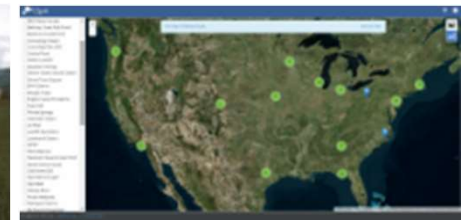


Continuous Monitoring and Adaptive Control

Innovative Approaches to Retrofitting Stormwater Ponds

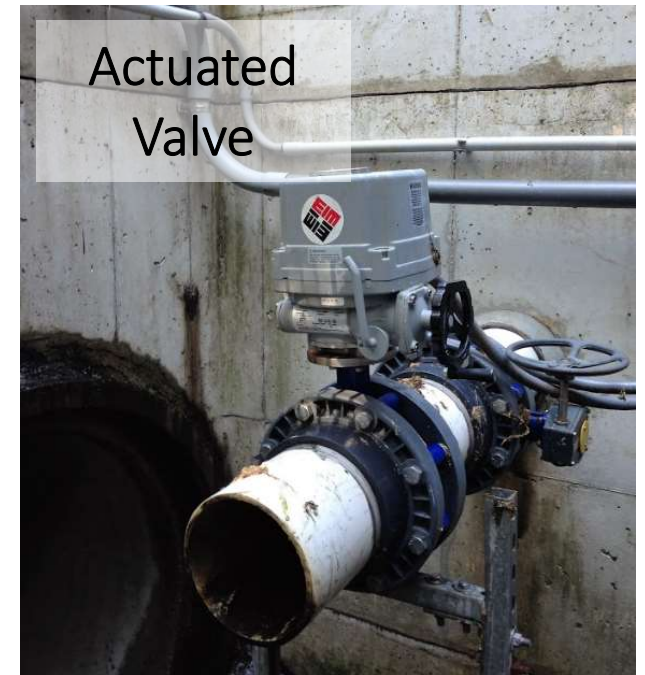
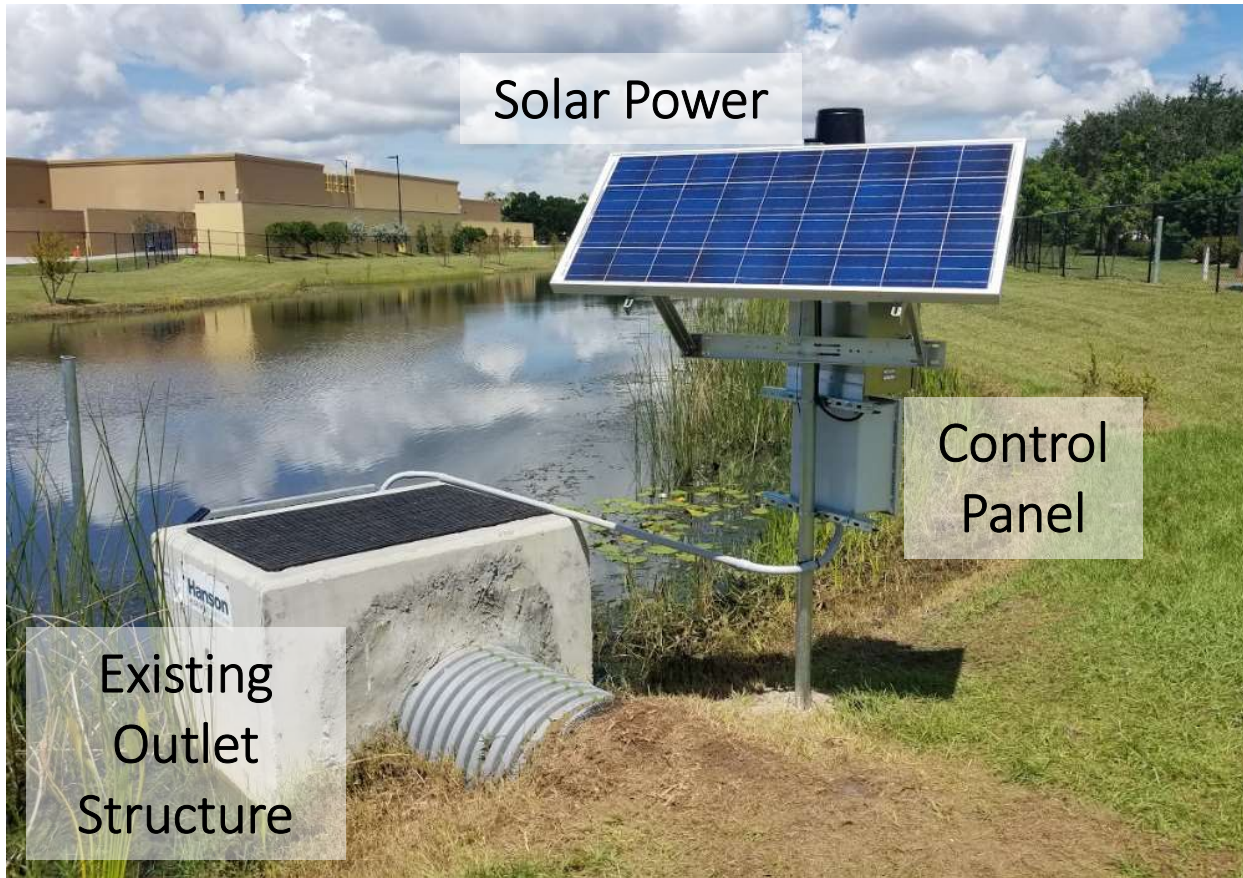
Metro Washington Council of Governments Workshop
November 29, 2016



Outline

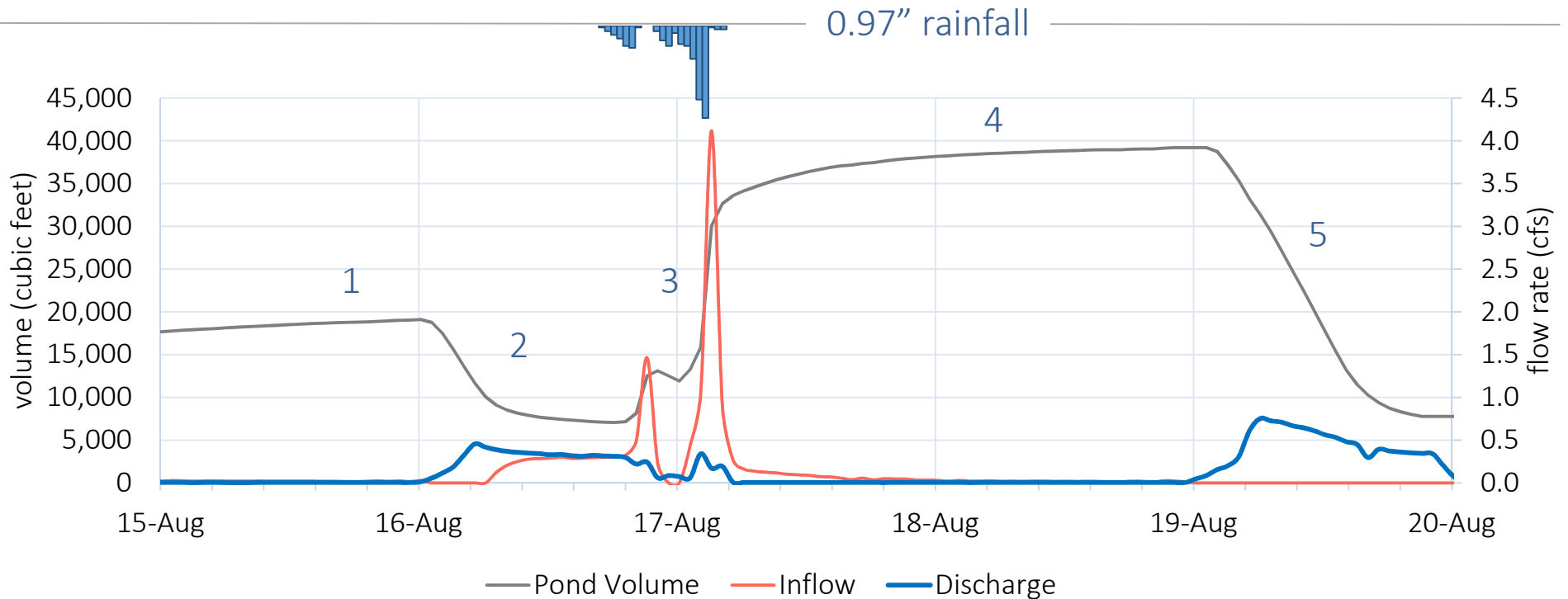
- What is CMAC?
- NFWF performance study (draft results)
 - Dry Pond
 - Wet Pond
- Regulatory approval status
 - MDE
 - Chesapeake Bay Program
- Community adoption
 - Montgomery County
 - Fairfax County

