BMP Evaluation and Design Improvement

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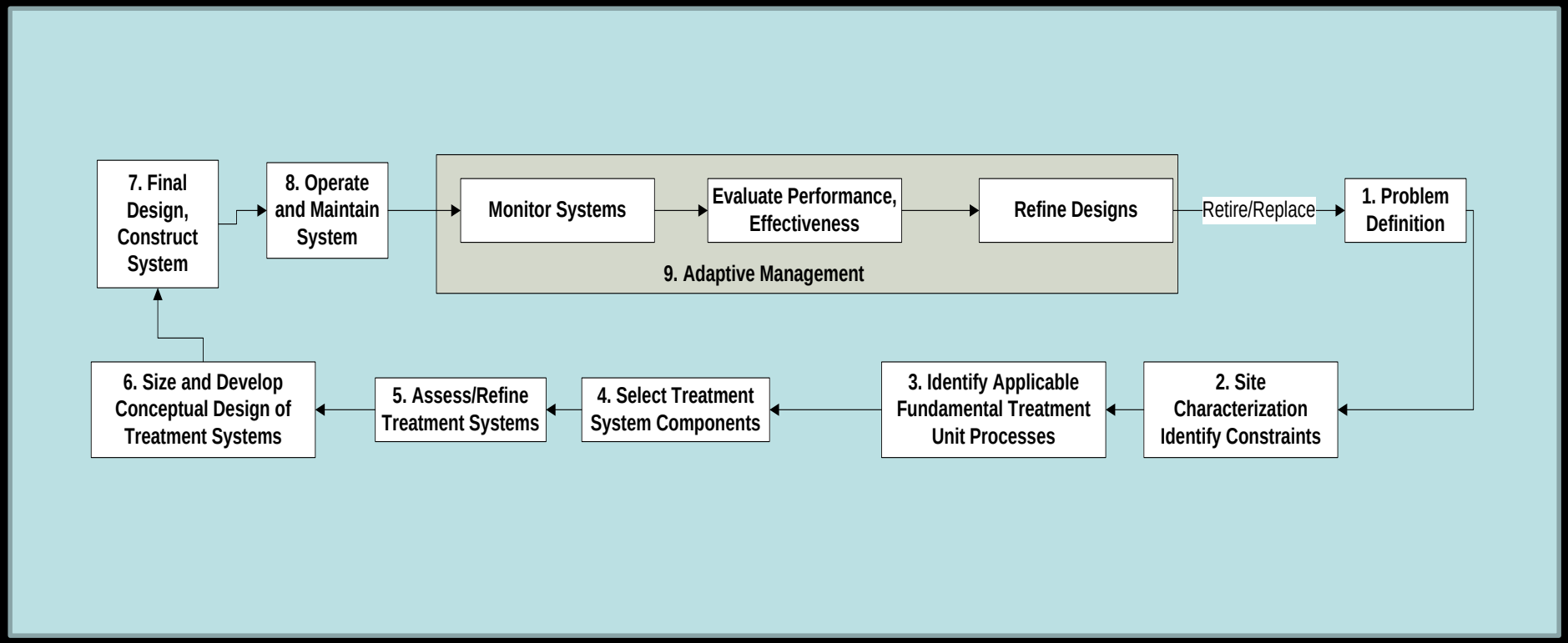
Evaluating Proprietary BMPs, is it Time for a State, Regional or National Program?
Northern Virginia Regional Commission, Fairfax, VA
March 24, 2015

VirginiaTech
Invent the Future

Outline

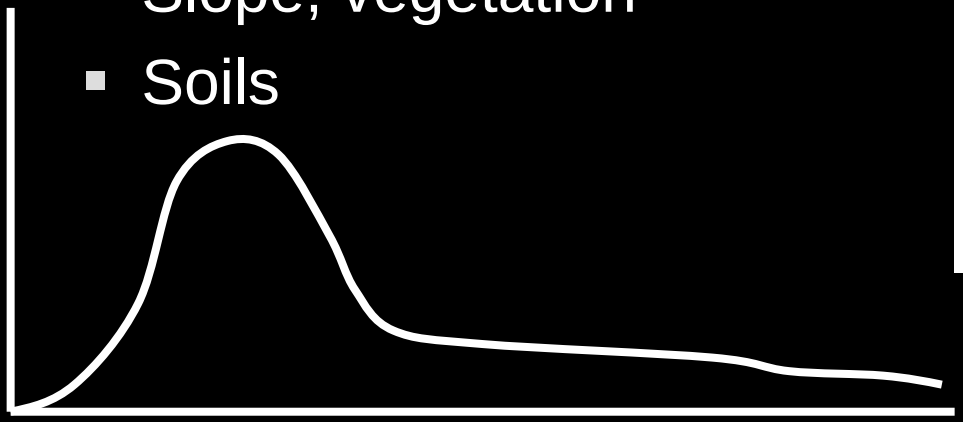
- Adaptive management in design
- Stormwater quality and BMP effectiveness
- Monitoring to support design
- Modeling to support design
  - Computational model
  - Physical model
- Balancing competing interests in BMP evaluations

