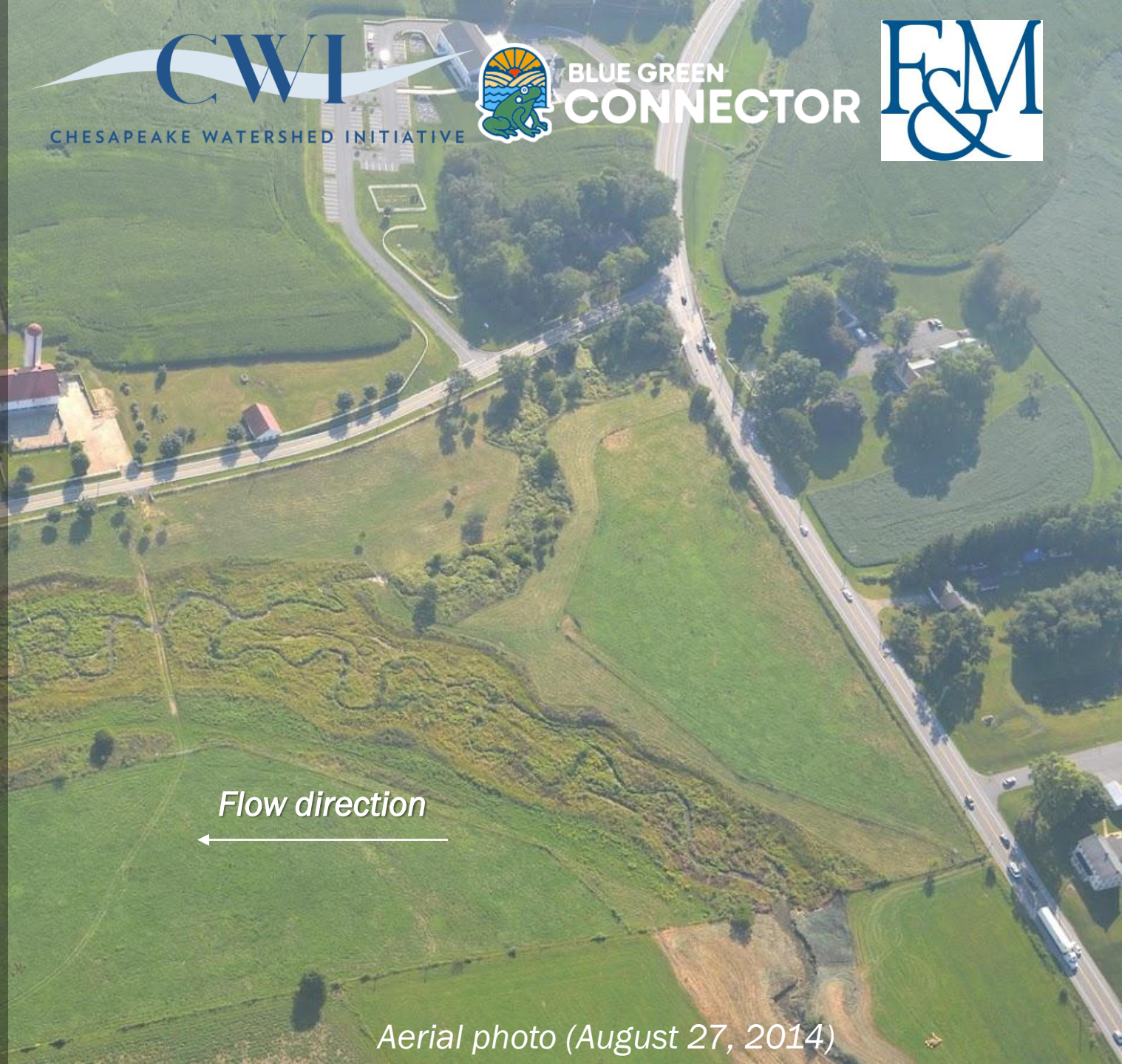
Big Spring Run Continuing Research & Other Regional Findings

Joe Galella, Julia Carr, & Shuyu Chang

incl. Dorothy Merritts, Bob Walter, Mike Rahnis, the Chesapeake Watershed Initiative & many, many others

Franklin and Marshall College



Aerial photo (August 27, 2014)

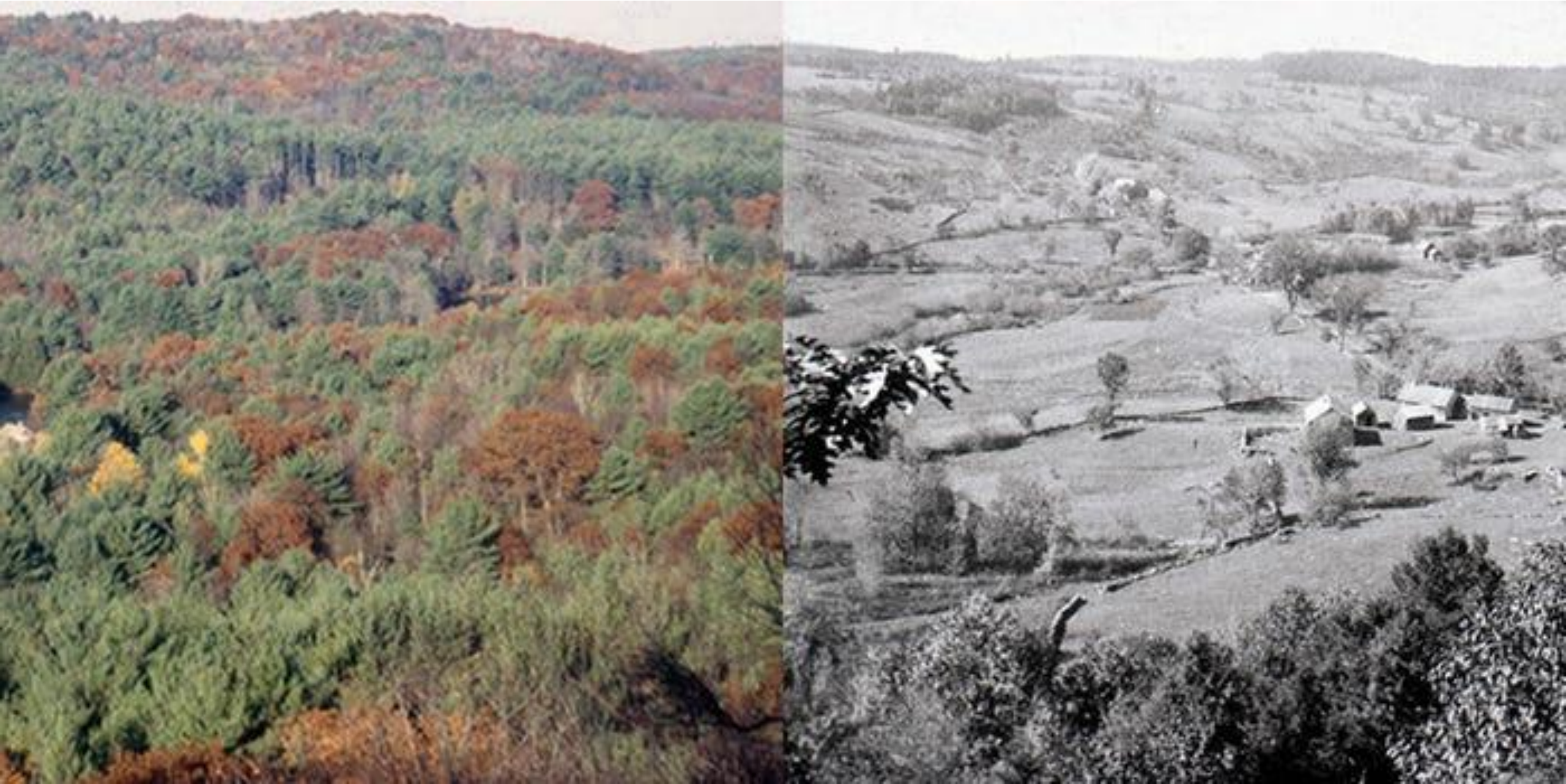
Current Restoration Projects…

The Blue Green Corridor on Little Conestoga Creek

CWI
CHESAPEAKE WATERSHED INITIATIVE

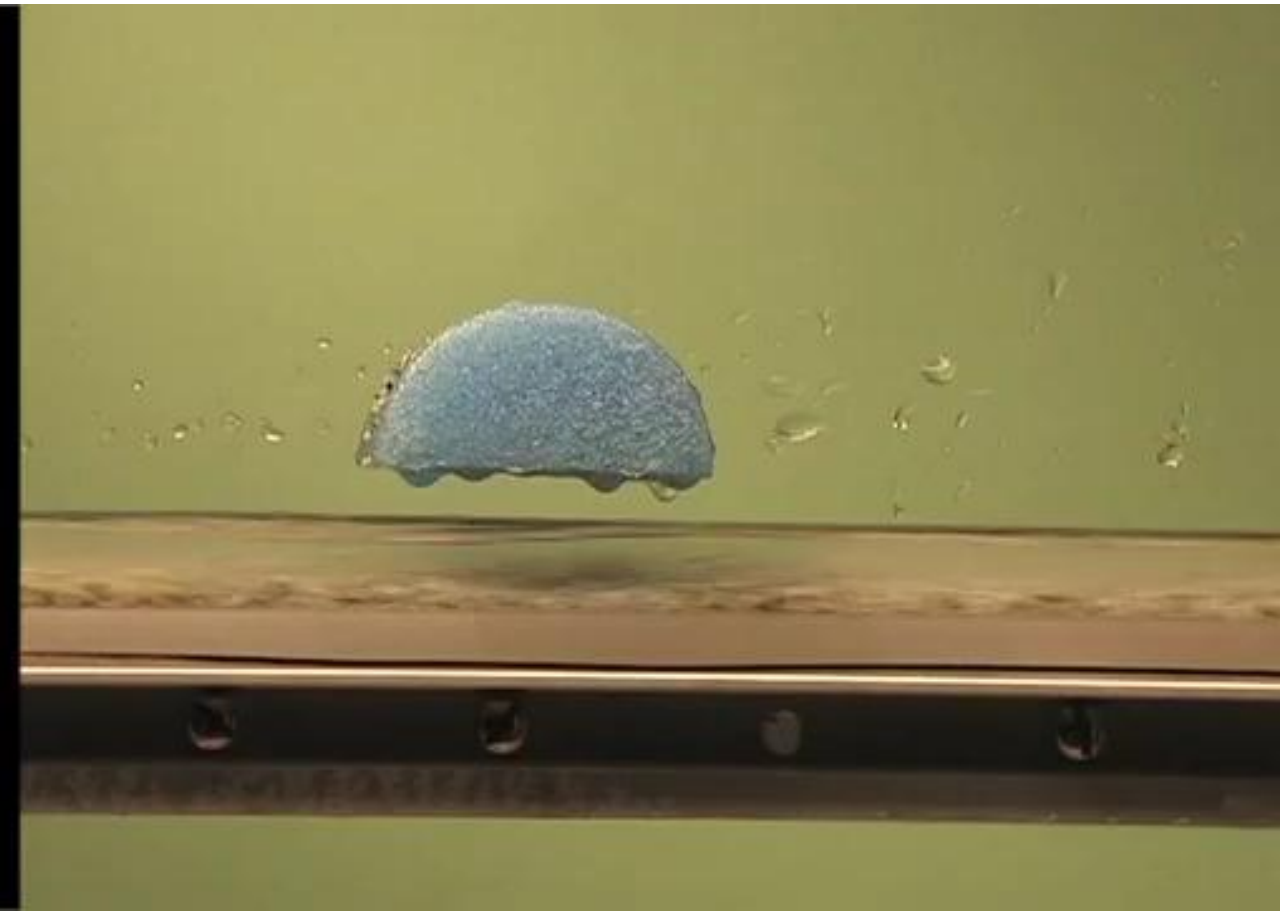
F&M

The Mid-Atlantic's Colonial Legacy

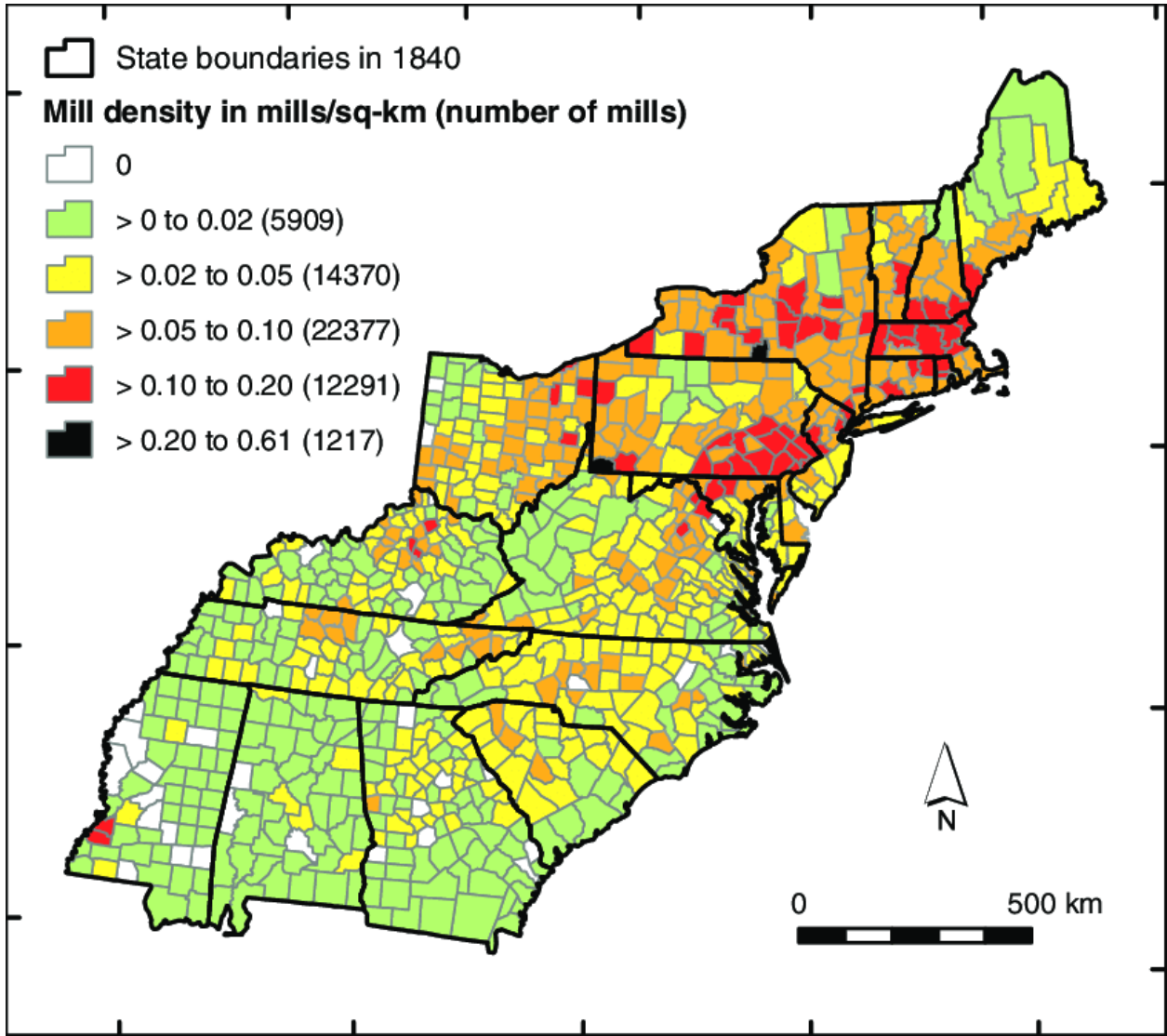


The Mid-Atlantic's Colonial Legacy

Emriver Inc



Walter and Merritts, 2008




Land
Studies

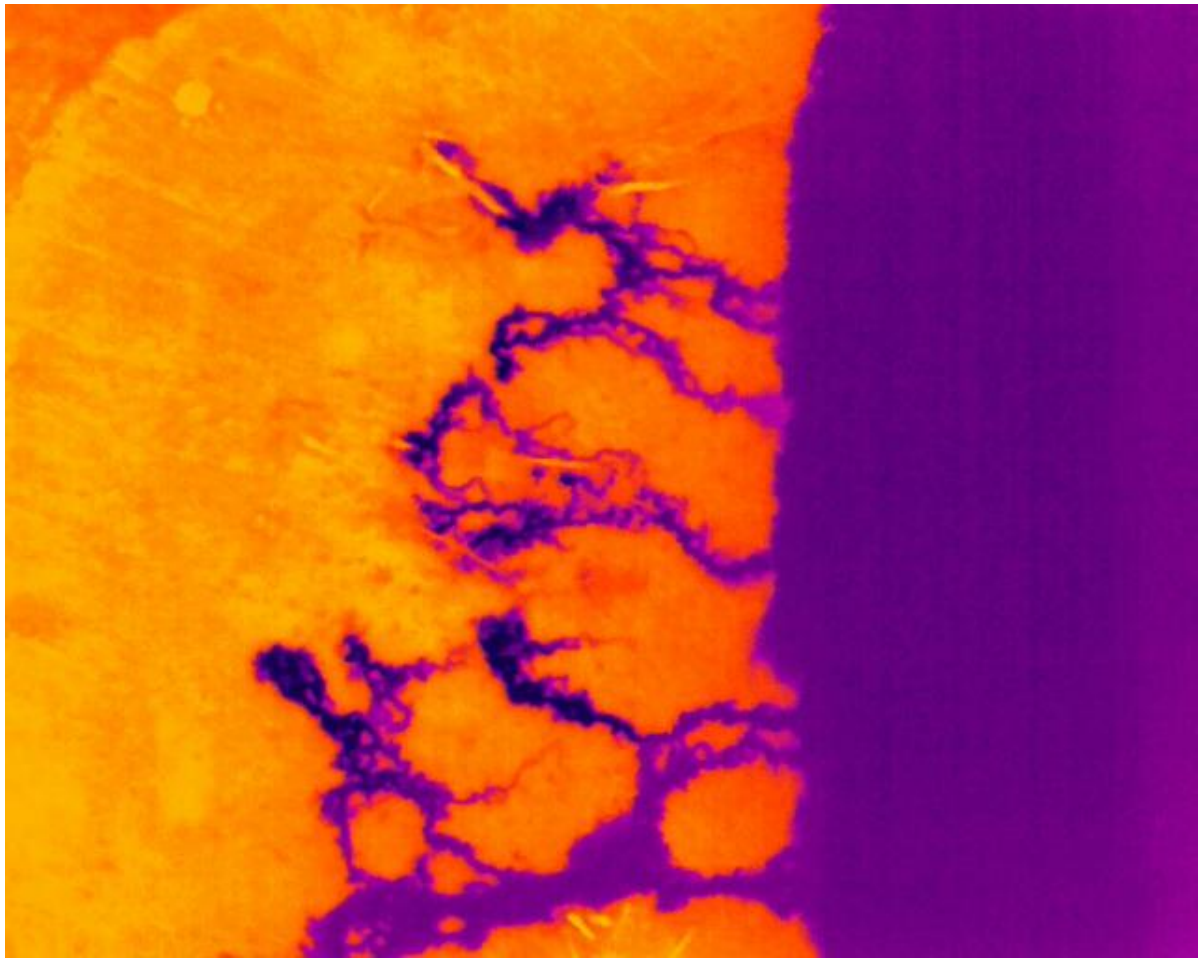

Land
Studies

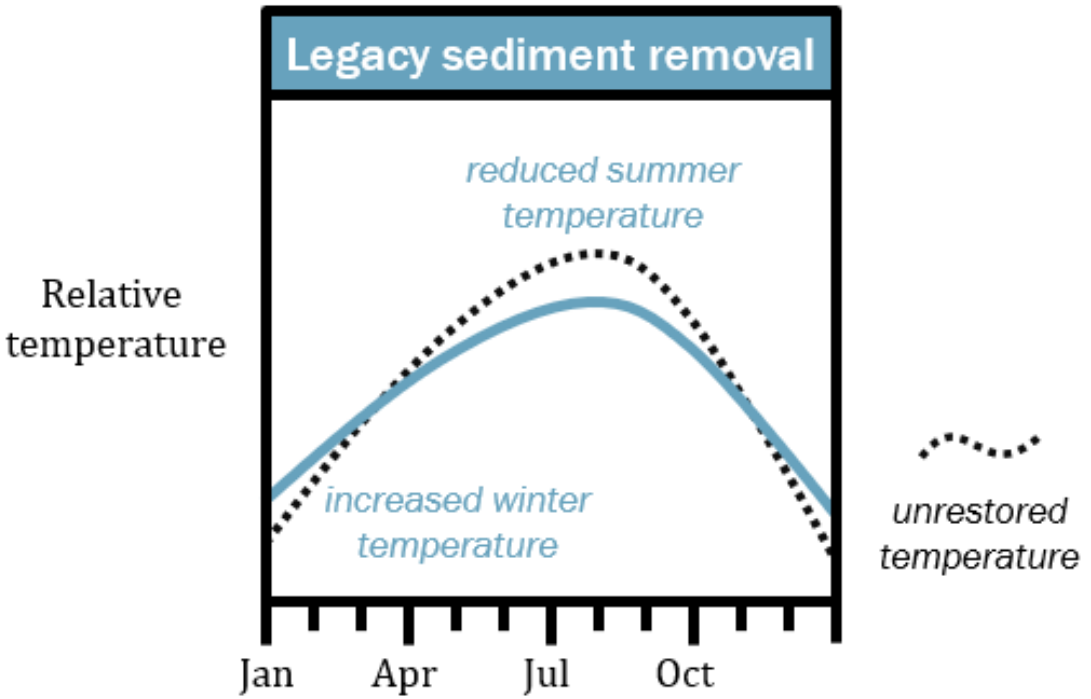
Goals of Legacy Sediment Restoration

- Floodplain reconnection
  - Exhumation of distinct wet meadow floodplain habitat buried for ~300 years