Retrofit Components



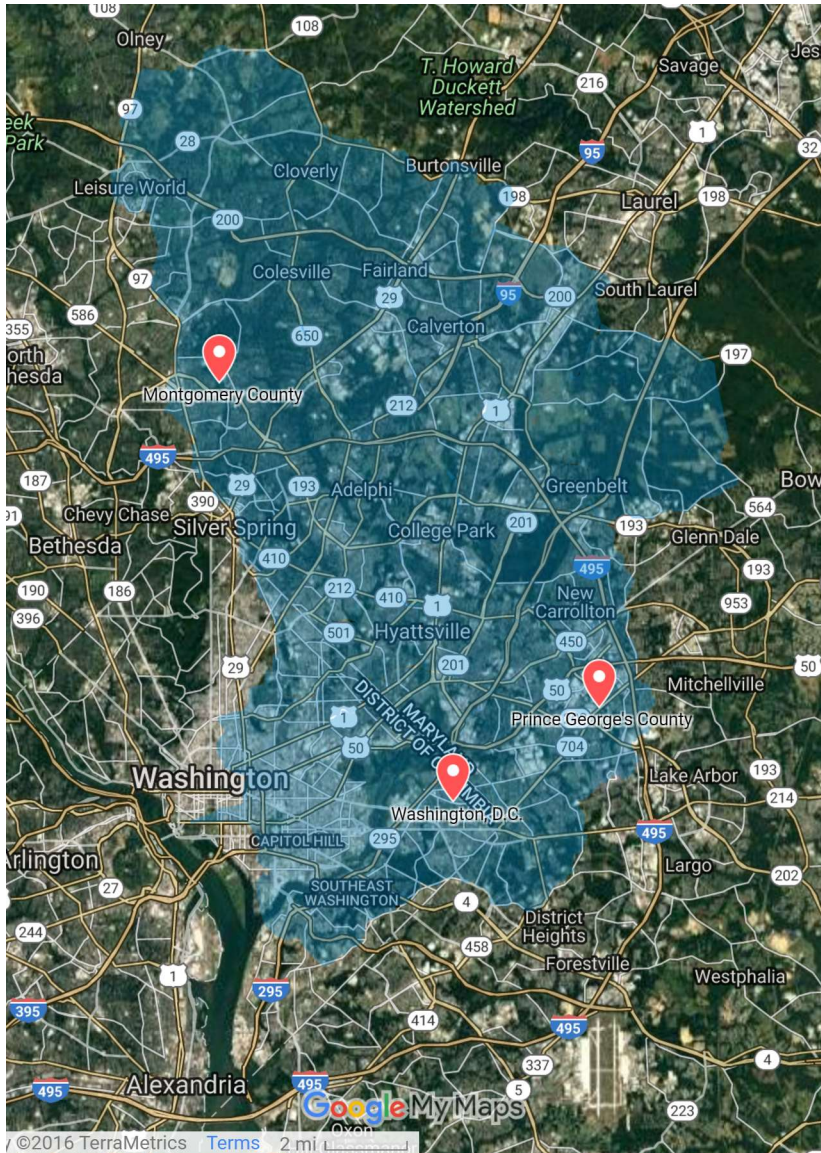
How CMAC Works

1. Read forecast
2. Prepare for incoming runoff
3. Manage discharge during wet weather
4. Meet retention goals
5. Manage discharge to return to dry weather level



Performance Study

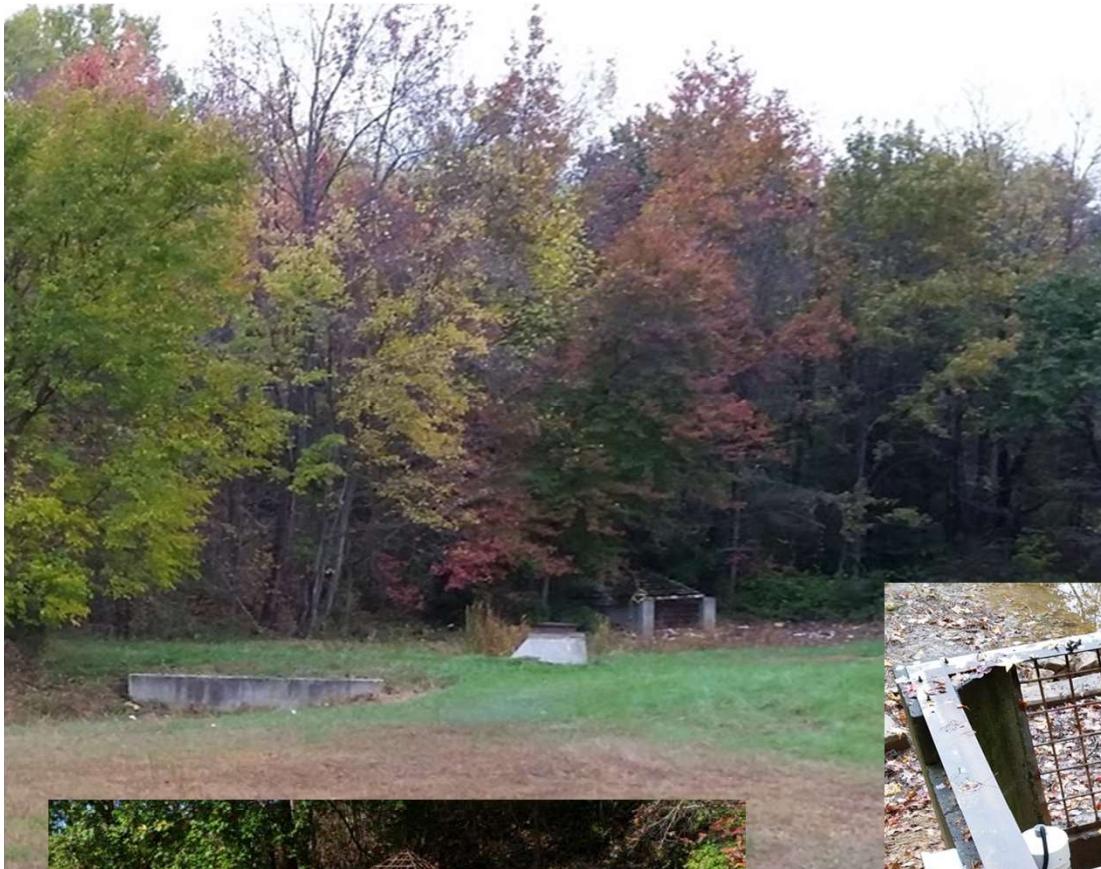
Performance Study – Anacostia River Watershed



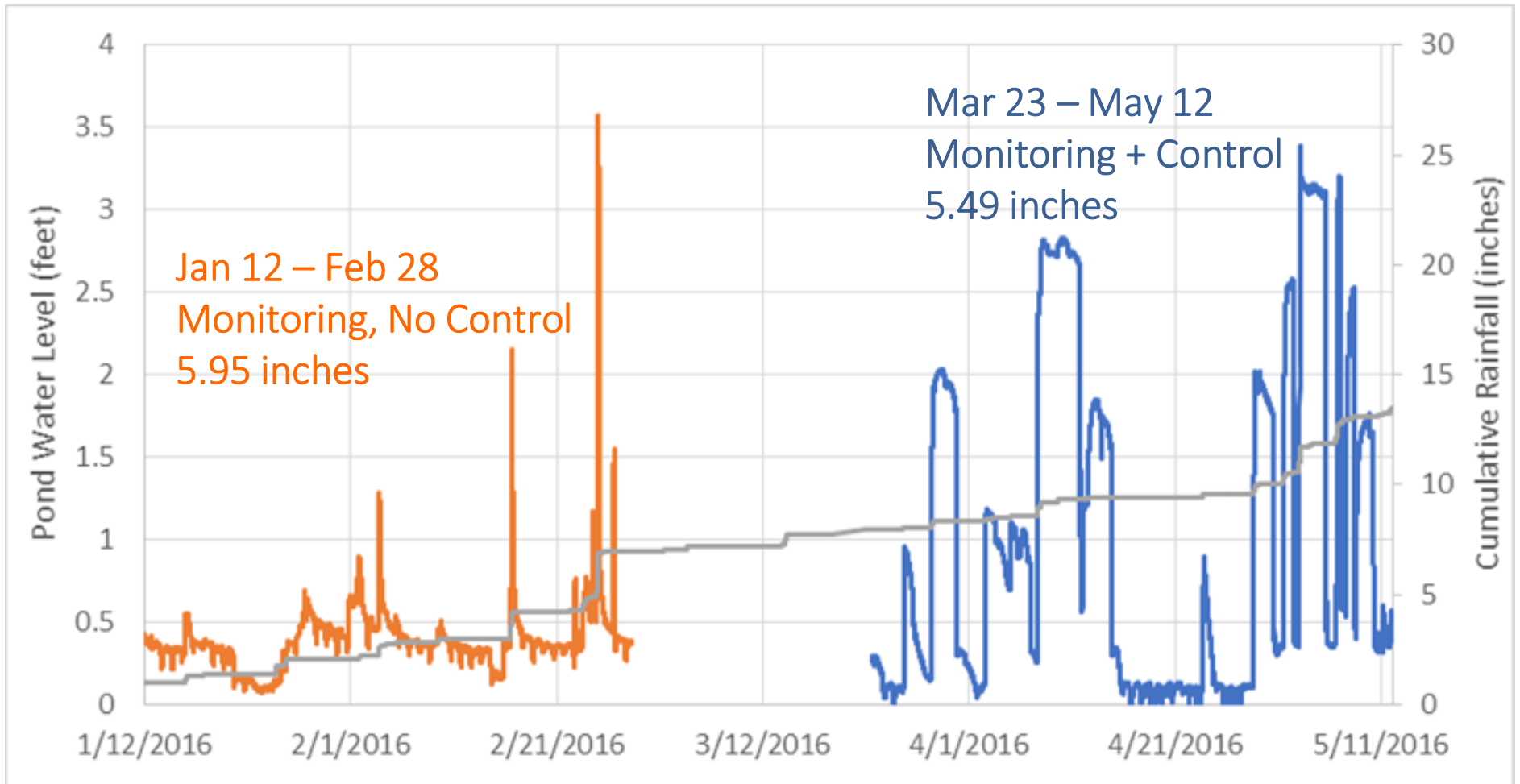
- 3 CMAC retrofits (2 ponds)
- Prince George's County
 - Frost Pond
 - 2 ac-ft dry pond
 - 60 acre drainage; 32% imp.
 - Built 1988
- Montgomery County
 - University Blvd Pond
 - 15 ac-ft wet pond
 - 440 acre drainage; 36% imp.
 - In line on Sligo Creek
- Ponds retrofit November 2015