Adaptive Management in Design



Stormwater Quality-Variability

- Stormwater Quality highly variable
  - Spatial
  - Temporal
- Function of:
  - Land use/imperviousness
  - Slope, vegetation
  - Soils



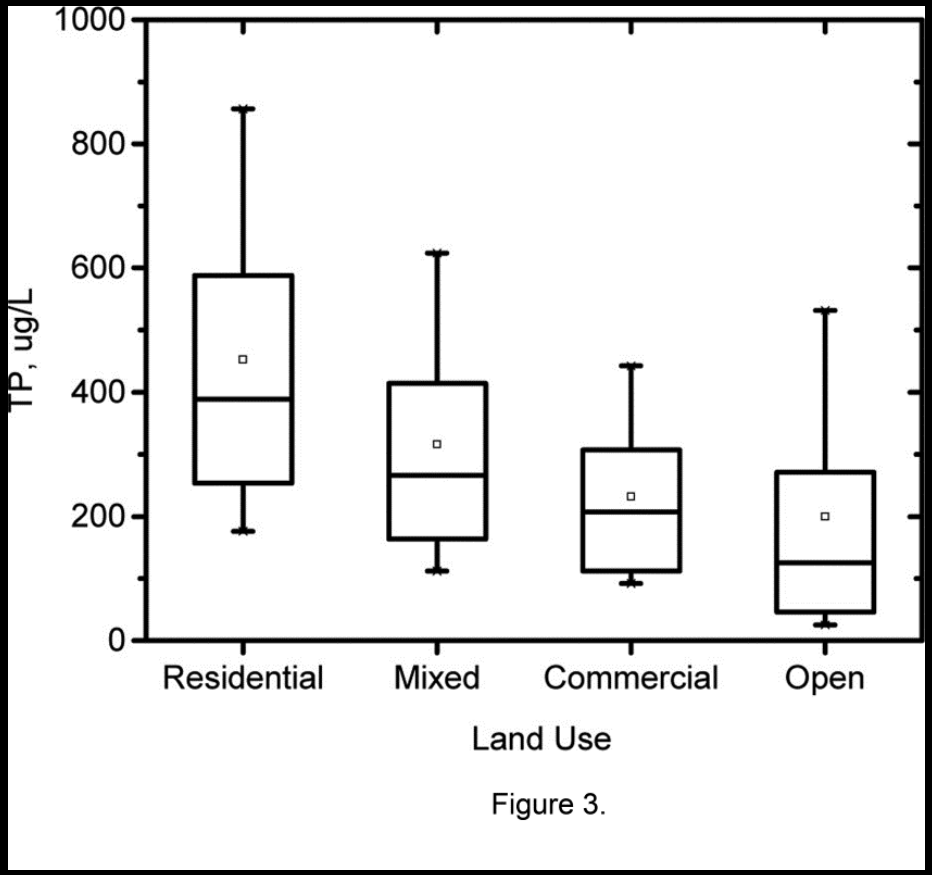


Figure 3.

Sample, D.J., Grizzard, T.J., Sansalone, J., Davis, A.P., Roseen, R.M., Walker, J., 2012. Assessing performance of manufactured treatment devices for the removal of phosphorus from urban stormwater. Journal of Environmental Management, 113, pp. 279-291, doi: 10.1016/j.jenvman.2012.08.039.

