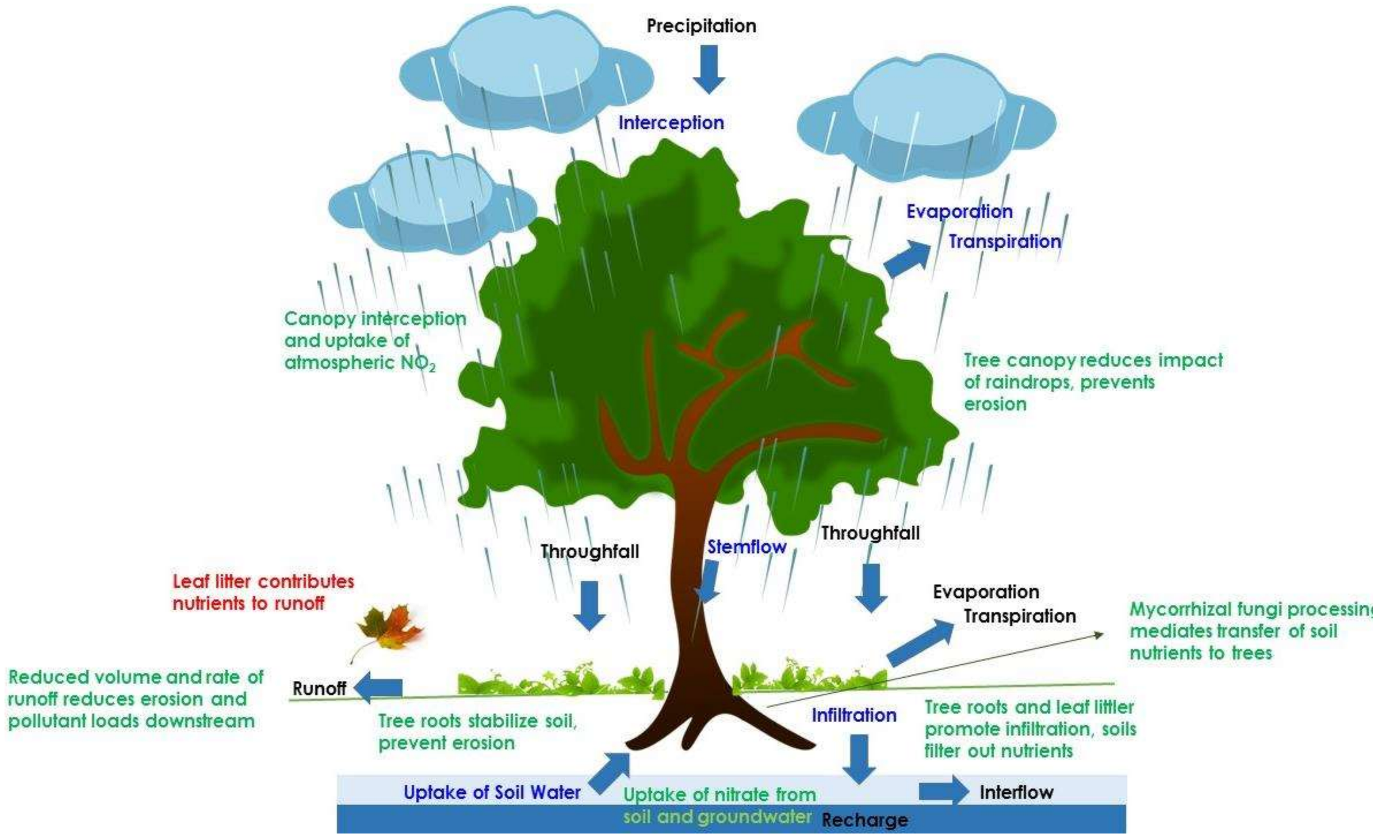
Session 1 – Innovations in Stormwater Control Measures

With a Focus on Nutrient Control

May 10, 2023

The Future of Stormwater In New England:
Strategies to solve our nutrient dilemma

Role of Urban Trees in Stormwater Management



CENTER FOR WATERSHED PROTECTION

Deb Caraco, PE
Senior Water Resources Engineer

Urban Trees as a Stormwater Practice: Key Questions

- How should we credit urban BMPs?
- Do trees function differently in different settings?
- How should they be modeled?
- How should we account for trees as they grow/die off?
- For Phosphorus: How should leaf litter be managed?

