



Use of drinking water treatment residuals in green stormwater infrastructure retrofits for enhanced P removal

Mike Ament, Ph.D. Candidate, University of Vermont



Contributing Authors: Dr. Eric Roy (UVM), Dr. Stephanie Hurley (UVM), Dr. Yongping Yuan (EPA), Eric Perkins (EPA), Mark Voorhees (EPA)



Urbanization and climate change driving increased stormwater volumes



Green stormwater infrastructure increasingly used to manage urban runoff

Bioretention



Stormwater Ponds



Gravel Wetlands



Managing stormwater at its source with GSI



Hydrologic Control:

- Temporarily hold water on the landscape
- Reduce peak flow rates

Water Quality Control

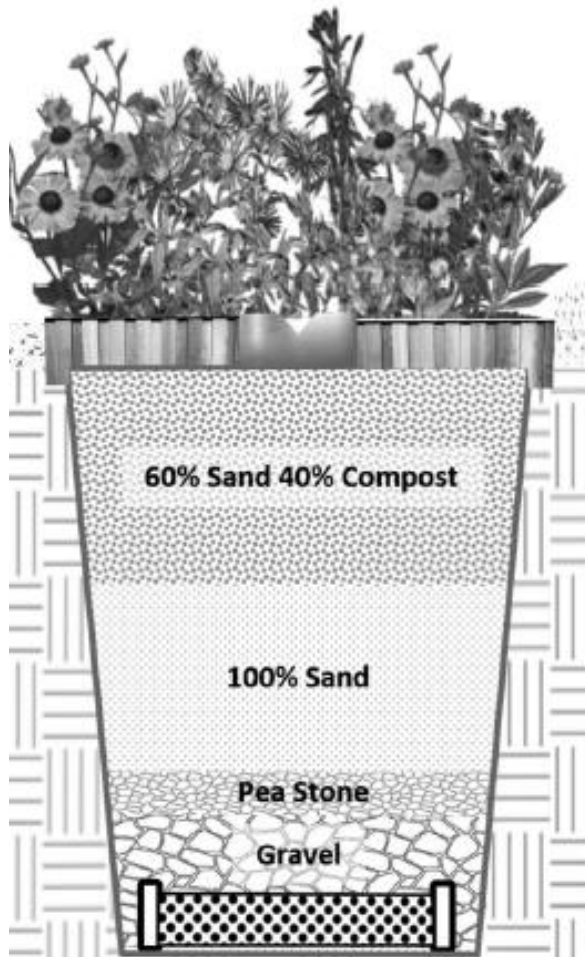
- Remove contaminants (*sediments, nutrients, heavy metals*)

Phosphorus control particularly important for freshwater ecosystems



P removal in GSI is highly variable

Bioretention



Stormwater Ponds



P sorbing amendments

Fly Ash



Steel Slag



Water Treatment Residuals



Challenging tradeoff

P Sorption



Hydraulic
Conductivity



Tradeoff pronounced in urban bioretention



My Research: How can we use DWTRs in bioretention to enhance P removal without restricting flow?



