

# The Future of Environmental Recovery is Dependent on a Paradigm Shift that Embraces the Past

STAC Stream Restoration Workshop  
March 23, 2023



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“Memory shapes our future” – Ben Hayes

# Ecological amnesia

“The idea that each generation perceives the environment into which it's born, no matter how developed, urbanized or polluted, as the norm. And so what each generation comes to think of as 'nature' is relative, based on what it's exposed to.” – Peter Kahn



# “Anecdotes and the shifting baseline syndrome of fisheries” – Daniel Pauly (1995)

“Essentially, this syndrome was arisen because each generation of fisheries scientists accepts as a baseline the stock size and species composition that occurred at the beginning of their careers, and uses this to evaluate changes. When the next generation starts its career, the stocks have further declined, but it is the stocks at that time that serve as a new baseline. The result obviously is a gradual shift of the baseline, a gradual accommodation of the creeping disappearance of resource species...

[Unlike sciences like astronomy and oceanography] fisheries science does not have formal approaches for dealing with early accounts of ‘large catches’ of presently extirpated resources, which are viewed as anecdotes.”

# “Anecdotes and the shifting baseline syndrome of fisheries” – D. Pauly (1995) (cont.)

“Developing frameworks for incorporation of earlier knowledge—which is what the anecdotes are—into the present models of fisheries scientists would not only have the effect of adding history to a discipline that has suffered from lack of historical reflection, but also of bringing into biodiversity debates an extremely speciose group of vertebrates: the fishes, whose ecology and evolution are as strongly impacted by human activities as the denizens of the tropical and other rain forests that presently occupy center stage in such debates.”

*Dr. Pauly is a fisheries biology professor at the University of British Columbia*



# The Practice Paradigm Begins to Shift (2000)



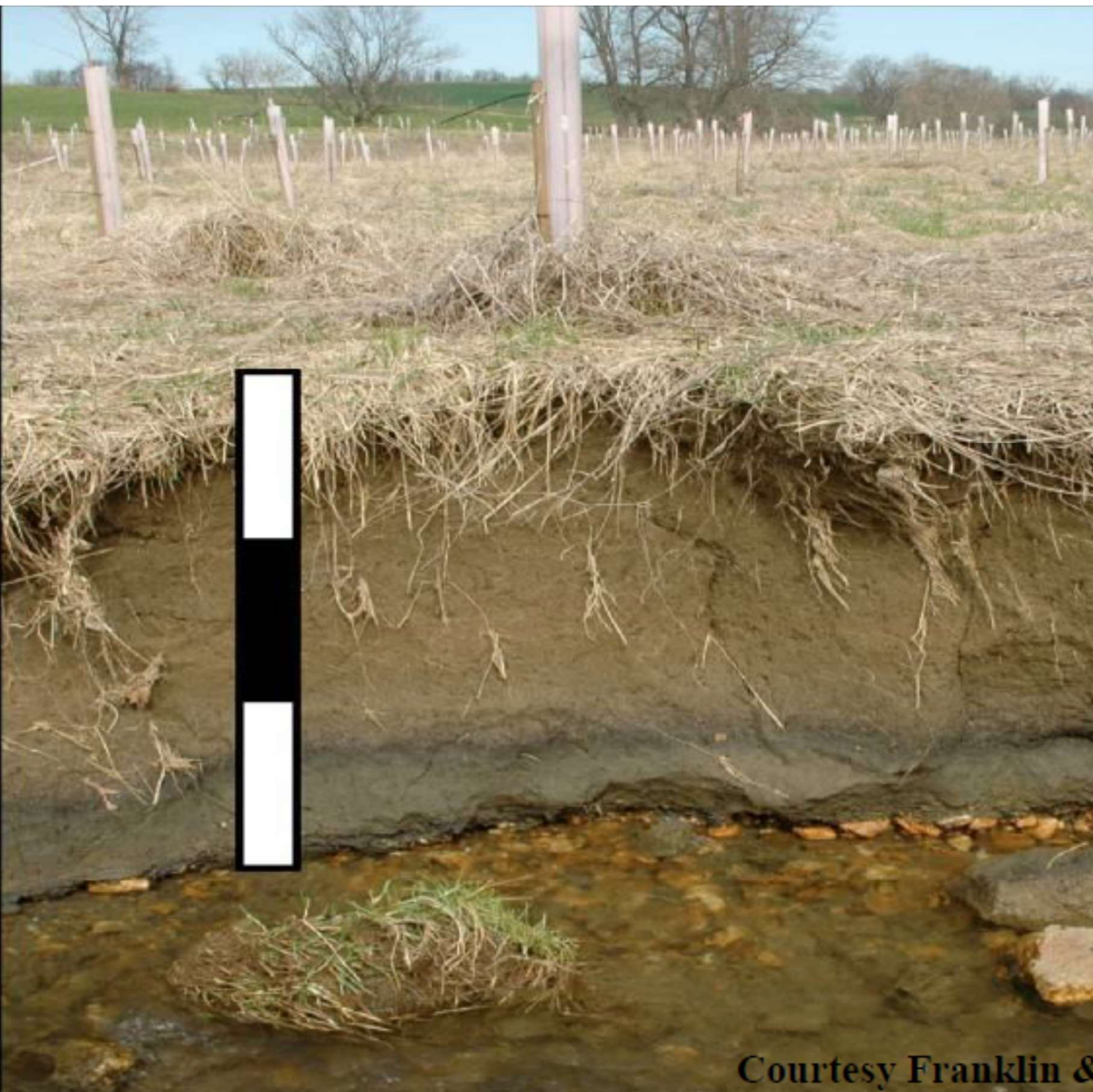
Howard's Branch (constructed 2001)