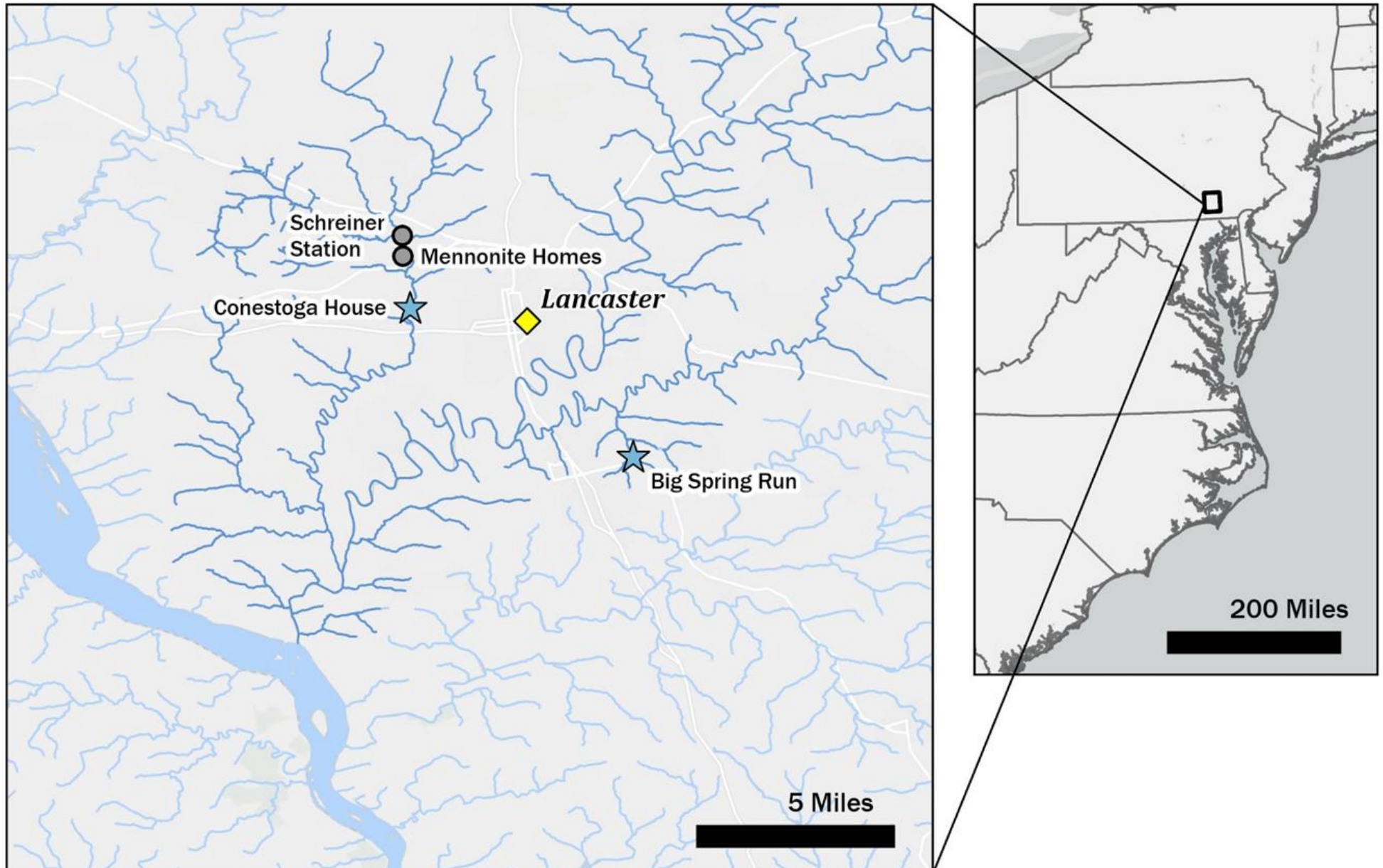
Goals of Legacy Sediment Restoration

- Thermal regulation from exposed groundwater seeps / springs

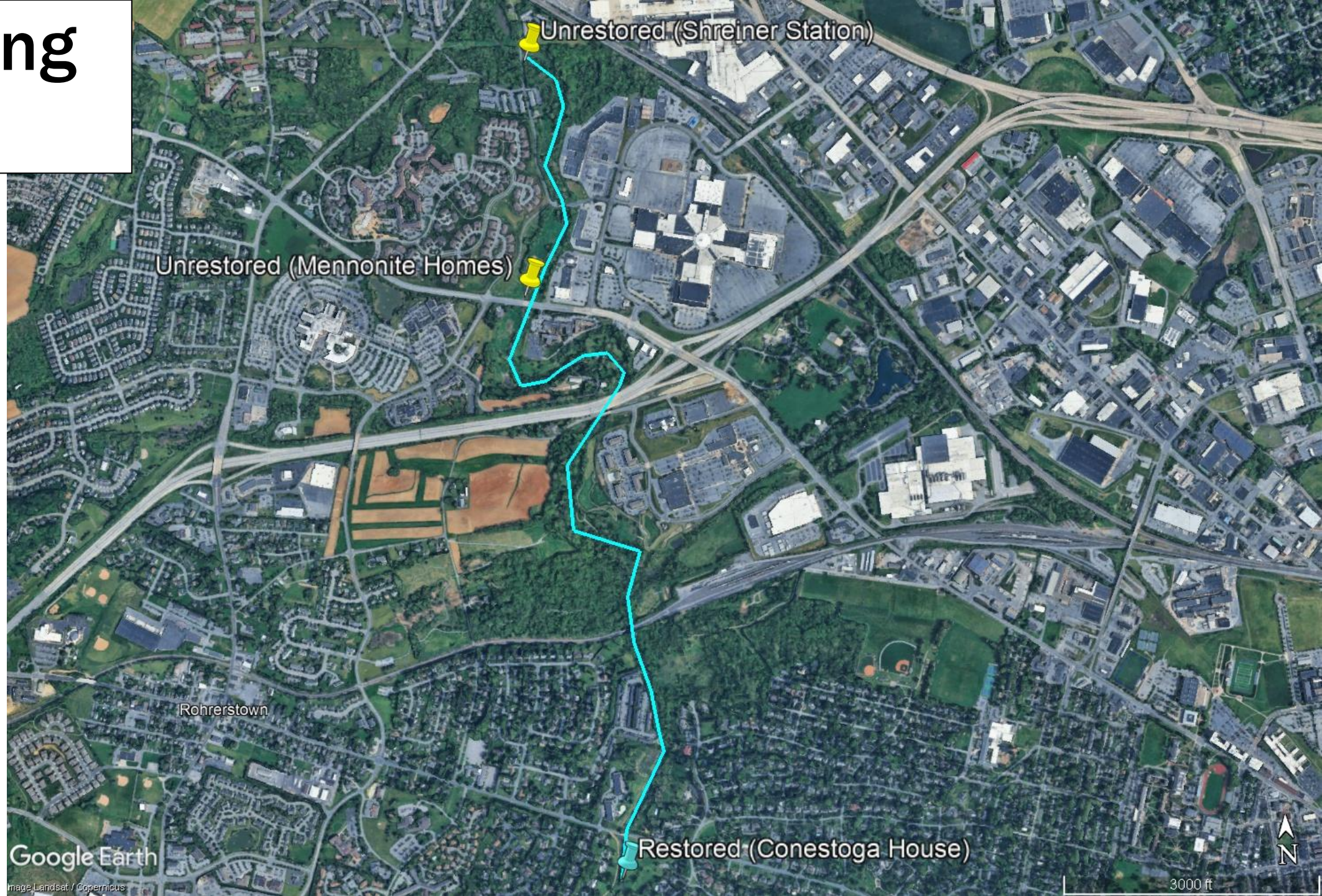




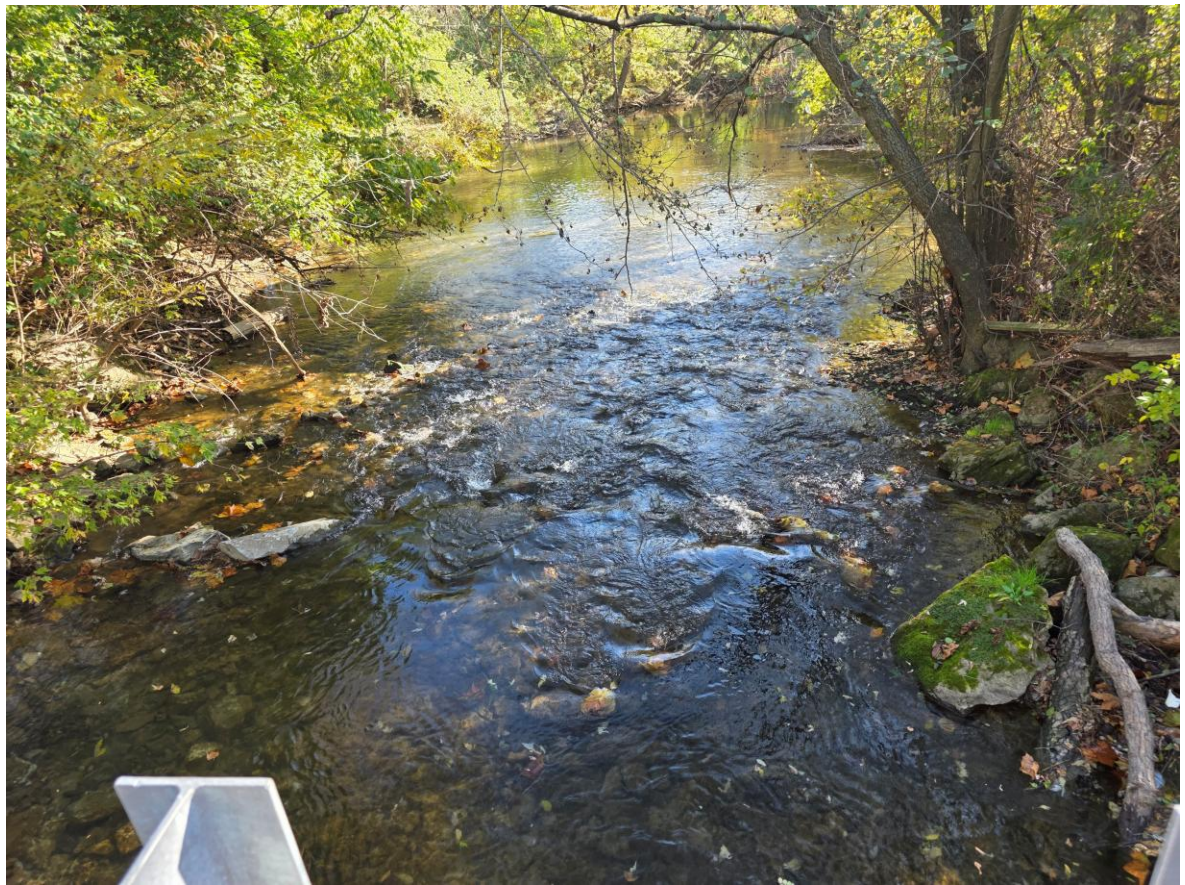
Restoration and Monitoring Sites



Monitoring Sites

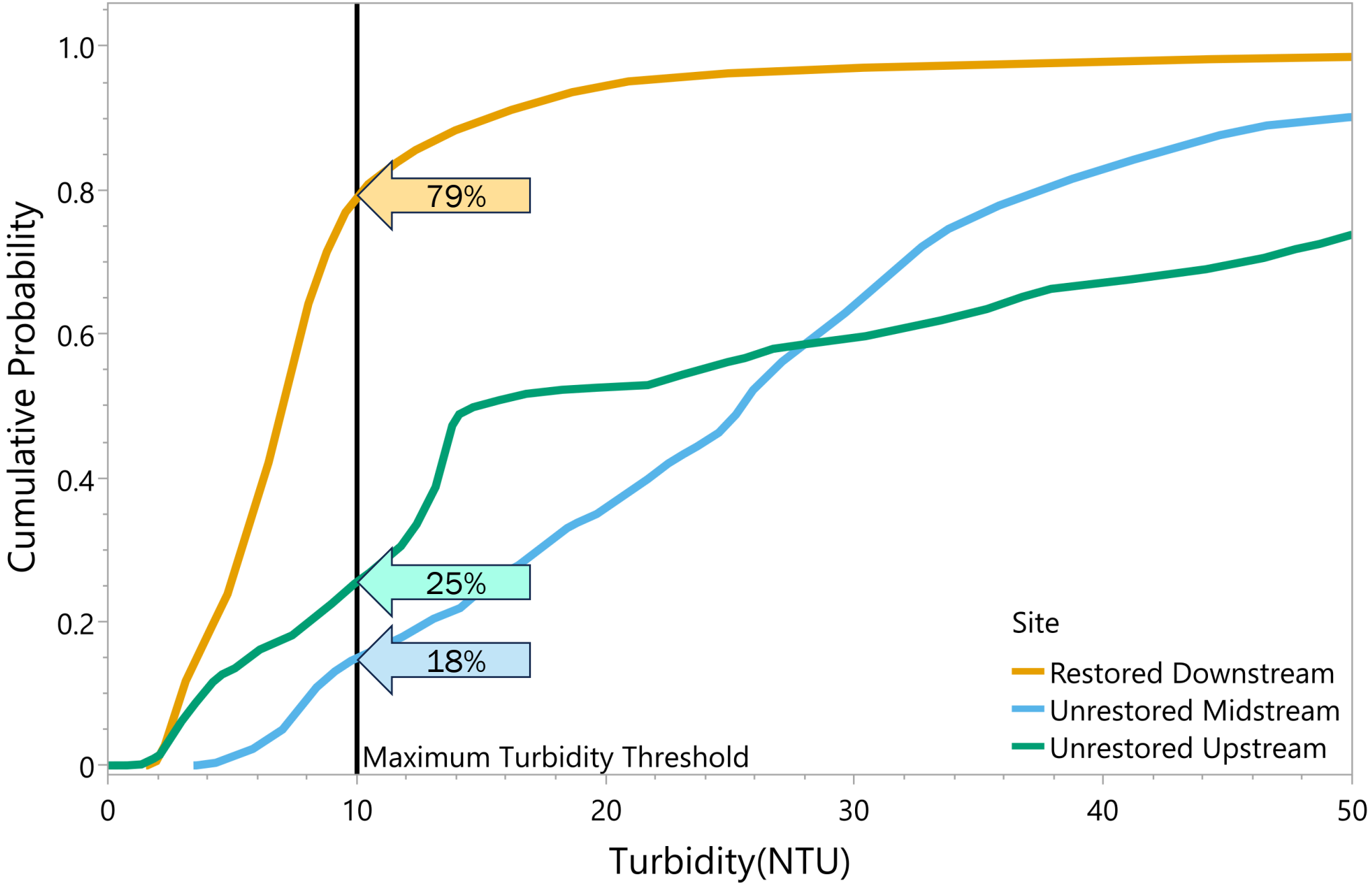


Baseflow

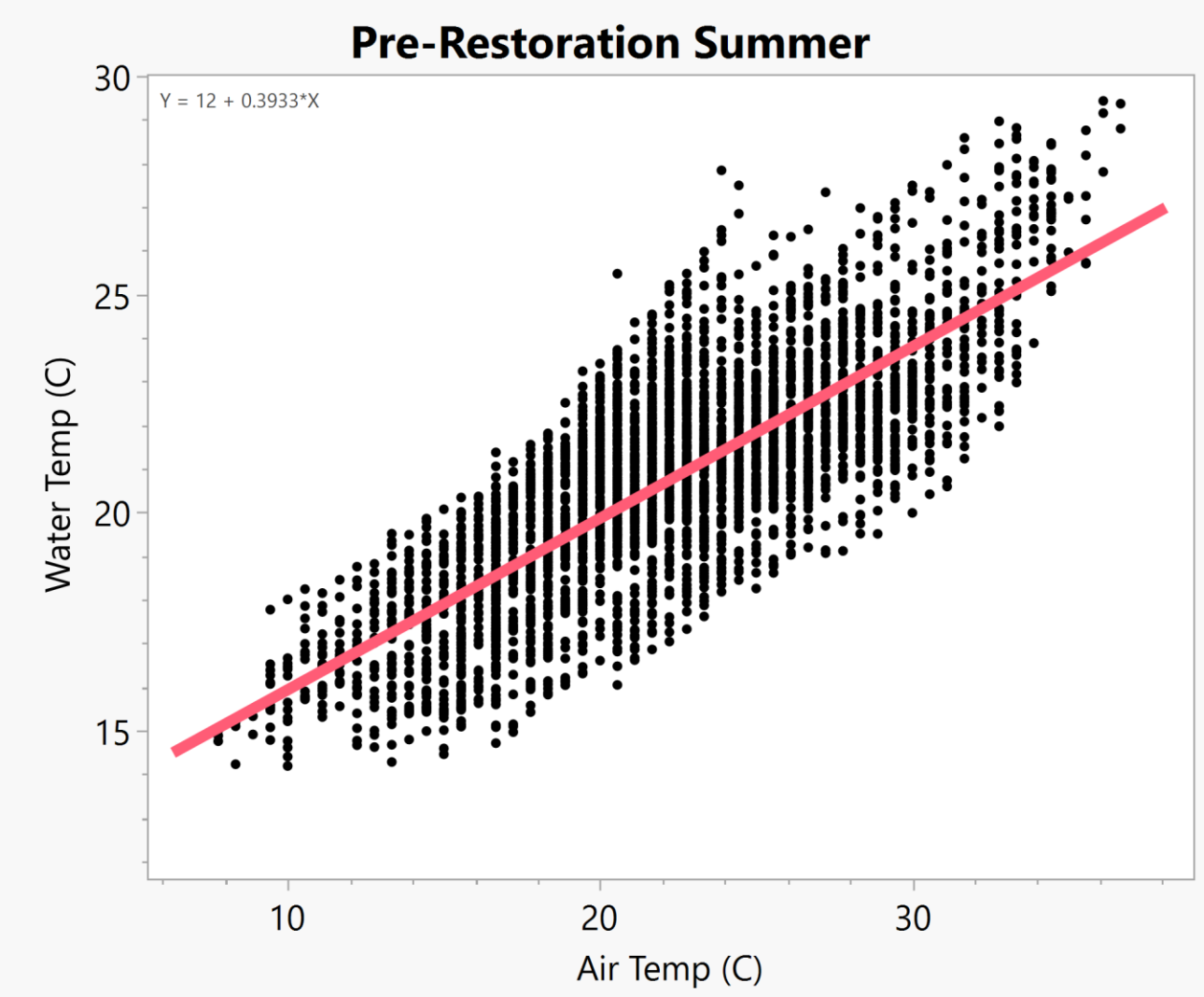


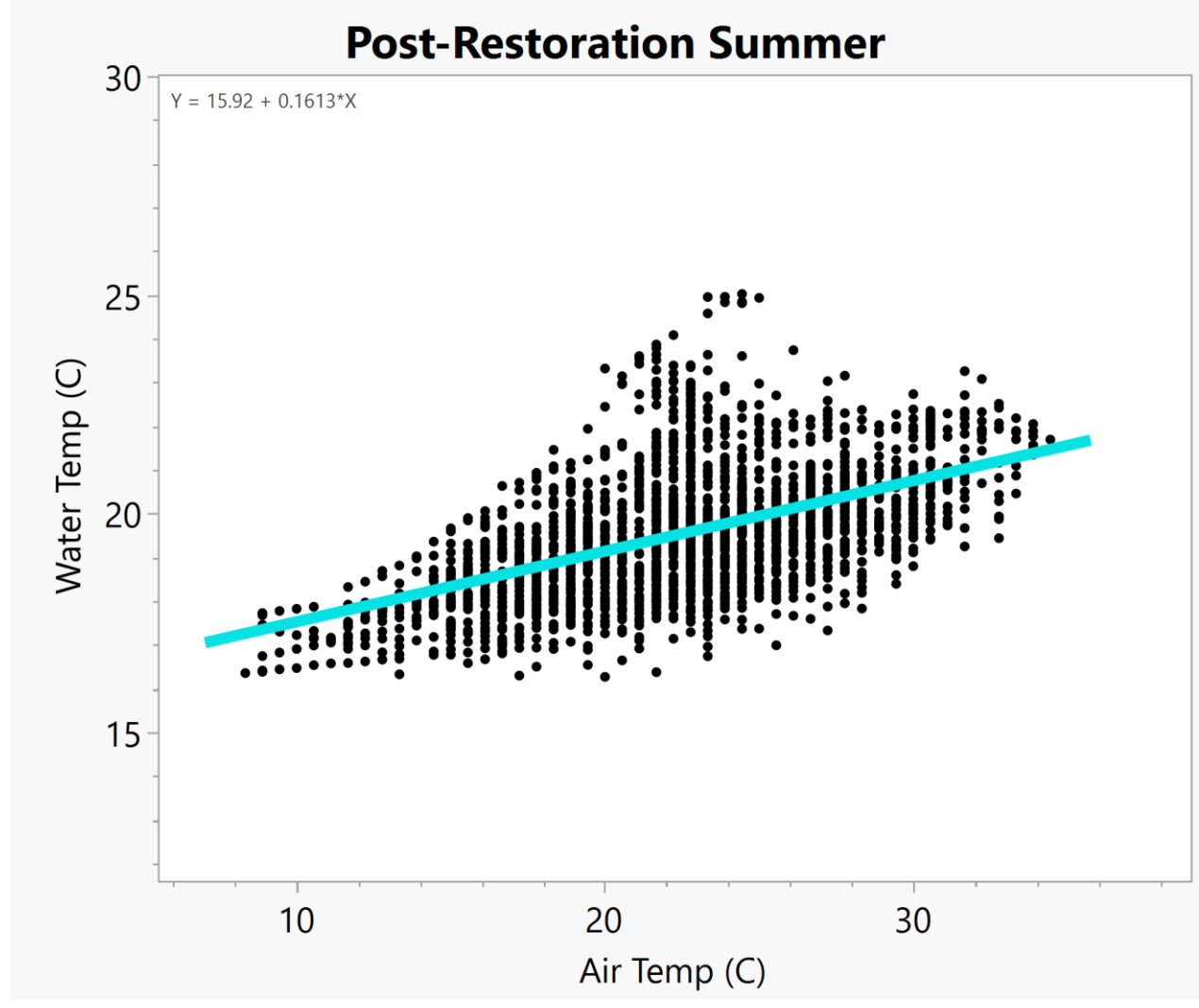
Stormflow

Decreased turbidity in restored reaches (preliminary data)



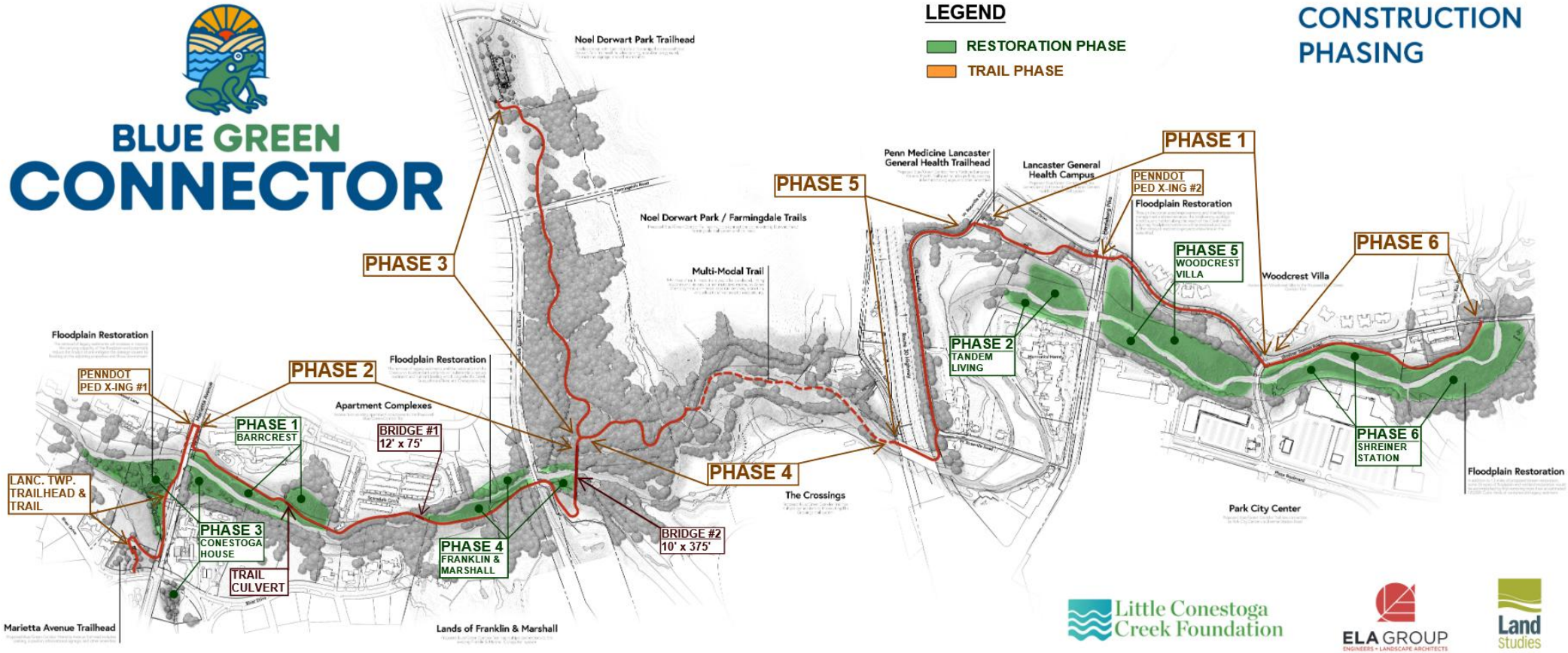
Thermal Sensitivity During Summer (Jul-Sept)





Monitoring is continuing!