BMP Efficiency Varies

- RRM, literature review, expert panel assessment
  - Level 1- median removal efficiency
  - Level 2- 3rd quartile (75%) removal efficiency

Practice	Total Nitrogen				Total Phosphorous	
	RRM TNR (%)		*Koch et al. TNR (%)*		*RRM TPR (%)*	*Weiss et al. TPR (%)*
	Q50	*Q75*	*Q50*	*Q75*[1]	*Q50*	*Average*[5]
ED Pond	10	24	18	-[2]	15	25
Wet Pond	30	40	40	65	50	52
Wetland	25	55	61	81	50	42
Swale	25-55[3]	35-74[3]	50	52[4]	-	-
Bioretention	-	-	-	-	55	72
Sand Filter	-	-	-	-	60	46
Infiltration	-	-	-	-	63	65[6]

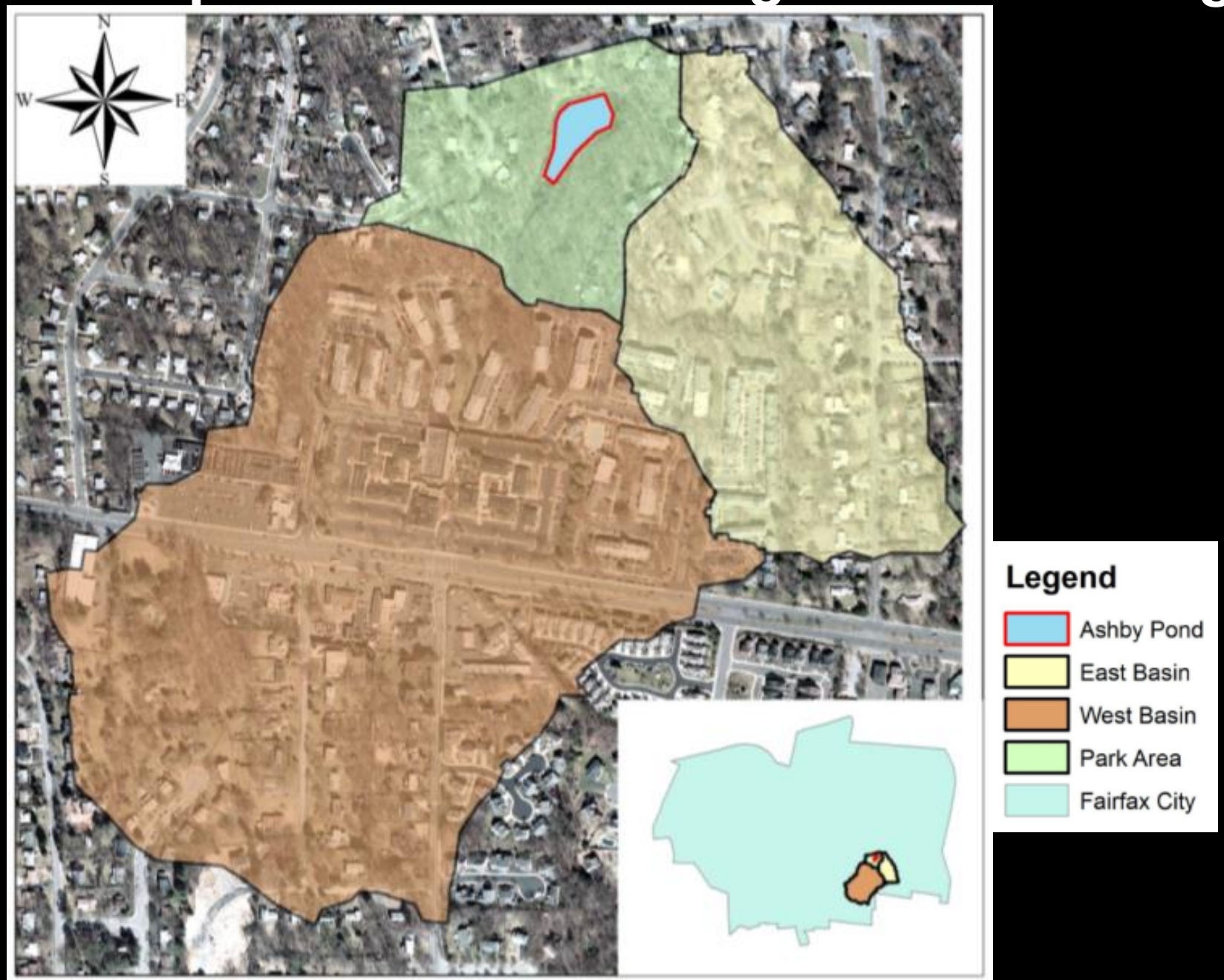
Koch, B. J.; Febria, C. M.; Gevrey, M.; Wainger, L. A.; Palmer, M. A. (2014) Nitrogen Removal by Stormwater Management Structures: A Data Synthesis. J. Am. Water Resour. As., 50, 1594-1607.

