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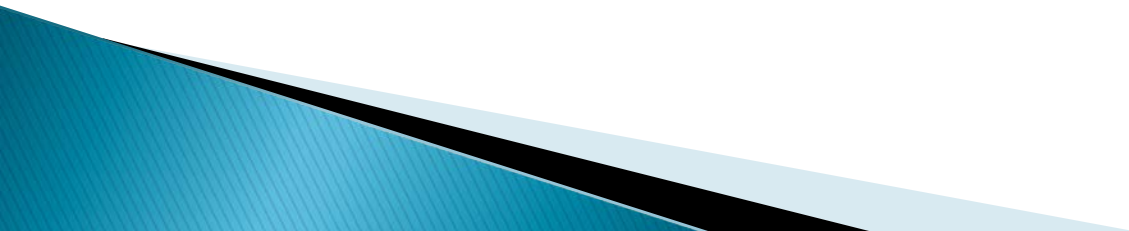
Toronto and Region
Conservation
for The Living City



Using Polymer Enhanced Best Management Practices to Control Erosion and Enhance Water Quality

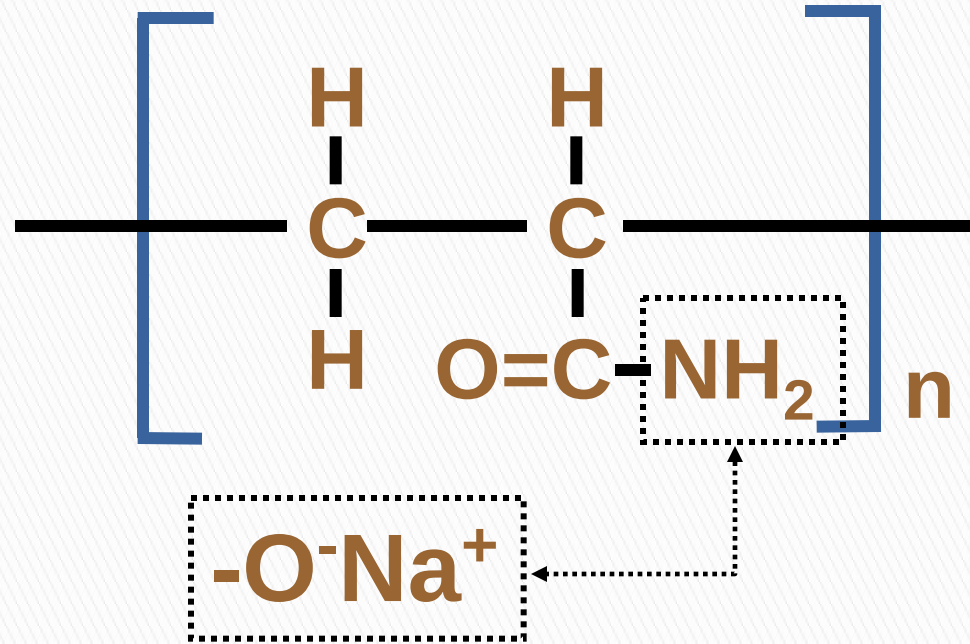
Seva Iwinski Bray

Applied Polymer Systems, Inc.



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



Anionic PAM is the active ingredient. Only products using water soluble anionic PAM as the active polymer ingredient should be used. Products containing a synthetic cationic polymer or chitosan should not be used due to their higher toxicity to aquatic organisms.

–Anionic Polyacrylamide Application Guide for Urban Construction in Ontario

Prepared by Toronto and Region Conservation

June 2013

http://sustainabletechnologies.ca/wp/wp-content/uploads/2013/02/Polymer-Guide-Final_NewFormat.pdf

Although cationic polymers are effective flocculants and do reduce turbidity, their positive charges make them toxic to aquatic organisms when dissolved in water. Consequently they should not be used as flocculants in stormwater that runs off the land into natural waterbodies. However, anionic polymers, which carry a negative charge, are not toxic.

- Office of Water, 4203M

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

Stormwater Best Management Practice: ***Polymer Flocculation October 2013***

Anionic Erosion and Water clarifications PAM based polymers are FAR less toxic than Fungicides, Insecticides, Rodenticides, Cationic Polymers, most Herbicides and even concentrated Fertilizers.

-USDA
Kimberly, ID

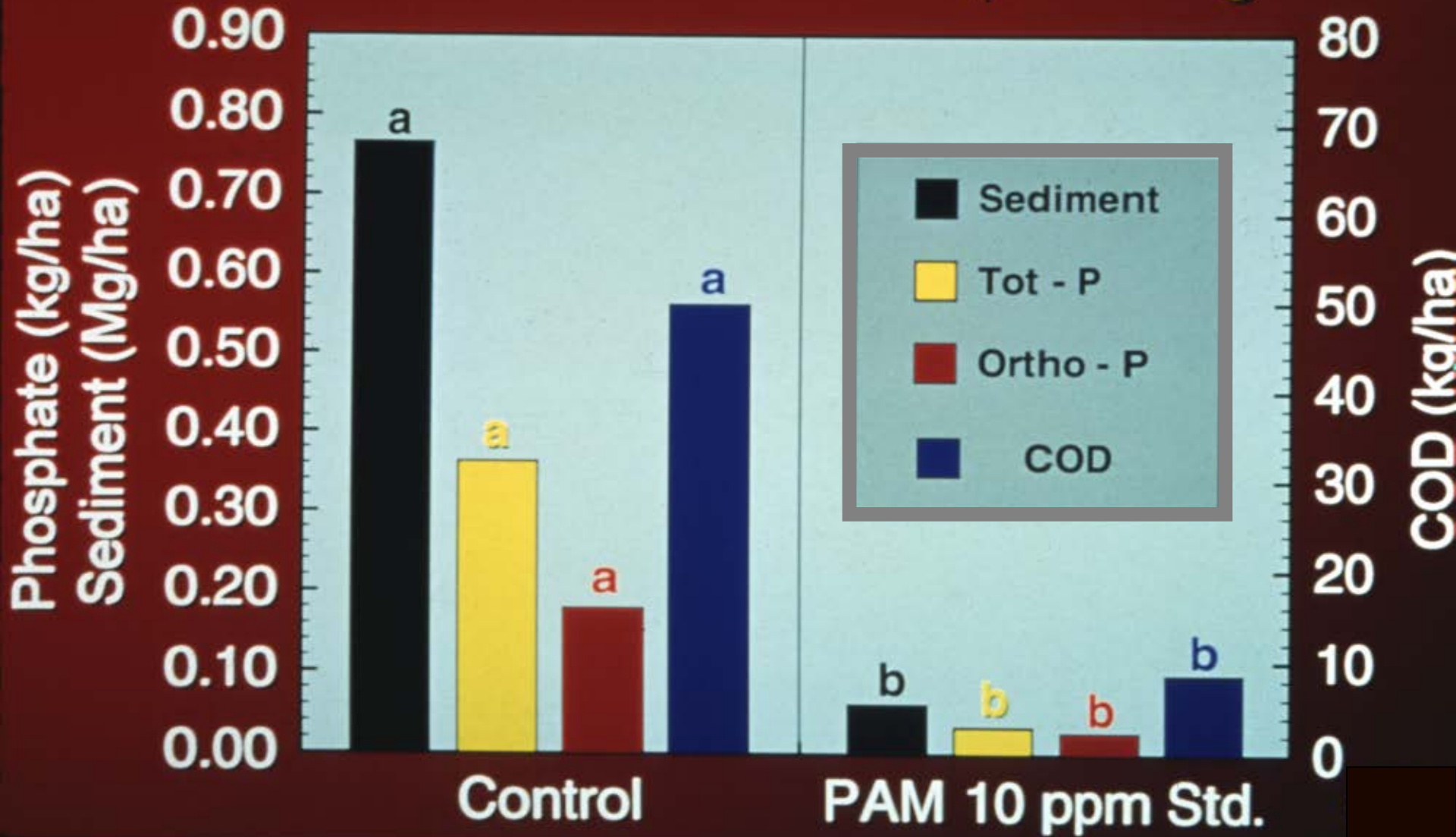


USDA Has Used PAM To:

- Reduce Agricultural Erosion**
- Increase Soil Infiltration**
- Improve Crop Yield**



Mean Runoff Amounts per Irrigation



California & Idaho Research Also Show Reduced Pesticide in Runoff

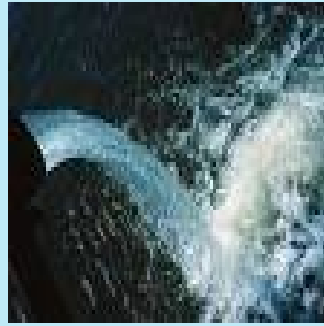


NWISRL
Kimberly, ID



Uses of Polyacrylamide

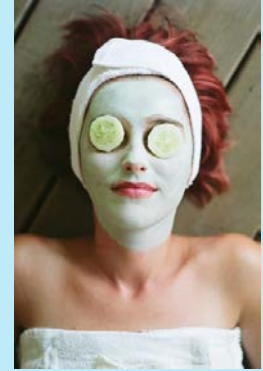
Removal of suspended solids from industrial waste water before discharging, reuse, or disposal