Come and visit our project!



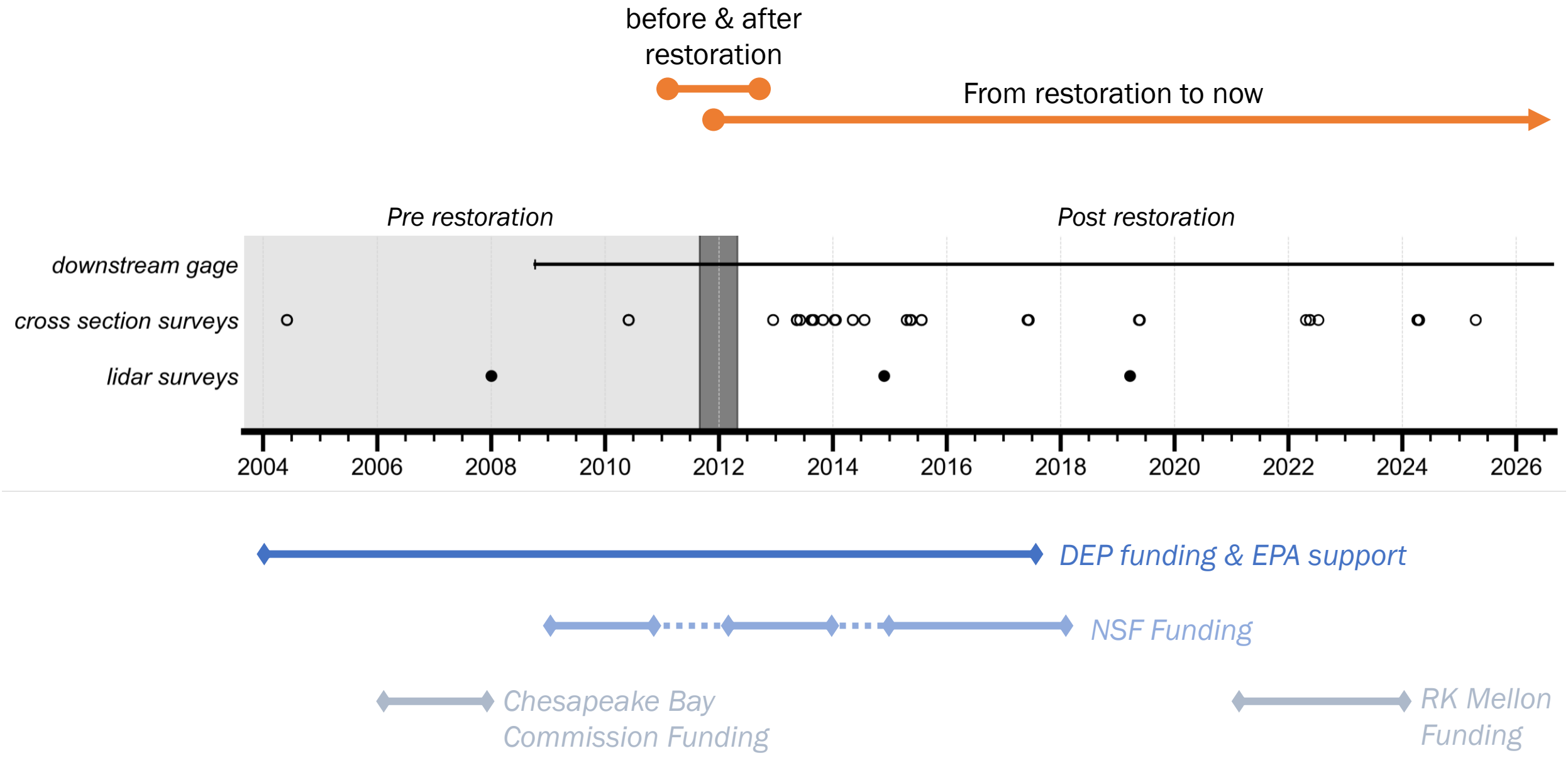
Legacy Sediment restoration at Big Spring Run

Pre-restoration (winter 2009-2010)

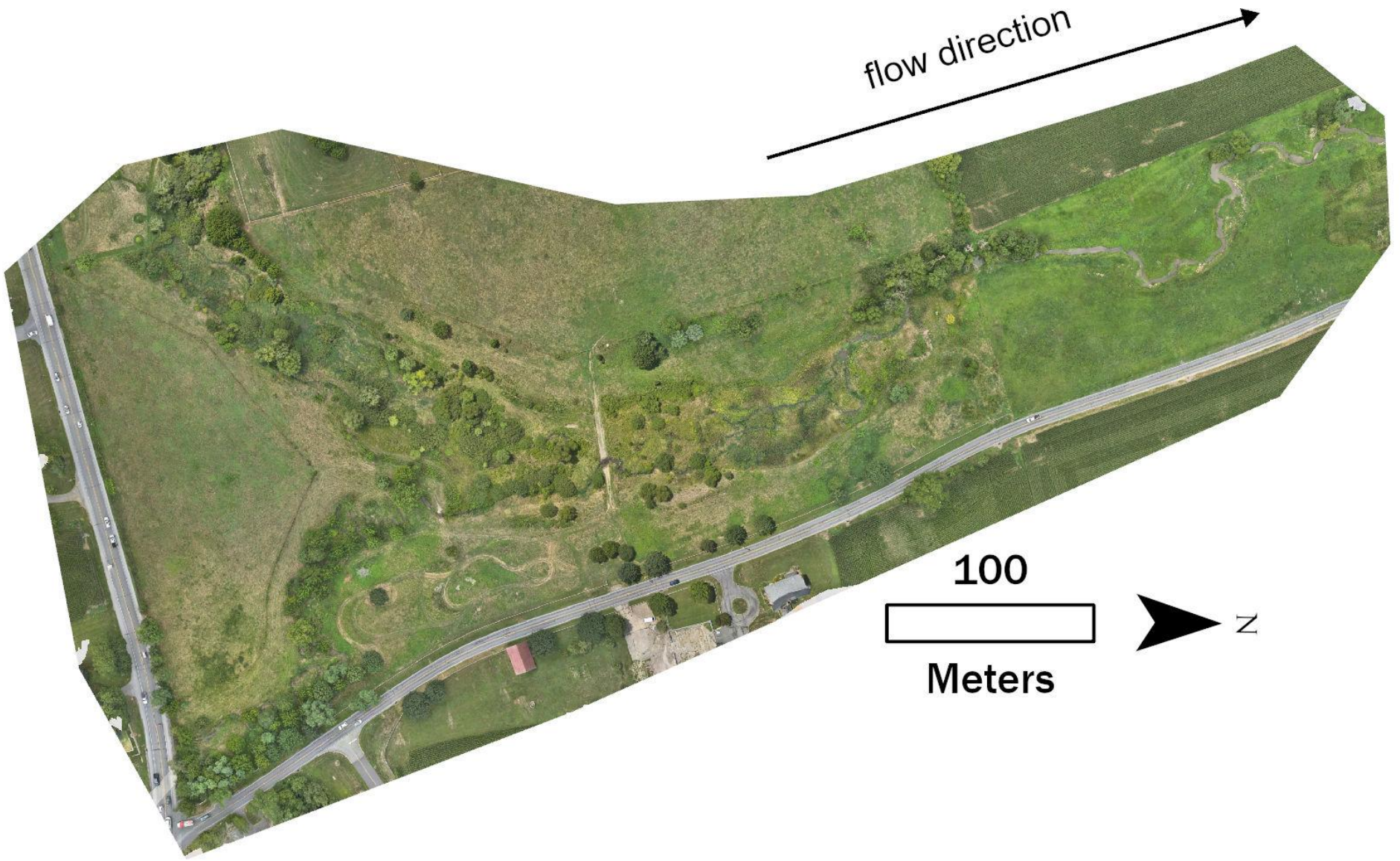
End of restoration (October 2011)

6 months after restoration (May 2012)