Weiss, P.T., Gulliver, J.S., & Erickson, A.J. (2007). Cost and Pollutant Removal of Storm-Water Treatment Practices. Journal of Water Resources Planning and Management, 133(3), 218-229. doi: 10.1061/(ASCE)0733-9496(2007)133:3(218)

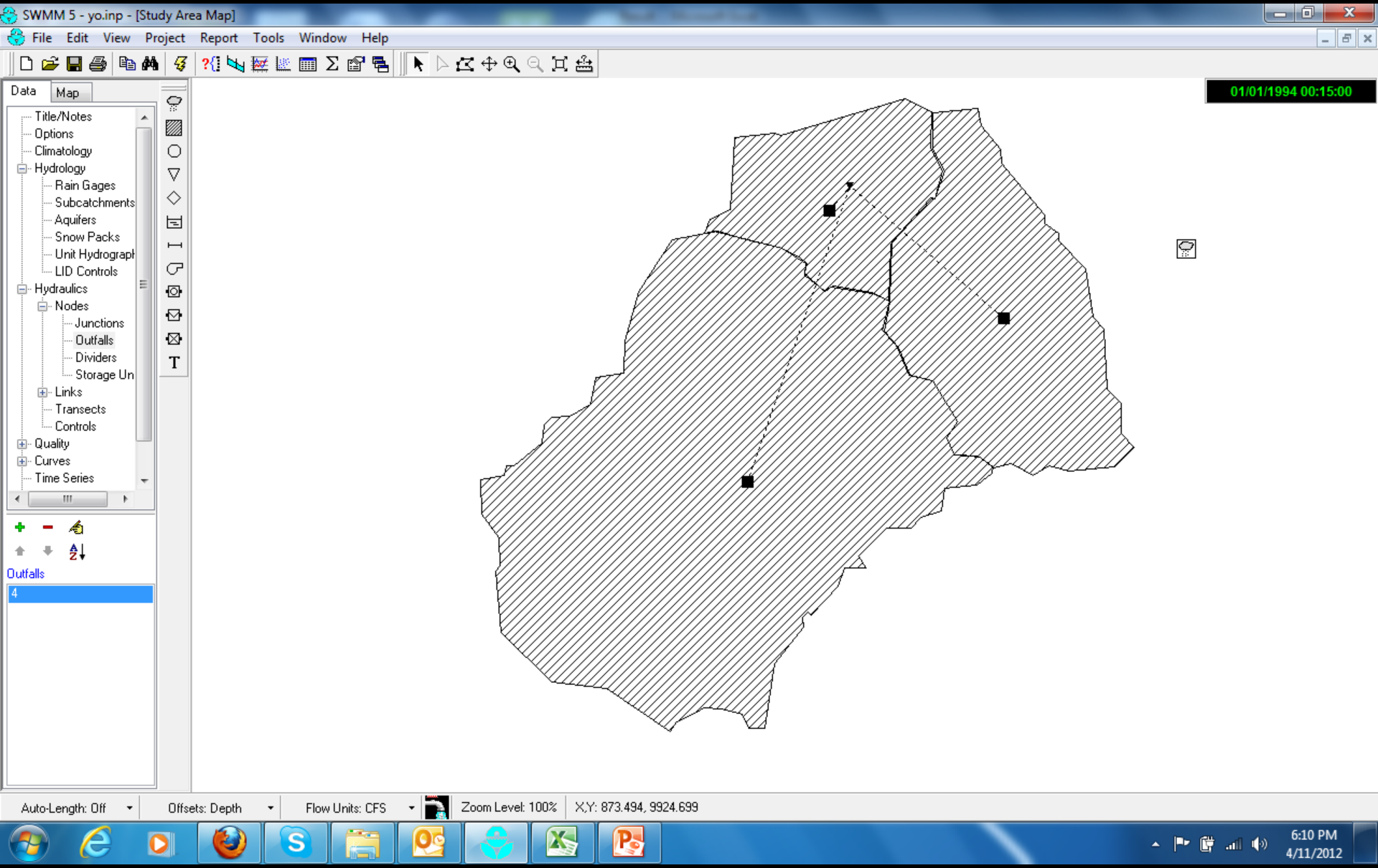
BMP Monitoring and Assessment

- Hydraulic Monitoring (mass-in, mass-out)
- Paired watershed monitoring
  - Spatial
  - Temporal
- Models
  - Computational
  - Physical