Recent Research on Bioretention Soil Media

Dr. Stephanie Hurley, DDes, MLA
Associate Professor, Department of Plant & Soil Science
Fellow of the Gund Institute for Environment
University of Vermont

The Future of Stormwater In New England:
Strategies to solve our nutrient dilemma

Nutrient Leaching from Compost & Lessons for Bioretention Soil Media Design

- Lab study: Variability among composts tested, but all leached dissolved P and nitrate.
- Field study: 4-year old bioretention systems still leaching P and N.
- **Choose "low-P" composts primarily derived from yard, leaf, and wood waste,** and *avoid* feedstocks with manures, biosolids, foodscraps
- Consider "spot applying" compost only where roots can use it
- Limit compost application near nutrient-impaired waters, and areas prone to saturation.
- *Going Forward with Bioretention Soil Media and Gravel Bed Wetland installations*: Test the compost alone, or the combined soil media [New Testing Guidance!]

Bioretention Field Study Results (800+ samples, 8 bioretention cells)

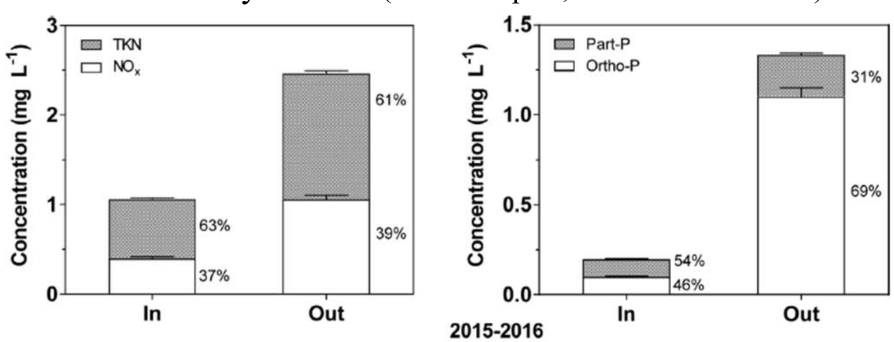


Fig. 4. Nitrogen and phosphorus composition for storm inflows and outflows (for matched samples only) monitored across all storm events from May to October/November 2015 and 2016 ($802 \le n \le 843$). Numbers beside each box show the percent mean, and error bars are ± 1 SE. The total bars represent total nitrogen (TKN + NO_x) and total phosphorus (Part-P + Ortho-P).

Bioretention and Gravel Wetland Soil Media Testing Guidance

Phosphorus Testing Requirement

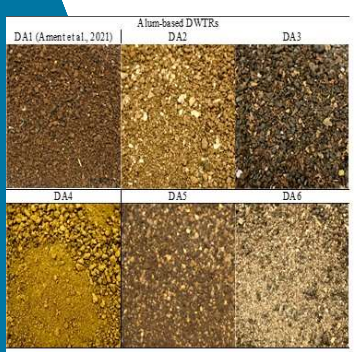
P testing is required for **upper media layer of bioretention systems** and **gravel wetland soil layers**. Final mixes must have a Phosphorus Saturation Ratio (PSR) less than or equal to 0.10