Clarify fruit juices and sugar liquors



COSMETICS



Flocculent in the treatment of municipal water supply

Mineral Processing

POTABLE WATER



Adhesives and Paper in contact with food



-Mining and Drilling applications-

Paper and Pulp Production

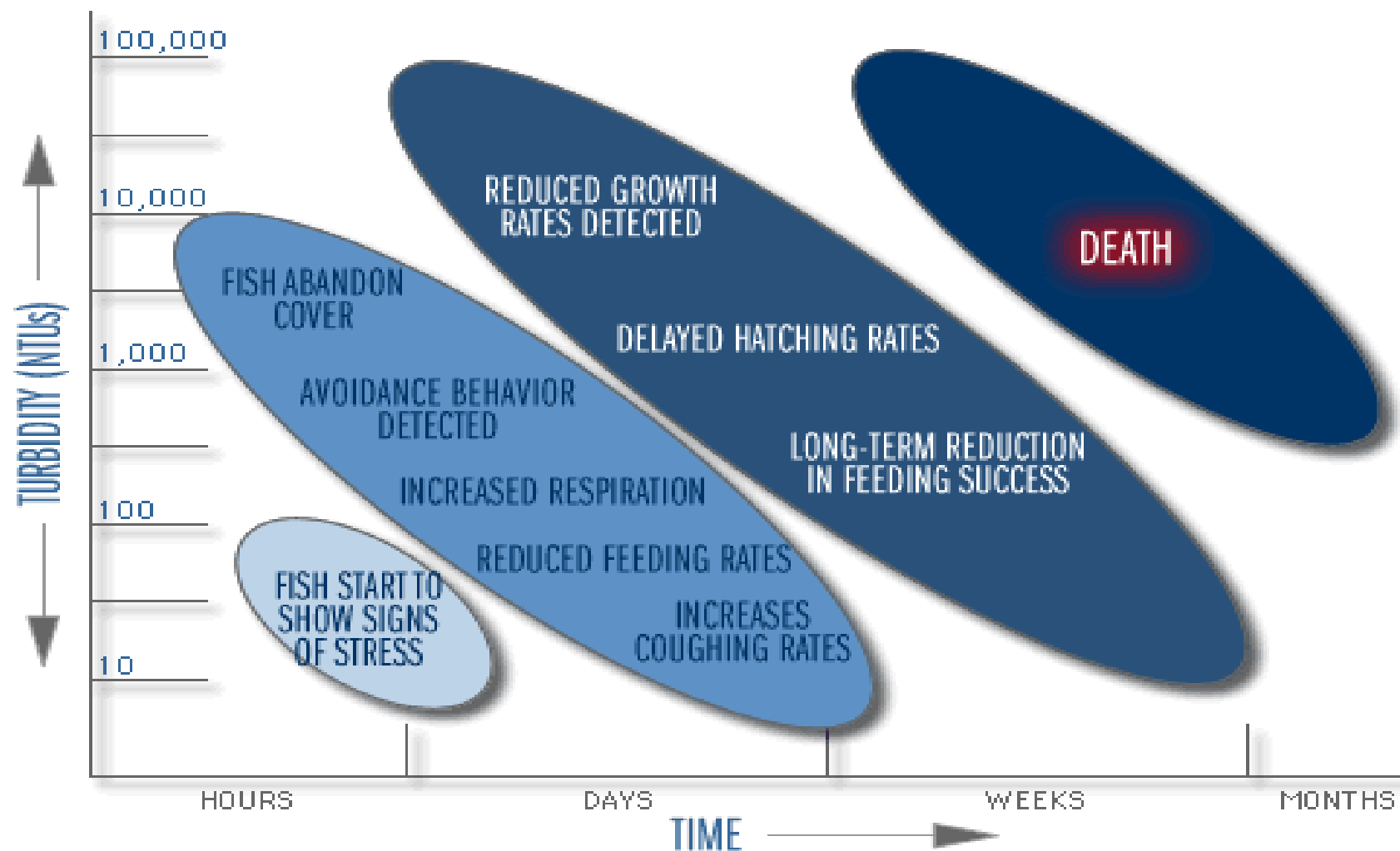


Animal Feed Thickener



****Soil conditioning agent****

RELATIONAL TRENDS OF FRESH WATER FISH ACTIVITY TO TURBIDITY VALUES AND TIME



http://duluthstreams.org/understanding/param_turbidity.html

Schematic adapted from "Turbidity: A Water Quality Measure", Water Action Volunteers, Monitoring Factsheet Series, UW-Extension, Environmental Resources Center. It is a generic, un-calibrated impact assessment model based on Newcombe, C. P., and J. O. T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management. 16: 693-711.

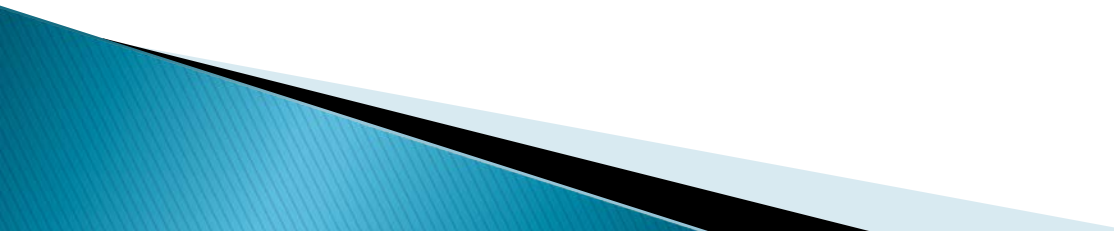


PRODUCT SELECTION:

Safe based on expected release rates, toxicity reports and product Material Safety Data Sheets (MSDS). An MSDS should be available for the specific anionic PAM product to be used, and should indicate that the product is safe at the anticipated concentration (calculated from product release rate) and based on the intended use. As a minimum, acute and chronic toxicity test data should also be available from the manufacturer or a third party organization....

-Anionic Polyacryamide Application Guide for Urban Construction in Ontario

http://sustainabletechnologies.ca/wp/wp-content/uploads/2013/02/Polymer-Guide-Final_NewFormat.pdf



PERFORMANCE

- ▶ One PAM does not work on all soil and water chemistries
- ▶ Performance testing before applying is necessary to ensure results
- ▶ Can be done doing a simple “cup test”
- ▶ Using an incorrect PAM:
 - You may not see results
 - It may not bind to your soil at all



TREATMENT TRAIN:

One of them alone (BMP's) may be sufficient for a relatively simple project, or several of these BMPs may be used together to design a polymer flocculation system for a larger project.

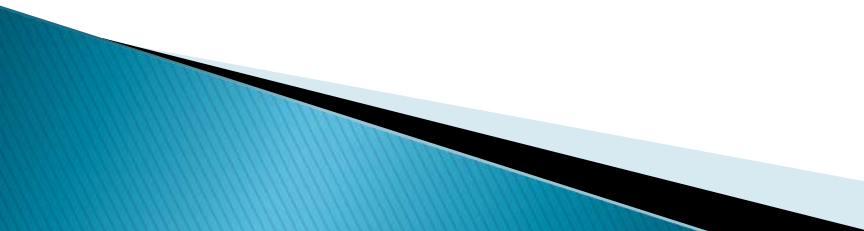
Designing polymer flocculation systems often involves using multiple BMPs and having them work well together.