Research methodology



- 1) Material Characterization
- 2) P Sorption Capacity
- 3) Sorption Kinetics



Bioretention Media Design

Media Blends

Control

90% Sand +
10% Low P Compost

100% Sand

Pea Stone

Gravel



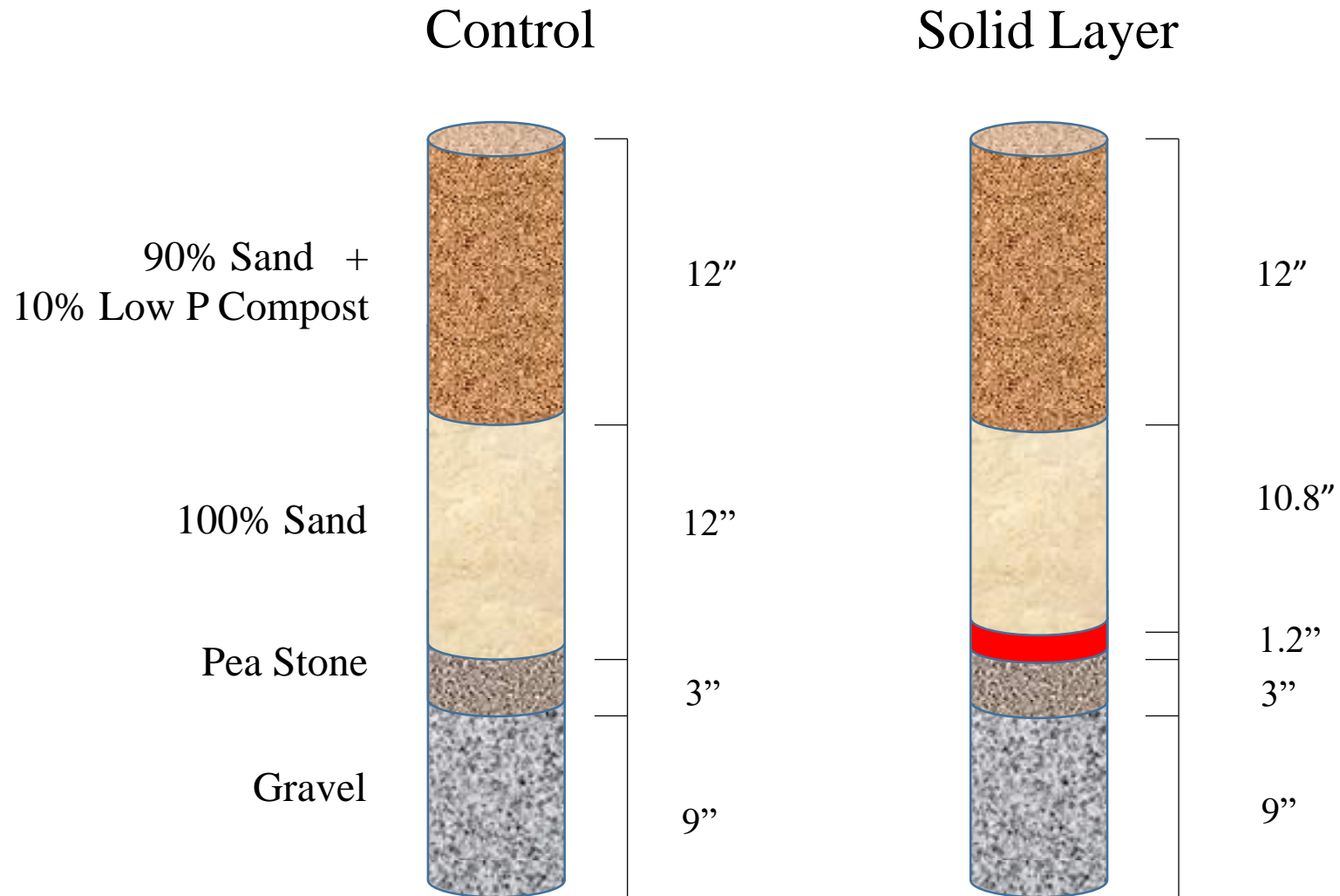
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12"