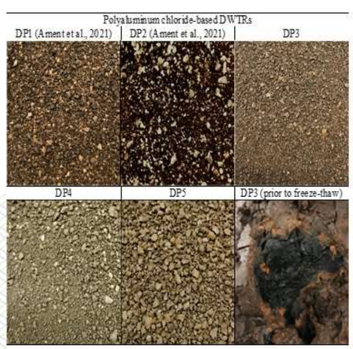
https://www.uvm.edu/seagrant/outreach/green-infrastructure-stormwater

NEWEA
WORKING FOR WATER QUALITY

Drinking Water Treatment Residuals for Phosphorus Sorption

- DWTR is a variable material with variable performance in lab studies: P retention by DWTR materials is generally high, but varies by ~1 order of magnitude.
- Low bulk density, high porosity, and high Al_{ox} + Fe_{ox} can be good predictors for DWTR P sorption
- Arsenic leaching risk is low but should continue to be studied; DWTRs should be tested for PFAS abundance at least once prior to use in the field
- Mixed layers preferred in lab simulations *and* field studies comparing bioretention media with and without DWTR.
- New research compares low-P topsoil, woodchips and DWTR in bioretention mesocosms





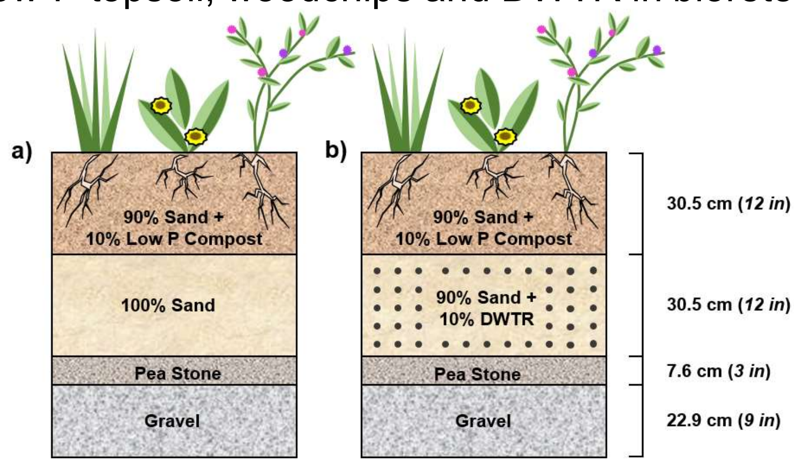


Fig. 1. *Bioretention media profiles: (a) control media; and (b) DWTR media.*

References

Ament, M.R., Hurley, S.E., Voorhees, M., Perkins, E., Yuan, Y., Faulkner, J.W., Roy, E.D., 2021. Balancing Hydraulic Control and Phosphorus Removal in Bioretention Media Amended with Drinking Water Treatment Residuals. ACS ES&T Water 1, 688–697.

Ament, M., Roy, E., Yuan, Y., and Hurley, S. 2021. “Phosphorus removal, metals dynamics, and hydraulics in stormwater bioretention systems amended with drinking water treatment residuals.” *Journal of Sustainable Water in the Built Environment.*

Coleman, S., Hurley, S**.**, Koliba, C., Rizzo, D. and Zia, A. 2018. “From the Household to Watershed: a cross-scale analysis of residential intent to adopt Green Stormwater Infrastructure.” *Landscape and Urban Planning*.

Cording, A., Hurley, S., and Adair, C. 2018. “Influence of critical bioretention design factors and projected increases in precipitation due to climate change on roadside bioretention performance.” *Journal of Environmental Engineering* 144(9).

Cording, A., Hurley, S., and Whitney, D. 2017. “Monitoring methods and designs for evaluating bioretention performance.” *Journal of Environmental Engineering*, 143(12).

Hurley, S., Shrestha, P., Cording, A. 2017. “Nutrient leaching from compost: implications for bioretention and other green stormwater infrastructure.” *Journal of Sustainable Water in the Built Environment*, American Society of Civil Engineering, 3(3).