Performance Study – Frost Dry Pond



Frost Dry Pond– Hydraulic Monitoring



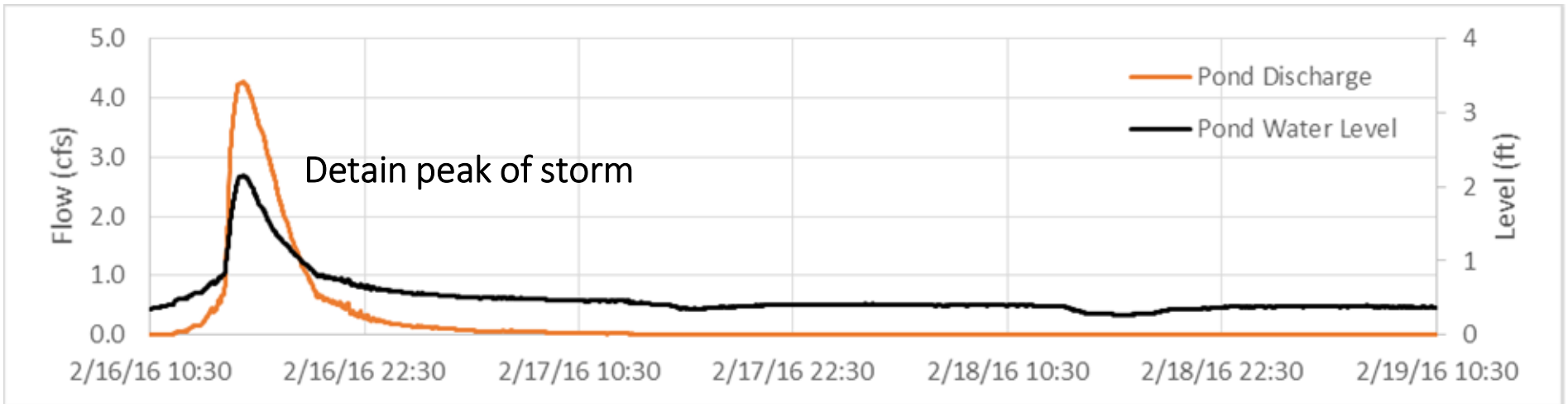
Frost Dry Pond – Enhanced Performance

	No Control	Forecast-Based CMAC Control
Total Rainfall (in)	5.95	5.49
Total Runoff (CF)	336,481 C = 0.23	279,310 C = 0.26
Total Discharge (CF)	305,840	197,243
Total Infiltration and ET (CF)	30,803 9%	81,524 29%
Average Retention Time (hrs)	4.0	18.2

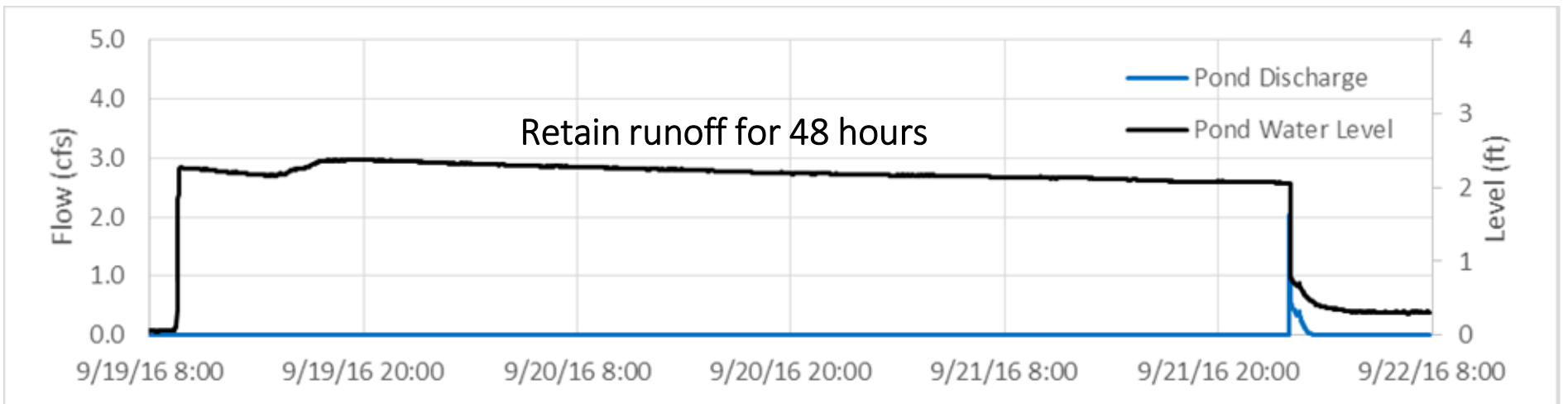
The CMAC retrofit increases infiltration and ET by extending the retention time, also providing a mechanism for increased settling and nutrient uptake.