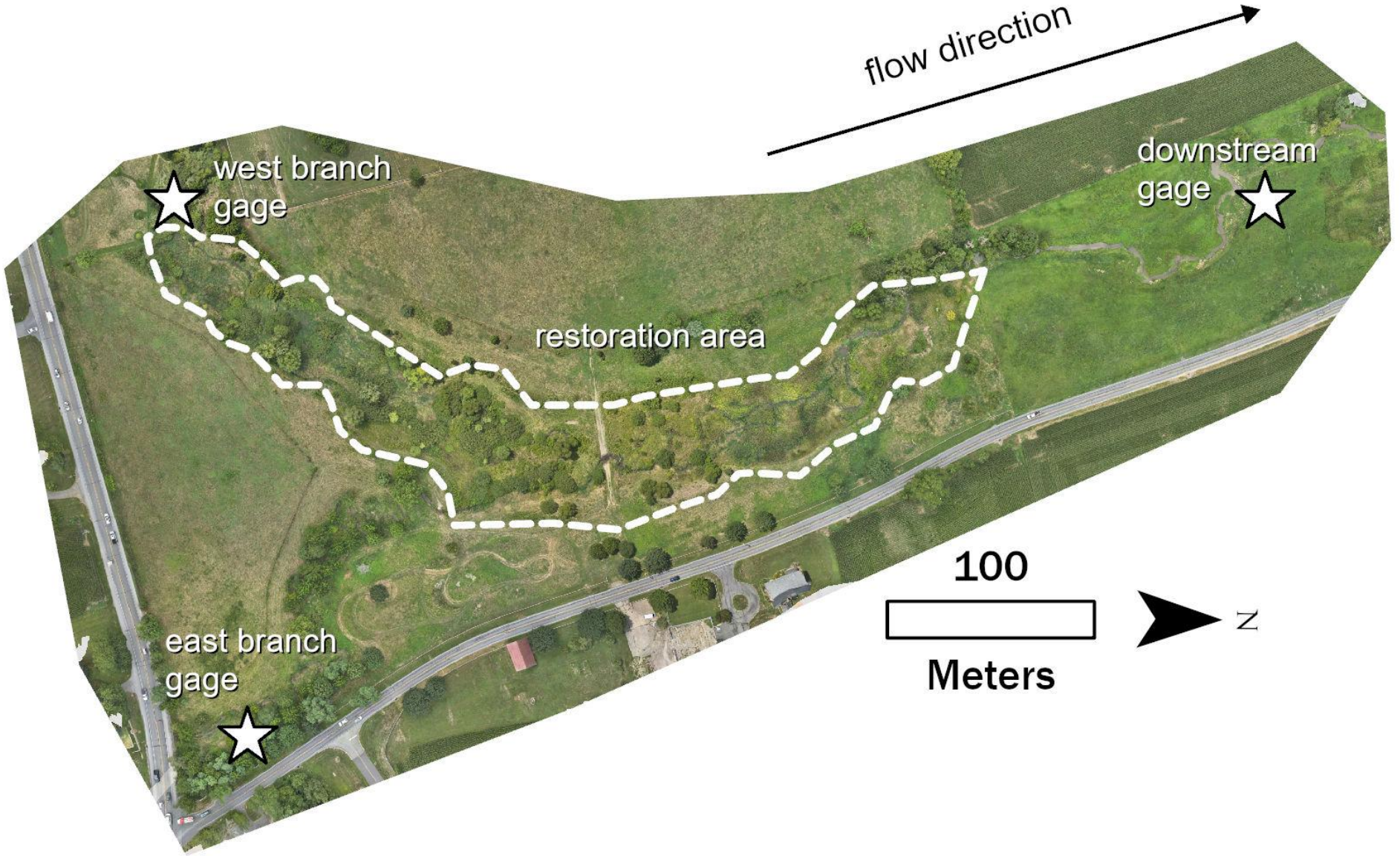
Big Spring Run restoration timeline



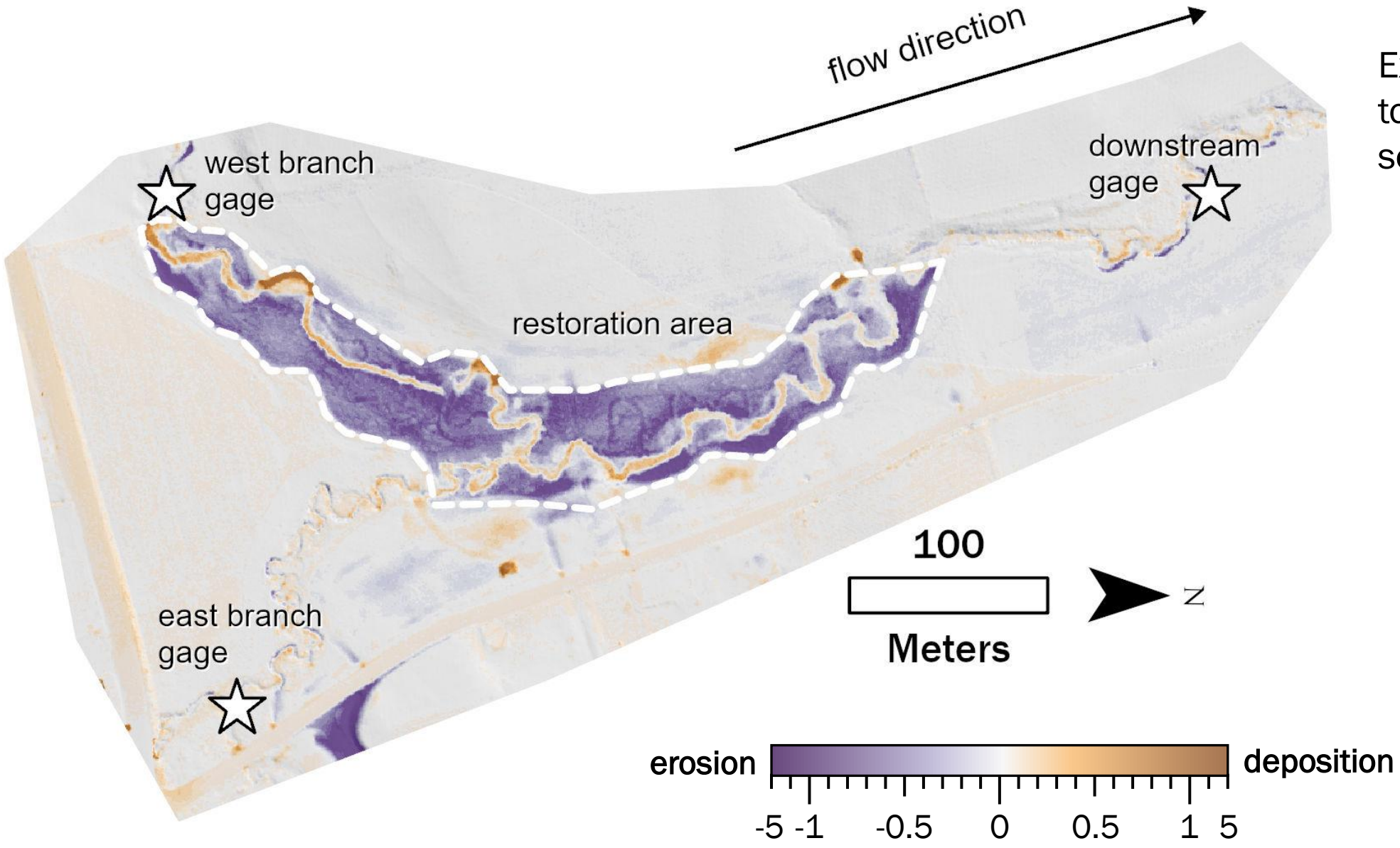
Big Spring Run



Big Spring Run

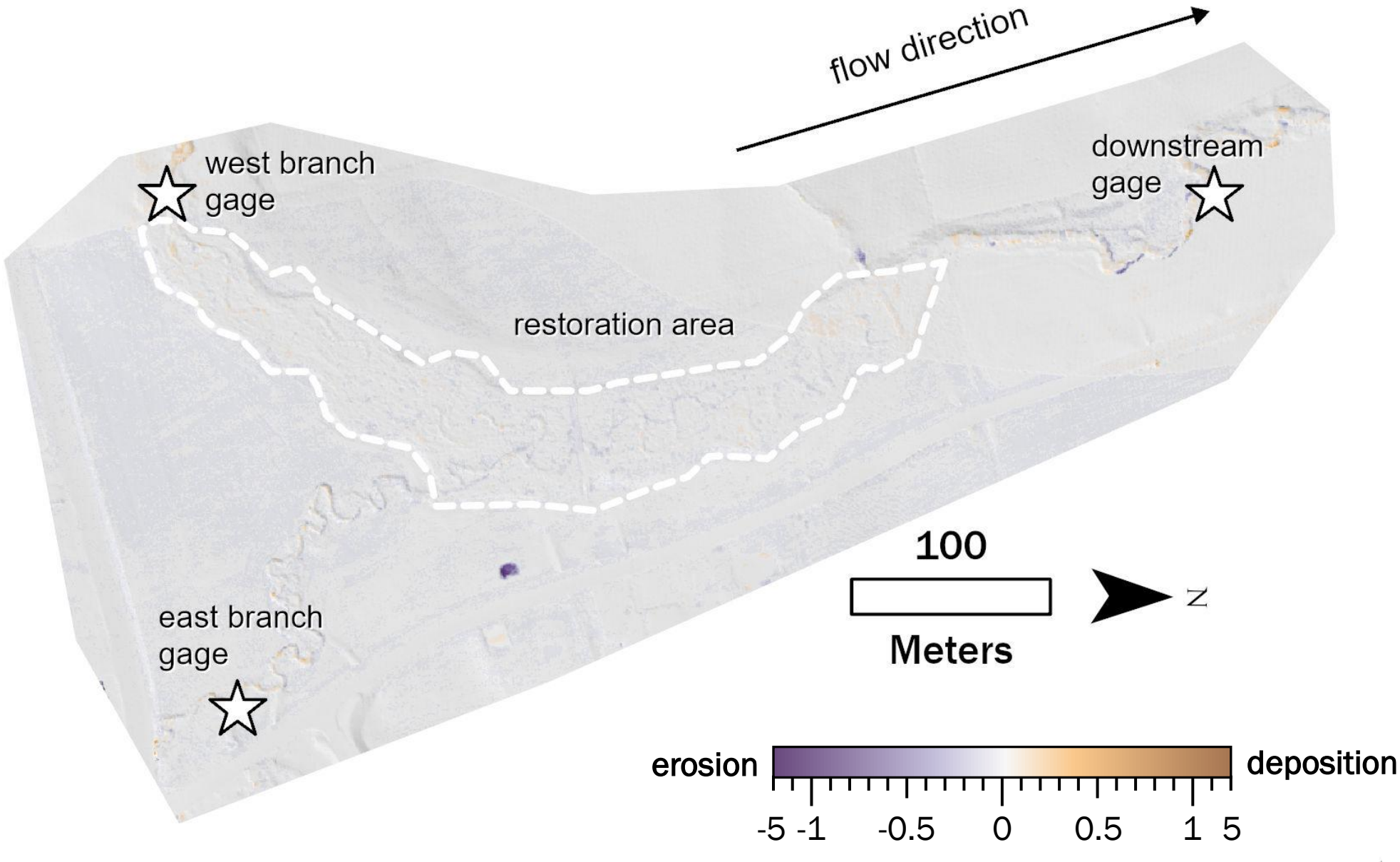


Sediment change 2008→ 2014

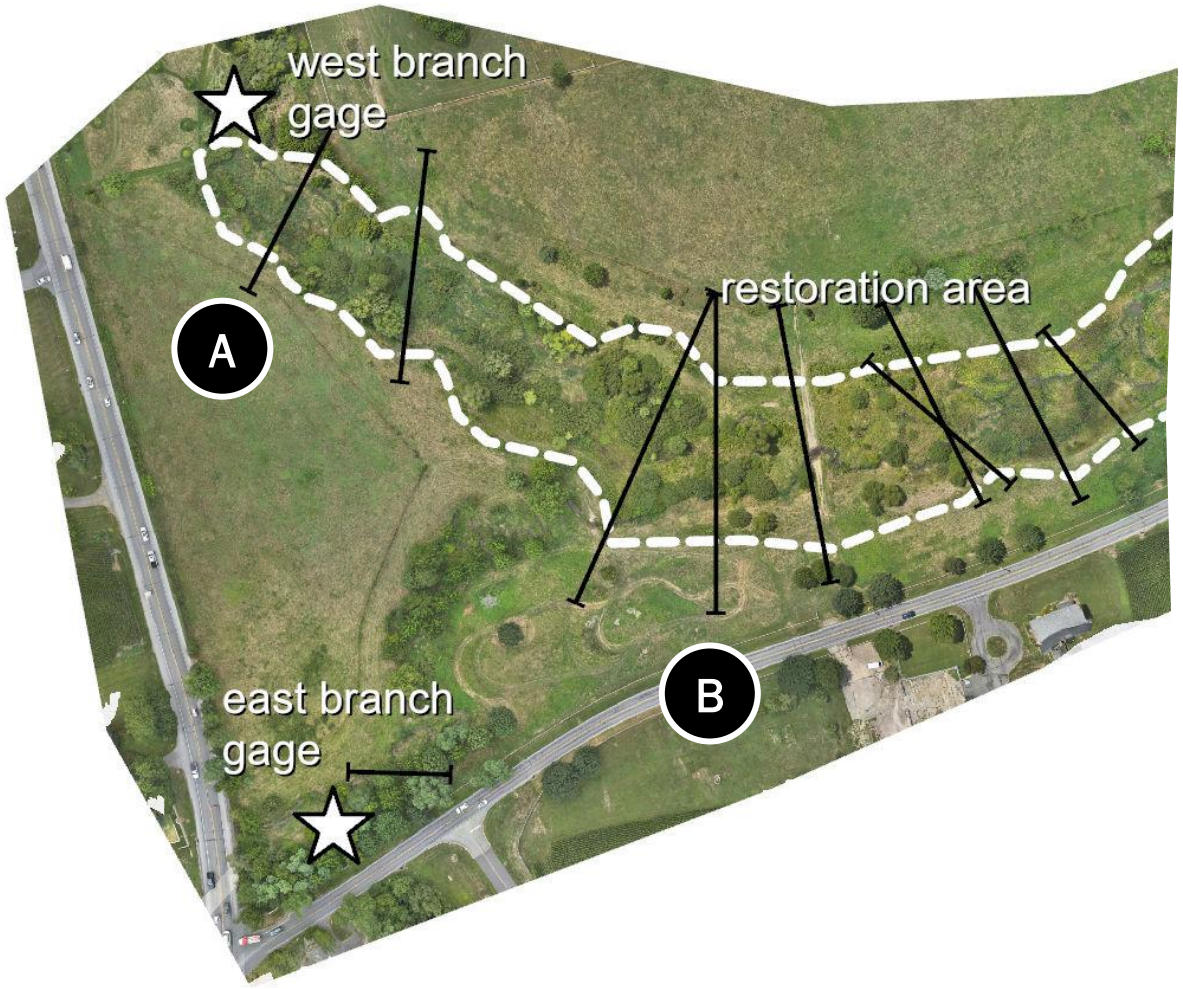


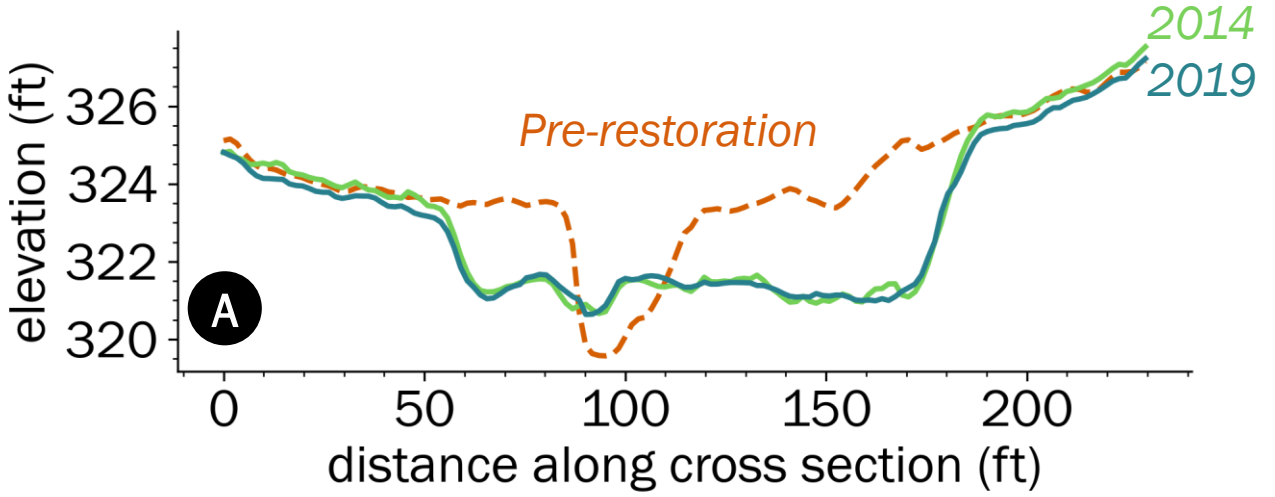
Excavated 20,000 tons of legacy sediment

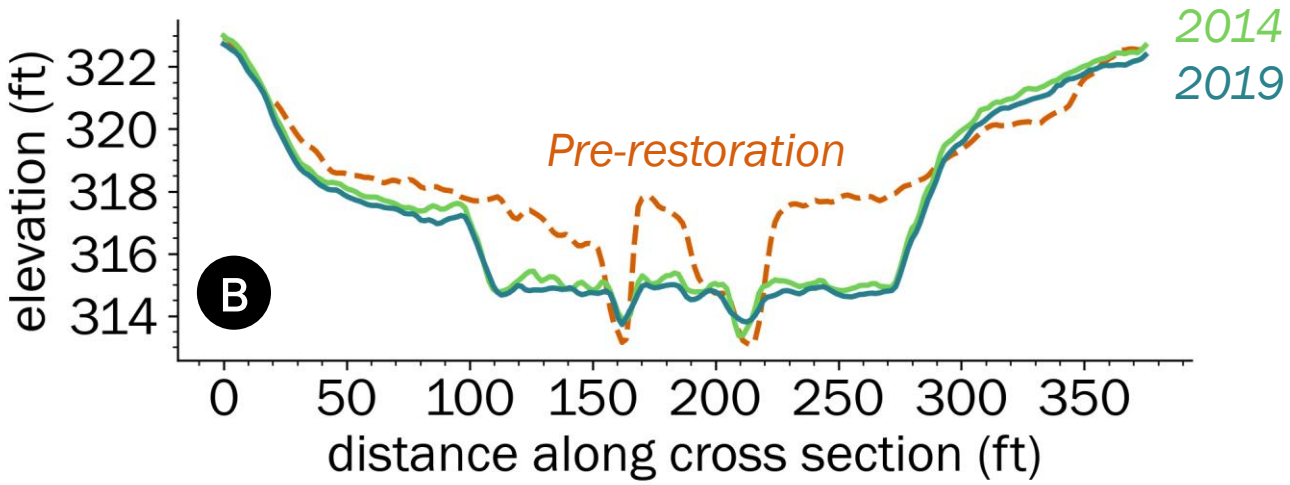
Sediment change 2014→ 2019



Excavated wetlands remain stable after restoration

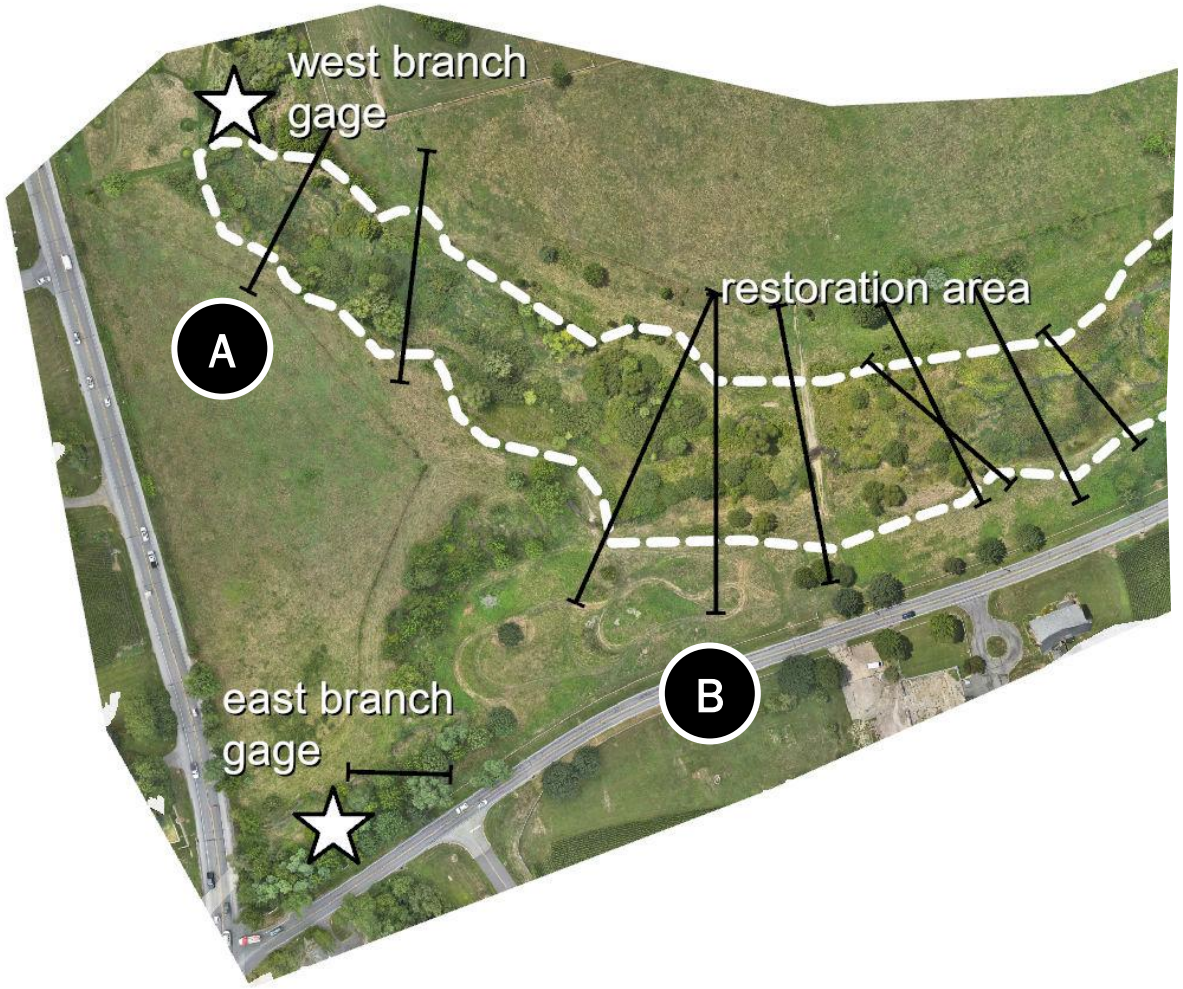


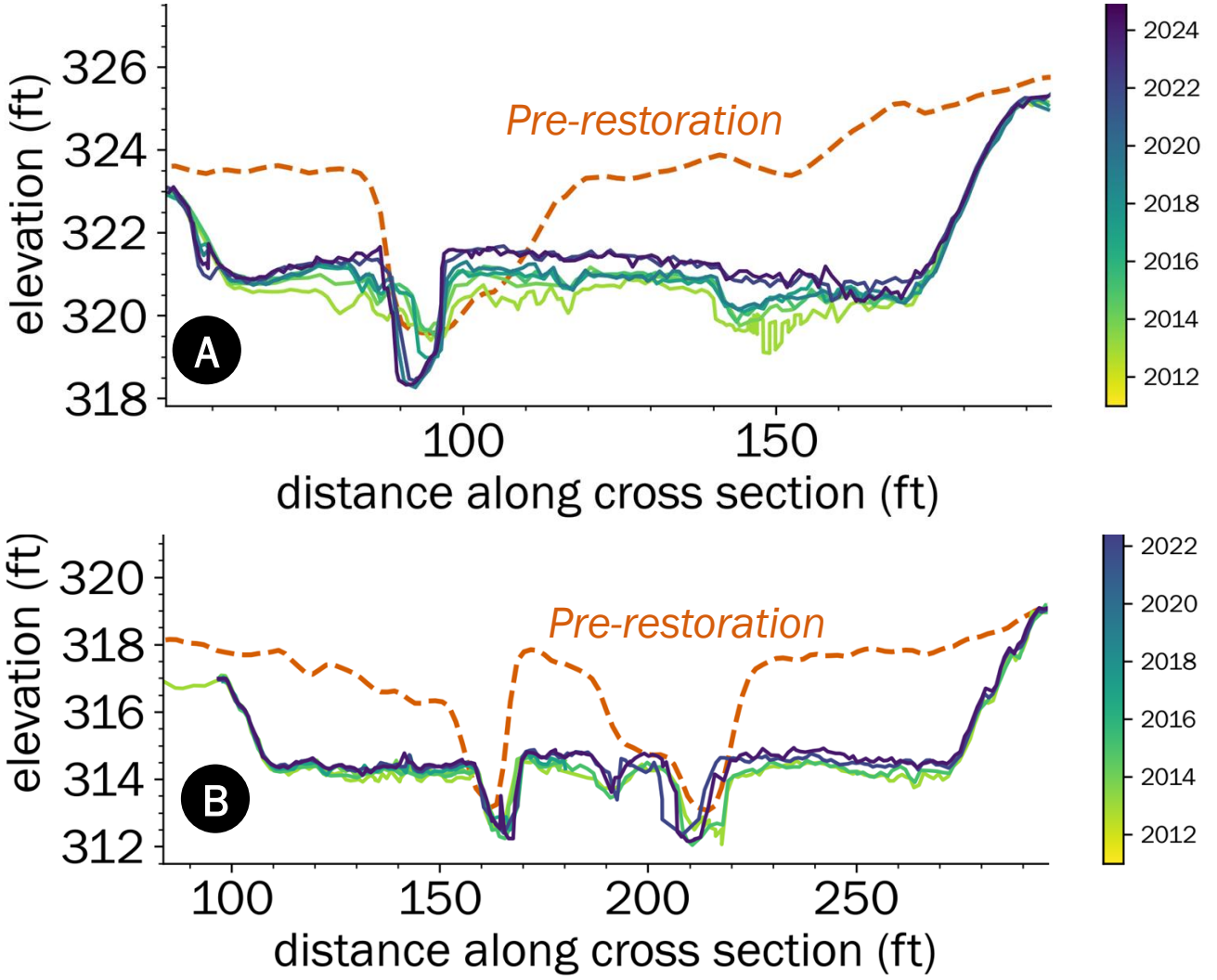




Topographic change from regional LiDAR

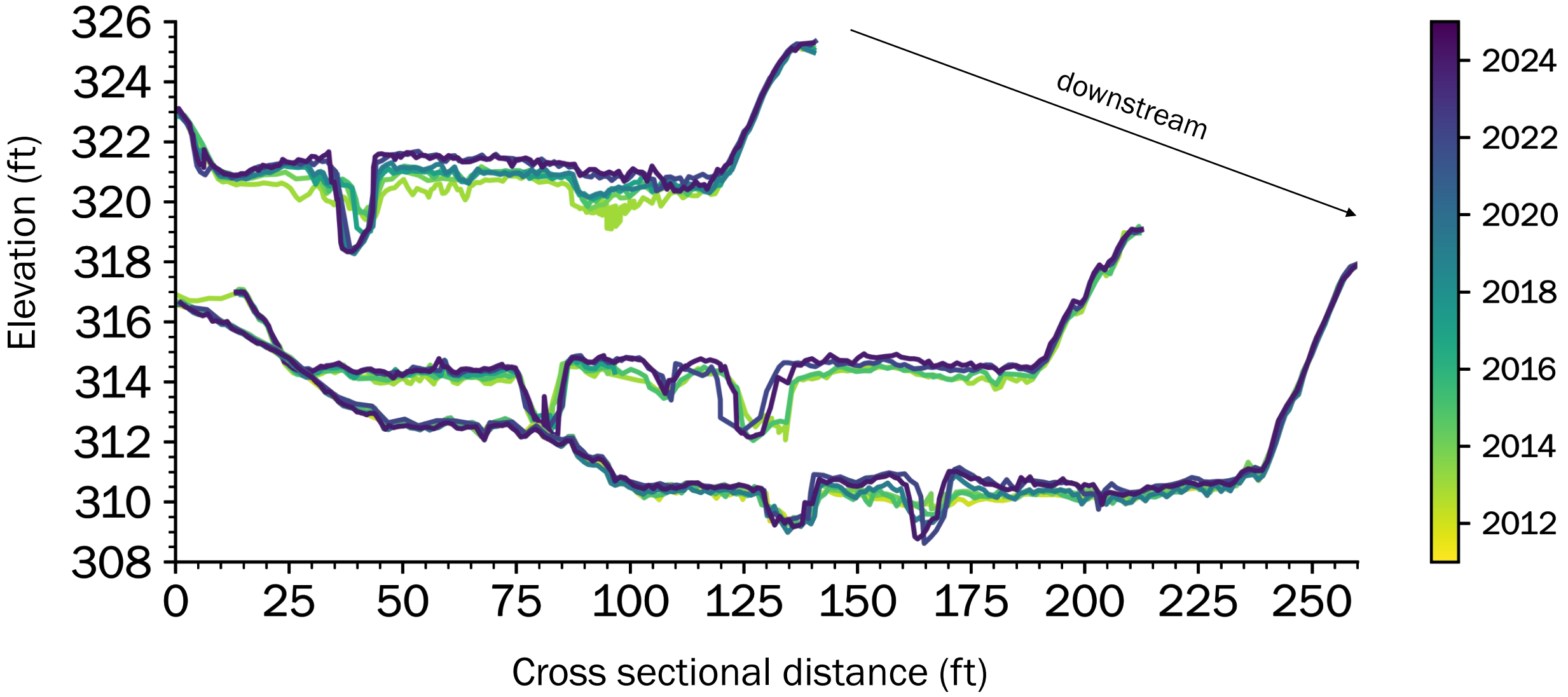
Excavated wetlands remain stable after restoration



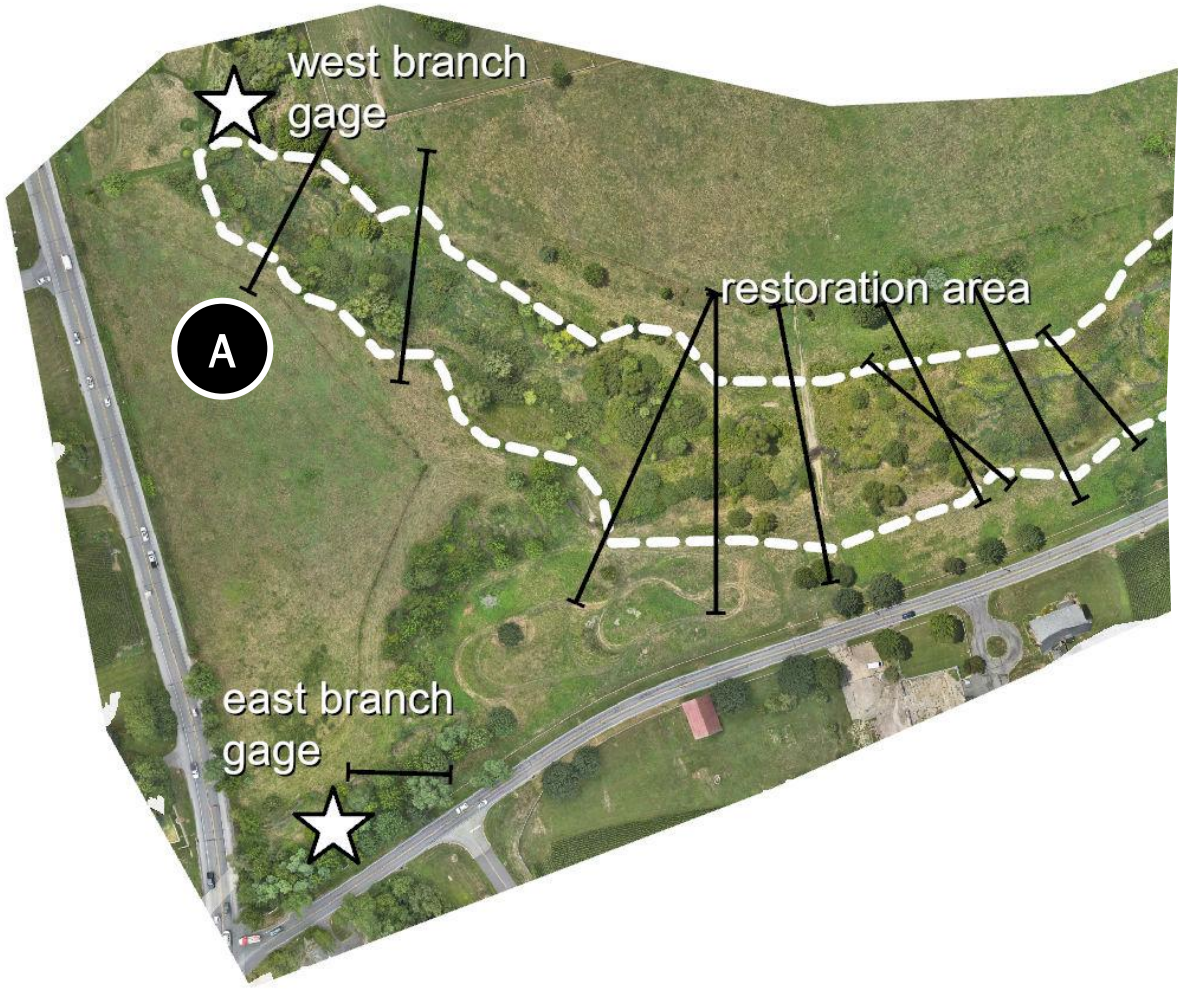


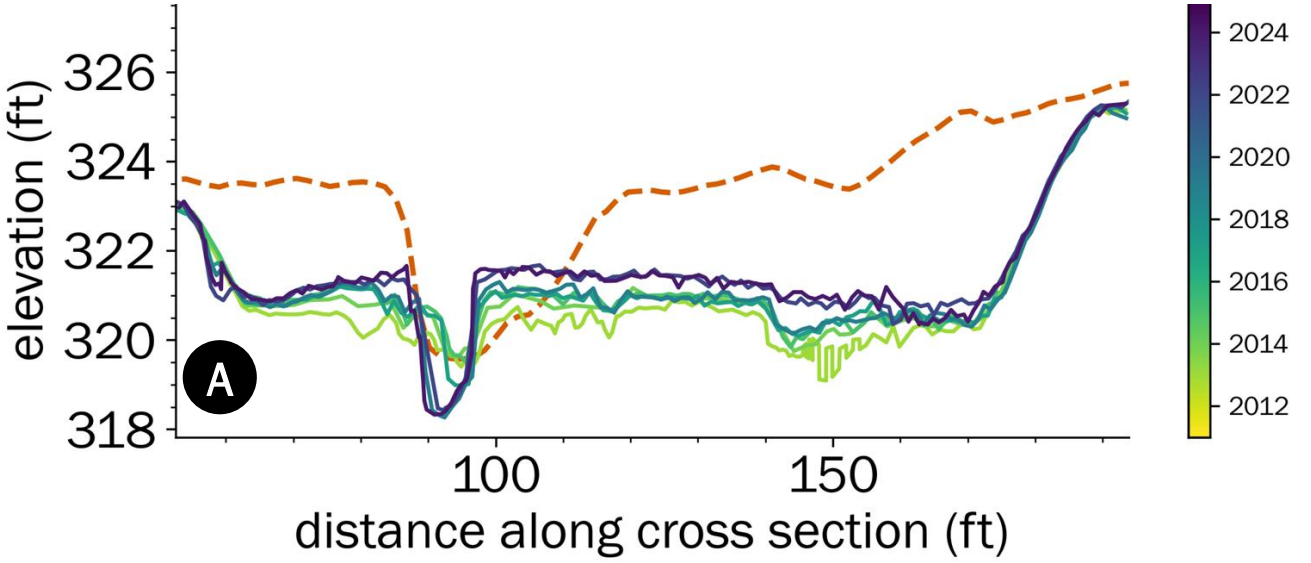
Topographic change from field measurements