Sarazen, J. Hurley, S. and Faulkner, J. 2022. “Nitrogen and Phosphorus Removal in a Bioretention Cell Experiment Receiving Agricultural Runoff from a Dairy Farm Production Area During Third and Fourth Years of Operation” *Journal of Environmental Quality*.

Shrestha, P., Hurley, S., and Adair, C. 2018. “Soil Media CO_2 and N_2O Fluxes Dynamics from Sand-Based Roadside Bioretention Systems.” *Water* 10(2): 185.

Shrestha, P., Faulkner, J., Kokkinos, J., and Hurley, S. 2020. “Influence of low-phosphorus compost and vegetation in bioretention for nutrient and sediment control in runoff from a dairy farm production area.” *Ecological Engineering* 150.

Shrestha, P., Hurley, S., and Wemple, B. “Effects of different soil media, vegetation, and hydrologic treatments on nutrient and sediment removal in roadside bioretention systems.” *Ecological Engineering* 112: 116-131 (March 2018).

Infiltration trenches as nutrient reduction tool in cities

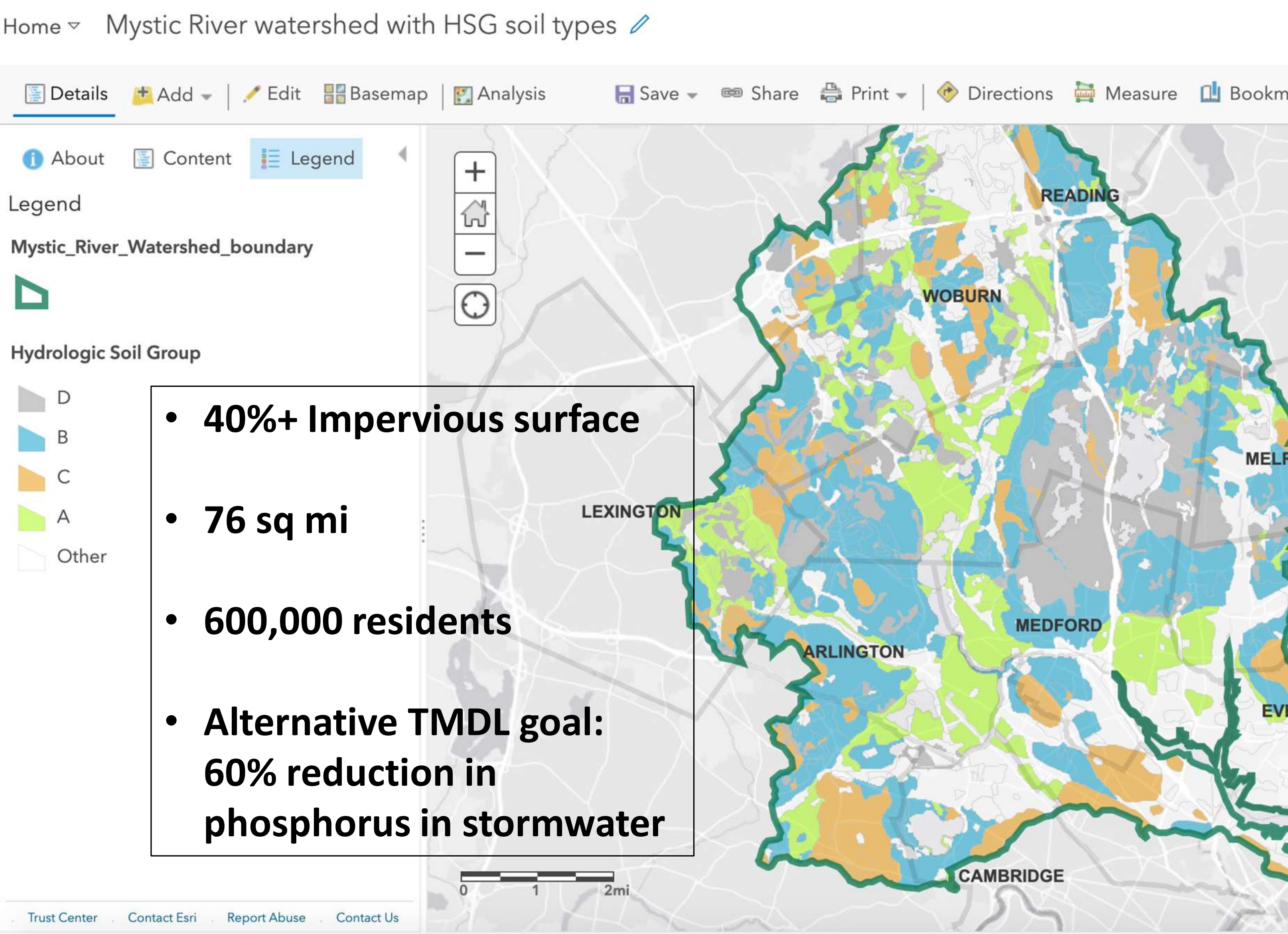
Lessons from Stormwater Retrofits in the Mystic River Watershed