Wilelinor (constructed 2005)





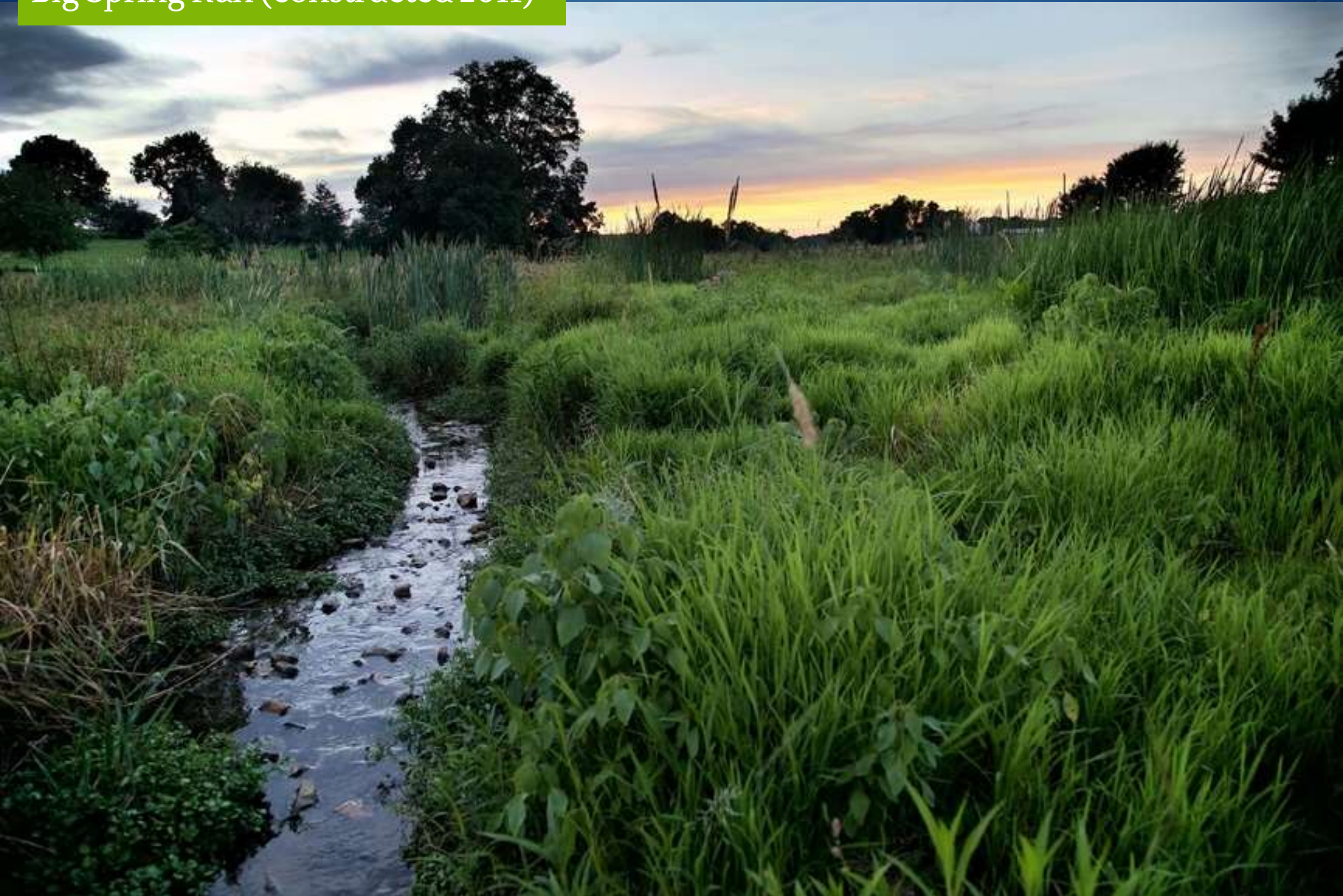


Courtesy Franklin & Marshall College

Only those restoration projects that converted lowland streams to stream-wetland complexes seemed to be effective at reducing nitrogen fluxes. Restoration design should include features that enhance the processing and retention of different forms of nitrogen (Filoso & Palmer, 2011).