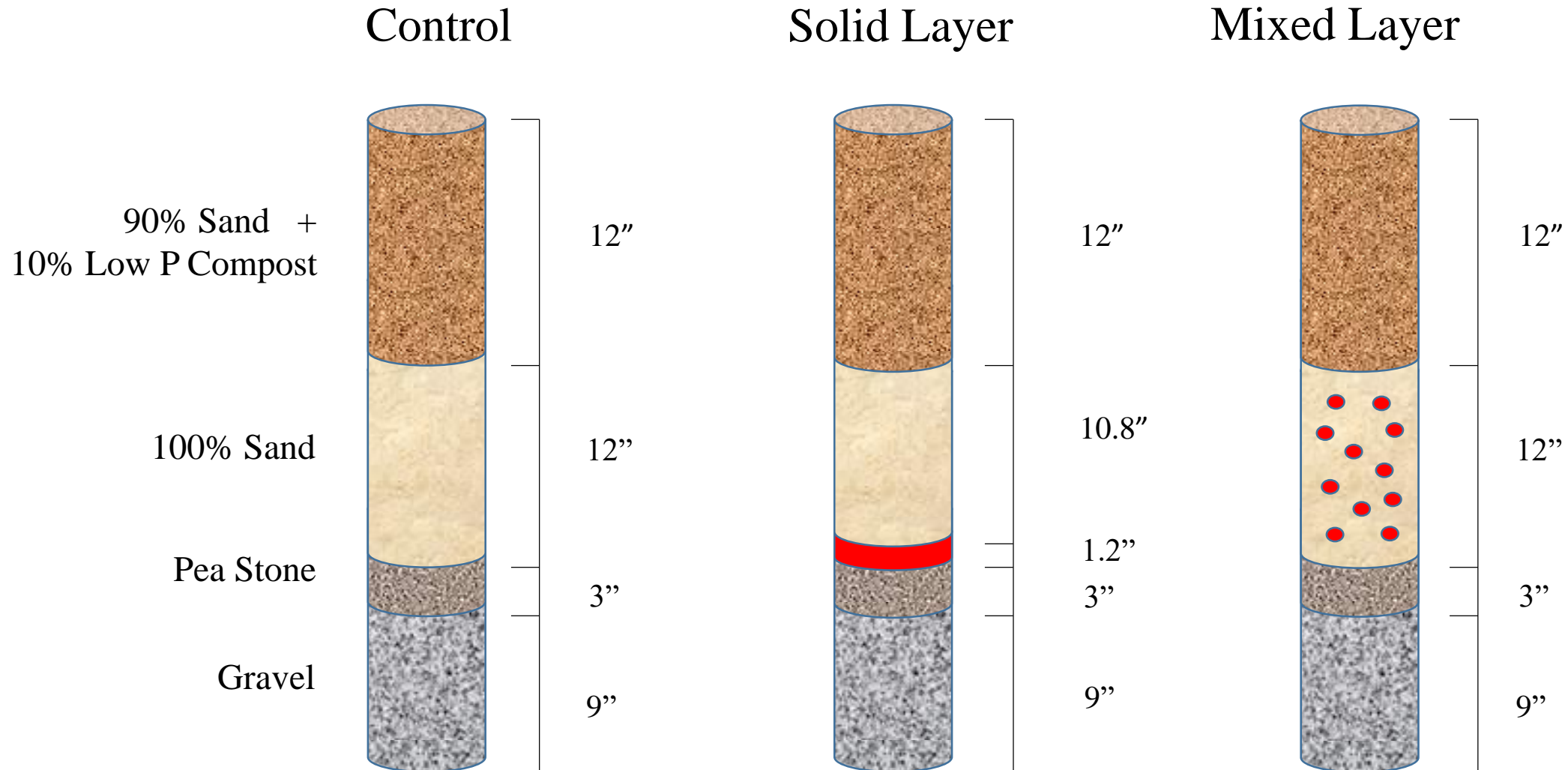
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9"