Andy Hrycyna, Mystic River Watershed Association

May 10, 2023

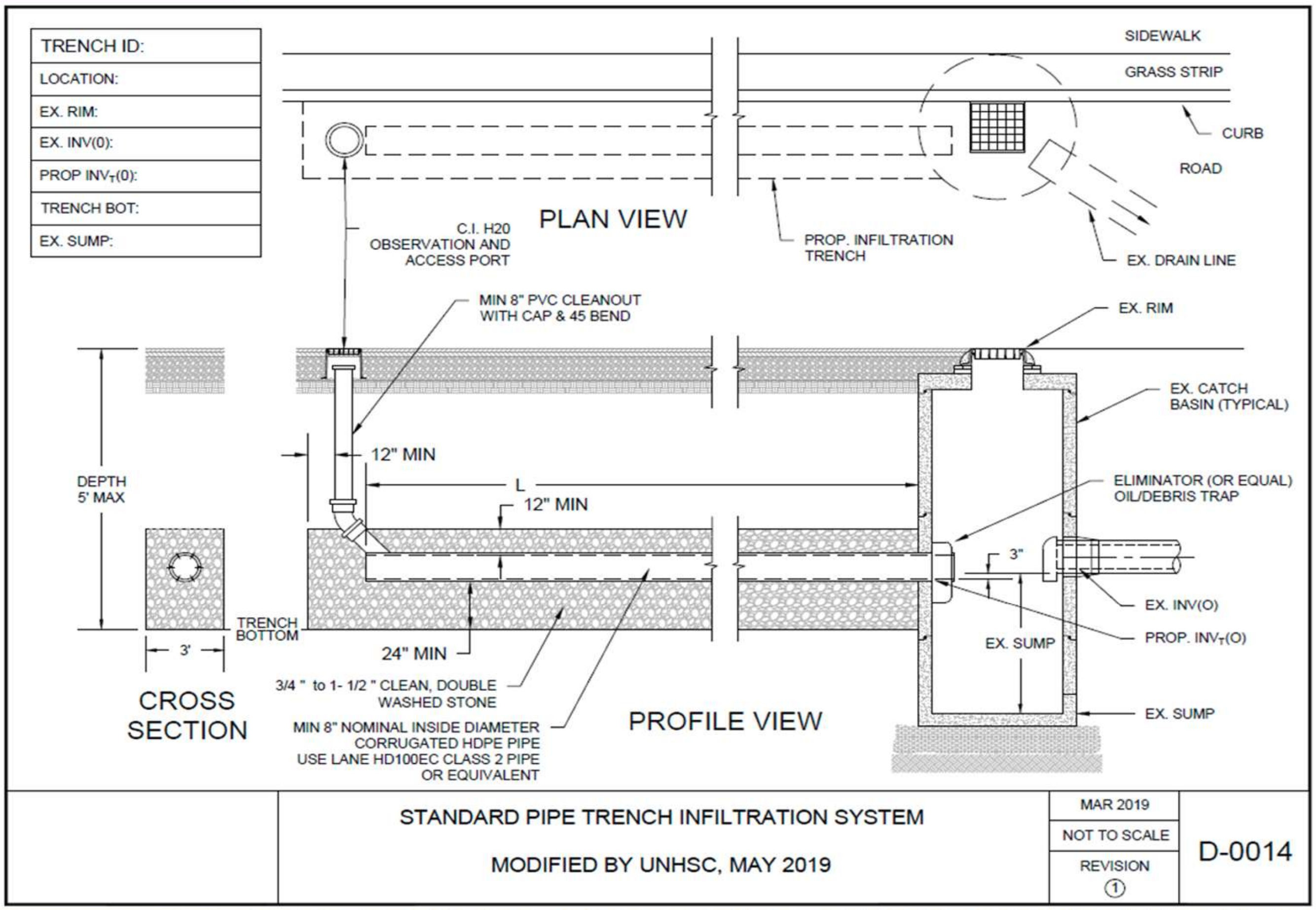
The Future of Stormwater In New England:
Strategies to solve our nutrient dilemma