## Big Spring Run (constructed 2011)

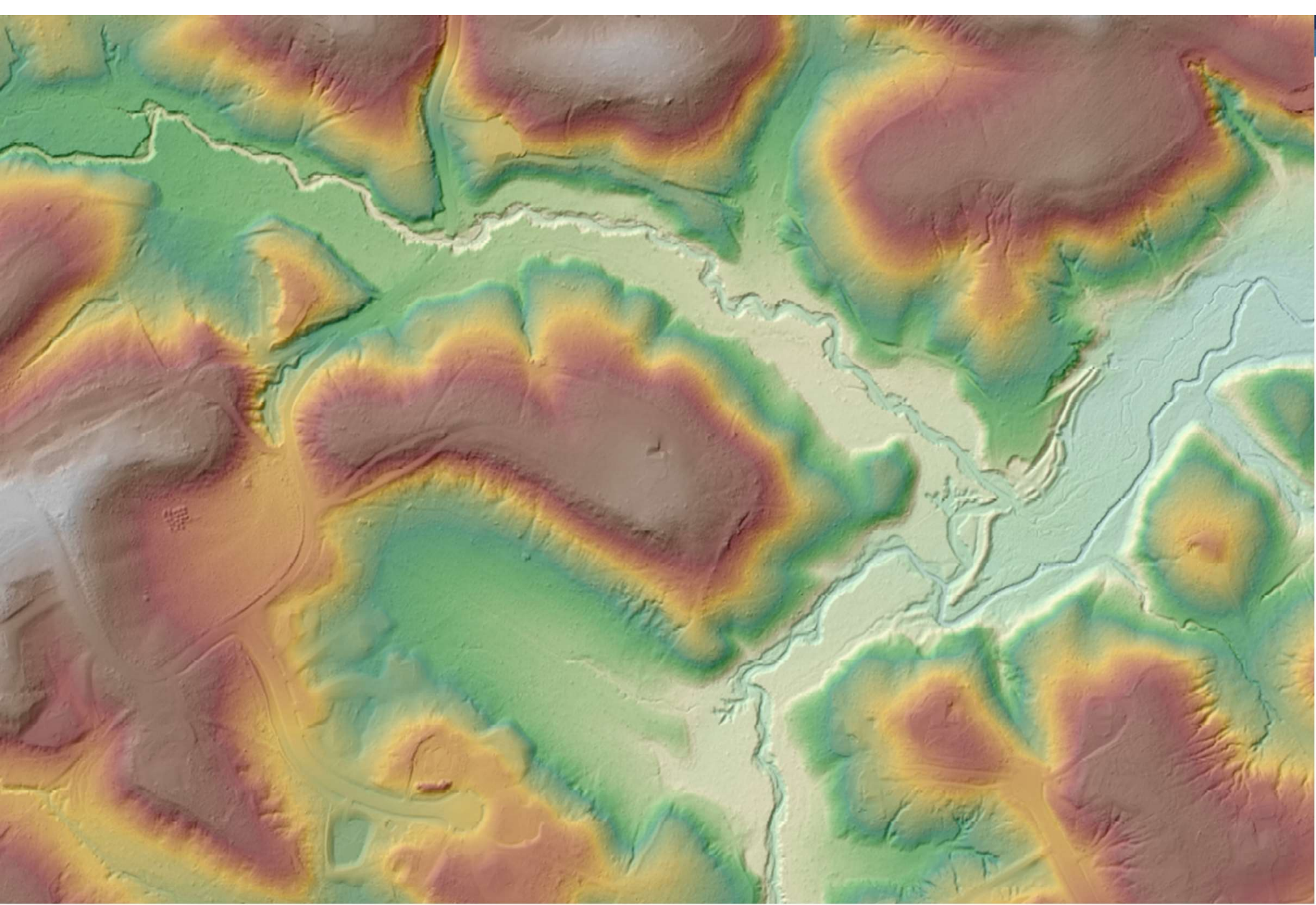


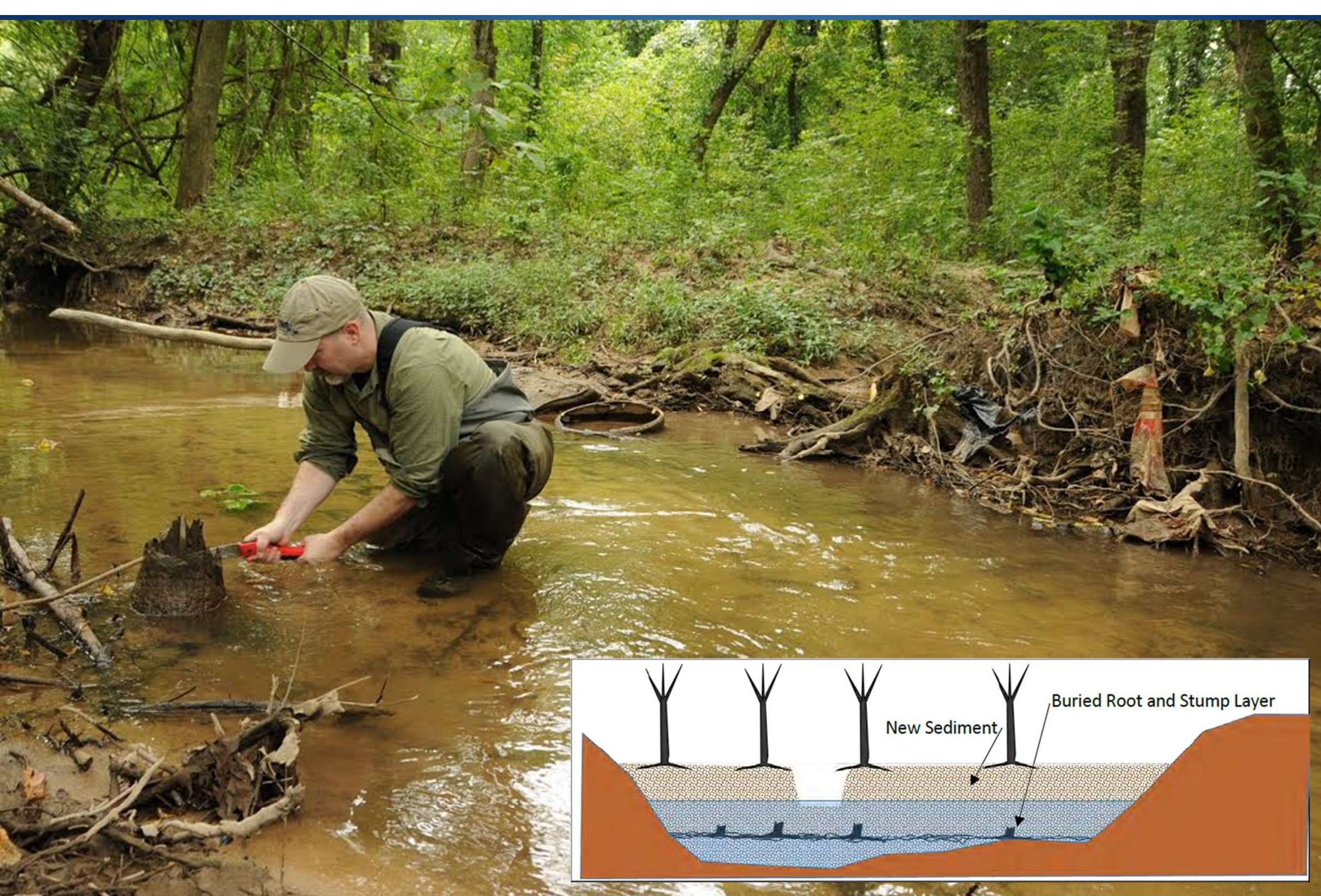
# Legacy Sediment, Riparian Corridors, and Total Maximum Daily Loads

April 24, 2017 @ 9:30 am - April 25, 2017 @ 3:30 pm



This STAC workshop will be structured around panel discussions on each of three themes: legacy sediment, riparian corridors, and total maximum daily loads, with three-four experts on the panel who will be asked to address specific questions and cite key evidence. These will be followed by



