion and sediment problems

Settling basin

Kentucky Lake

- 2- step treatment system
- 1: Mixing
  - *Polymer logs and mixing channel*
- 2: Particle catchment/ collection
  - *Dispersion field (jute matting) lined forested area prior to discharge back to lake*



Kentucky Lake – Mixing and Treatment with Polymer Logs

Kentucky Lake – Particle Catchment (PAM Enhanced Soft Armoring)

5. Demucking

Sediment Removal/ Demucking
(Dredge Spoils)

6. Pond and Lake Management with Pond Logs

Nutrient (Phosphorus) Control

Pond and Lake Management

- Nutrient removal (flocculation)
- Phosphorus (P) flocculation results in fluffy white precipitate
- Pond Logs result in up to 75-90% P removal
- 95% turbidity reduction

Pond and Lake Management

- Mixing required – water flows over log and aides in dissolution and dispersion of log components
- Logs used in conjunction with:
- Aerators
- Fountains
- Waterfalls

Hillman Lake Case Study: Solar Bee

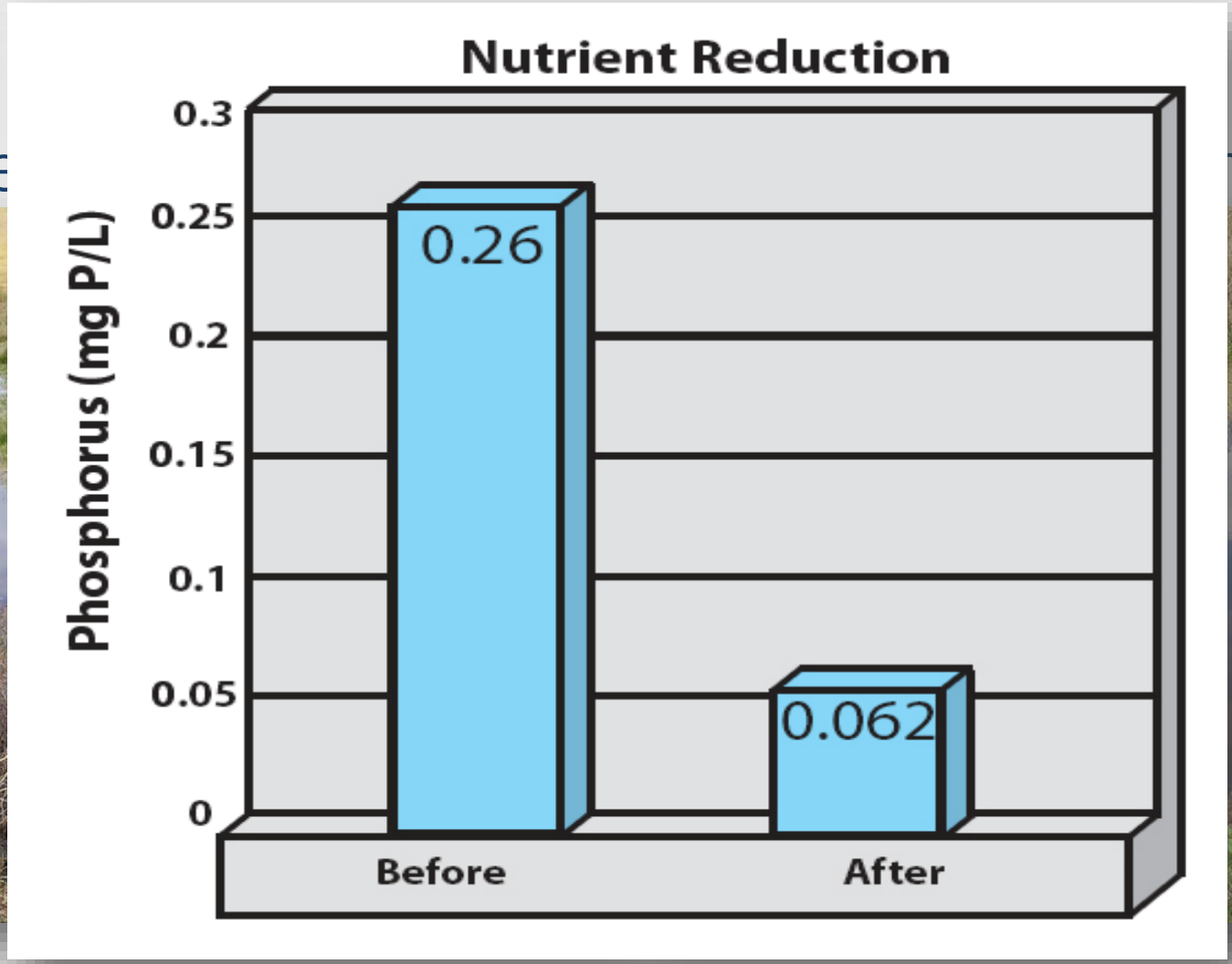
- Hillman Lake
- 2.4 acre storm water pond
- 3 million gallons circulated – 347 gpm
- Reedy Creek Water Management District
- 1,000 day study
- Solar powered aerator (SolarBee) used with PAM blend (log) technology
- Monitored by Florida DEP

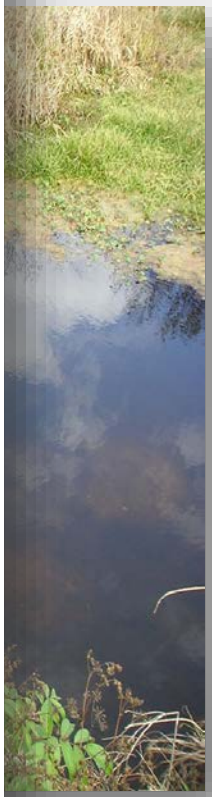
Hillman Lake Case Study: Solar Bee

- Logs tied to SolarBee
- Placed in flow of water to facilitate dissolving, mixing, and reaction
- Polymer in log form can be added to many typed of fountains, aerators, diffusors, circulators
- Can flocculate nutrients, sediment, and other particulate to improve water quality

Hillman Lake Case Study: Solar Bee

Be nt





7. Polymer Enhanced BMPs Case Study
Treatment Trains

1. Anna River Culvert Replacement

Anna River Culvert Replacement

- Culvert replacement on Anna River
- Environmentally sensitive
- Permitted through Michigan Department of Environmental Quality
- Environmentally safe anionic water soluble polymers
  - *Floc Logs & Silt Stop Powder*
- Site specific performance testing
- PEBMP Treatment Train

Polymer enhance soft armored rock checks in the ditch next to the new road to capture sediment moving into the stream.

An excavator was used to begin the removal of the old culvert.

Polymer enhanced soft armoring was installed to stabilize the areas where sediment could move into the stream.

The mixture was spread on all areas of bare soil. The polymer not only stabilized the soil but prevents the seed and fertilizer from washing into the stream.

One year after installation

Conclusions

- Minimal erosion of sediment loss throughout culvert replacement
- Absence of toxicity to aquatic organisms
- PEBMP treatment train allowed achievement of optimal results
- Vegetation was successfully established with polymer enhanced soil stabilization

Thank you! Questions?

www.siltstop.com

info@siltstop.com

Polymer References

http://kimberly.ars.usda.gov/pampage.shtml

www.stormwater.ucf.edu

www.epa.gov/npdes/pubs/polymerfloc.pdf

www.epa.gov/npdes/stormwater/menuofbmps

www.siltstop.com

Go to: Polymer Enhanced BMP Application Guide