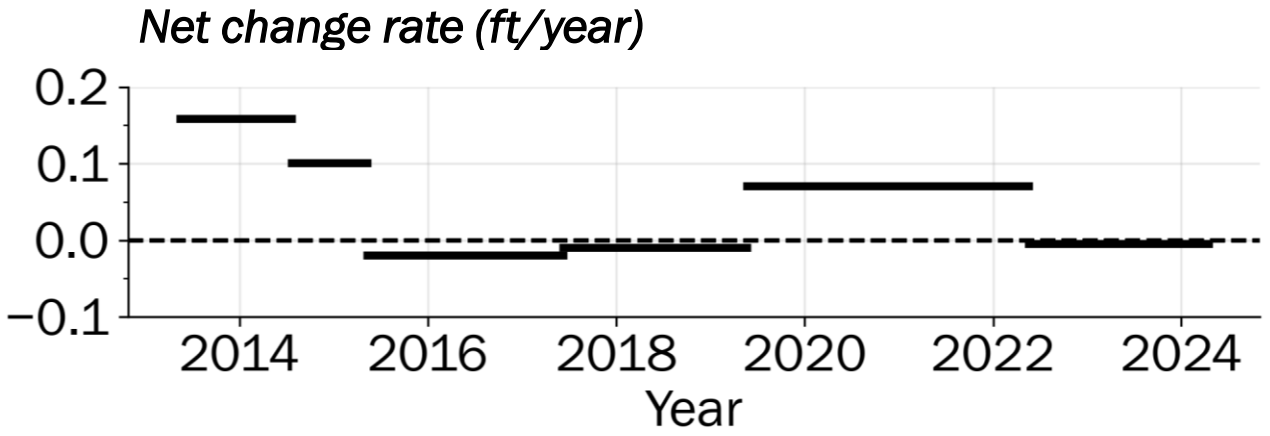
Deposition set by wetland width & downstream position