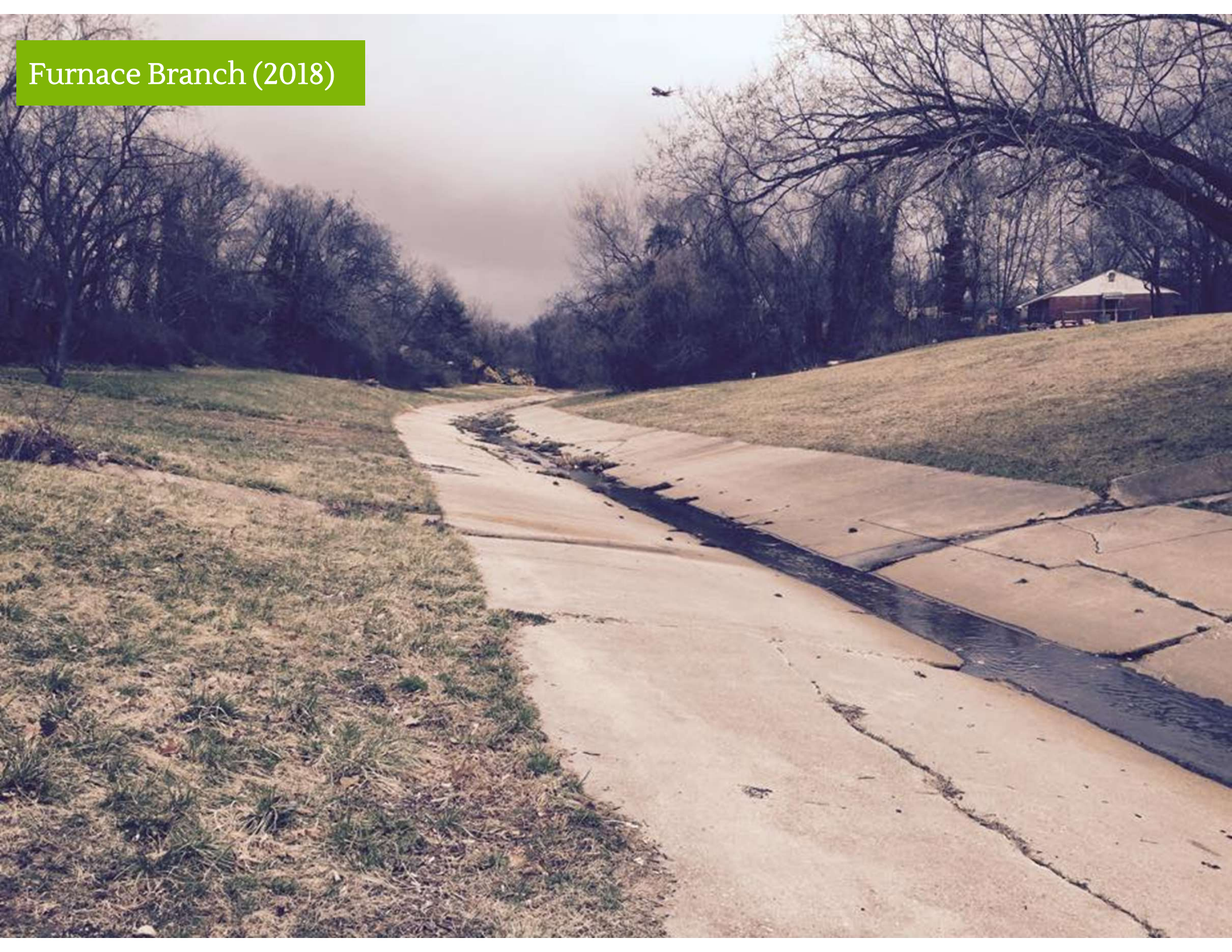


Patapsco River tributary

## USGS sampling Bacon Ridge (Initiated in 2018)

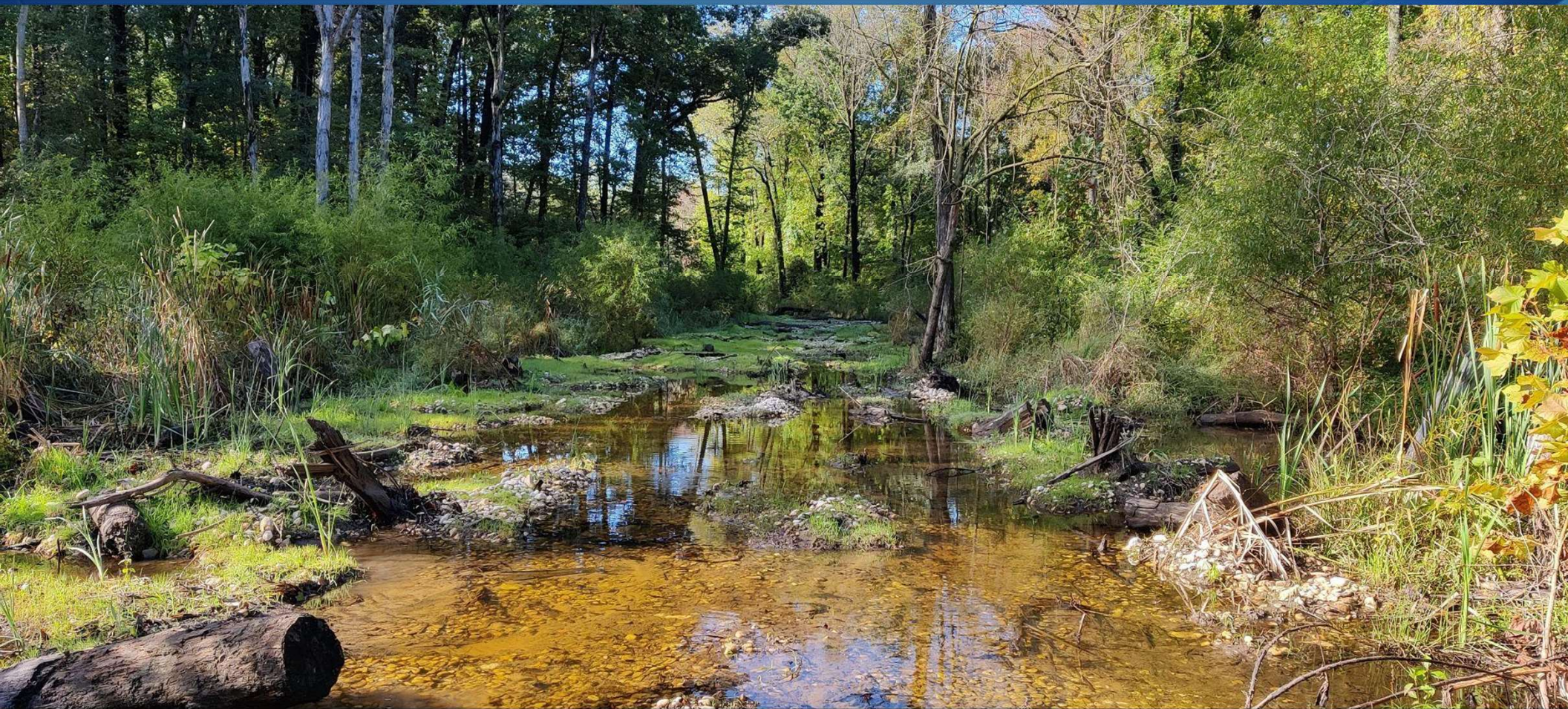


Furnace Branch (2018)





Furnace Branch (2022)



# Furnace Creek Post-Restoration Sampling

Species observed:

American Eel

Creek Chubsucker

Mummichog

Banded Killifish

Pumpkinseed

White Sucker

FIBI = 3.00 (Fair)



## Towser's Branch (2020)



Towser's Branch (2021)



# Meanwhile, a Convergent Evolution of Approaches that Function Similarly Occurs

- Regenerative Stream Conveyance (RSC)
- Legacy sediment removal
- Valley restoration
- Beaver dam analogs
- Stage Zero restoration



Regenerative  
Stream  
Conveyance (RSC)



Legacy Sediment Removal – PA/KY

# Valley restoration







Beaver Dam Analogs - Colorado



Stage Zero Restoration - Oregon

# Study Summary

- Geomorphically “stable” precolonial conditions
  - Characterized by peaty sediments
  - Little evidence of large erosion, despite fire/Native American agriculture
  - Precolonial sediment dates cover centuries/millennia; Colonial cover decades
- Massive amounts of legacy sediment present in floodplains but hidden from sight beneath floodplain and channel
  - Up to 11 feet beneath floodplain, buried multiple feet beneath streambed.
  - Distinguishable by color, enriched in mined metals

Sites exhibited altered plant communities following colonization

- Precolonial: Wooded scrub/shrub/forested swamp of Alder, Oak, Hickory, Fern
- Postcolonial: Canopy losses, reduced hardwoods, increased herbs, cattail, grasses, upland pine



Contents lists available at ScienceDirect

Journal of Hydrology

journal homepage: [www.elsevier.com/locate/jhydrol](http://www.elsevier.com/locate/jhydrol)

## Research papers

## Changes in hydrology and pollutant loads from stream restoration in an urban headwater catchment

Michael R. Williams<sup>a,\*</sup>, Solange Filoso<sup>b</sup>

Compared to the control catchment, RSCs in Washington, DC:

- Increased baseflow by 6% (compared to a 6% loss of baseflow in the control).
- Reduced nitrogen.
- Reduced phosphorus
- Reduced sediment

“Results of study provide evidence that RSCs decrease pollutant loads and improve natural hydrological functions. Thus, RSCs as a stream restoration design have the potential to be used as an effective best management practice (BMP) to improve water quality and help attain TMDL goals for Chesapeake Bay.”