-Office of Water, 4203M

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

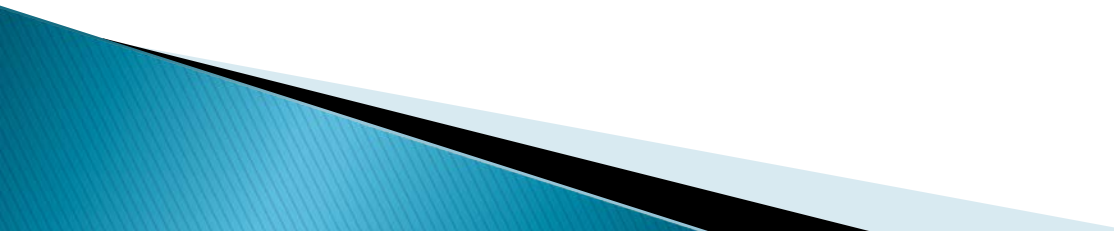
www.epa.gov/npdes/stormwater/menuofbmps

Stormwater Best Management Practice: ***Polymer Flocculation October 2013***

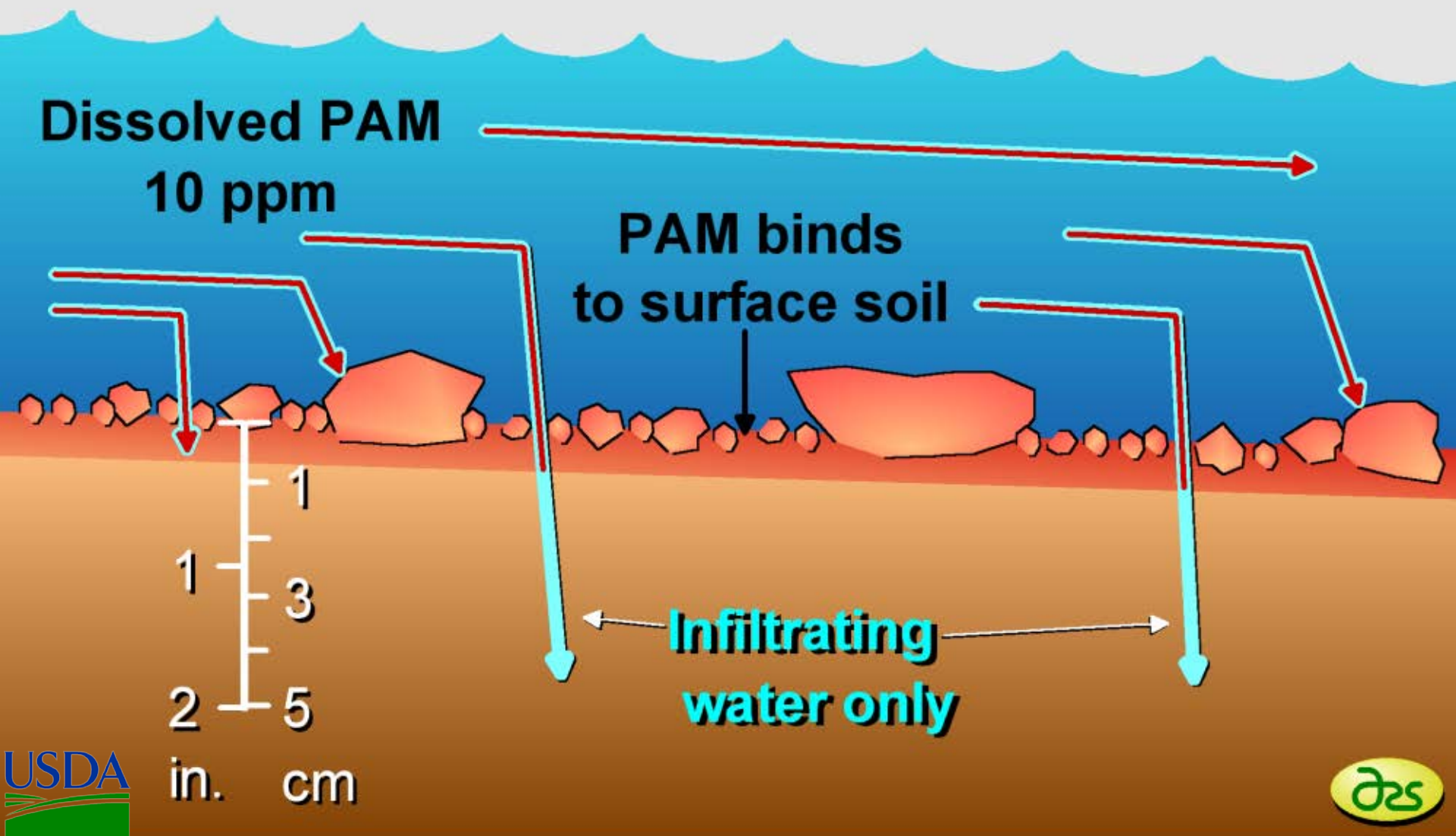


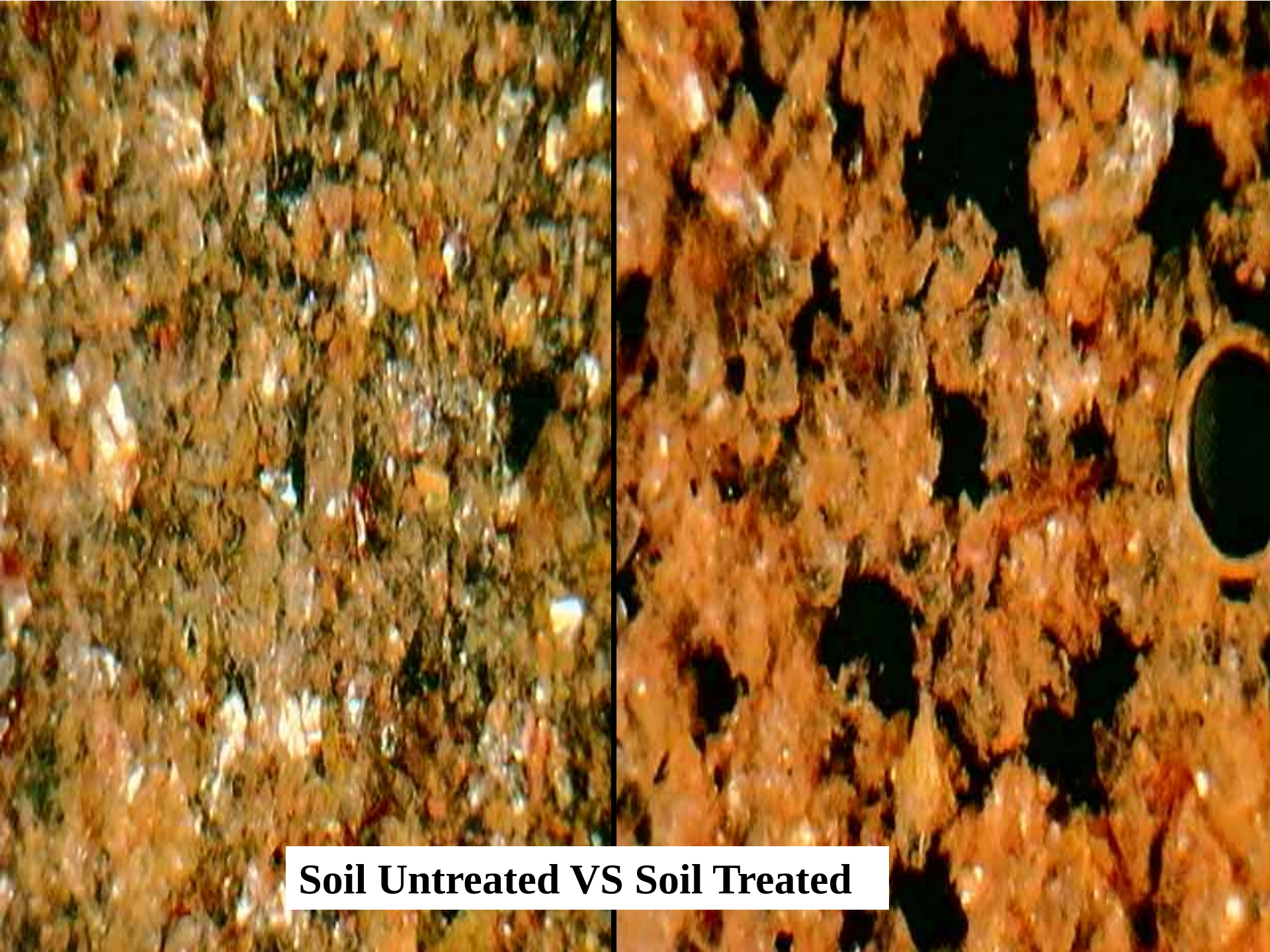
Polymer Enhanced Soil Stabilization

**(Including Polymer Enhanced Soft Armoring
technique)**

A decorative graphic element in the bottom-left corner of the slide, consisting of overlapping blue and black geometric shapes.

PAM-Treated Furrow Irrigation





Soil Untreated VS Soil Treated

Soil

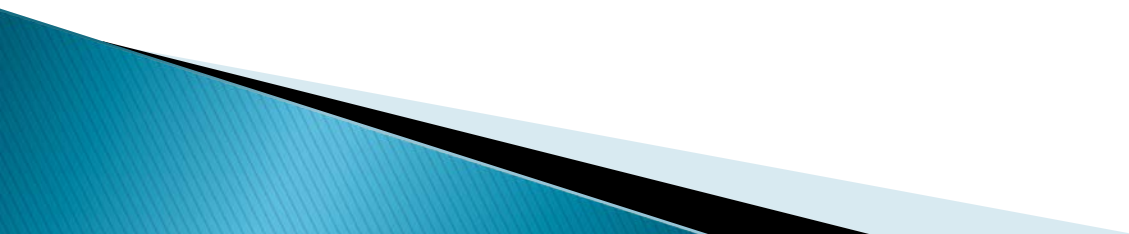
Polymer

**Soil Specific Polymer
(must be tested before
application)**

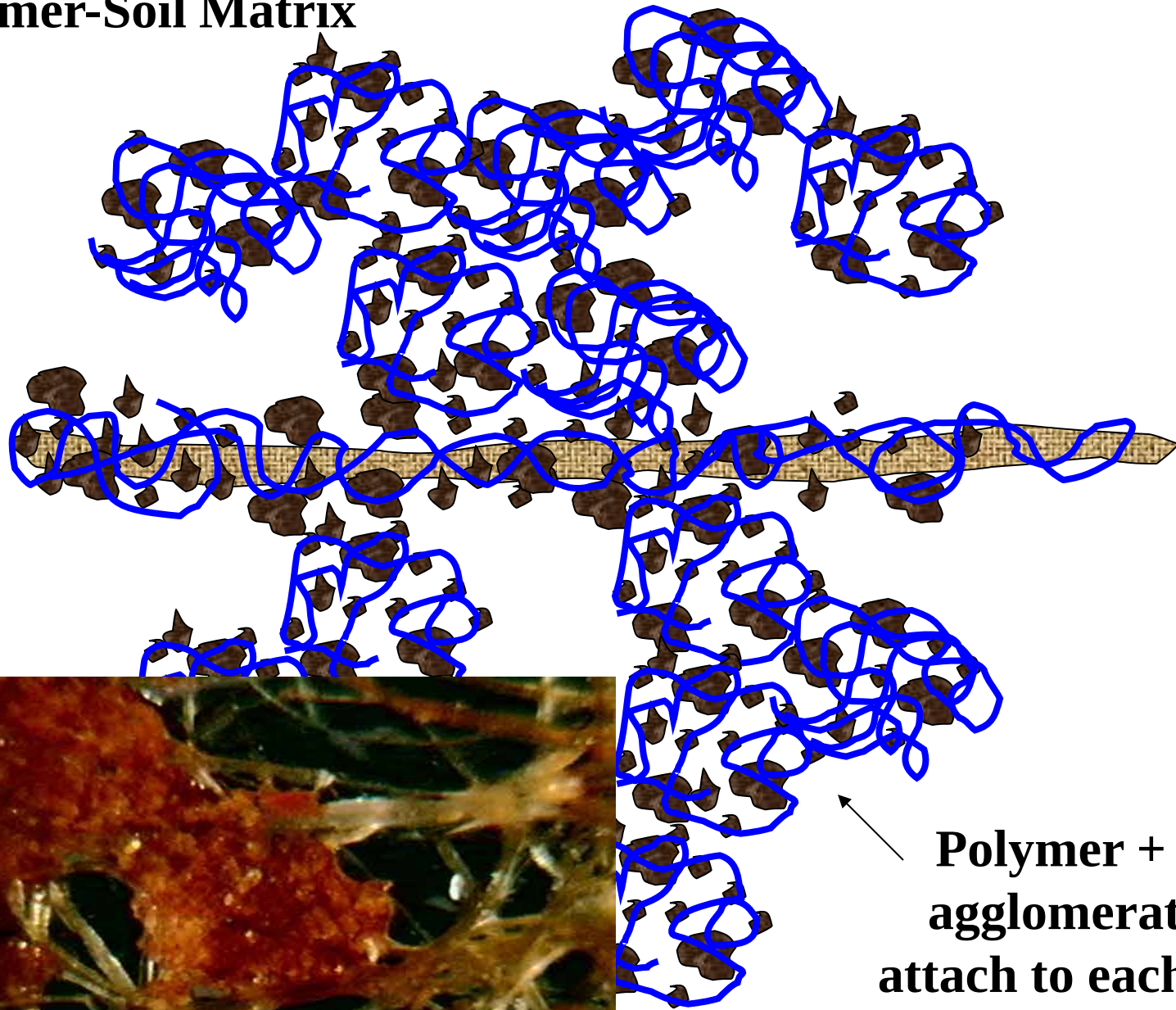
**Coconut or Jute
Matting, Mulch or Straw
(provides attachment
surface)**