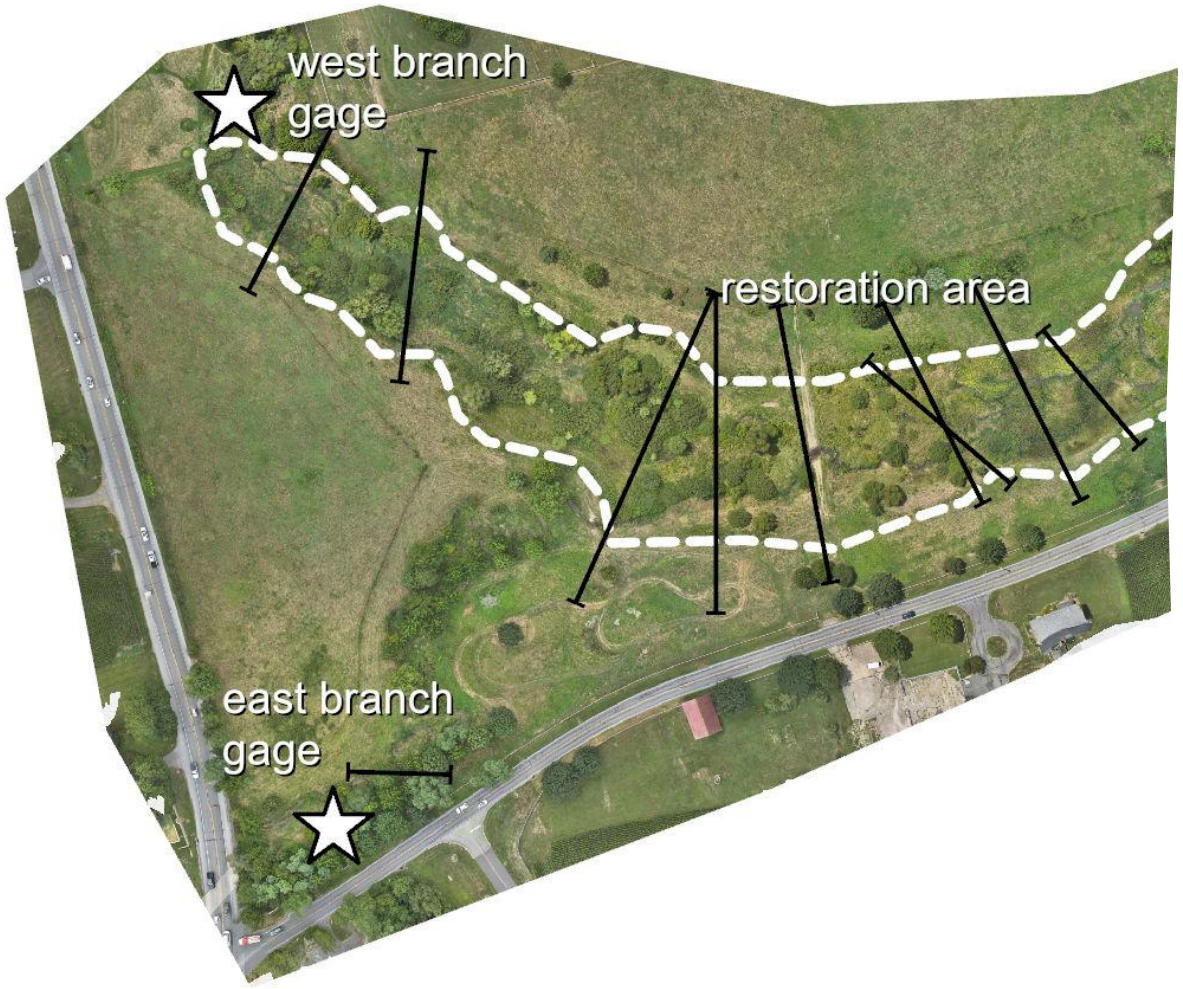
Deposition rate decreases over time

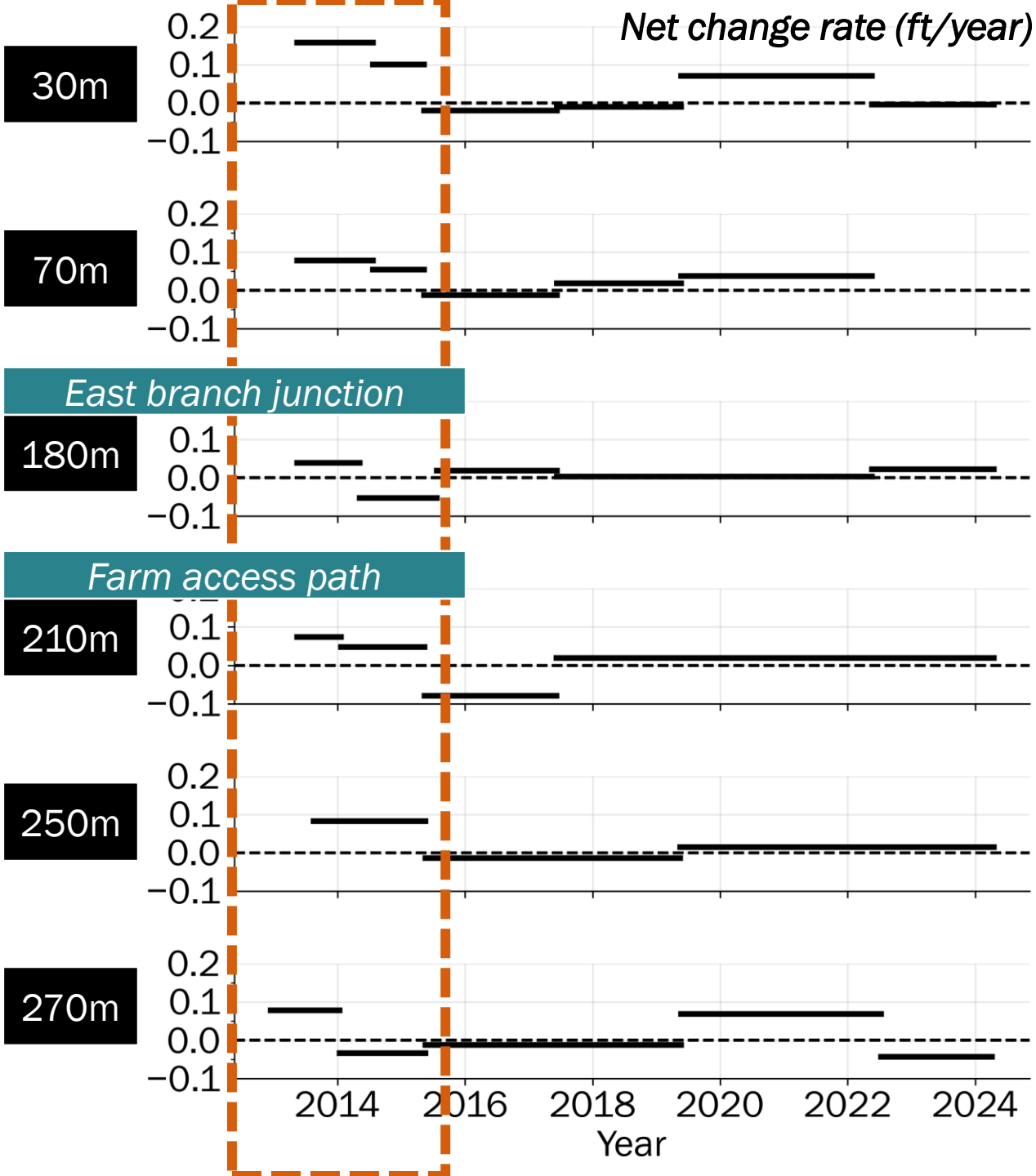




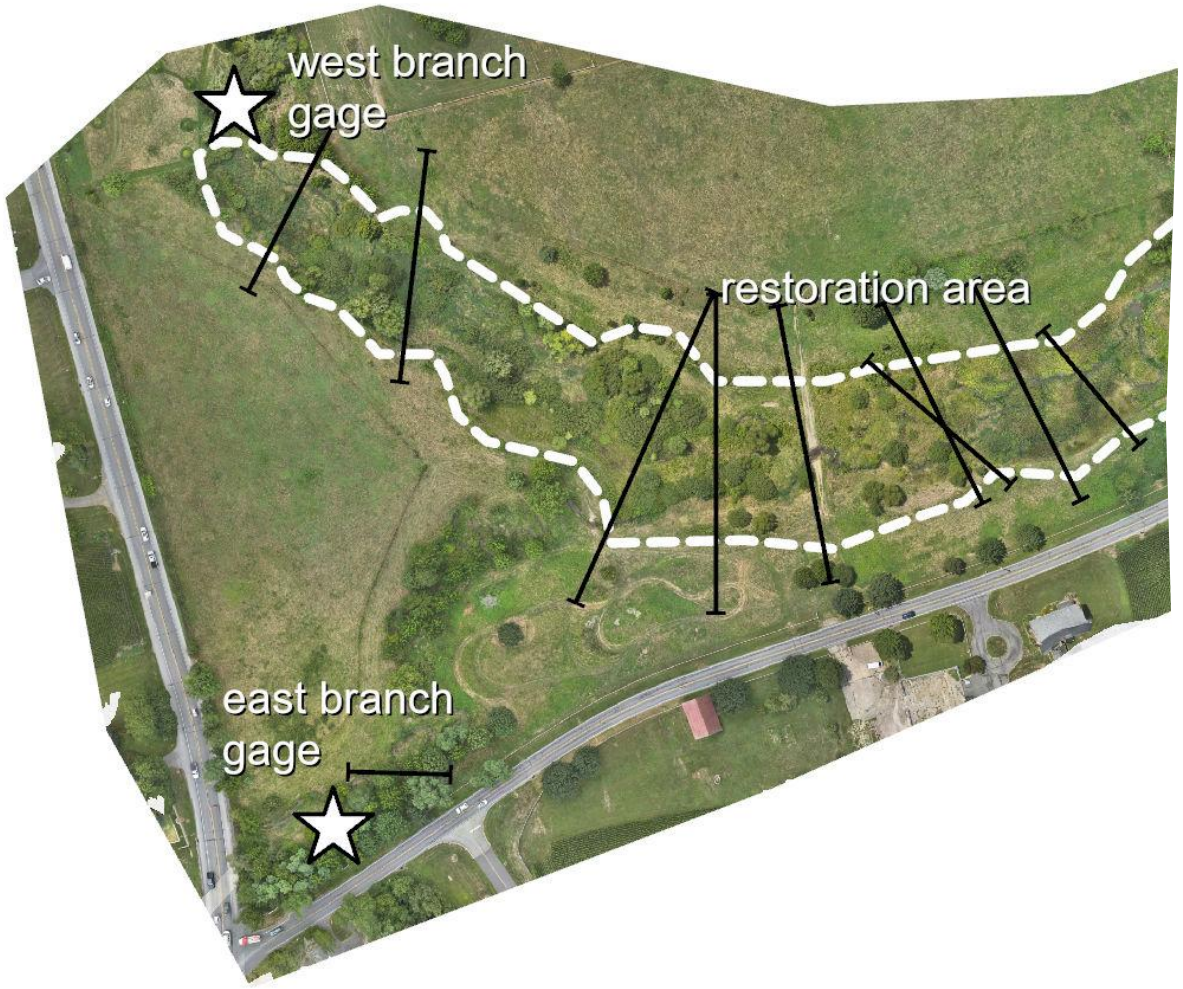


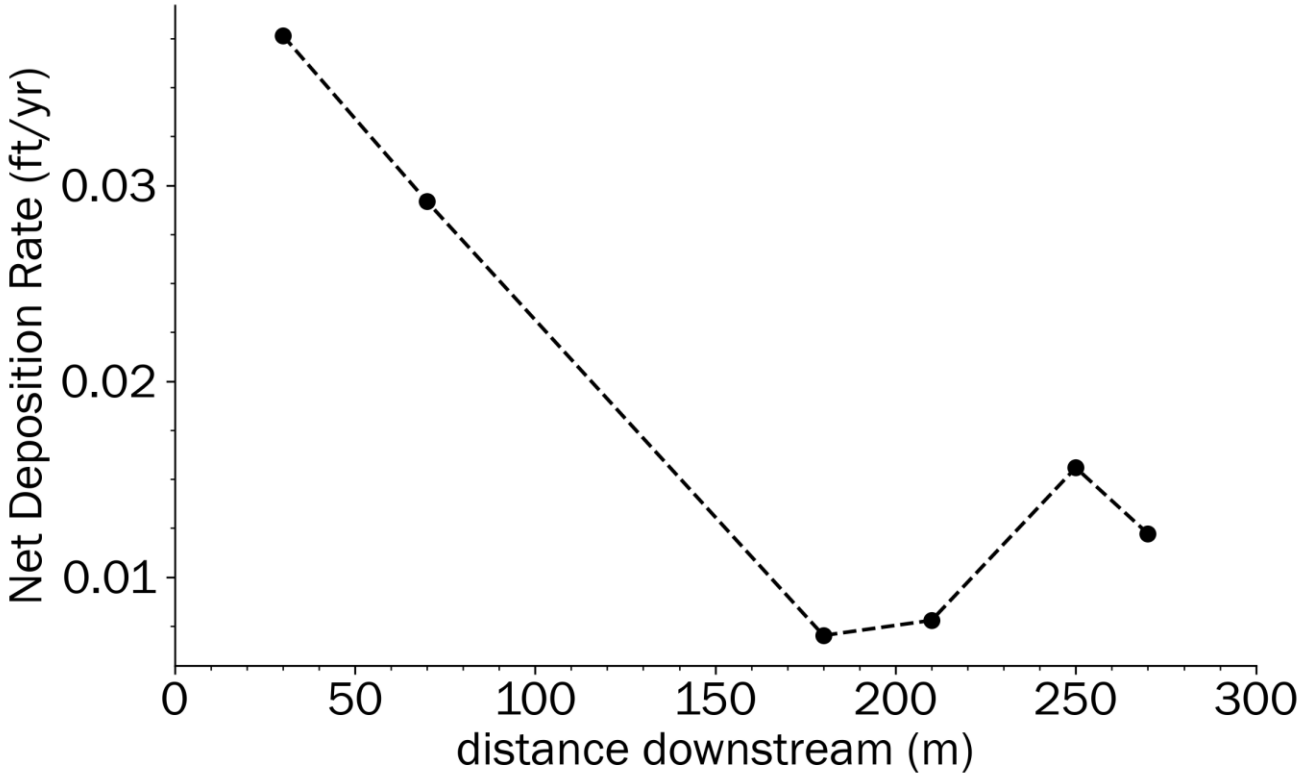
Sediment inputs buffered with distance



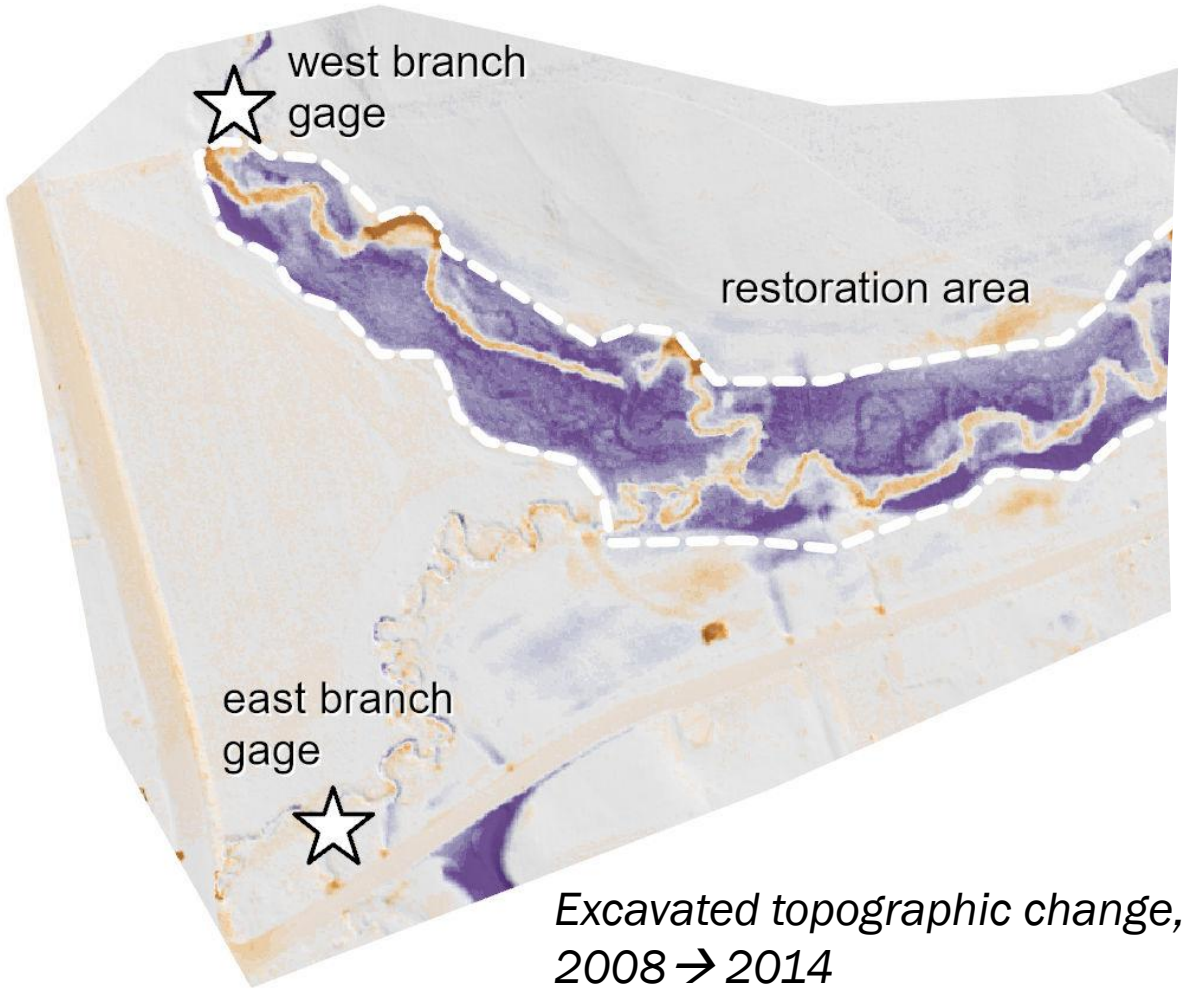


Deposition rate decreases downstream



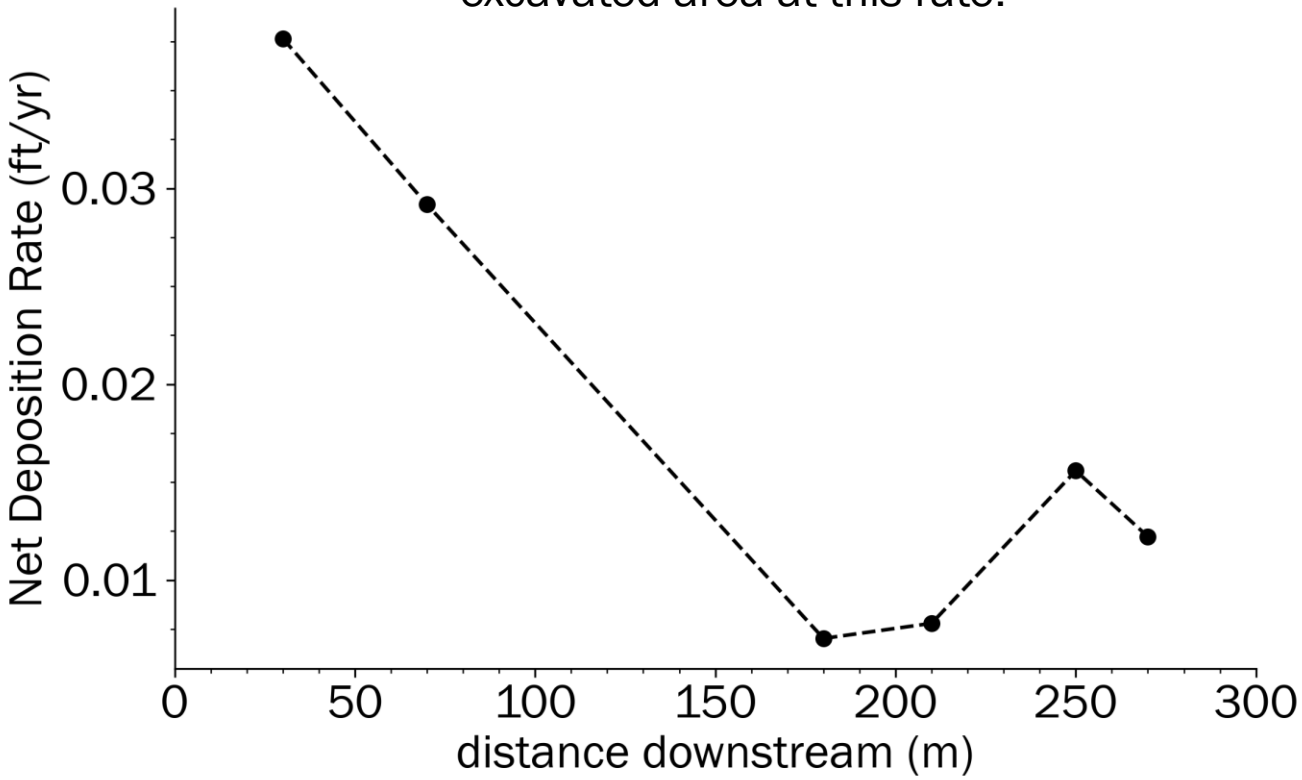


Deposition rate decreases downstream

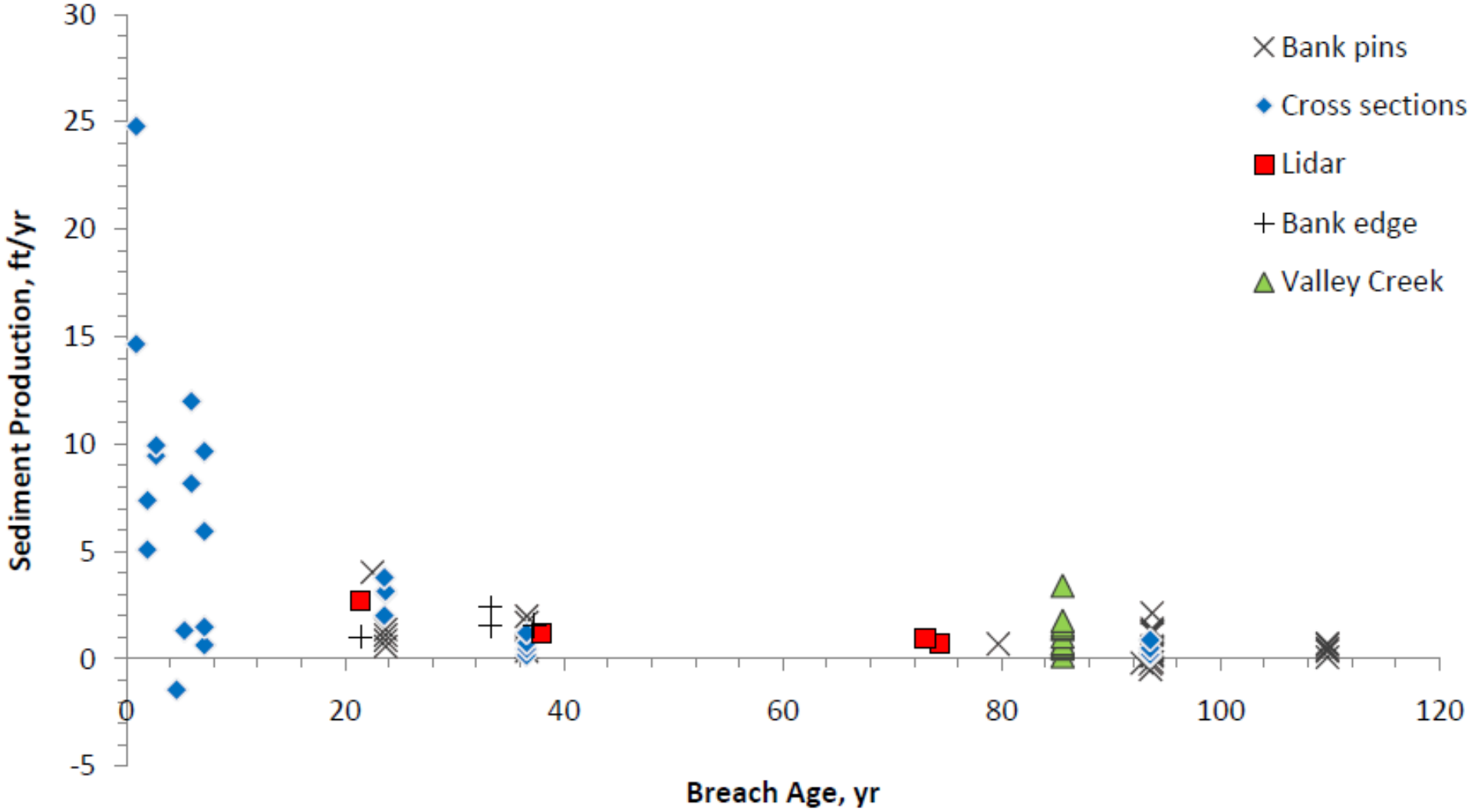


Excavated topographic change, 2008 → 2014

Think of the time to fill back in the excavated area at this rate!



Sediment production rates in unrestored sections ~1 order of magnitude higher



Merritts, Walter & Rahnis (2010)

Can observe this bank erosion in unrestored sites

Sample along banks

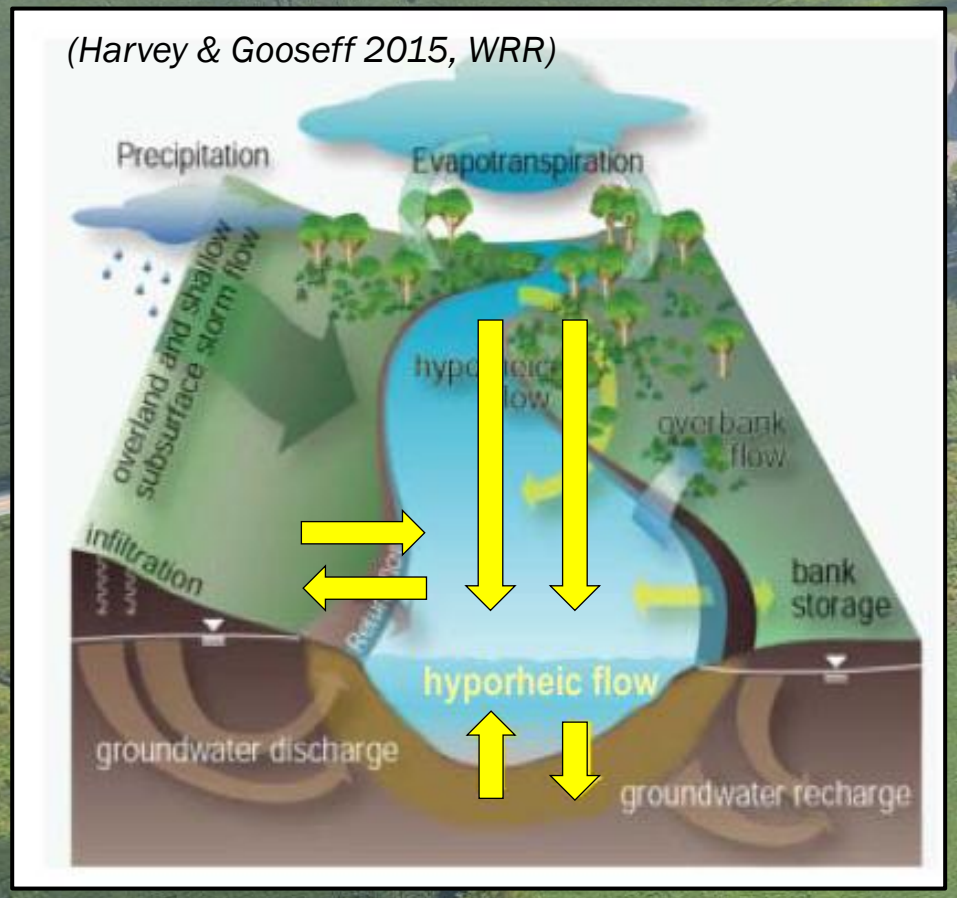
Excavate sediment deposited since January 24 storm to estimate winter bank erosion

iPhone lidar scan, February 12, 2026

Legacy Sediment restoration at Big Spring Run

Legacy Sediment restoration at Big Spring Run

- **To what extent has restoration altered hydrological regimes?**

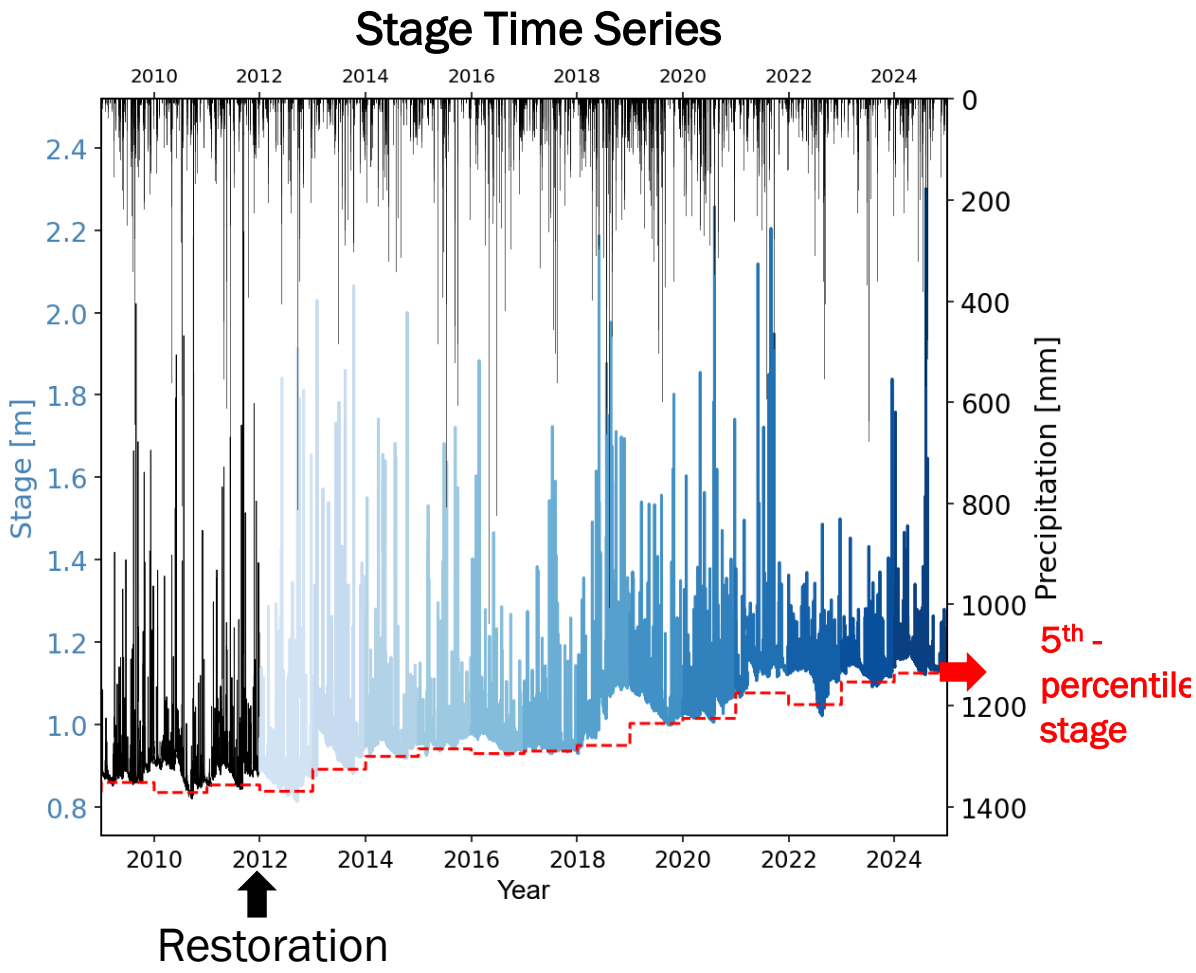


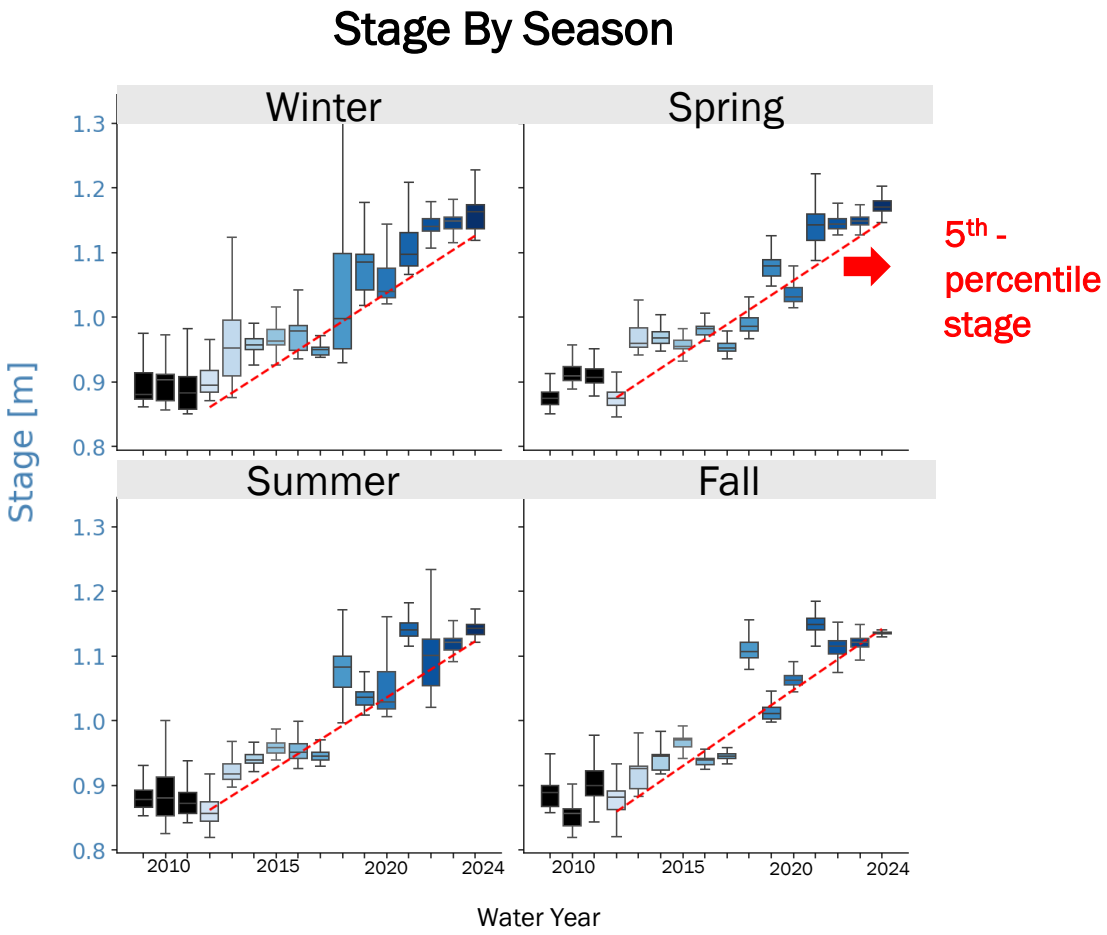
Rise
Baseflow

Enhanced
Storage
Capacity

Reduce
velocity

Rising Baseflow

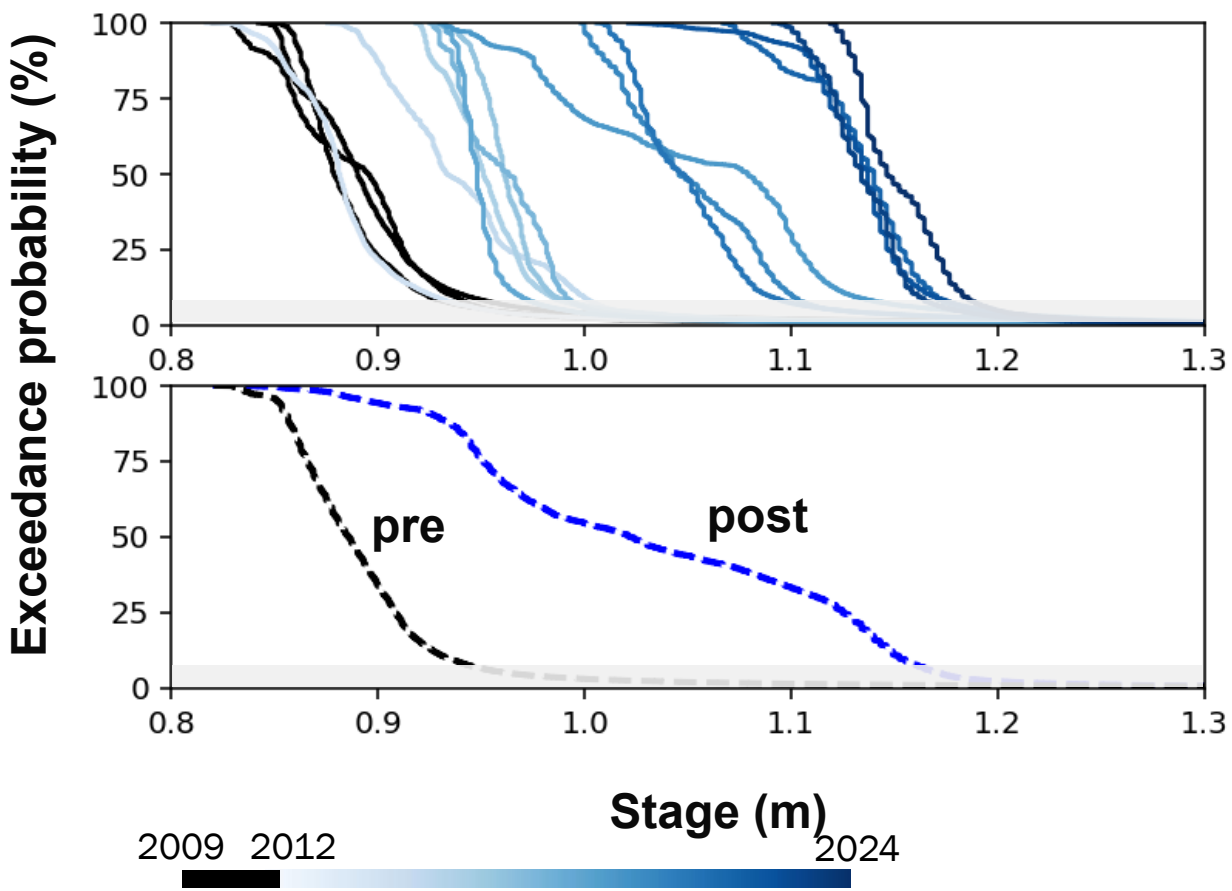




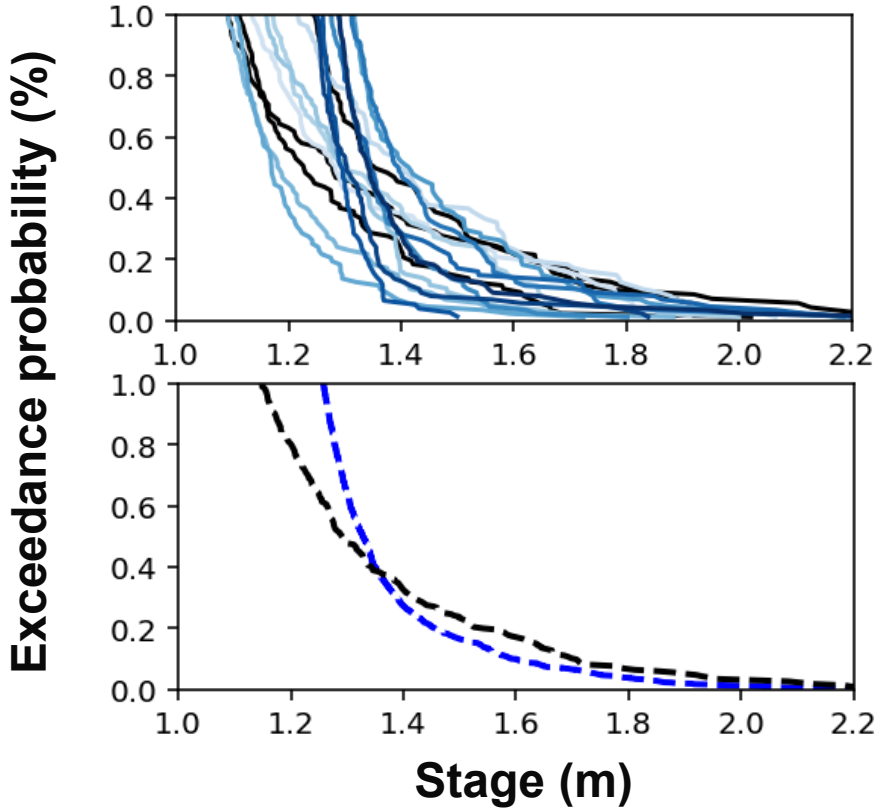
- We see a sustained increase in baseflow following restoration.
- Enhanced groundwater recharge.