But What About Climate  
Change, Urbanization, and  
Changing Boundary  
Conditions?

# WATERSHED EFFECTS ON SUCCESS OF STREAM RESTORATION FOR EXCESS NITROGEN MITIGATION

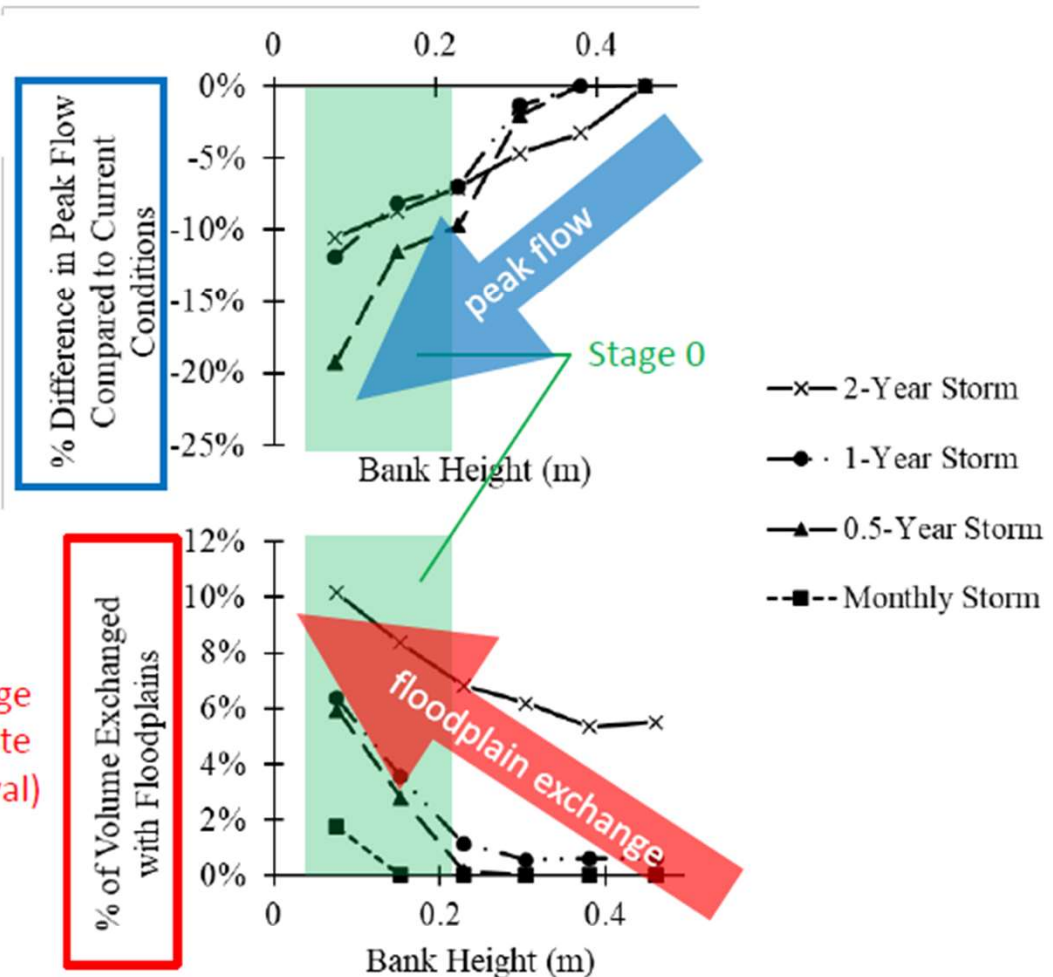
## Task 3: Project effectiveness varies with restoration technique

Stage 0 (low banks) more effective than high banks (bankfull floodplain)