Soil

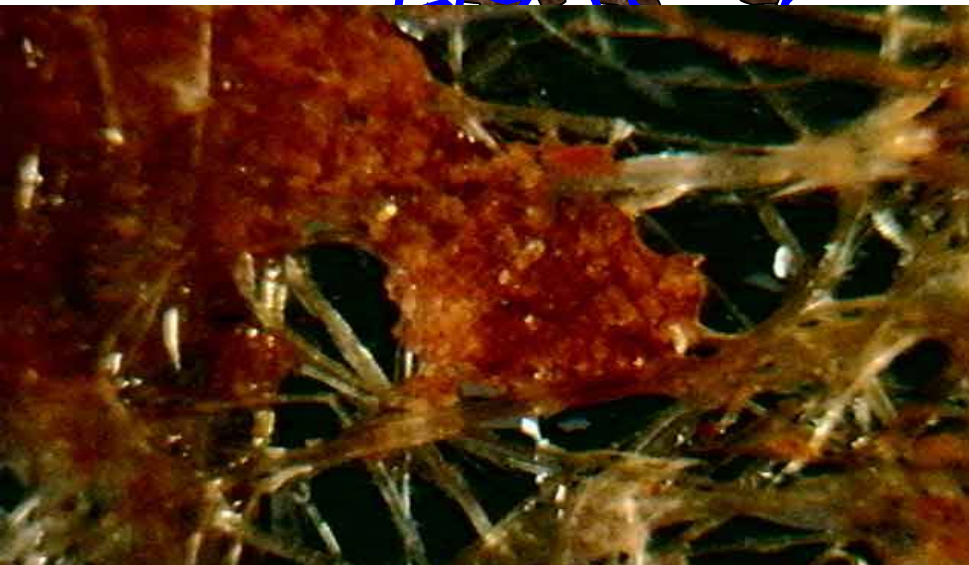
Polymer



Polymer-Soil Matrix

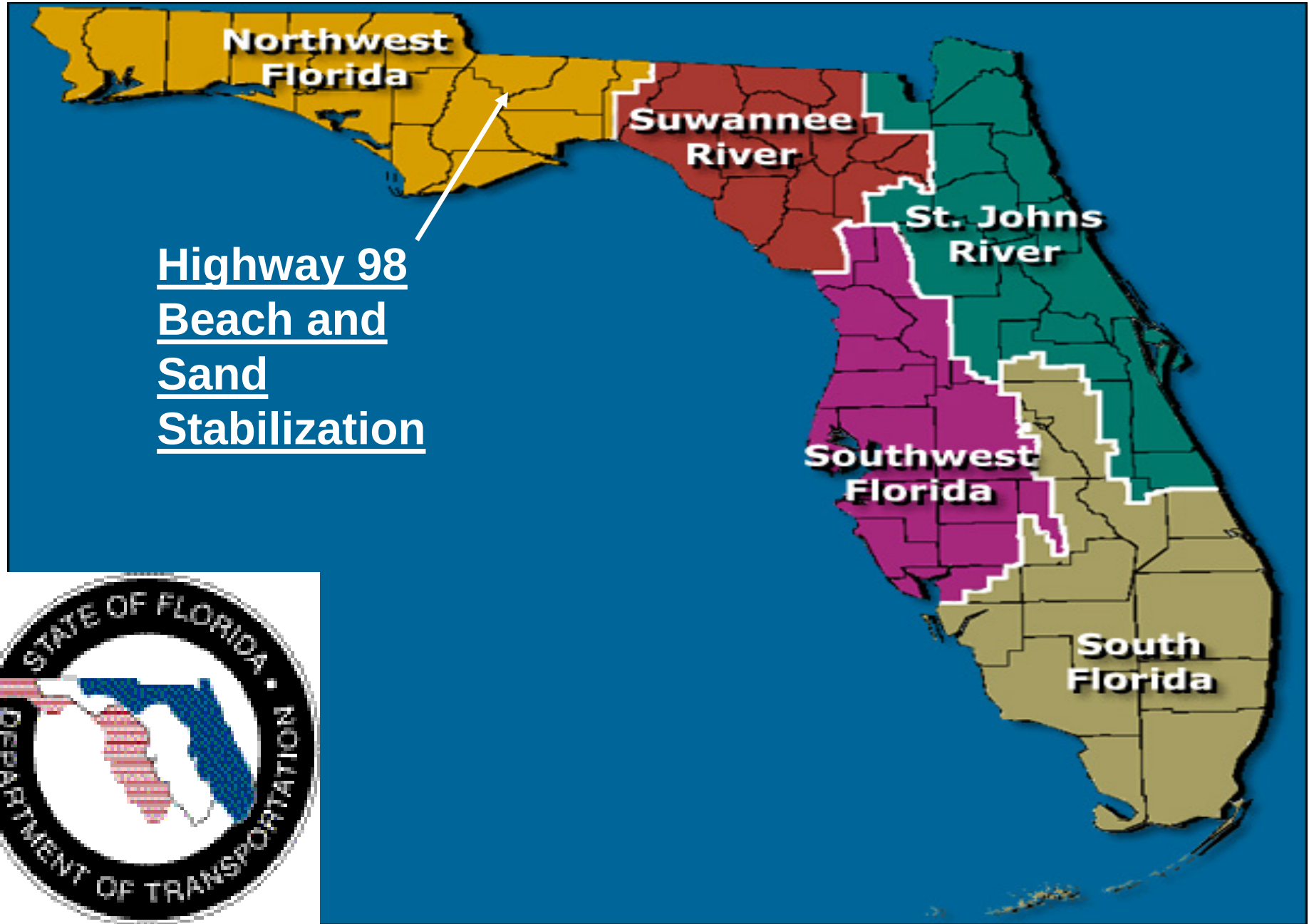


**Polymer + Soil
agglomerations
attach to each other**





HWY 98 DOT Project



Highway 98 Damage by Hurricane Dennis (Carabelle to Eastpoint)



Highway 98 Repair - Carabelle to Eastpoint





Erosion after initial repair required an industrial BMP that would work on beach sands



Polymer Enhanced Soft Armor Systems was chosen. After grading, compost was placed as an organic layer

Jute matting was placed over the organic layer as a binding media for attachment of the polymer, sand and soil

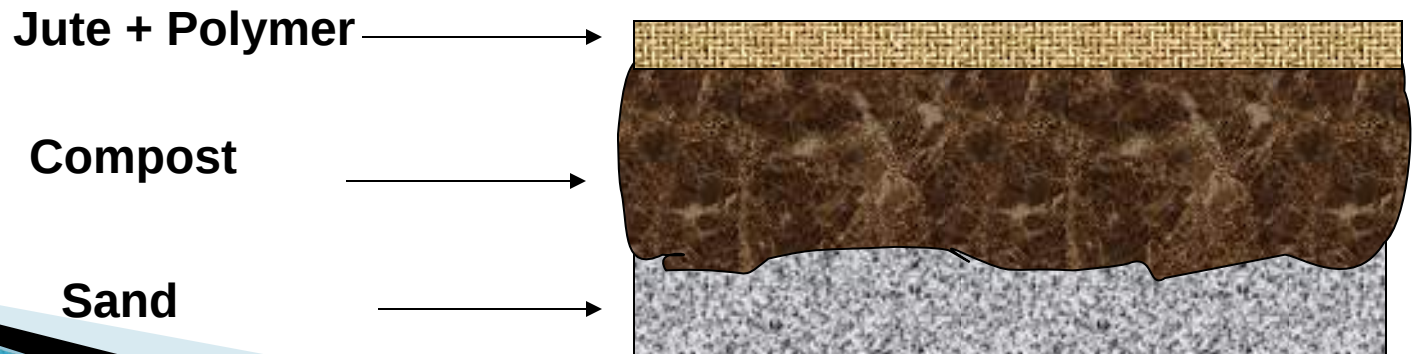


09/14/2005

GROUND "SOD" STAPLES
6" X 1" X 6"
100 PIECES



Jute matting was placed over the 14 miles of repair area as a binding agent. 50 pounds / acre polymer application rate was used





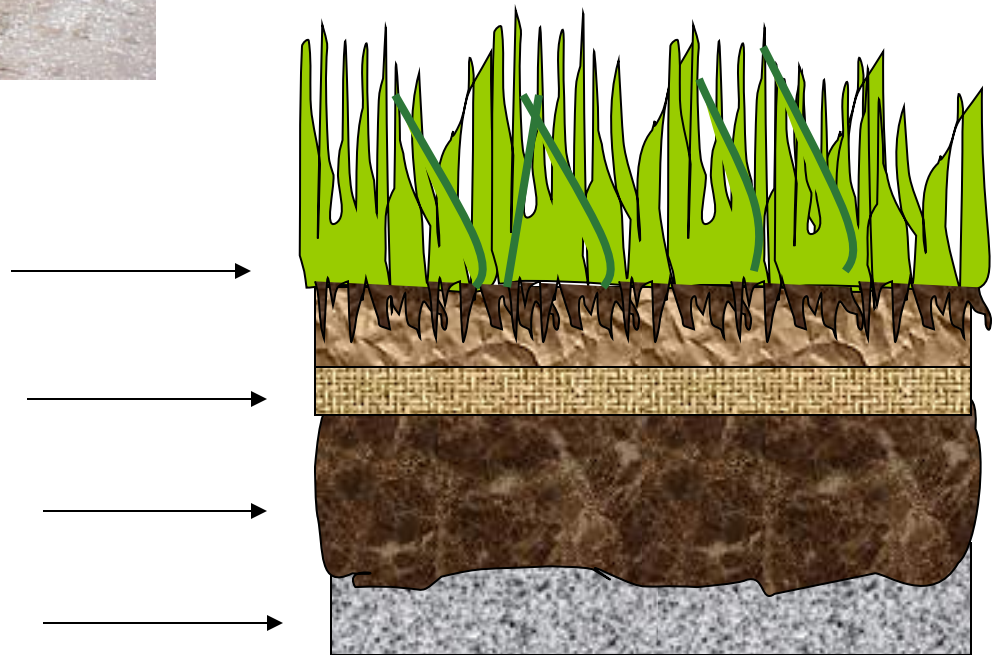
**Sod was placed over the
polymer enhanced BMP**