Frost Dry Pond – 1 inch Rainfall Event

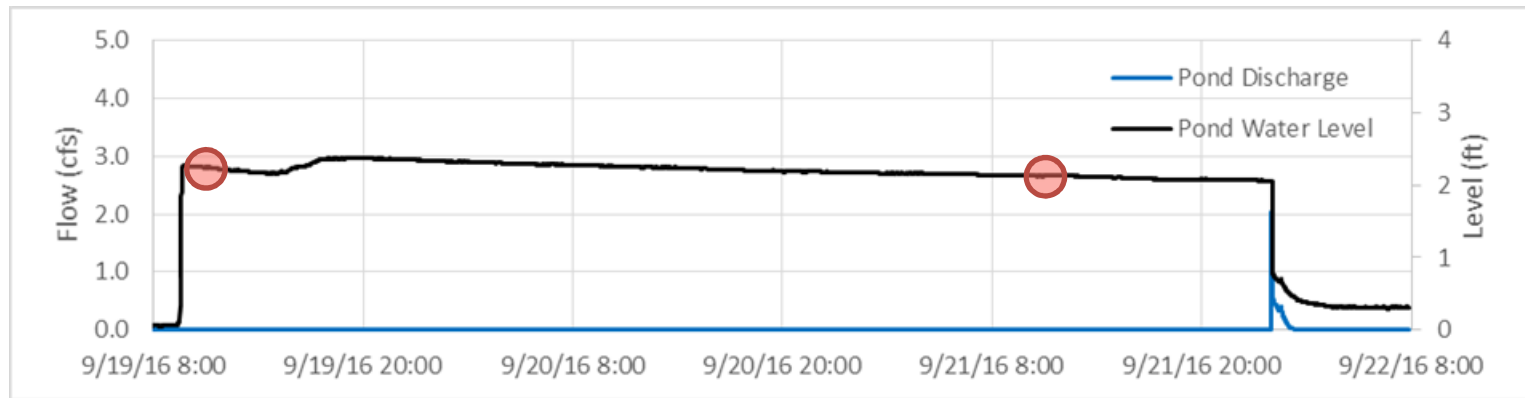
No Outflow Control



CMAC Retrofit



Frost Dry Pond – September 19, 2016 Rainfall Event



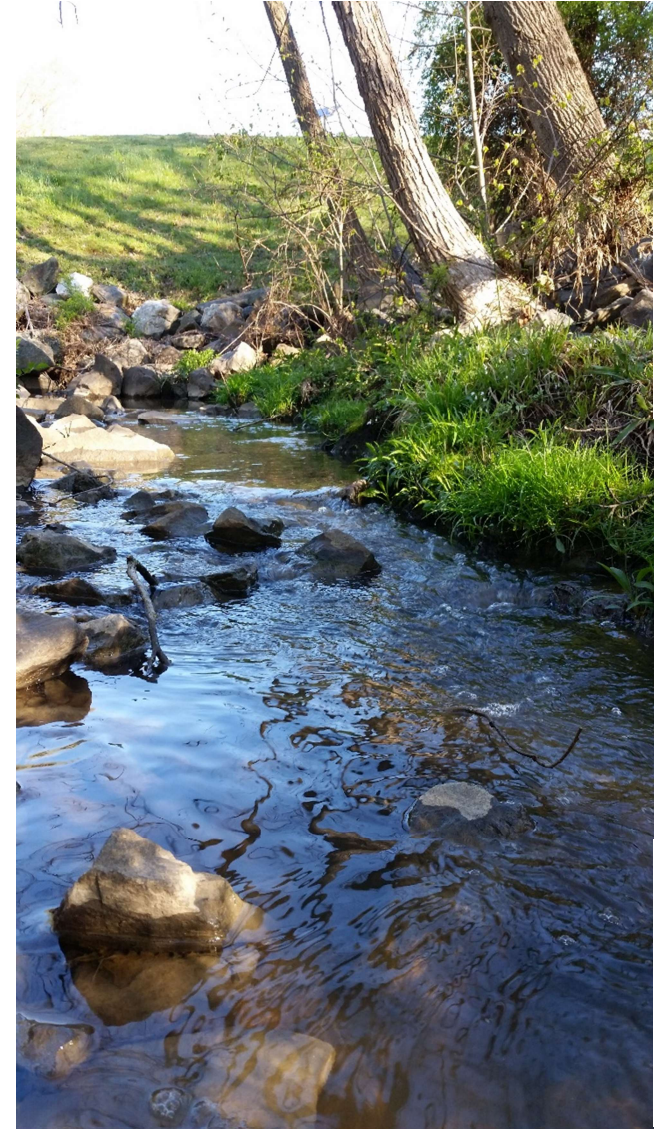
9/19/2016 9:35AM



9/21/2016 10:04AM



Performance Study – University Blvd Wet Pond



University Blvd Wet Pond – Monitoring 2015 to 2017

Continuous

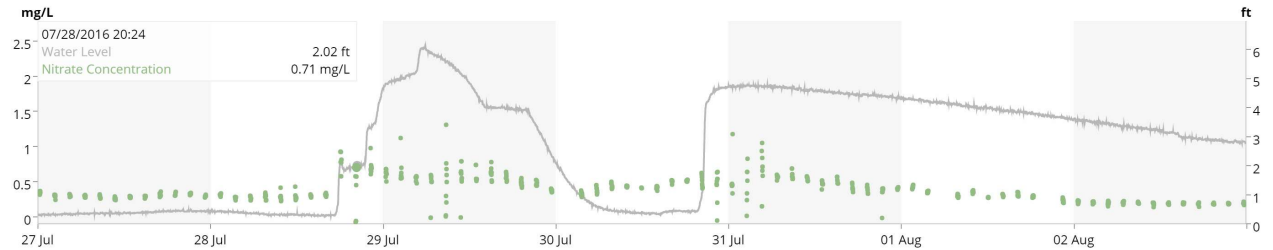
- Water level
- Rainfall
- Temperature
- Conductivity
- pH
- Turbidity
- Nitrate
- TSS