Media Blends



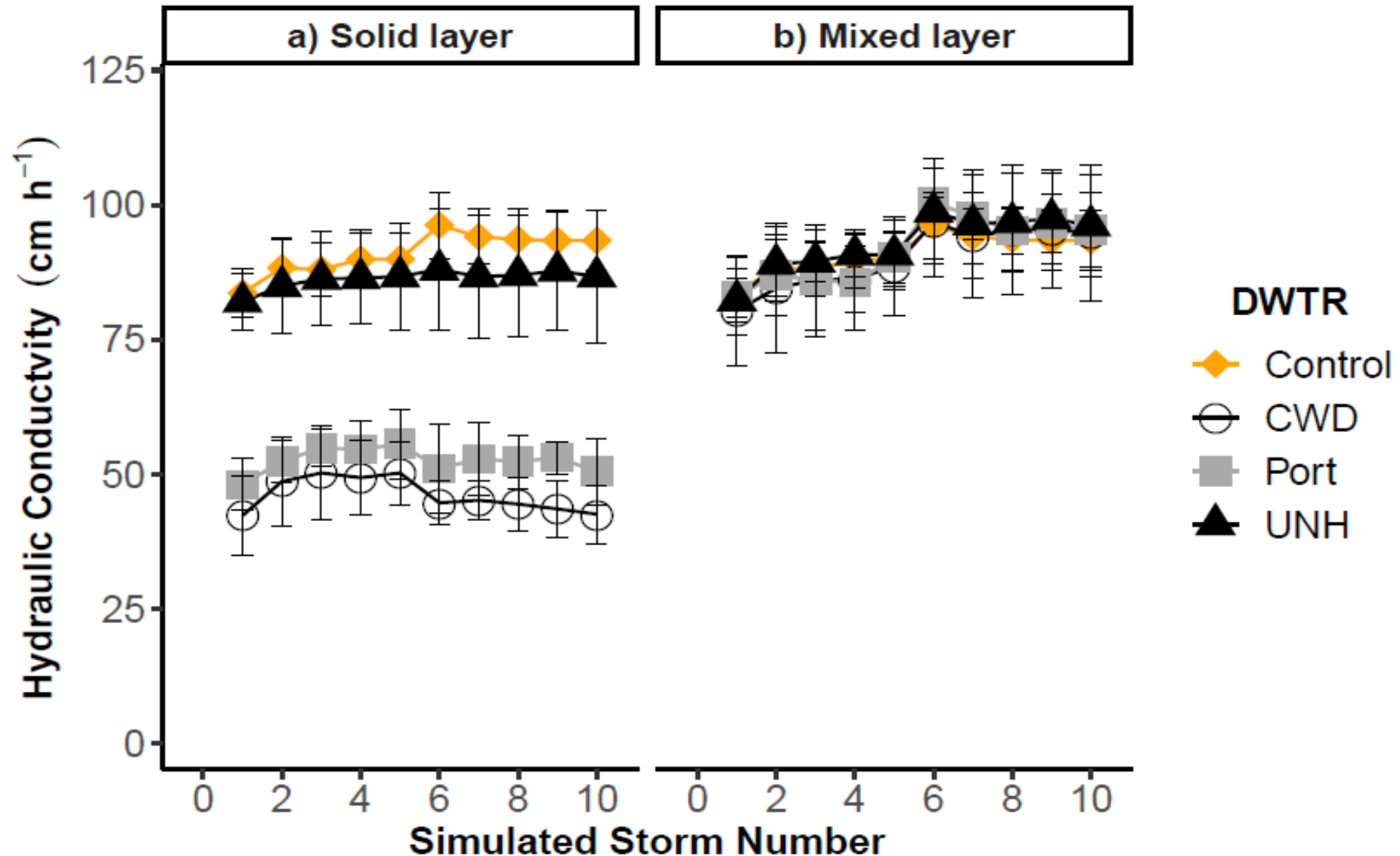
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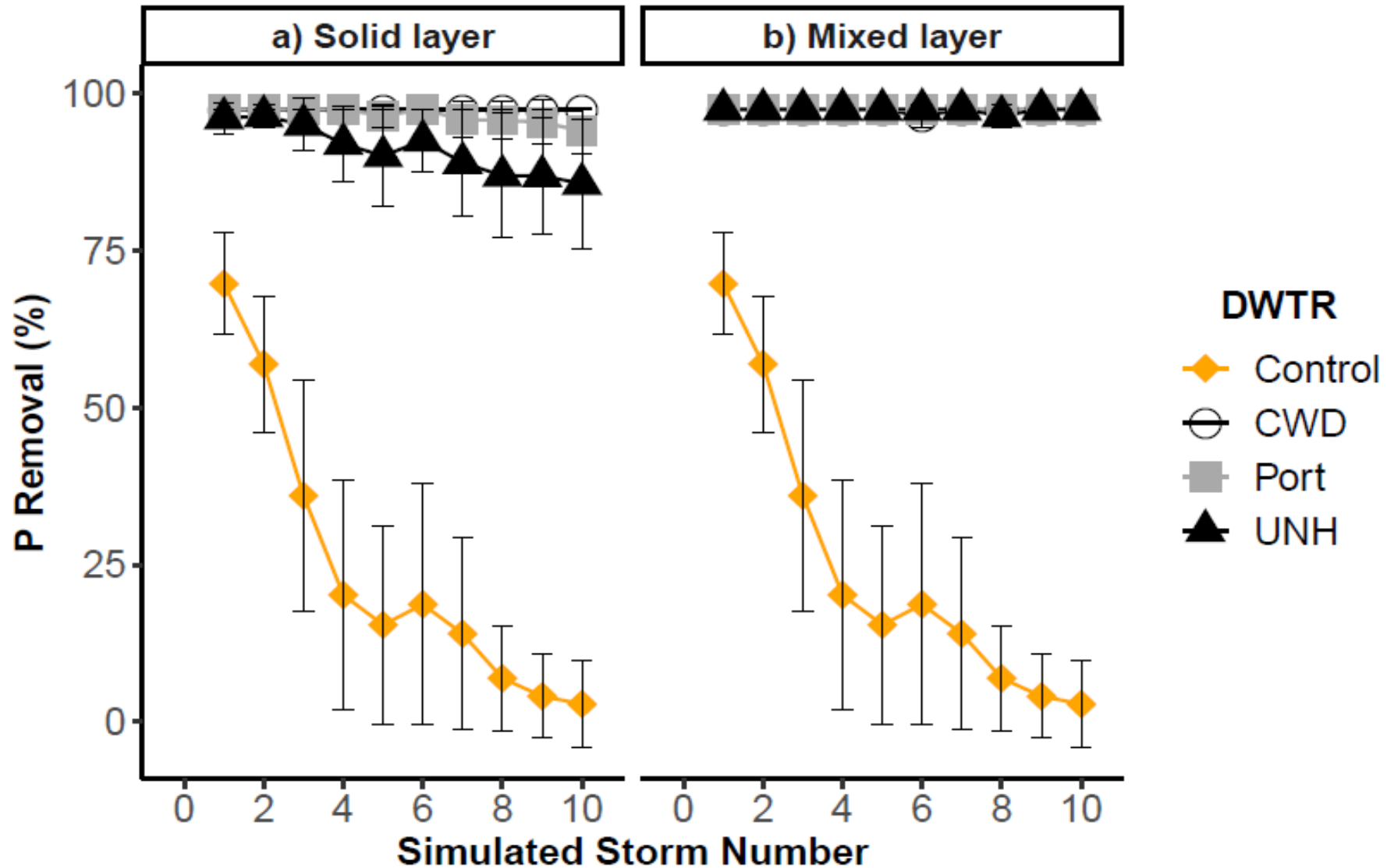
Large Column Study



Large column results: *hydraulic conductivity*



Large column results: *P* removal



Key takeaways

- 1) P sorbing materials can provide long-term P removal in GSI
- 2) Tradeoffs can be mediated through design

Challenges and opportunities

Bioretention:

- Full system retrofits are expensive
- Cartridge filters have potential, but practically challenging
 - a) placement (inside or outside the system?)*
 - b) hydraulic restrictions*
 - c) hydraulic bypass*
- Woodchips coated in DWTRs
- Granularization of DWTRs

Challenges and Opportunities

Stormwater Ponds:

- Placement (*pond sediment vs end of pond filter*)?
 - Reliance on diffusion vs flow?
 - How to create hydraulic head?
 - Risk of clogging and localized flooding
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- Combining DWTR-based filters with pond fountains for simultaneous aeration and P removal?

Questions?