Sod

Jute & Polymer

Compost

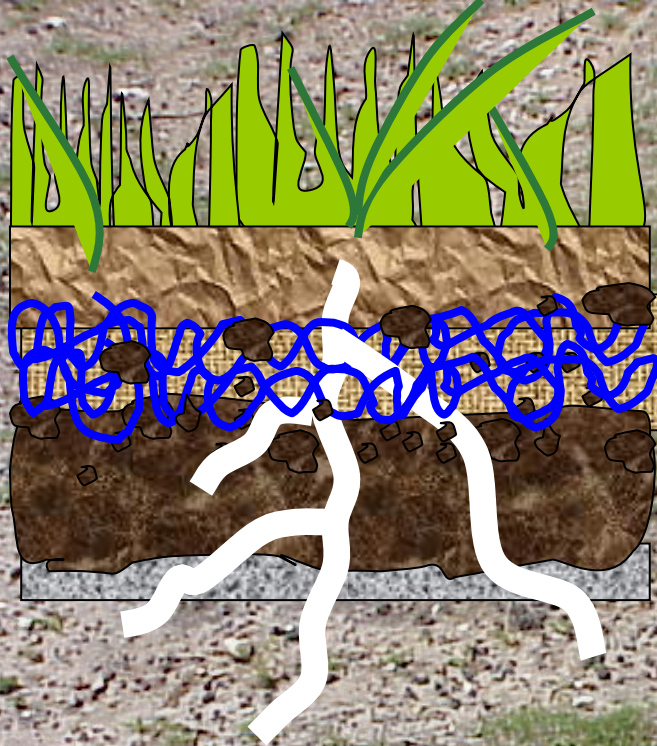
Sand



One year after placement shows no erosion or need for further repair. This area received a tropical depression and a category 1 hurricane after initial installation



06/13/2006



Polymer Enhanced Hydroseeding





Polymer Enhanced Inlet Protection



Sediment Retention Barriers (SRBs)



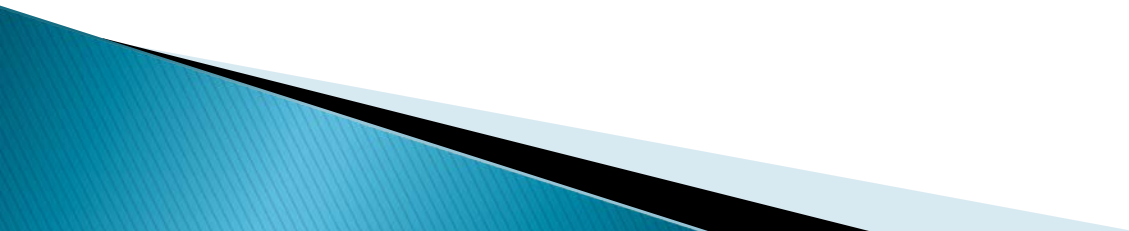
Sediment Retention Barriers (SRBs)



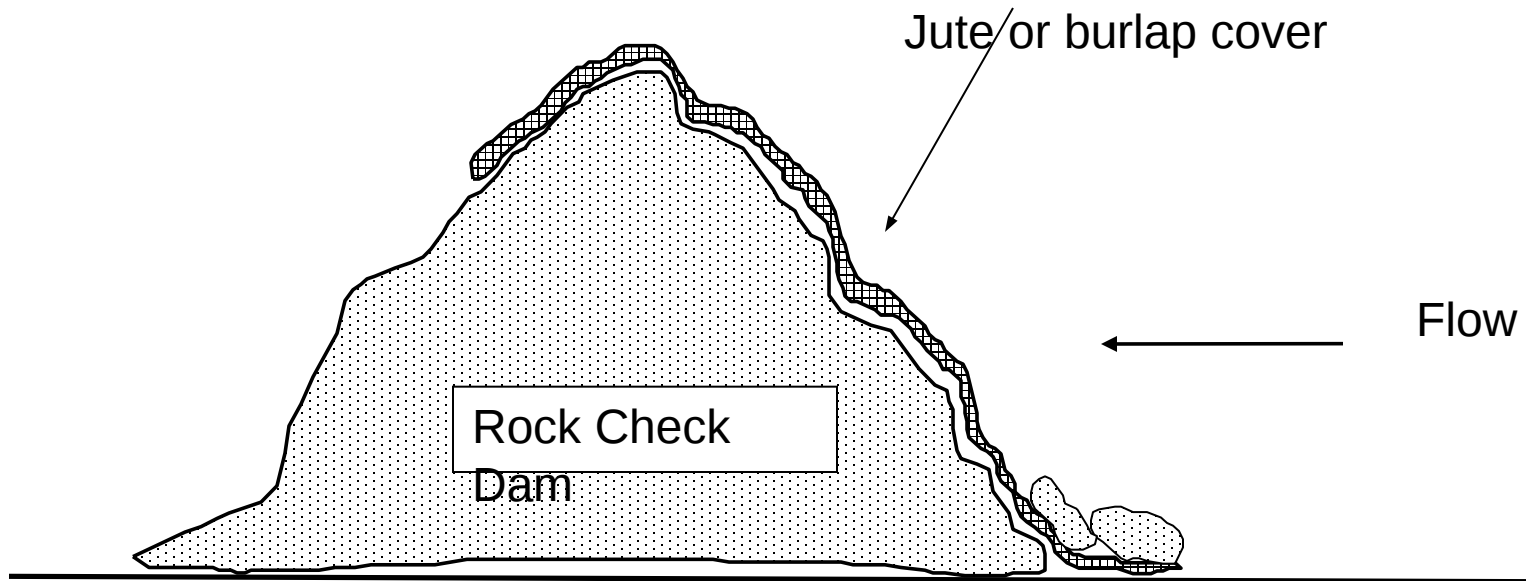
Sediment Retention Barriers (SRBs) in a treatment train