Grab Sampling

- Flow
- TSS
- Nitrogen
- Phosphorus

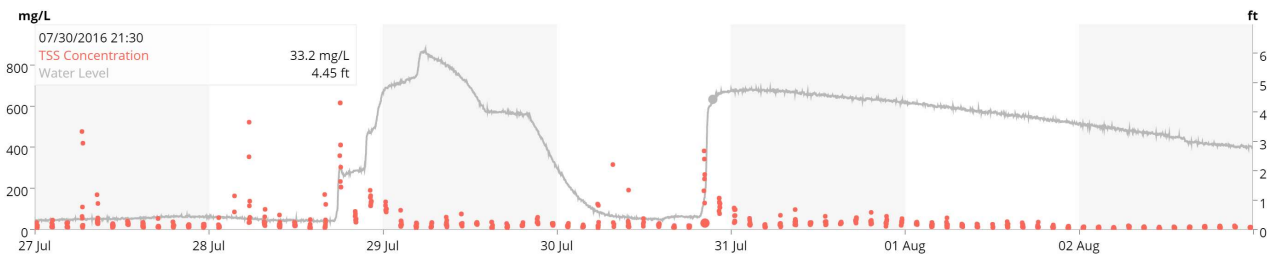
Pond Level and Nitrate

12hr | 24hr | 48hr | 1wk



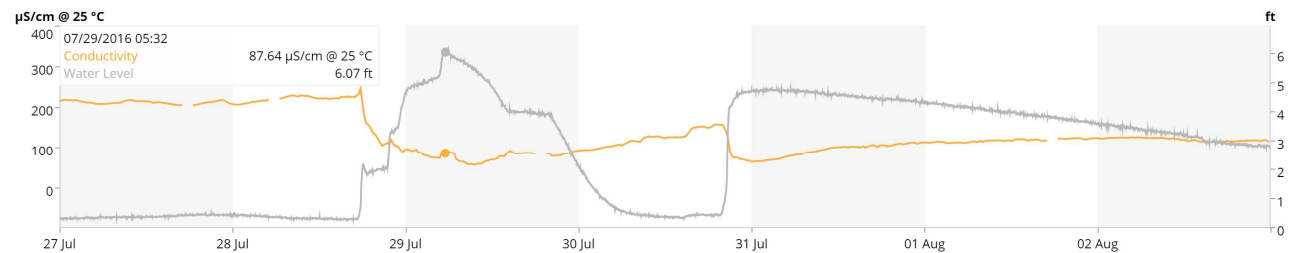
Pond Level and TSS ▲

12hr | 24hr | 48hr | 1wk

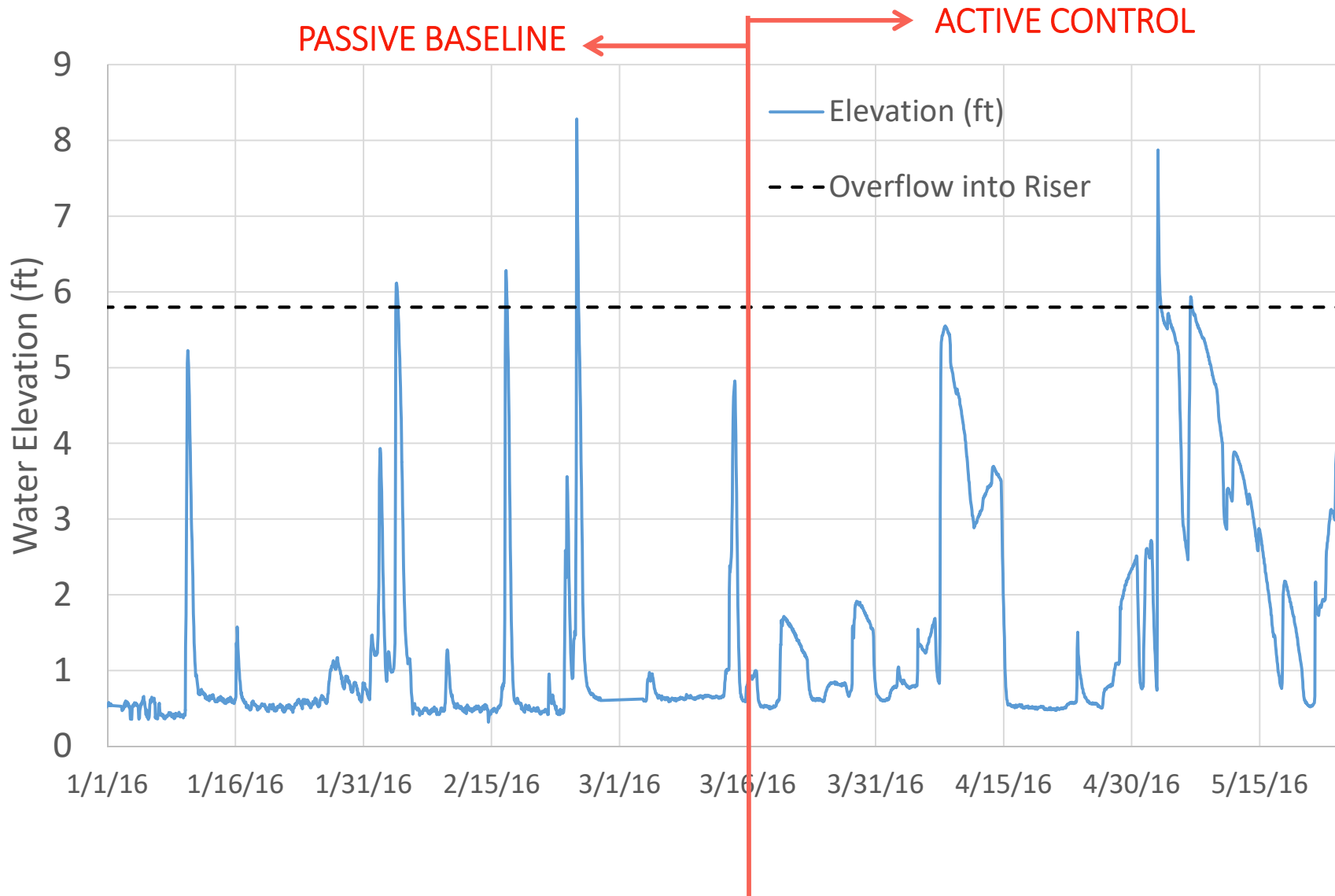


Pond Level and Conductivity

12hr | 24hr | 48hr | 1wk

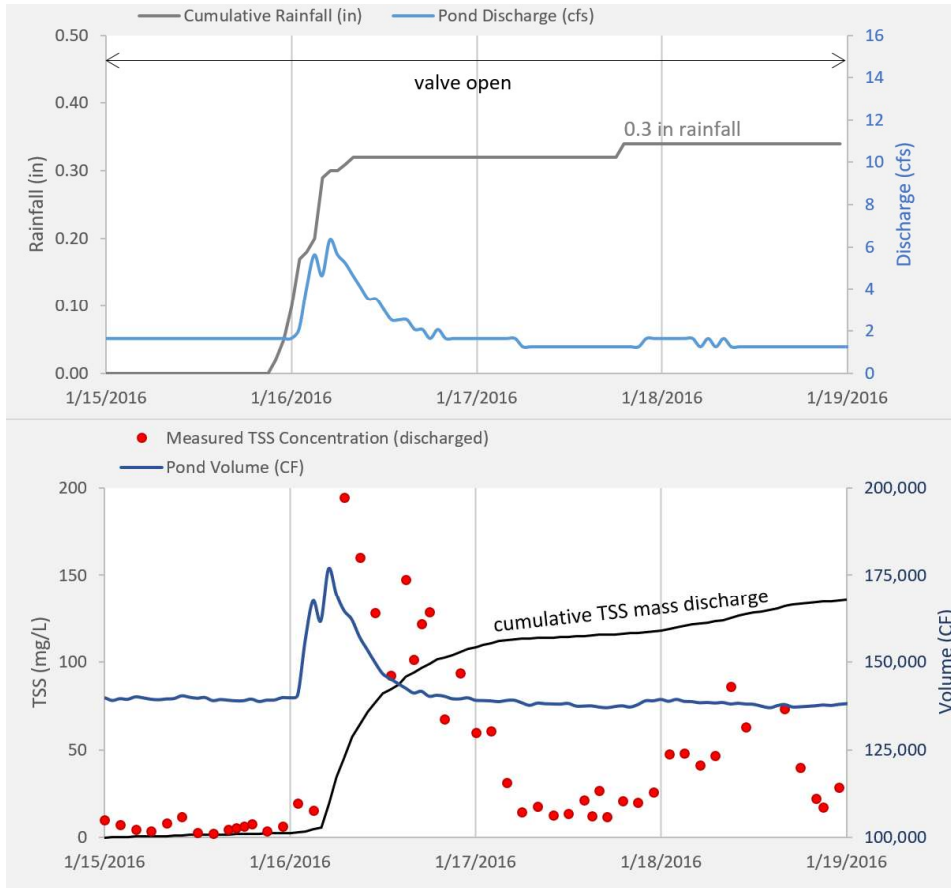


University Blvd Wet Pond – Hydraulic Monitoring

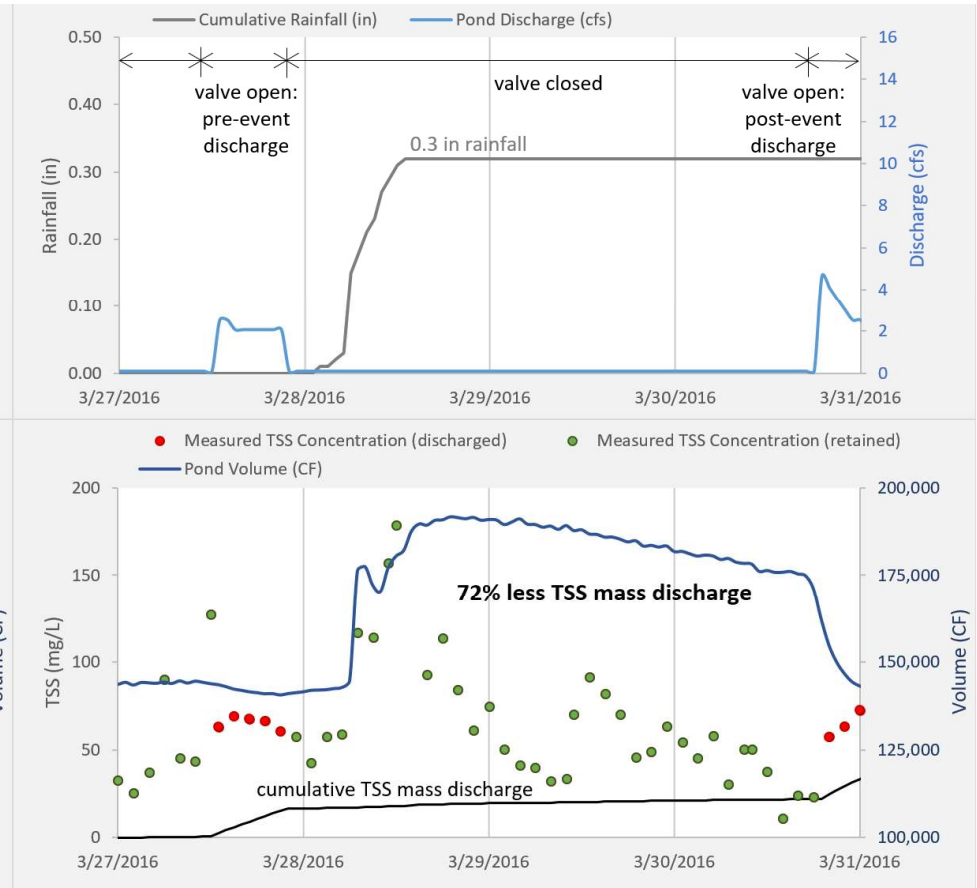


University Blvd Wet Pond – DRAFT TSS Removal Comparison

Passive Baseline



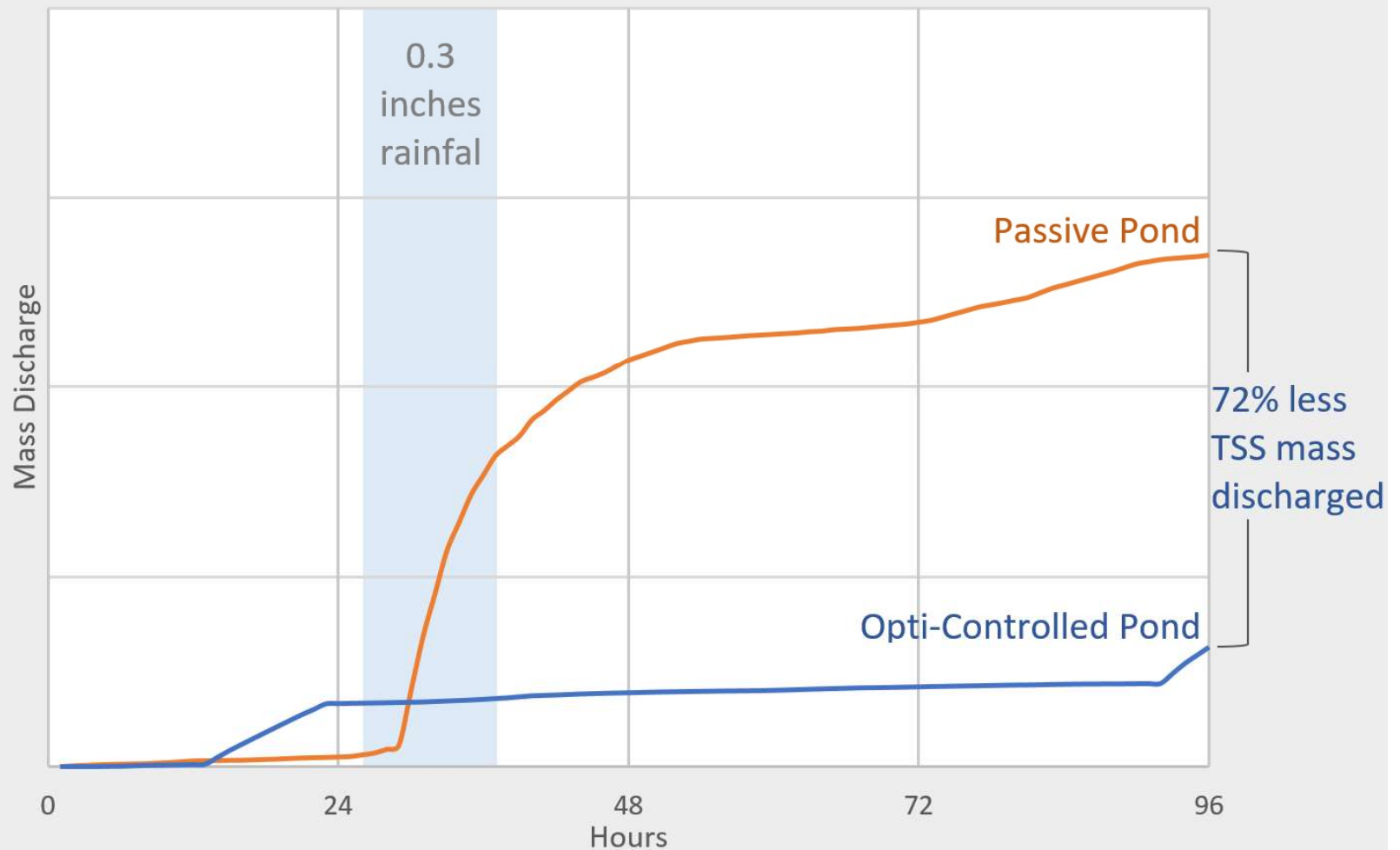
Active Control



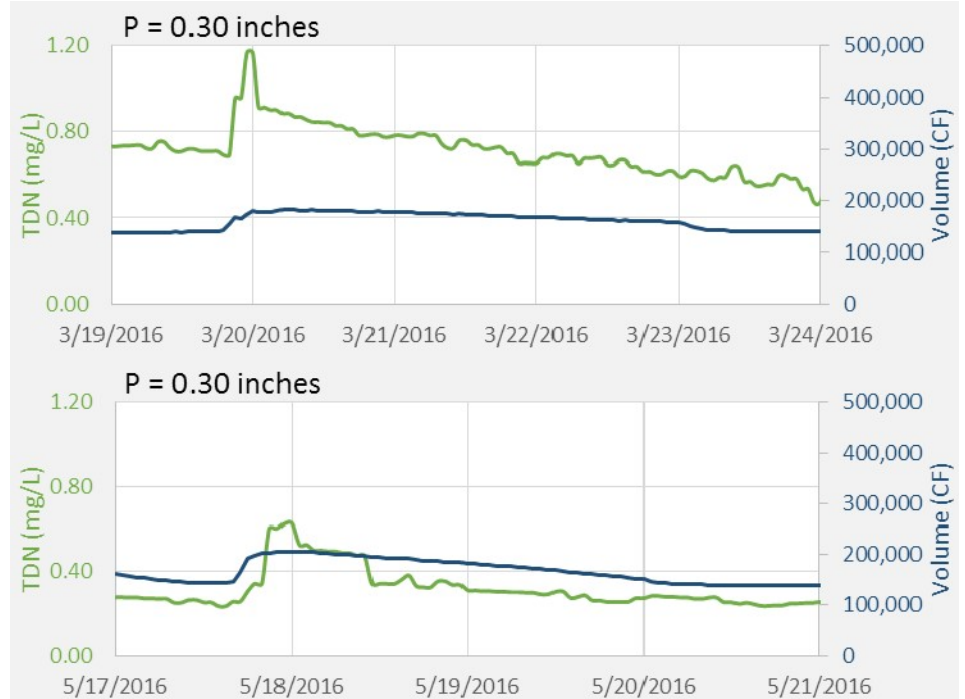
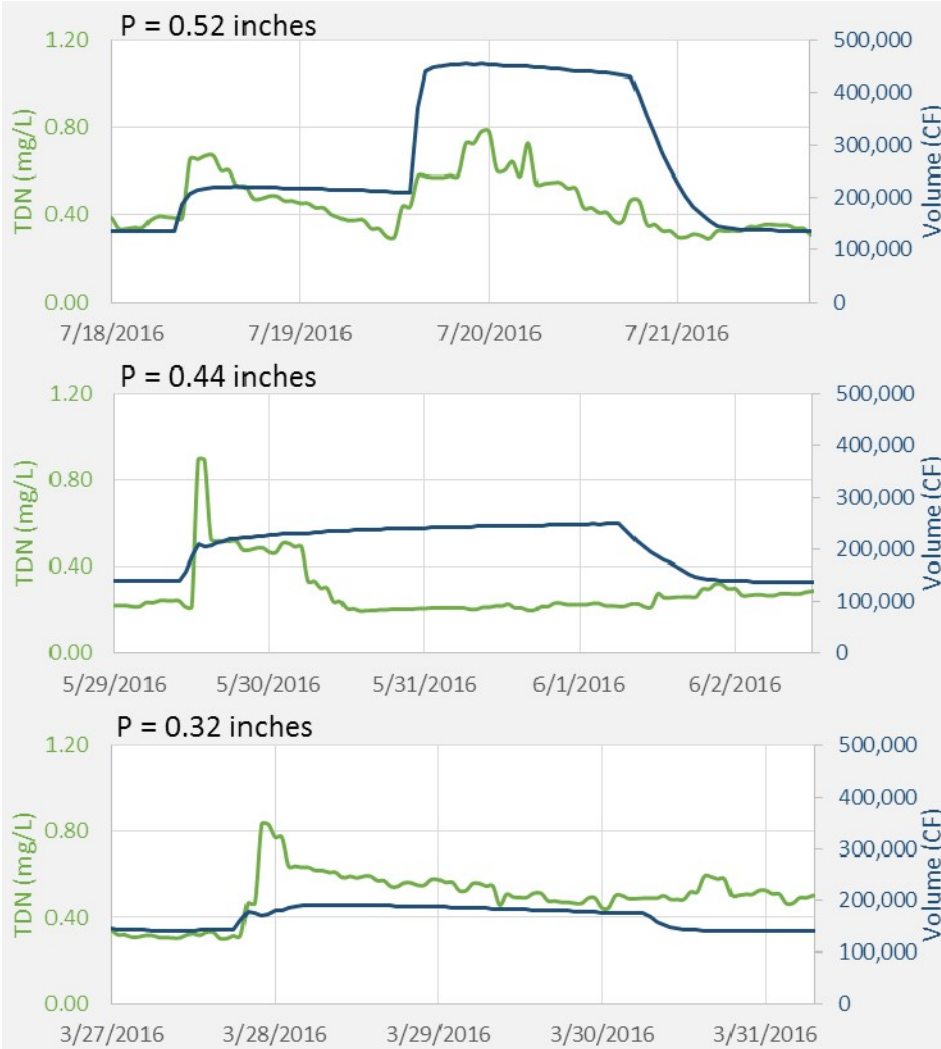
University Blvd Wet Pond – DRAFT TSS Removal

Cumulative TSS Mass Discharge

Results based on 480
TSS measurements
collected over 96 hours



University Blvd Wet Pond– DRAFT Nitrate Removal



Storm Size	Percent Removal	
	CMAC	MDE Wet Pond*
0.30	45%	20%
0.32	40%	21%
0.44	28%	24%
0.52	47%	26%

*Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated, MDE, 2014

Regulatory Approvals

Regulatory Approval – Maryland Dept. Environment



Larry Hogan
Governor
Ben Grumbles
Secretary
Boyd Rutherford
Lieutenant Governor
January 27, 2016

Ms. Jamie Lefkowitz, P.E.
Senior Water Resources Engineer, OptiRTC Inc.
356 Boylston Street, 2nd Floor
Boston, MA 116

Dear Ms. Lefkowitz:

Thank you for your letter to the Maryland Department of the Environment (MDE) regarding the use of the Continuous Monitoring and Adaptive Control (CMAC) system for new development, retrofitting, redevelopment, and infill applications. MDE has evaluated the product's description and supporting information with respect to potential treatment applications in Maryland. We offer the following:

When considering new development applications in Maryland, environmental site design (ESD) must be used to the maximum extent practicable (MEP) to reduce runoff and mimic natural hydrologic conditions. The use of ESD techniques and practices must be exhausted before structural practices may be used. Based on your application, MDE understands that the CMAC system is used to monitor facility performance, regulate outflow, and maximize storage capacity of wet pond variants. Please understand that wet ponds are considered as structural practices when designed in accordance with the criteria found in Chapter 3 of the 2000 Maryland Stormwater Design Manual (the Manual). MDE believes that the CMAC system can be used to augment the hydraulic controls for wet ponds. However, as a component of these practices, the CMAC is subject to the same conditions for the use of wet ponds (see pp. 3.2 to 3.15 of the Manual) in Maryland. This includes a maintenance agreement ensuring long term performance of the CMAC system.

MDE has determined that the CMAC system also may be used in wet ponds as retrofit applications to meet National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4) Phase I permit restoration requirements provided it is accepted locally. When used in this manner, pollutant removal efficiencies equivalent to those assigned to structural treatment (ST) practices as shown in Tables 1.E and 2.E in MDE's guidance, Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated (MDE 2014) may be used provided the design meets the conditions listed above. With respect to redevelopment, the local approval authority may allow the use of alternative

¹ 2000 Maryland Stormwater Design Manual, Volumes 1 and 2 (MDE, 2000 & 2009)

Ms. Jamie Lefkowitz, P.E.
January 27, 2016
page 2

stormwater management measures if impervious area reduction and ESD have been implemented to the maximum extent practicable (MEP). Therefore, MDE has no objections to the use of the CMAC system for redevelopment provided it is accepted locally.