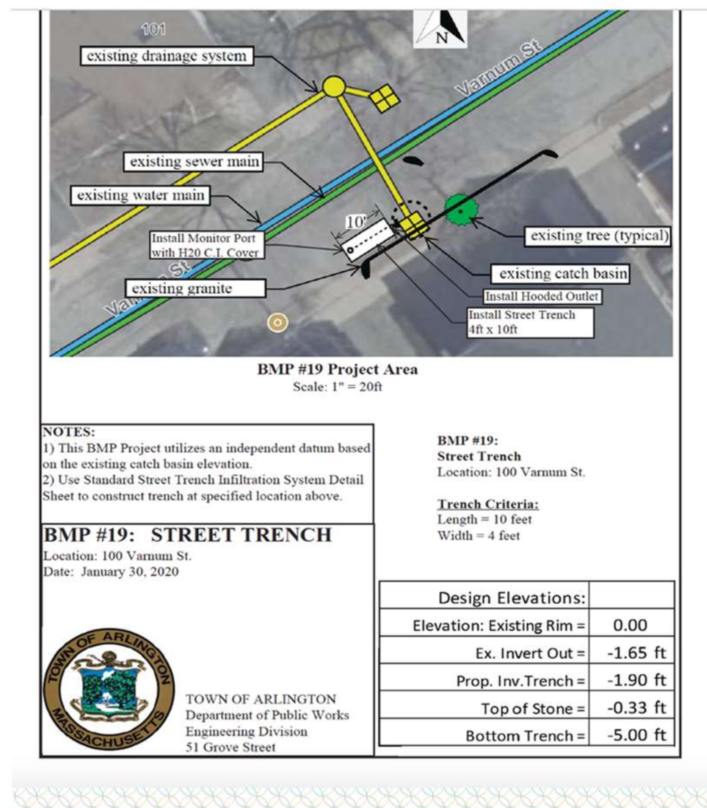
Mystic River
WATERSHED ASSOCIATION



- **40%+ Impervious surface**
- **76 sq mi**
- **600,000 residents**
- **Alternative TMDL goal: 60% reduction in phosphorus in stormwater**

Stormwater Infiltration Trenches: Arlington & UNHSC





Resource List for Urban Trees

Deb Caraco
Center for Watershed Protection
dsc@cwp.org

Making Urban Trees Count:
https://cwp.org/making-urban-trees-count

Urban Watershed Forestry:
https://cwp.org/urban-watershed-forestry

Novel Research Approach to Quantify the Stormwater Benefits of Urban Trees:
https://cbtrust.org/we-content/Novel_Research_Final_Report_CWP_July_2022.pdf