Rock checks and wattles



Polymer Enhanced Rock Checks/Wattles



Apply the correct soil specific polymer to the matting

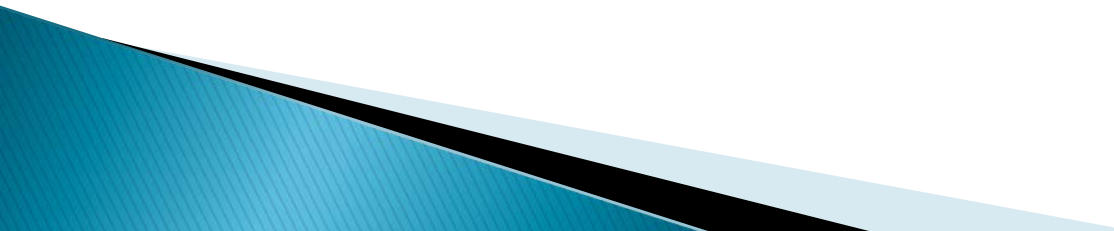
Polymer Enhanced Rock Checks/Wattles

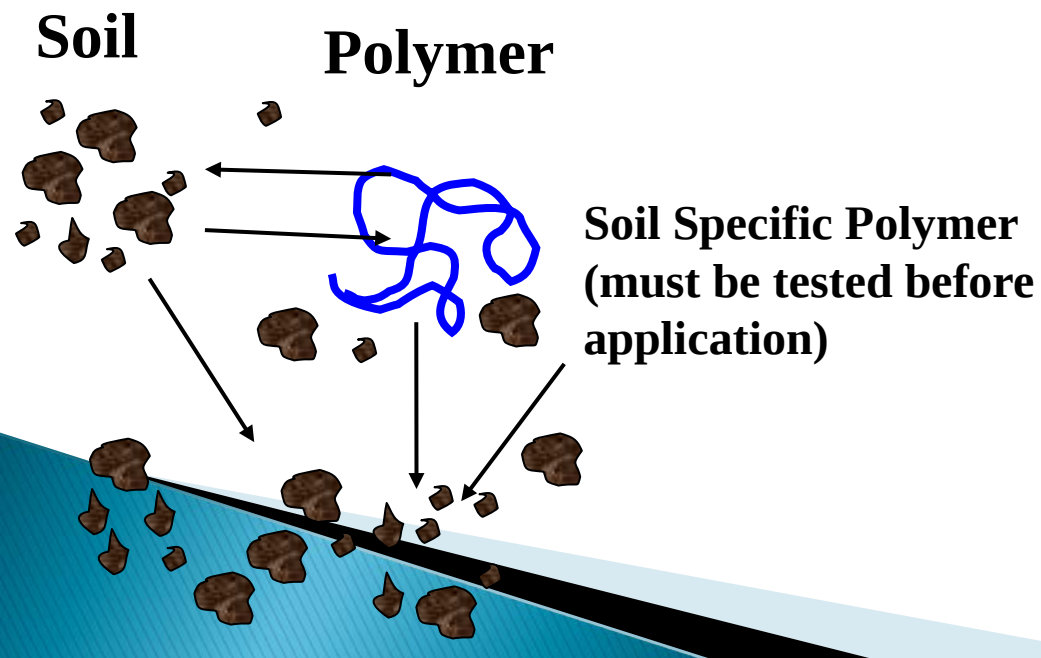


Polymer Enhanced Rock Checks/Wattles

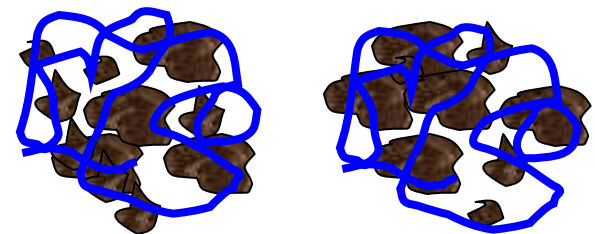


Water Clarification: Mixing and Dewatering Systems



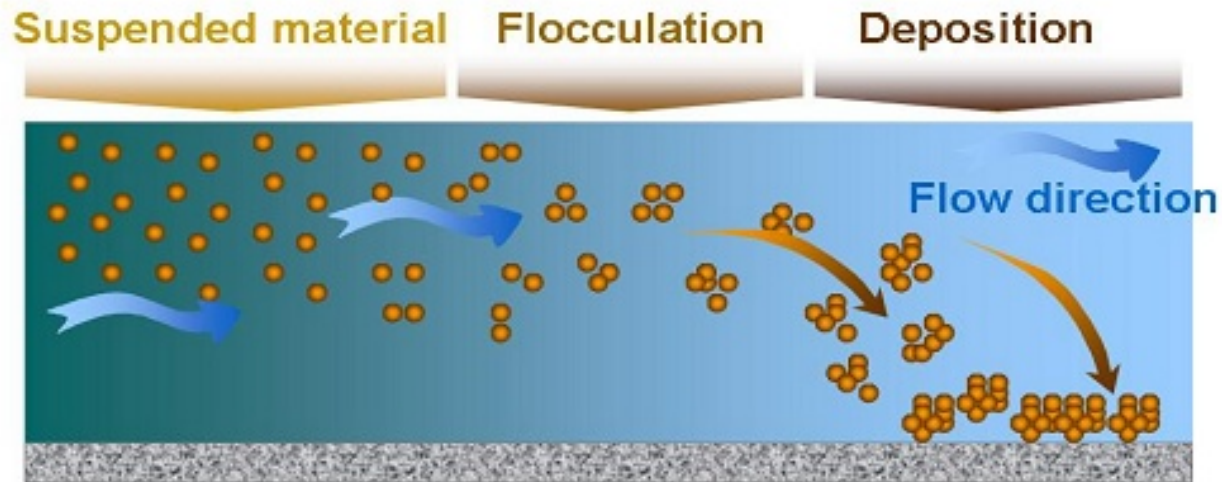


**Polymer + Soil
matrix forms an
agglomeration**



Flocculation is the process where a chemical agent (flocculant) is used to reduce the turbidity of a liquid by binding suspended particles in the liquid together to form larger particles (flocs) that are heavy enough to settle to the bottom of the liquid.....Polymer flocculation provides the basis for a number of best management practices (BMPs) for reducing turbidity and its toxicity.

-www.epa.gov/npdes/stormwater/menuofbmps



Dewatering/treatment ditches using polymer logs



Dewatering/treatment ditches using polymer logs



Dewatering/treatment ditches using polymer logs



Dewatering/treatment ditches using polymer logs



Dewatering/treatment ditches using polymer logs



Dewatering/treatment ditches using polymer logs



Dewatering/treatment ditches using polymer logs



Particle Curtains



Mixing Chambers



Baffle Grids and Mixing Chambers



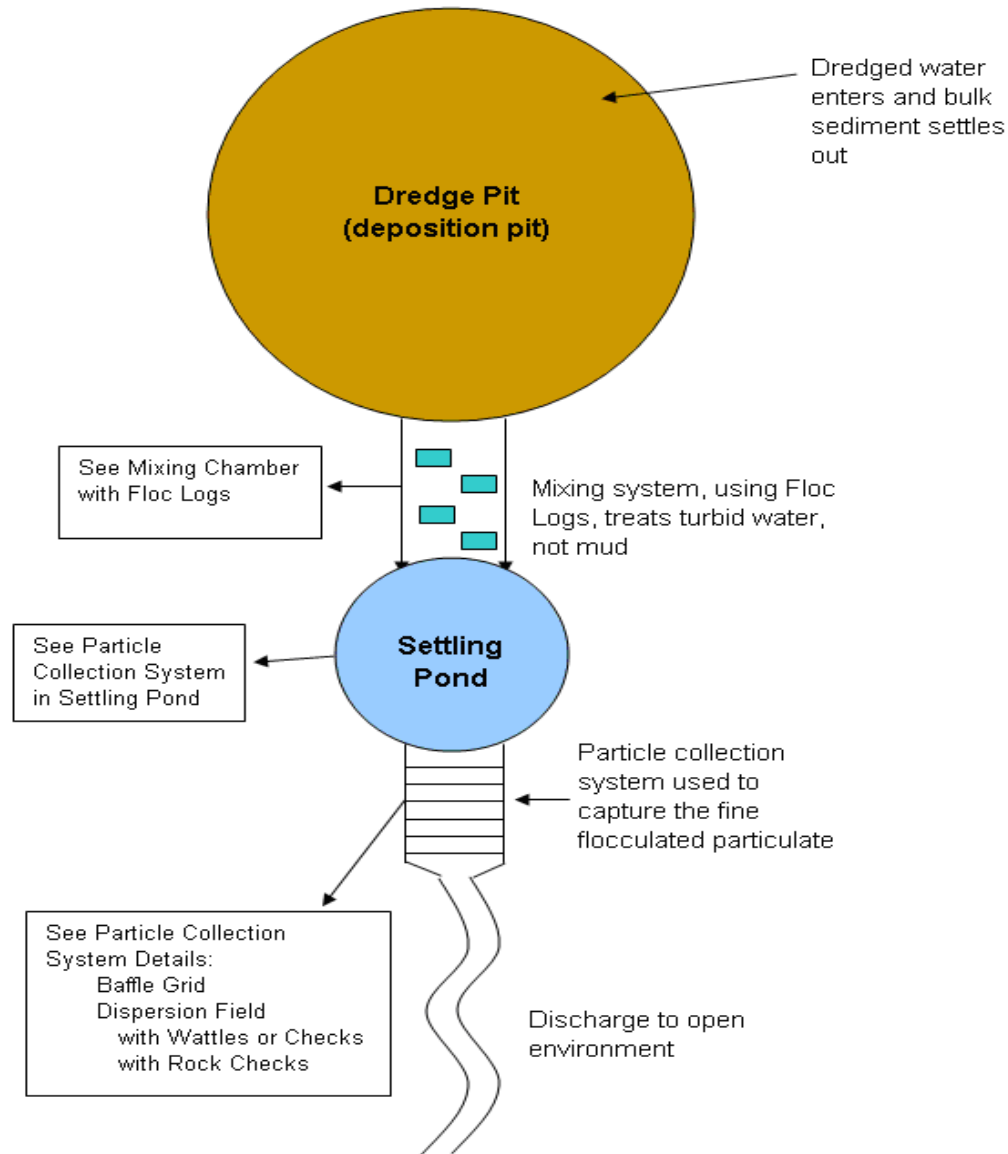
Baffle Grids and Mixing Chambers



SKIMMERS



Dredging



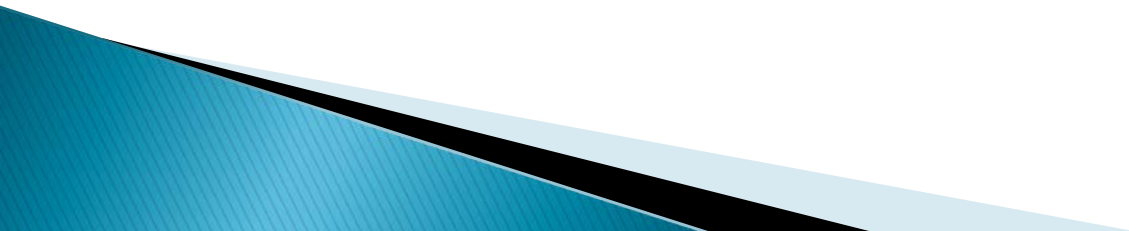
Basic rules for dredging with PAM

- ▶ It is crucial that the bulk sediment is settled out before treatment; leaving only turbid water, not mud.
- ▶ Adequate mixing is imperative. Flocculation begins when water moves over and around the Floc Logs.
- ▶ Provide a settling pond collects the flocculated particulate that settles out of the water leaving clean water for discharge.
- ▶ A particle collection system is very useful for catching the fine floating particulate that might not have settled in the settling pond.