In conclusion, the CMAC system may be used for new development and retrofitting if it meets the conditions as described above. Similarly, MDE has no objections to use of the CMAC system for redevelopment provided it is accepted locally. However, local jurisdictions may request a copy of a letter from MDE verifying product classification. Please consider this that letter. Thank you again for your interest. If you have any questions, please contact me at (410) 537-3550 or by email at stewart.comstock@maryland.gov.

Sincerely,

Stewart R. Comstock, P.E.
Senior Regulatory and Compliance Engineer
Program Review Division
Sediment, Stormwater, and Dam Safety Program

Alternative/Innovative Technology Review and Approval

"Using CMAC design, the water quality and channel protection volumes can be combined."

"...CMAC is subject to the same conditions for the use of wet ponds."

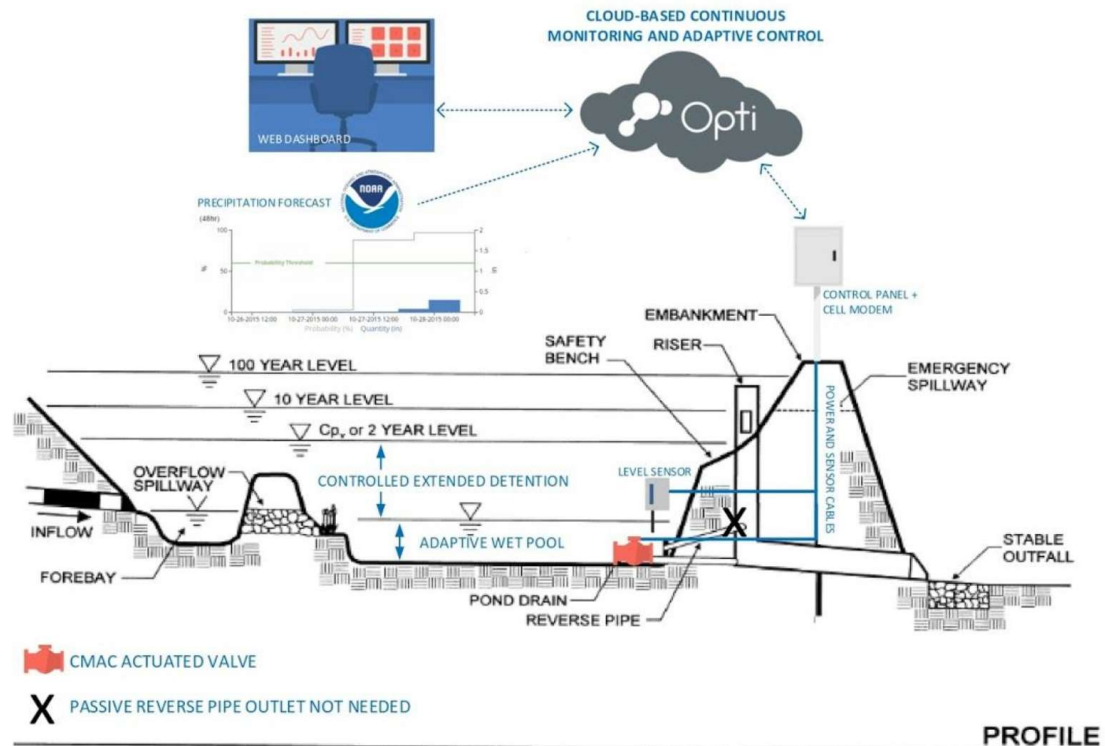
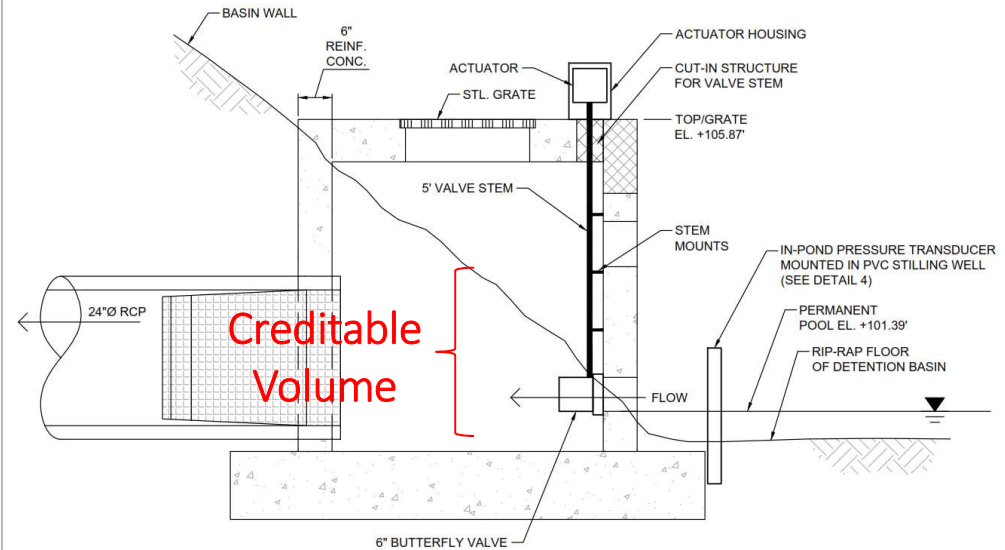
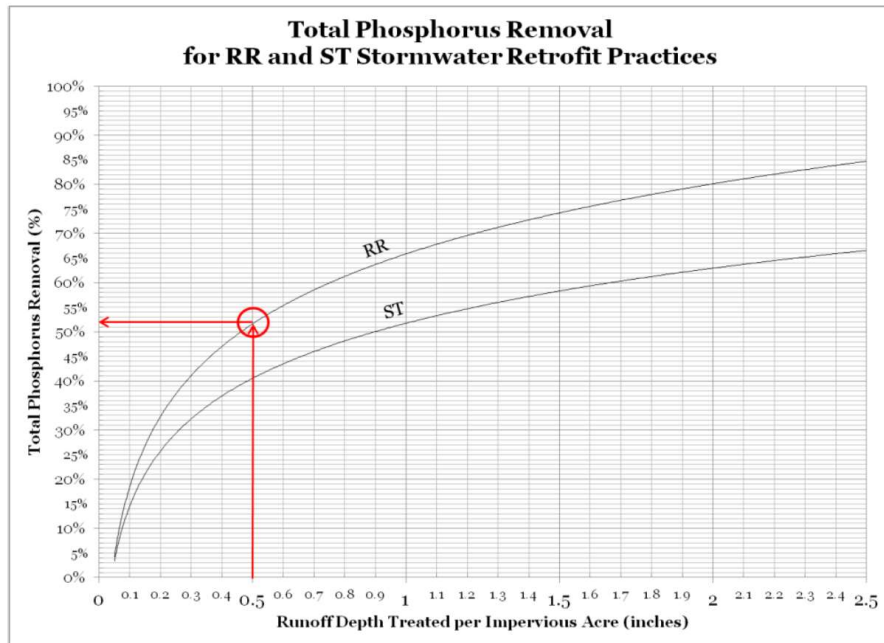


Figure 1. CMAC Schematic for Wet Extended Detention Pond

Regulatory Approval – Chesapeake Bay Program



- Urban Stormwater Workgroup endorsed CMAC as credit-worthy retrofit approach November 15, 2016
- Available credits = adaptively controlled volume

Chesapeake Bay Credit Calculations Example 1

Existing Dry Pond

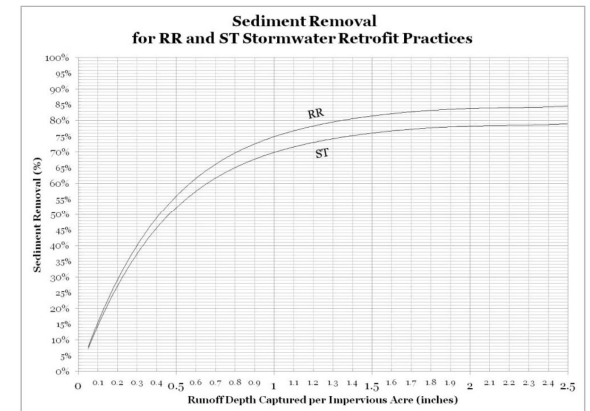
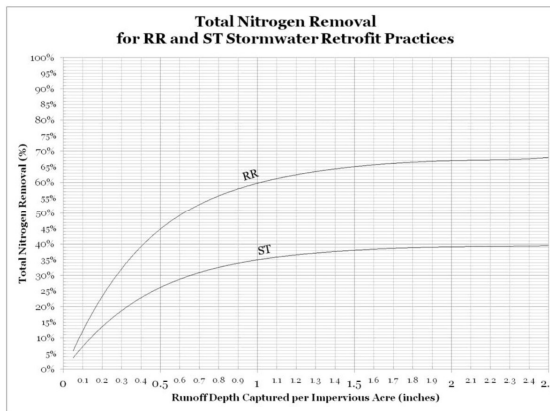
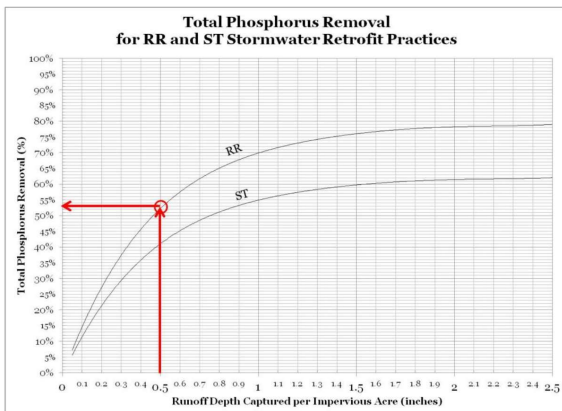
60 acre watershed (32% impervious)
2 ac-ft of storage between low flow outlet
and riser overflow
Zero pollutant removal credit