Enhanced Storage capacity

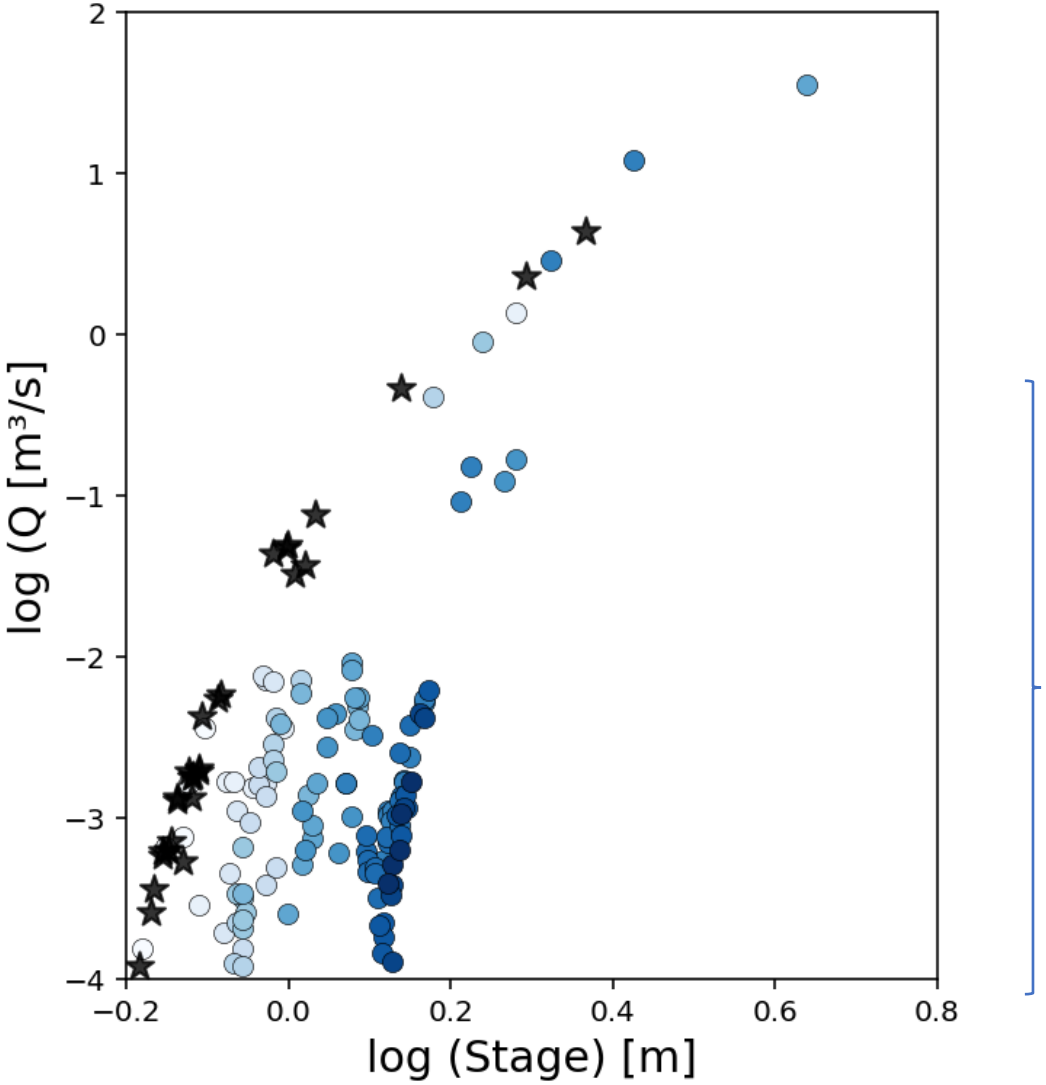
Low to Moderate Flow :
Greater groundwater inputs



High Flow :
Hold water at the restored floodplains



Reduced Velocity

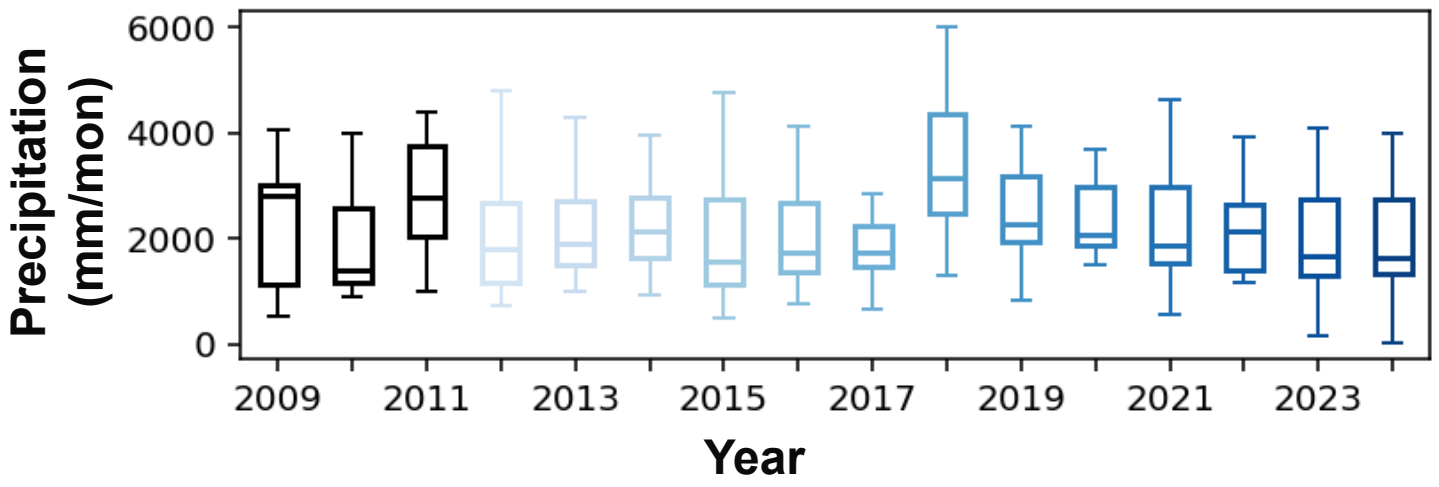


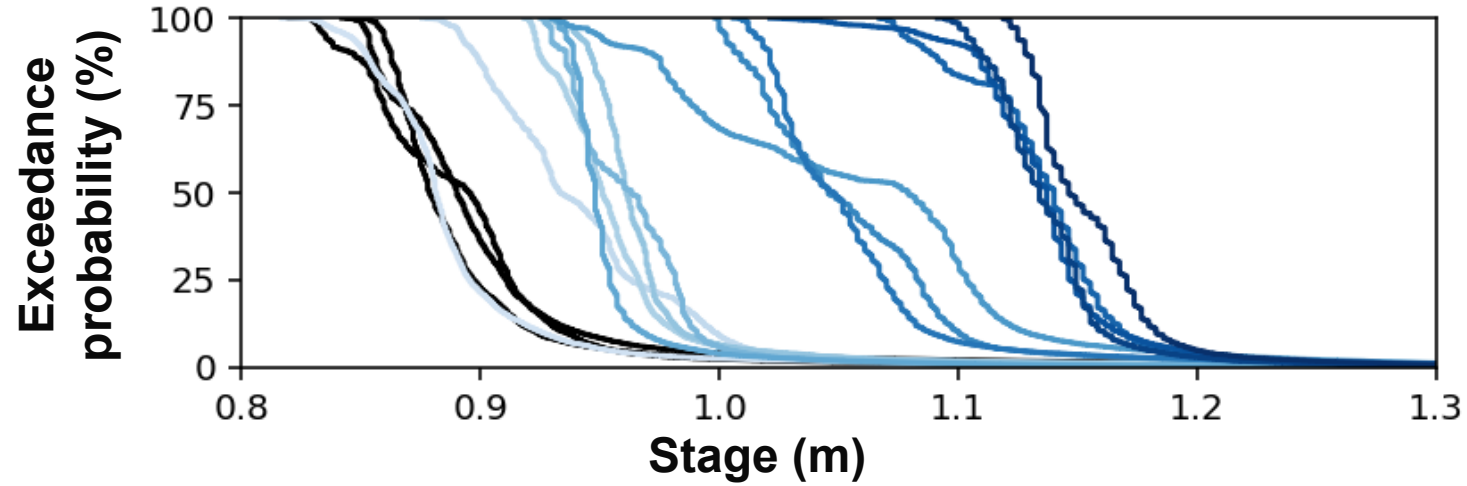
1. Water spread across the floodplain
2. Higher roughness
3. More infiltration and exchanges with the subsurface

- **For a given flow, water levels are higher than before.**
- **Decreased velocity**

$$\overline{Q} = A \times v$$

Flow Regime Shifts Beyond Climate Forcing

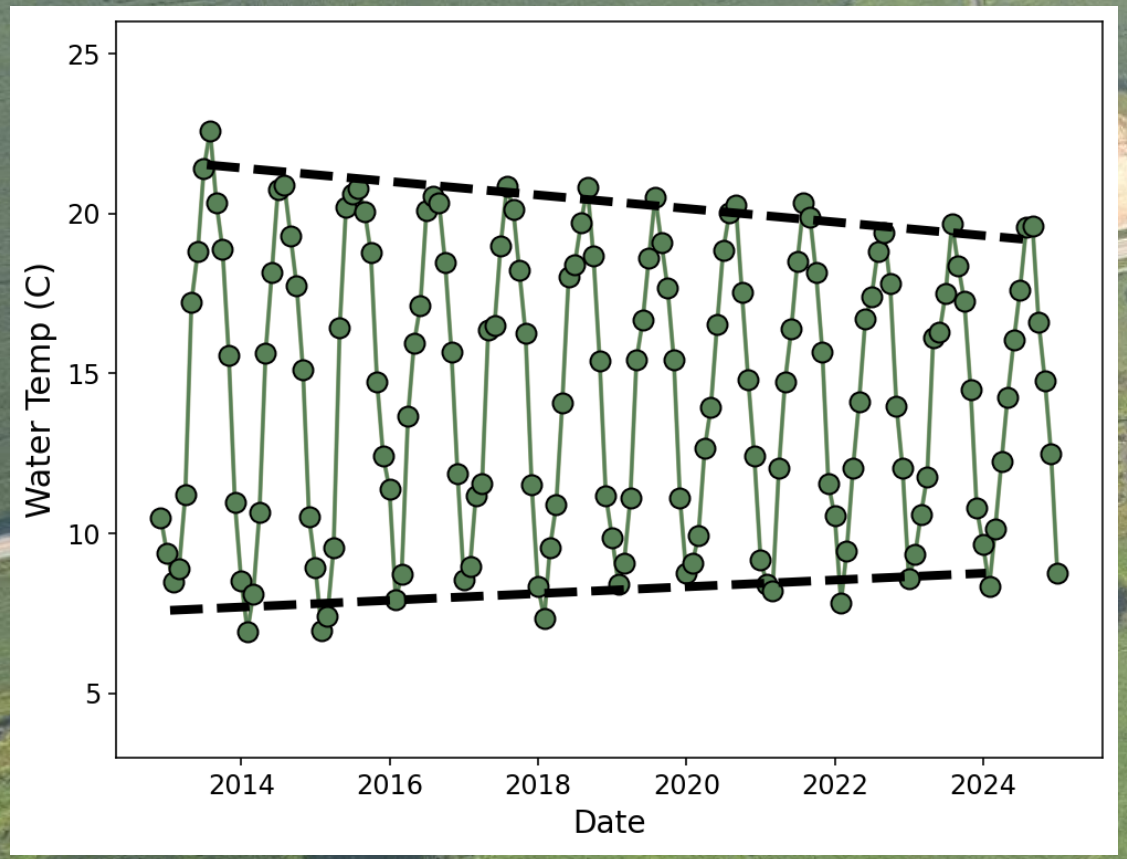




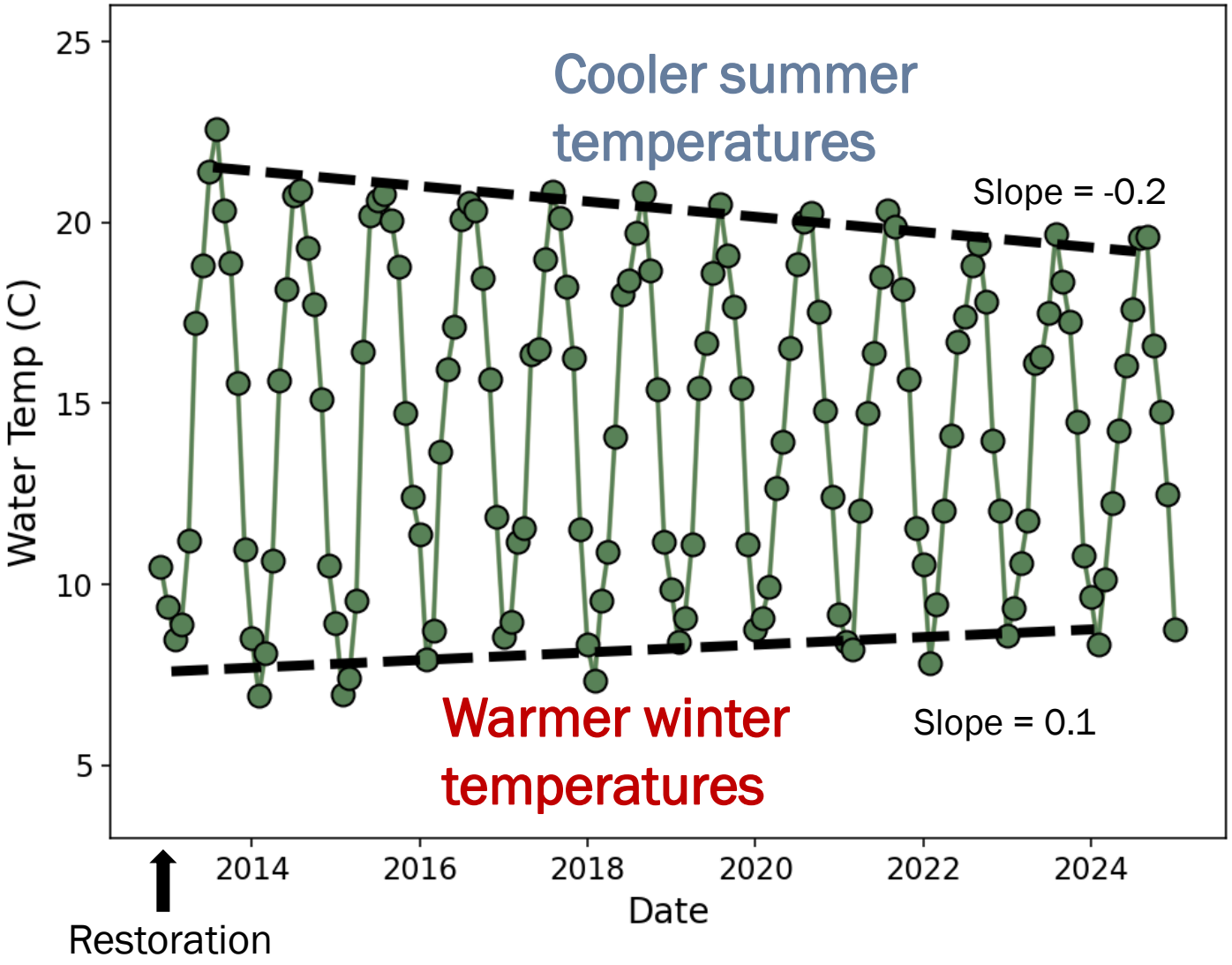
- The flow regime shift suggests influences beyond climatic variability and aligns with restoration efforts

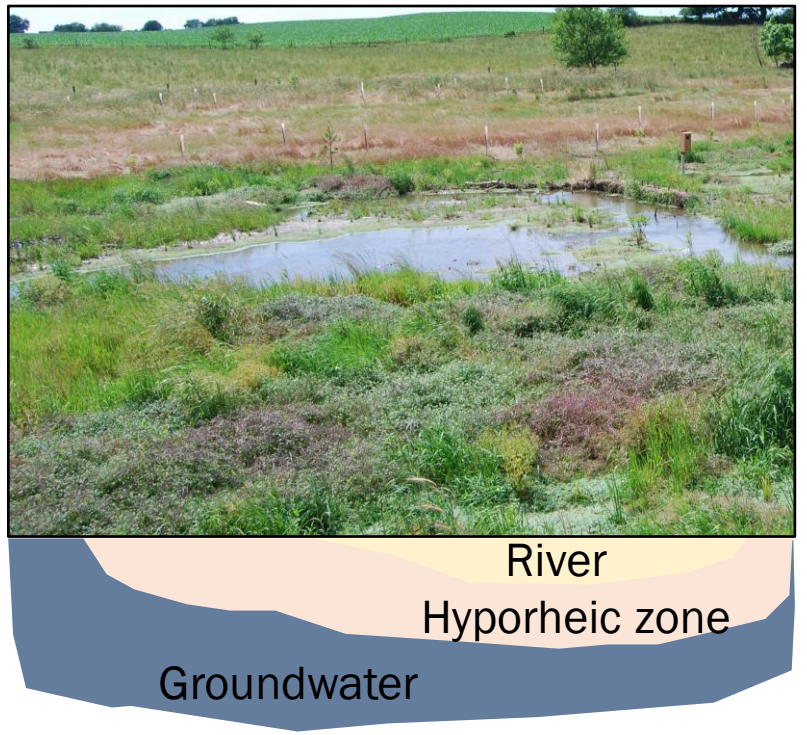
Legacy Sediment restoration at Big Spring Run

- How has floodplain restoration influenced river thermal regimes?