Dredging Treatment Systems

**Kentucky Lake Project
Tennessee Valley Authority (TVA)**

In Henry County, TN



Dewatering/treatment ditches using polymer logs



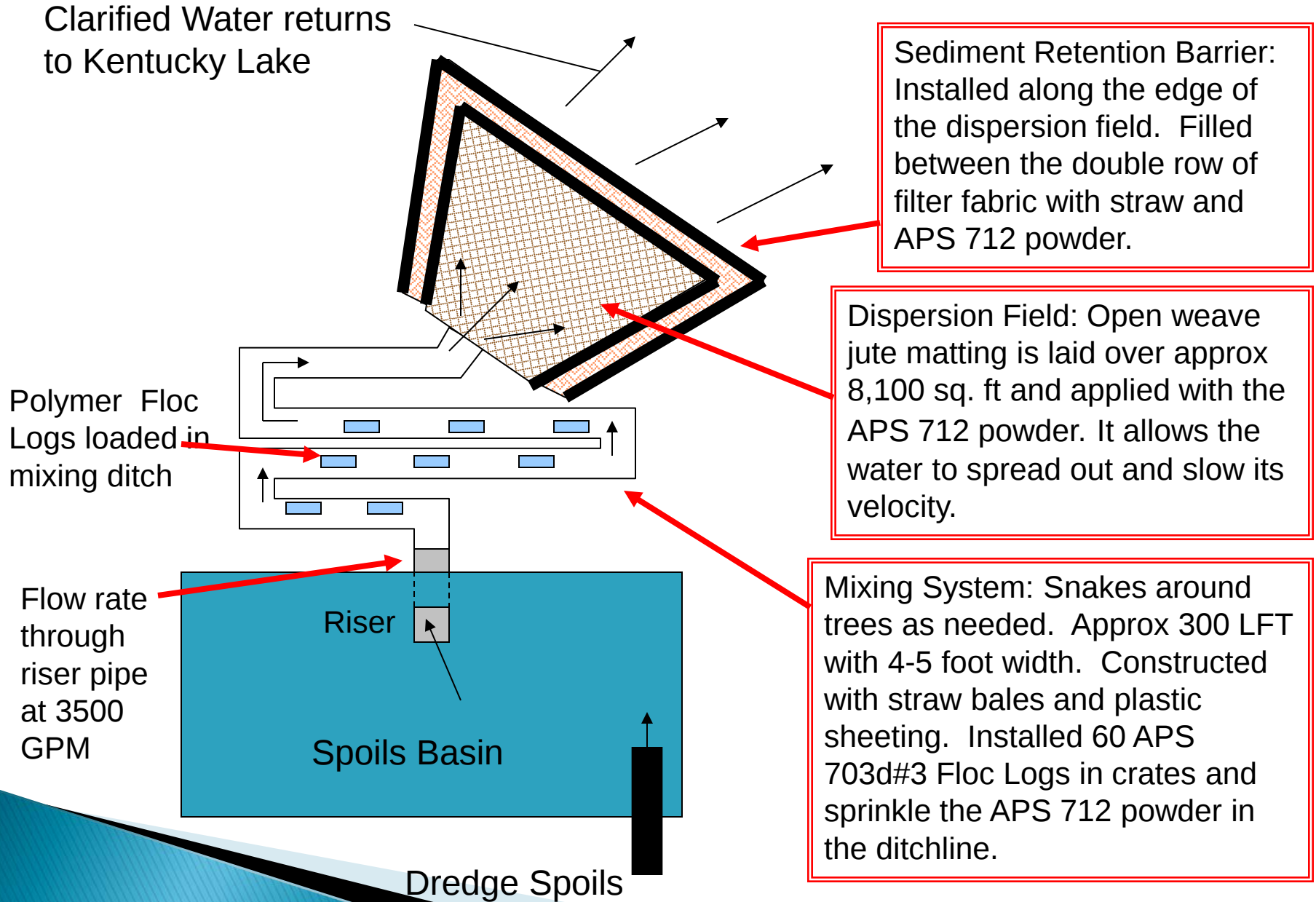
Dredge spoils from Kentucky lake were discharged to a stilling basin.

Dewatering/treatment ditches using polymer logs



The water discharged from the riser into a wooded wetland area (TVA owned) and eventually back to Kentucky Lake. Complaints of deposits of clay fines in the wetlands and concerns about erosion caused the project to be shut down by TDEC.

Kentucky Lake Project, Dewatering Treatment System Diagram



Dewatering/treatment ditches using polymer logs



Dewatering/treatment ditches using polymer logs



Dewatering/treatment ditches using polymer logs



Dewatering/treatment ditches using polymer logs



Dewatering/treatment ditches using polymer logs



Dewatering/treatment ditches using polymer logs



Dewatering/treatment ditches using polymer logs



Dewatering/treatment ditches using polymer logs



Mud/Sediment Removal (dredge spoils/pond cleanout)



Mud/Sediment Removal



Mud/Sediment Removal



Mud/Sediment Removal



Mud/Sediment Removal





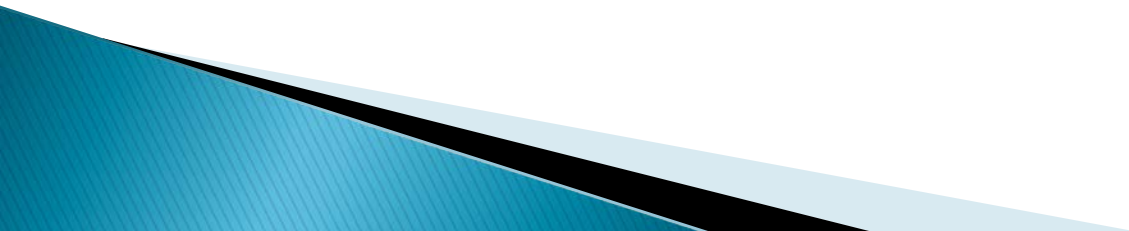
Mud/Sediment Removal



Mud/Sediment Removal



Pond Cleanout utilizing De-mucking techniques



Croft Pond

A pond at the Nashville Zoo that historically had water quality issues due to low flows, leaks and contamination from stormwater runoff from an industrial park.



A total of 7000 tons of sediment had to be removed that was covered by as much as 3 feet of standing water.



Water to the pond was diverted and the standing water on the pond was pumped out of the pond to a detention area and clarified with Floc Logs.



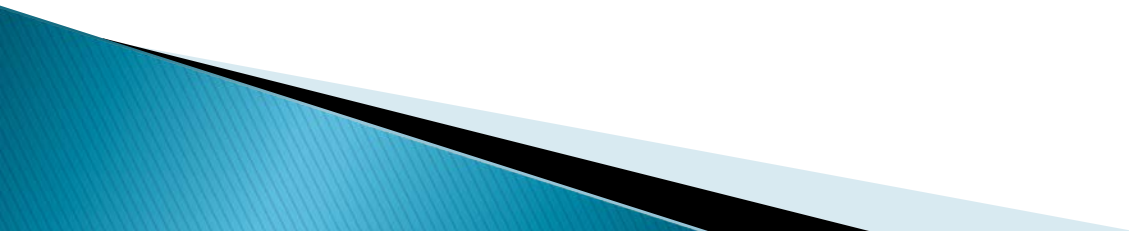
Once the standing water was removed de-mucking began using Silt Stop Powder and heavy machinery to get adequate mixing to thicken the unmanageable muck, making it manageable to scoop out and haul away.





Pond and Lake Management:

Nutrient (phosphorus) Control



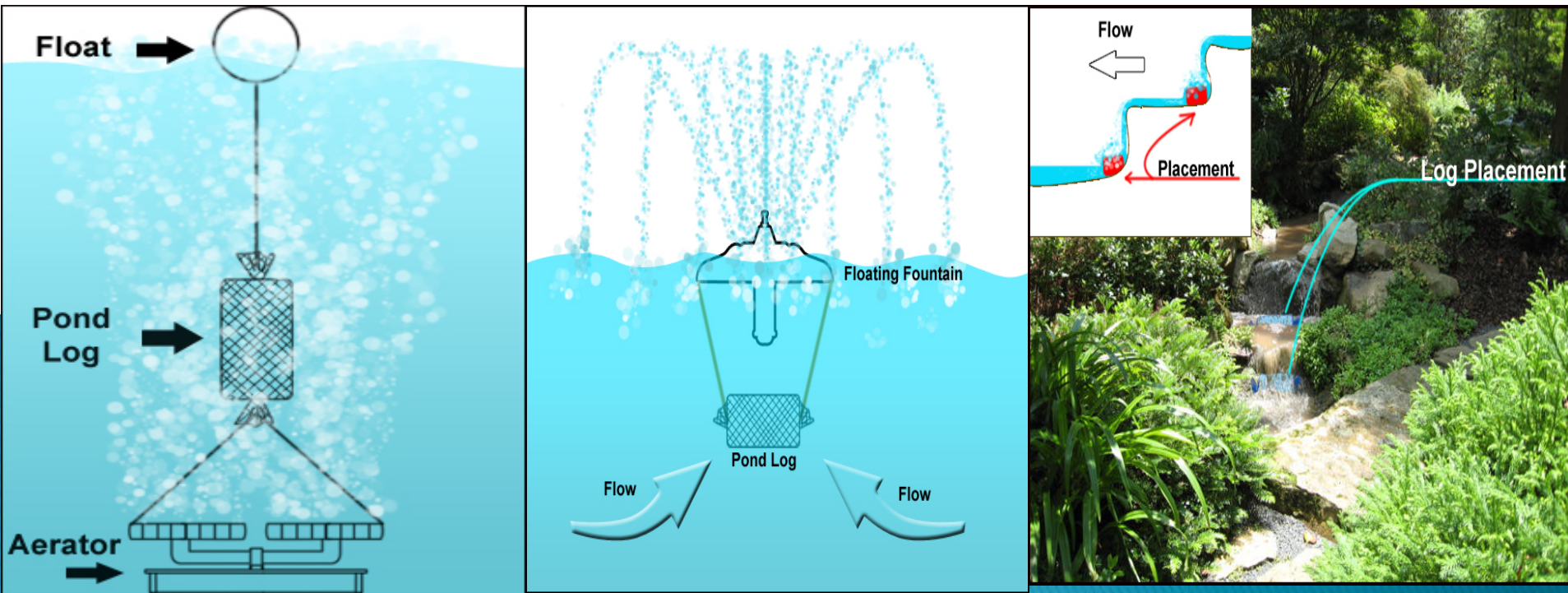
NUTRIENT REDUCTION USING POLYMER ENHANCED TECHNOLOGIES



- Various data from studies and research has shown up to a 75-90 percent reduction in phosphorus and up to a 95 percent reduction in overall turbidity using anionic PAM based technologies.



- Pond Logs need to be used in conjunction with circulation/aerations systems to get mixing, and in turn, reaction.
- As water flows over and around the Pond Log they slowly dissolve and their dissolved components are then circulated throughout the pond/lake.
- Phosphorus is then able to be bound together and removed from the water.