Retrofit Dry Pond

Actively controlled valve provides
retention for 2 ac-ft
1.25 in/impervious acre
Restored removal rates-
TP: 56% TN: 35% TSS: 70%



Note: credits are contingent on local jurisdictional requirements and approval



Chesapeake Bay Credit Calculations Example 2

Existing Wet Pond

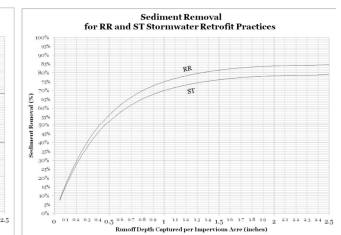
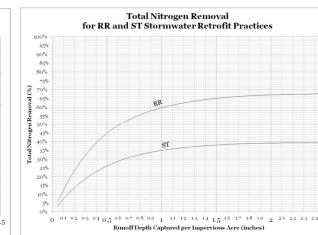
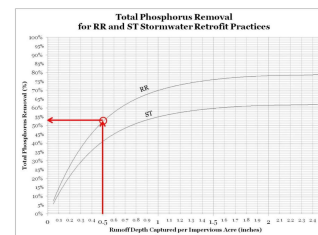
440 acre watershed (36% impervious)
3 ac-ft of permanent pool
0.22 in/impervious acre
12 ac-ft of storage between permanent pool and riser overflow
Existing removal rates-
TP: 26% TN: 17% TSS: 35%



Note: credits are contingent on local jurisdictional requirements and approval

Retrofit Wet Pond

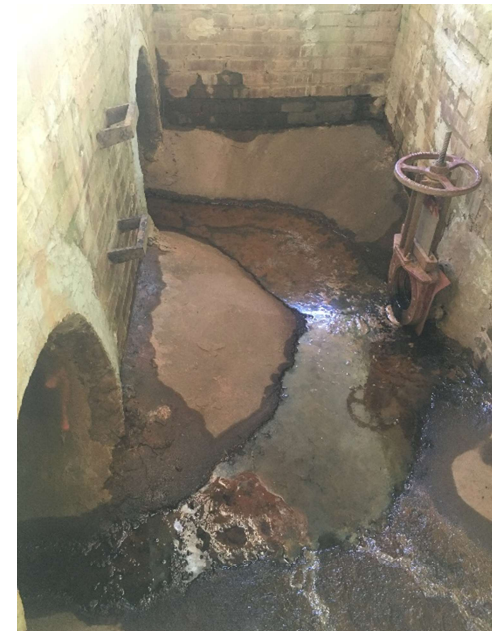
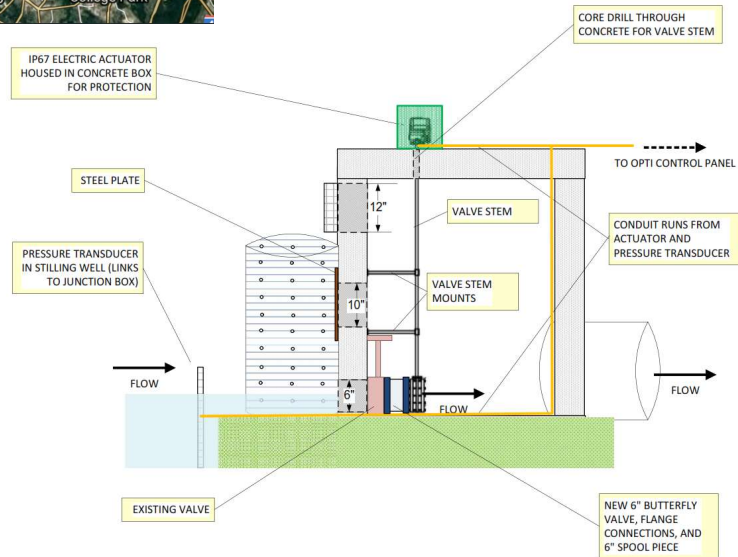
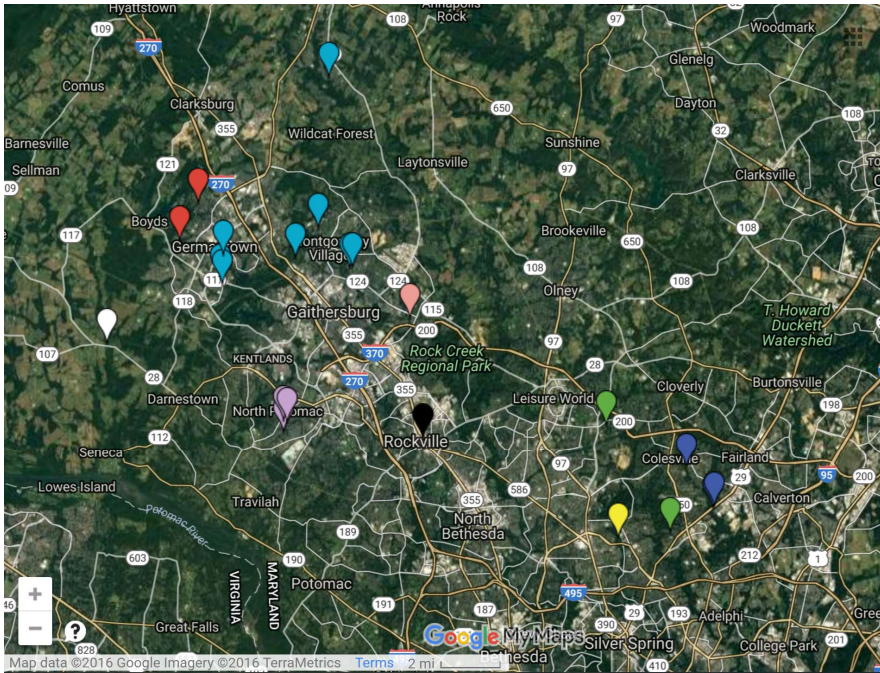
Actively controlled valve provides retention for 12 ac-ft above permanent pool
1.22 in/impervious acre
Restored removal rates-
TP: 55% TN: 34% TSS: 69%



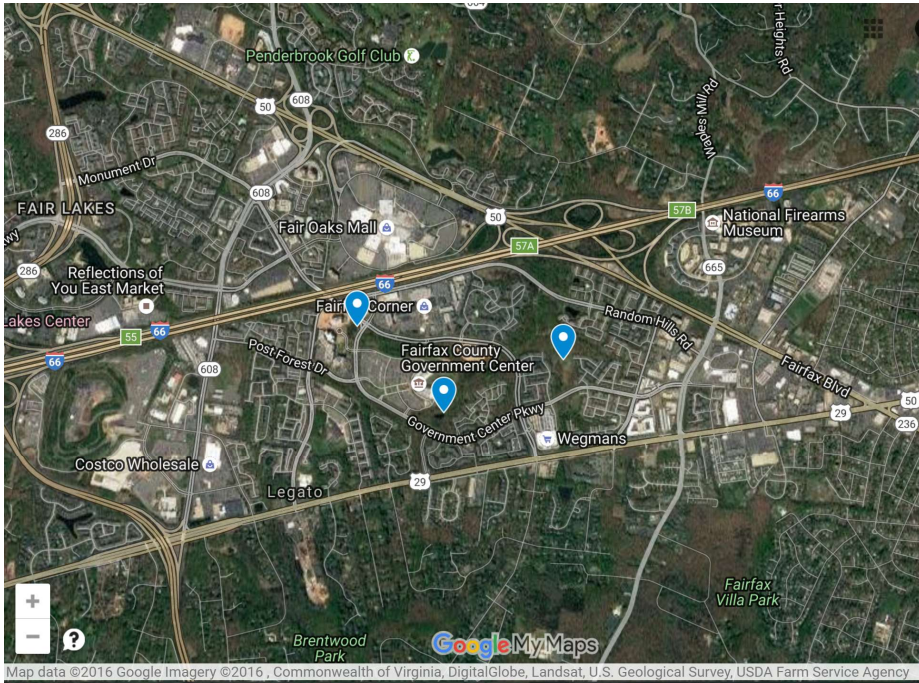


COG Communities Pursuing CMAC

Montgomery County CMAC Pilots



Fairfax County CMAC Pilots



Questions & Contact

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Fairfax County, VA