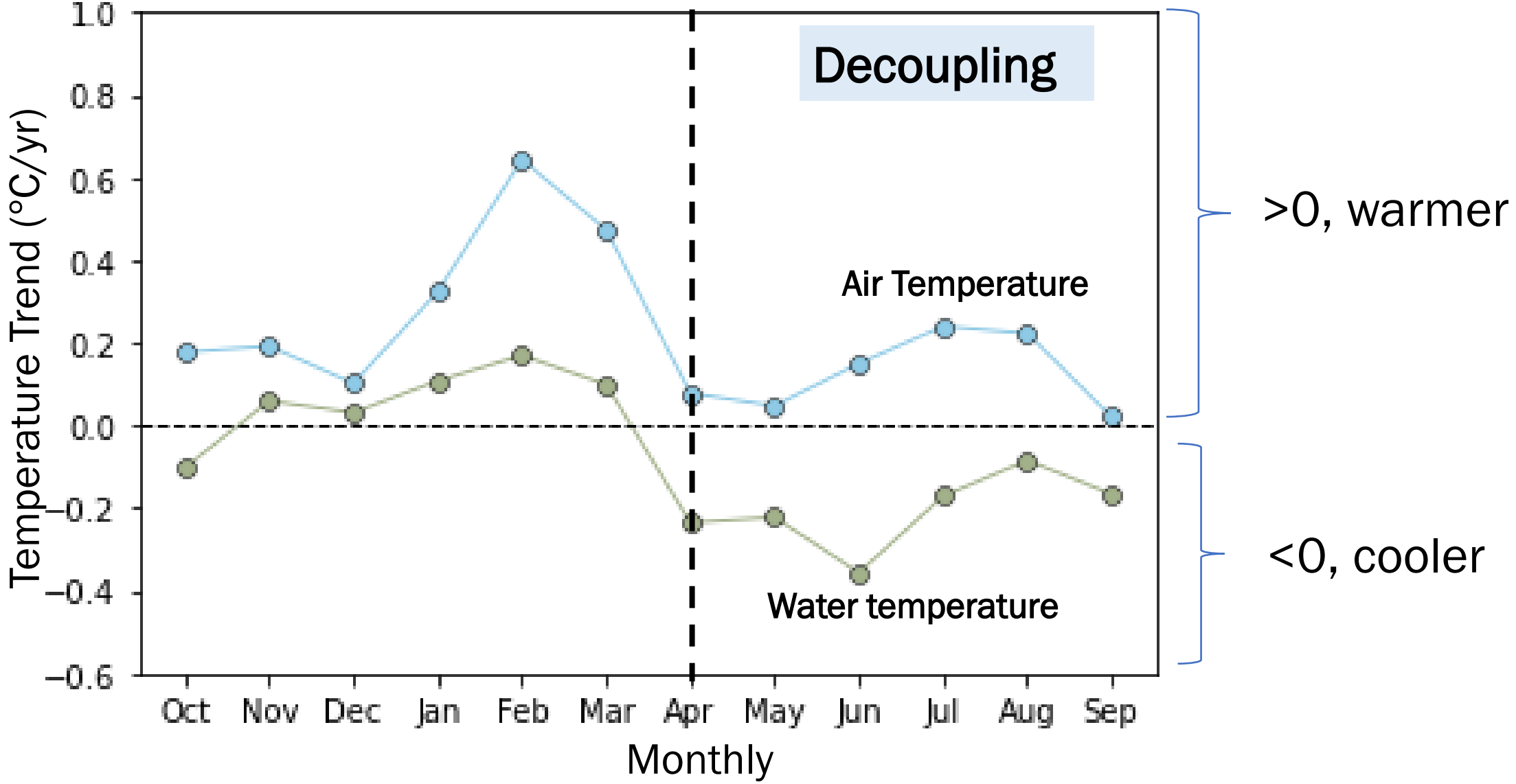


Moderated water temperatures

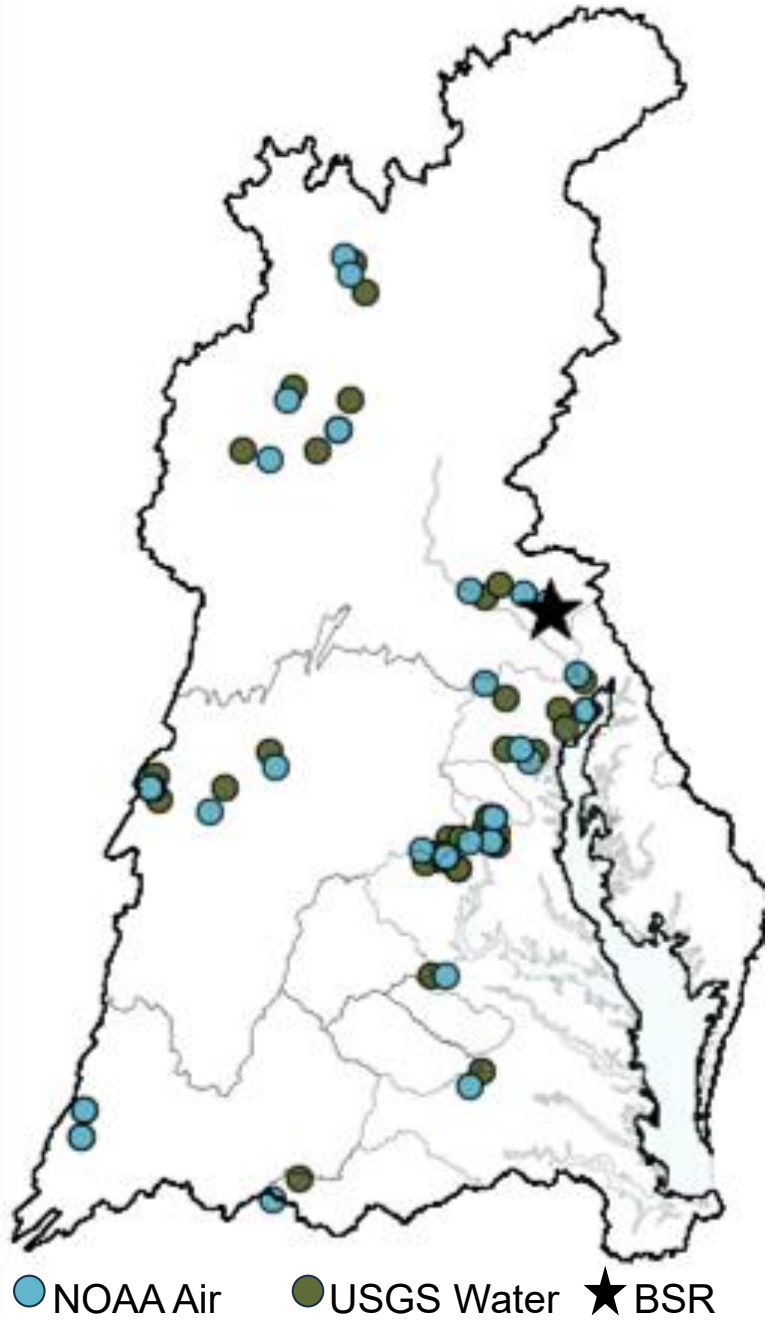


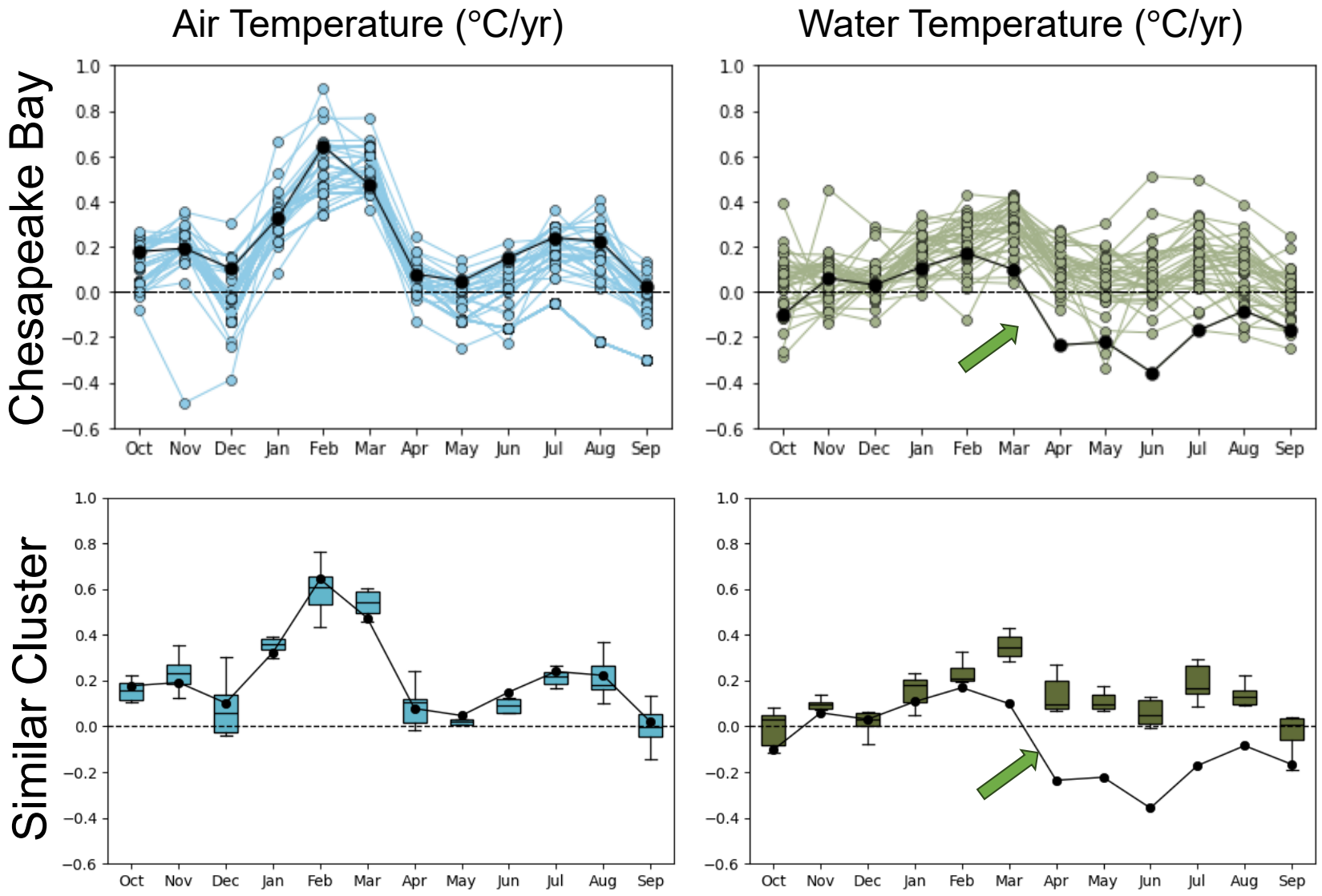


Daily maximum Air and Water Temperature Trends (2011-2024)



Temperature Trends: Chesapeake Bay and Similar Streams





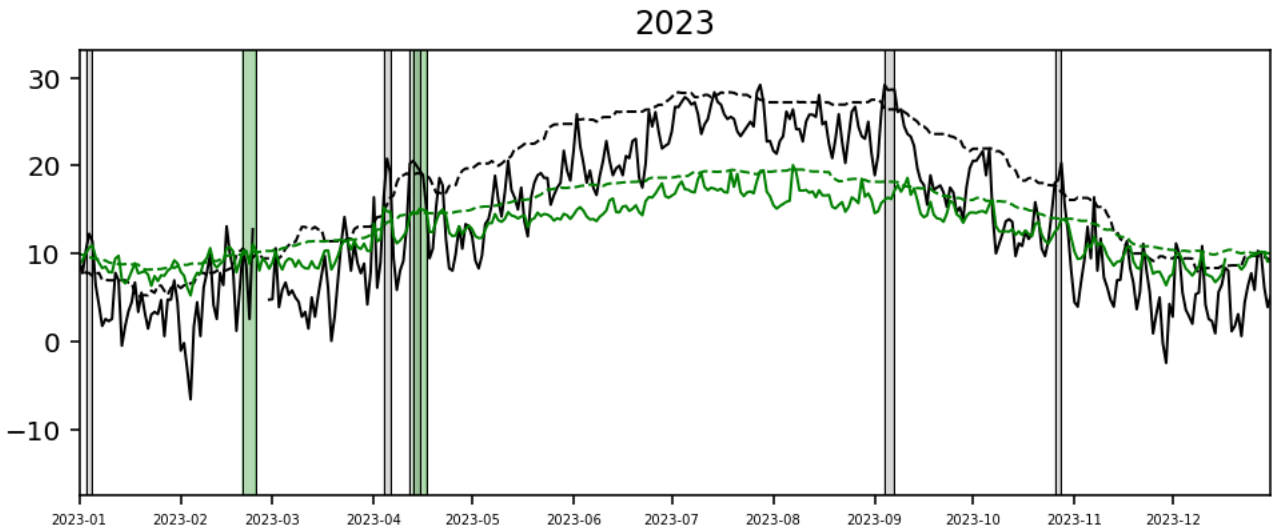
PNAS RESEARCH ARTICLE | ENVIRONMENTAL SCIENCES OPEN ACCESS

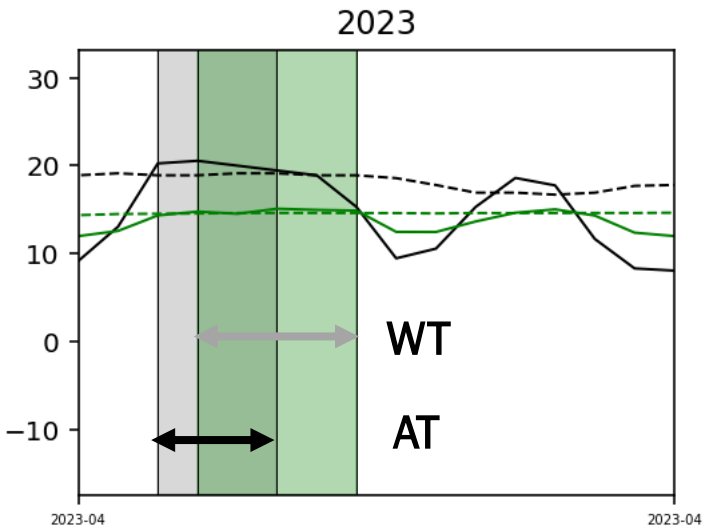
Riverine heat waves on the rise, outpacing air heat waves

Kayalvizhi Sadayappan[a] and Li Li[a,1]

Edited by Nancy Grimm, Arizona State University, Tempe, AZ; received February 10, 2025; accepted July 31, 2025

Heatwaves





Air heatwave (AT) Water heatwave (WT)

- Heatwaves are defined as consecutive days when temperature exceeds the local, seasonally varying 90th percentile.

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Heatwaves

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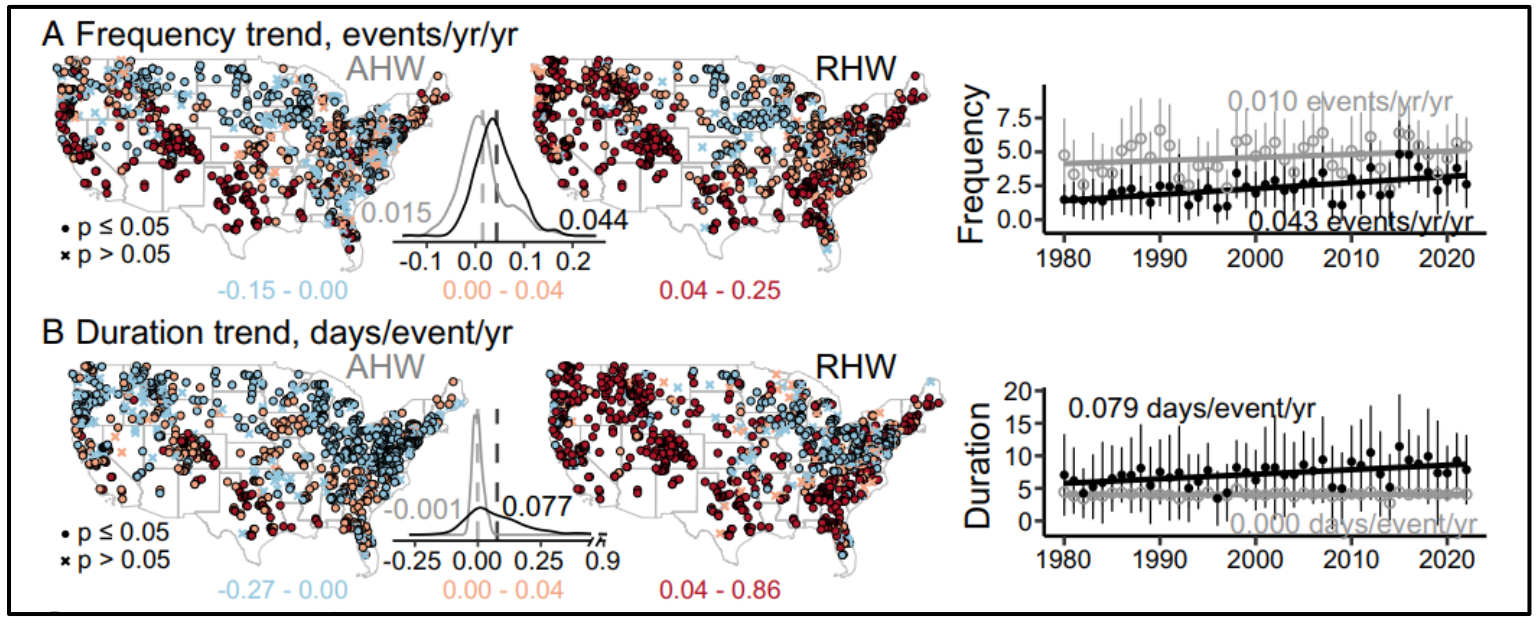
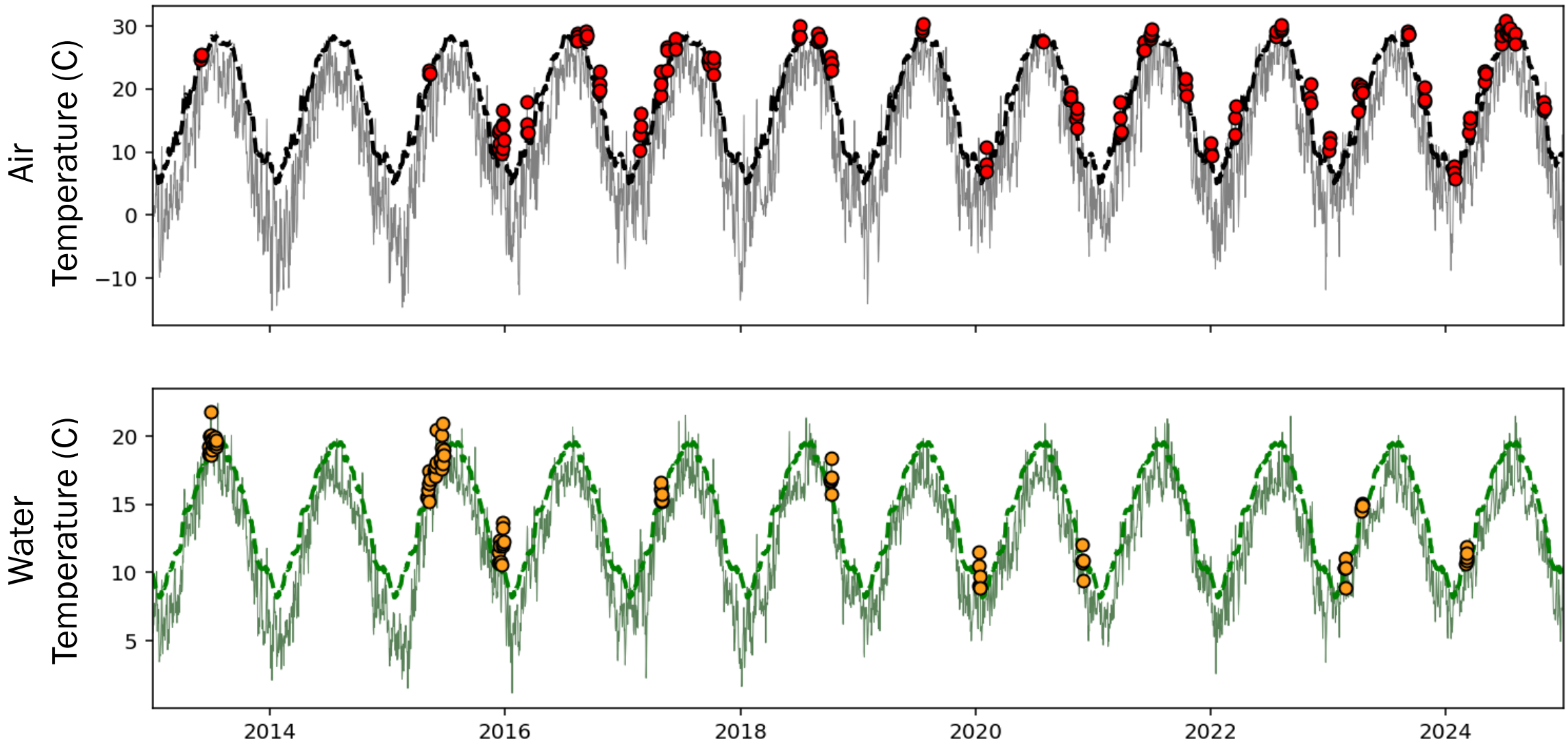


River heat waves rise more rapidly than air heat waves.

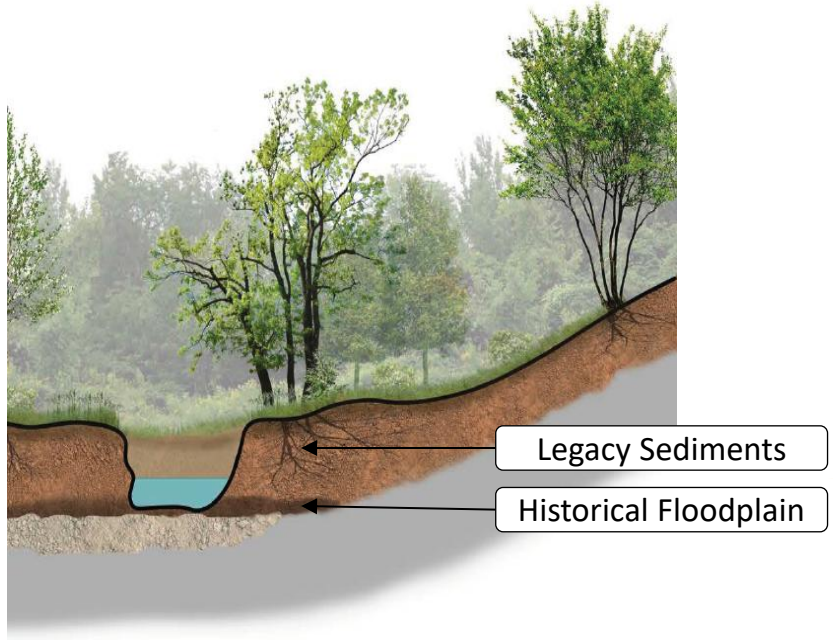
River heat waves become more frequent, intense, and longer.

BSR Air and Water Heatwaves



Benefits of Legacy Sediment Removal (LSR) Restoration

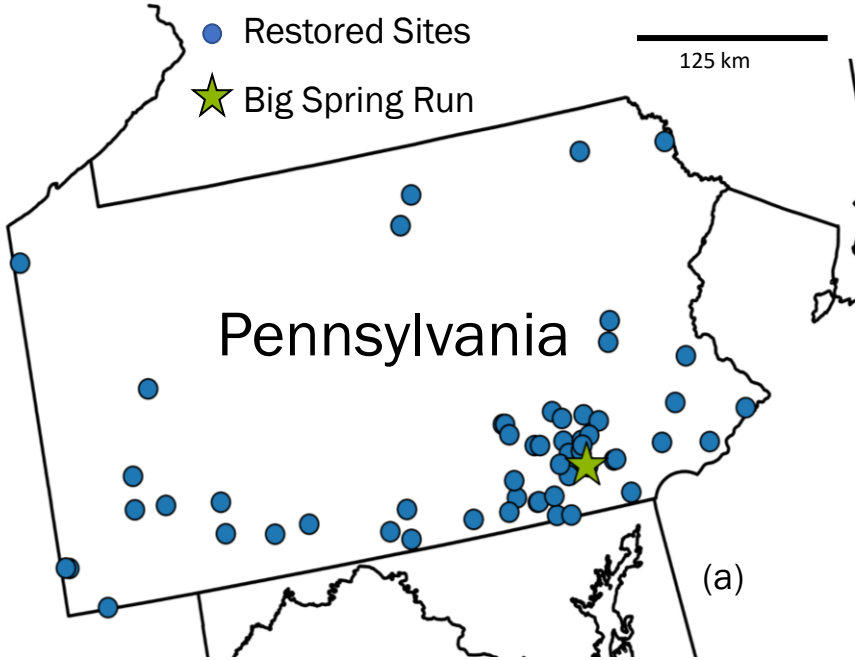
Pre-Restoration



Post-Restoration

Land Studies

- Reduced Erosion
- Floodplain Stability
- Rise Baseflow
- Enhanced Storage Capacity
- Moderate River Temperature



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Thank you!
Questions?