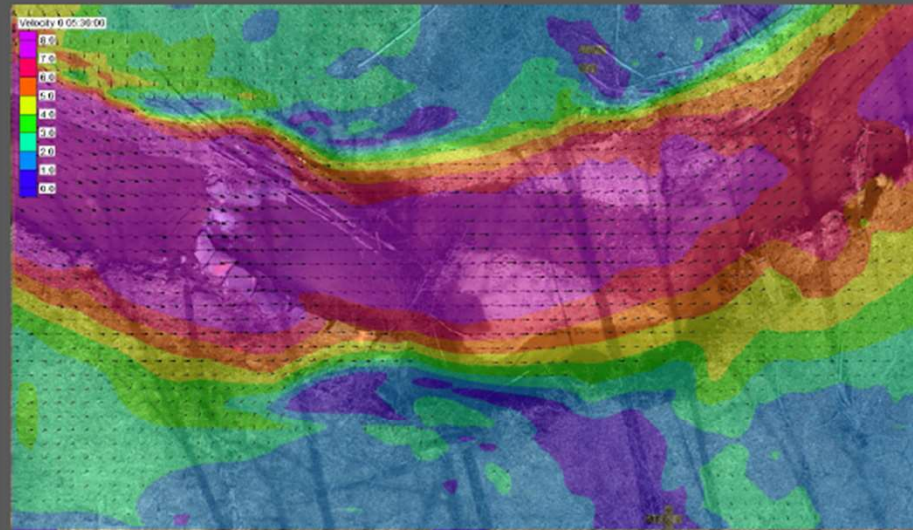
No tradeoff among restoration benefits; lower banks enhances both flood attenuation and floodplain exchange (water quality)

flood wave attenuation

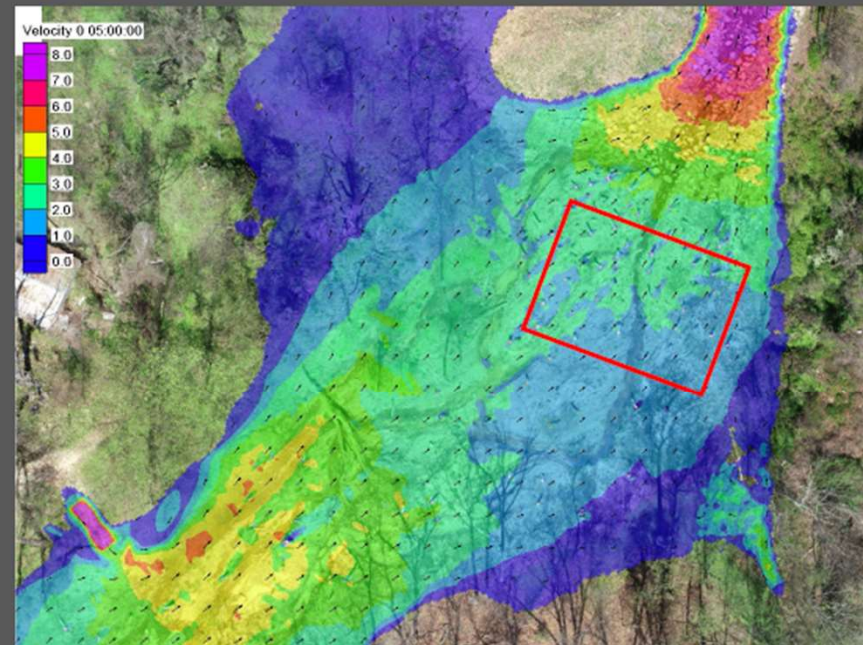
floodplain exchange (relates to nitrate removal)



- Across the 5 sites, 2D model predicted velocities show general agreement with the observed velocity conditions during floods



- Across the 5 sites, model low and high velocity regions correspond to undamaged and damaged areas in the classification data



“Philosophers of science have repeatedly demonstrated that more than one theoretical construction can always be placed upon a given collection of data. History of science indicates that, particularly in the early developmental stages of a new paradigm, it is not even very difficult to invent such alternates. But that invention of alternates is just what scientists seldom undertake except during the pre-paradigm stage of their science's development and at very special occasions during its subsequent evolution. So long as the tools a paradigm supplies continue to prove capable of solving the problems it defines, science moves fastest and penetrates most deeply through confident employment of those tools. The reason is clear. As in manufacture so in science - retooling is an extravagance to be reserved for the occasion that demands it. The significance of crises is the indication they provide that an occasion for retooling has arrived.” - *Thomas S. Kuhn in The Structure of Scientific Revolutions*



# Questions?

Erik Michelsen  
Senior Environmental Policy Officer &  
Deputy Director, Anne Arundel County Public Works  
Bureau of Watershed Protection & Restoration  
[pwmich20@aacounty.org](mailto:pwmich20@aacounty.org)

[aarivers.org](http://aarivers.org)

There are no solutions, there  
are only trade offs; you try to  
get the best trade off you  
can get, that's all you can  
hope for - *Thomas Sowell,*  
*economist*







# Conceptual Model of Beaver Ponds