Computational Modeling for BMP Design



SWMM Model


SWMM 5 - yo.inp - [Study Area Map]
File Edit View Project Report Tools Window Help
Data Map
Title/Notes
Options
Climatology
Hydrology
Rain Gages
Subcatchments
Aquifers
Snow Packs
Unit Hydrograph
LID Controls
Hydraulics
Nodes
Junctions
Outfalls
Dividers
Storage Un
Links
Transects
Controls
Quality
Curves
Time Series
Outfalls
4
01/01/1994 00:15:00
Auto-Length: Off
Offsets: Depth
Flow Units: CFS
Zoom Level: 100%
X,Y: 873.494, 9924.699
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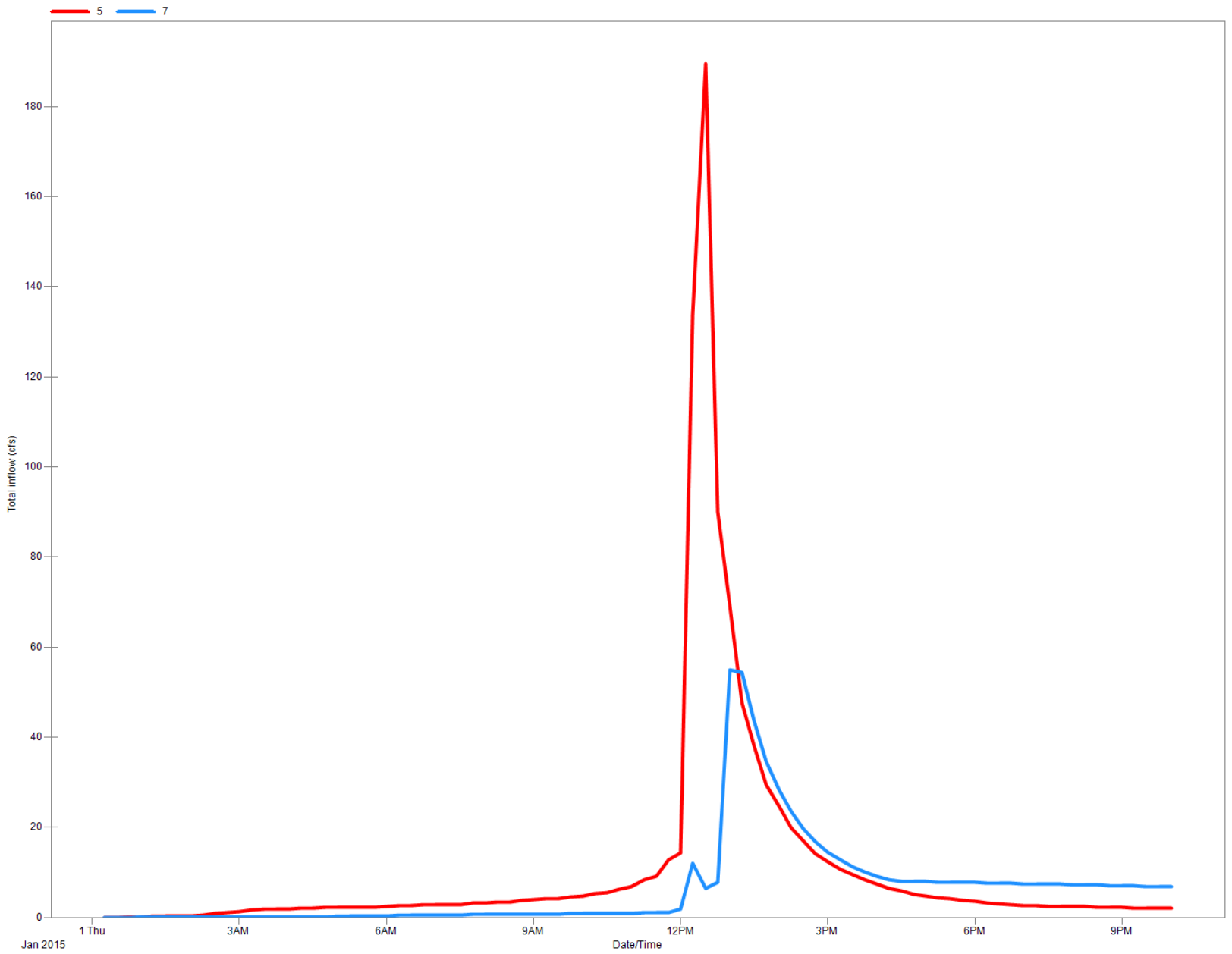
Model/Design Objective: Storage (2-yr)