Hiliman Lake DEP Solar Bee Study

- **Reedy Creek Water Management District did a 1,000 day study on Lake Hiliman starting in 2005**
- **A solar powered aerator/ circulator (SolarBee) was used in conjunction with the PAM blend technology**
- **The lake is a 2.4 acre storm water pond circulating 3 million gallons at 347 gpm**
- **Study was monitored and reported by Florida Department of Environmental Protection Agency**



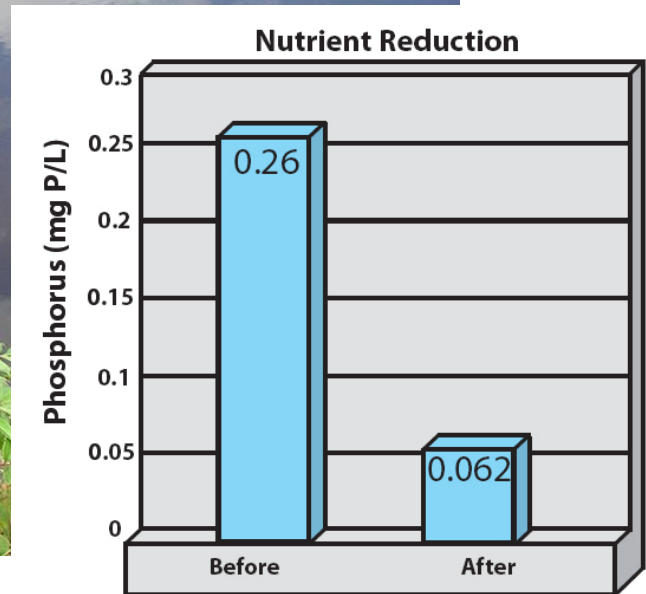
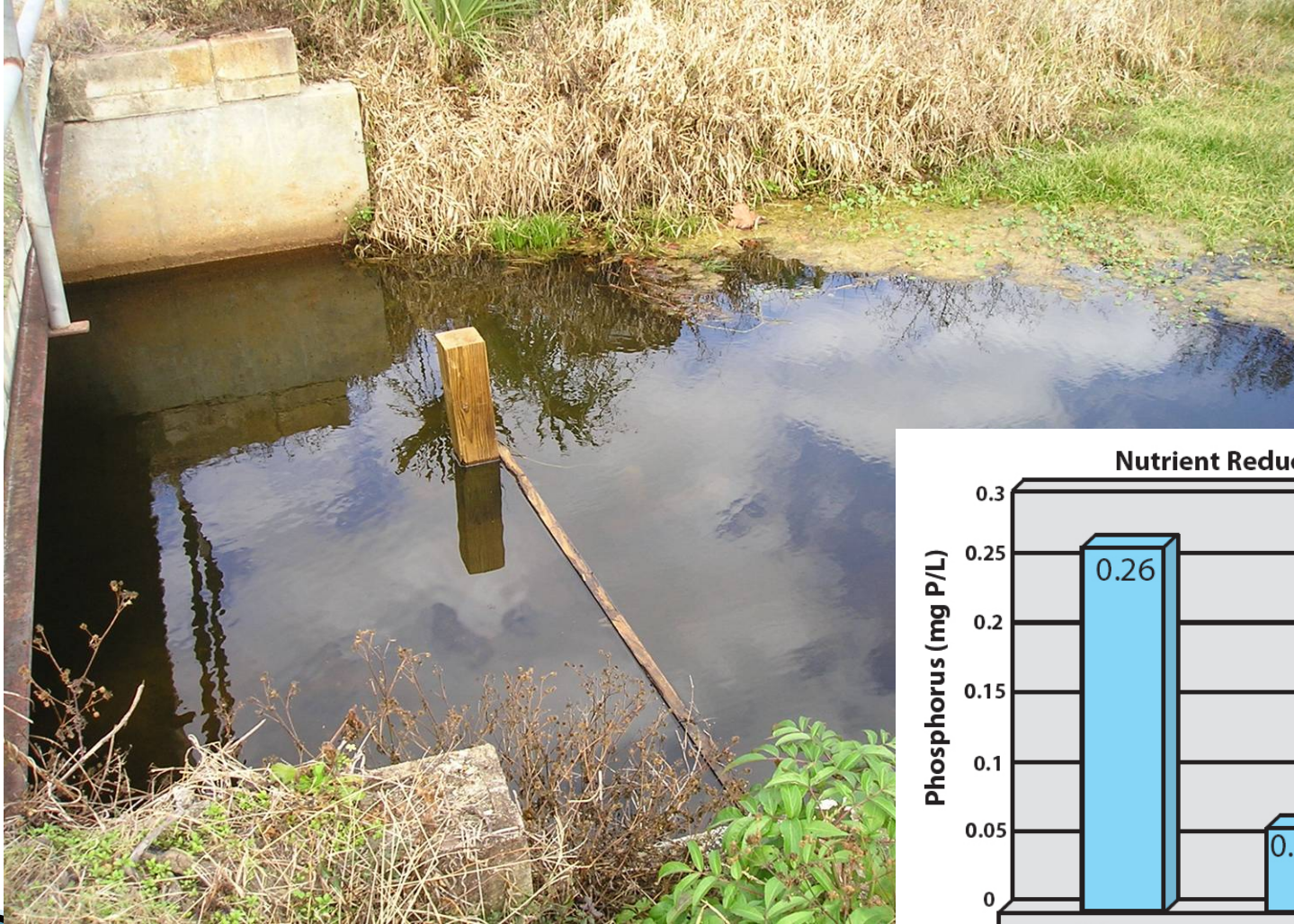
- ▶ Logs tied to a solar powered aerator/circulator
- ▶ Placed in the flow of water to facilitate dissolving, mixing, and reaction
- ▶ Polymer is in a log form and can be added to many types of fountains, aerators, diffusers, or circulators



Before treatment



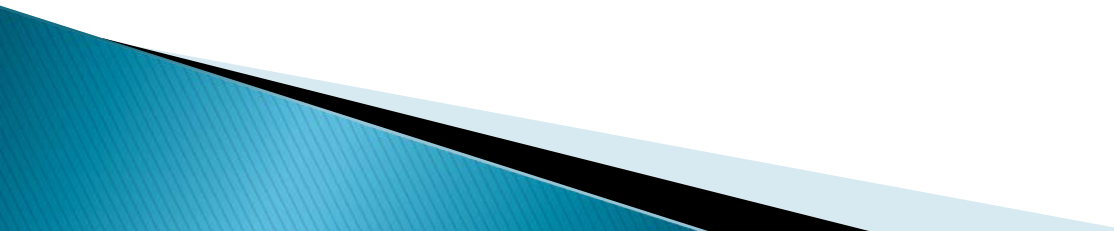
After treatment



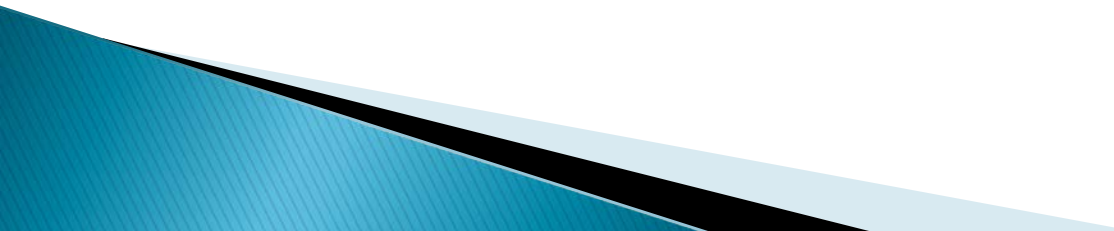
The Anna River Culvert Replacement Project

The Anna River culvert replacement project was done to replace an old metal culvert on Perch Lake Road that was beginning to rust away and potentially collapse and bury the Anna River. Due to Anna River being a live active salmon stream this project was permitted through Michigan Department of Environmental Quality and overseen by Alger Soil and Water Commission.

Environmentally safe anionic water soluble polymers were used on this project to ensure no sedimentation or turbid water escaped into the river during construction.



The Anna River Replacement Project outlines key points in correctly using Polymer Enhanced Best Management Applications:

- Absence of toxicity to aquatic organisms (In this case spawning salmon)
 - Polymers performance tested to ensure optimal results
 - Polymer Enhanced Best Management Practices (BMP's) used in a treatment train to achieve optimal results (not BMP's alone or polymer alone)
- 

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



A diversionary wall was built to isolate the stream and divert it to the other side while the culvert was torn out.



Particle curtains were placed down stream from the logs to capture flocculated particulate.

















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



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.

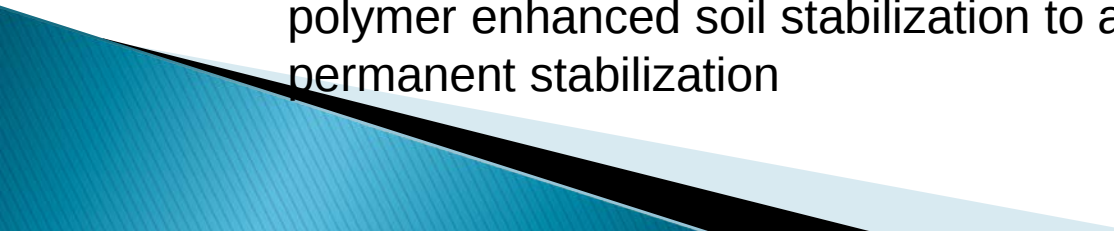




One year after installation



CONCLUSION

- No erosion or sediment loss occurred from start to finish of the culvert replacement
 - Absence of toxicity to aquatic organisms
 - No impact or affects to spawning habitats and egg deposition
 - Salmon were able to go through their normal life cycles due to the absence of disruption during construction activities
 - By using polymer enhanced BMP's in a treatment train optimal results were achieved
 - Vegetation was successfully established through polymer enhanced soil stabilization to achieve permanent stabilization
- 

QUESTIONS?



Polymer References

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

www.stormwater.ucf.edu

http://sustainabletechnologies.ca/wp/wp-content/uploads/2013/02/Polymer-Guide-Final_NewFormat.pdf

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

www.epa.gov/npdes/stormwater/menuofbmps

www.siltstop.com

**Go to: Polymer Enhanced BMP Application
Guide**