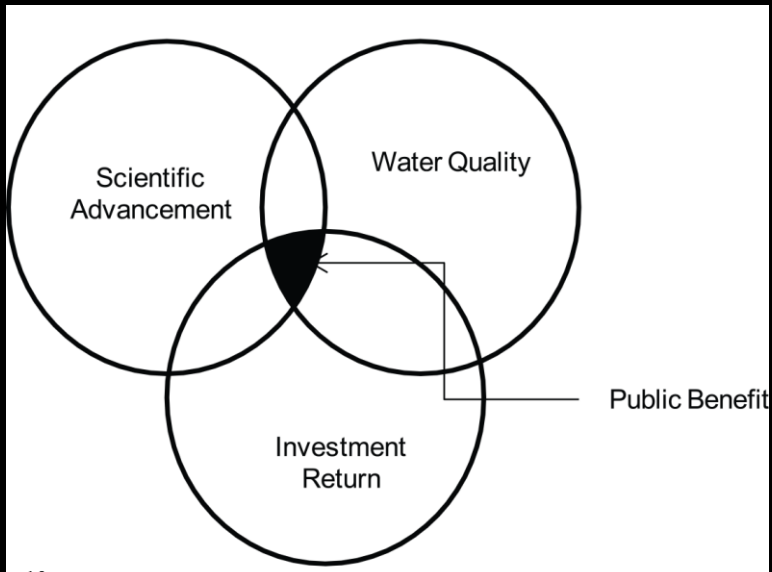


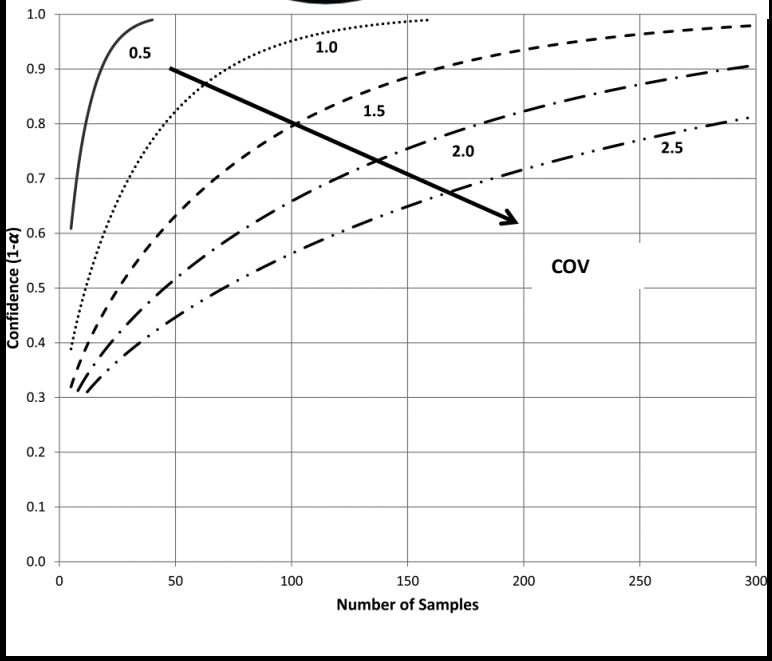
Physical Models/Mesocosms

- Applied in bioretention, floating wetlands
- Advantage: replication, controlled conditions

Balancing Competing Interests

- Balancing:
  - Science
  - Water quality/regulation
  - ROI
- Risk has to be managed, cannot be avoided





Source: Sample, D. J.; Grizzard, T. J.; Sansalone, J.; Davis, A. P.; Roseen, R. M.; Walker, J. (2012) Assessing performance of manufactured treatment devices for the removal of phosphorus from urban stormwater. Journal of Environmental Management, 113, 279-291.