The Trident Approach to Stormwater Management

Stormwater TMDL Strategies, Flooding and Sea Level Rise

Greg Johnson, P.E., City of Virginia Beach

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Dewberry

CDM Smith

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Project Contacts

City of Virginia Beach
Department of Public Works
Greg Johnson, Project Manager
Shanda Davenport
C.J. Bodnar
757-385-4131
gjohnson@vbgov.com

Comprehensive SLR Study
Dewberry
Brian Batten, PhD, CFM
804-823-6981
bbatten@dewberry.com

Water Quality Modeling
David J. Sample, Ph.D., P.E., D. WRE
Assoc. Professor & Extension Specialist
Biological Systems Engineering
AREC / VPI and State University
Virginia Beach, VA 23455.
dsample@vt.edu

Stormwater Master Plan
CDM Smith
Michael Morgan, P.E.
757-318-9826
MorganMC@cdmsmith.com

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Outline

Overview of Comprehensive Efforts

- **Sea Level Rise & Recurrent Flooding**
- **Master Drainage Planning & Analysis**
- **Water Quality Studies**

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We care about Our Water, it drives the Tourist Industry; our economy.

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Resiliency Viewpoint

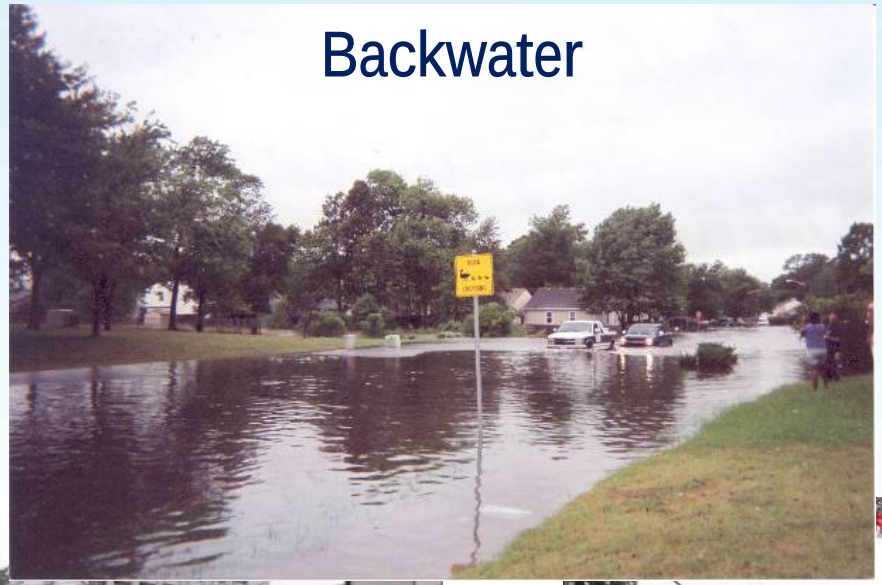
"Ensure the vibrant future of Virginia Beach"

- Engage in Systems Thinking
- Achieve Multiple Positive Outcome
- Maintain a Long-Term View
- Create an Accurate , Positive Community Image
- Ensure Sustainability
- Create Relationships and Partnerships
- Value and Promote Diversity
- Be Proactive and prevent problems

Water Quality Challenges

Flooding Issues: a Triple Threat

Backwater



Rainfall

Tidal

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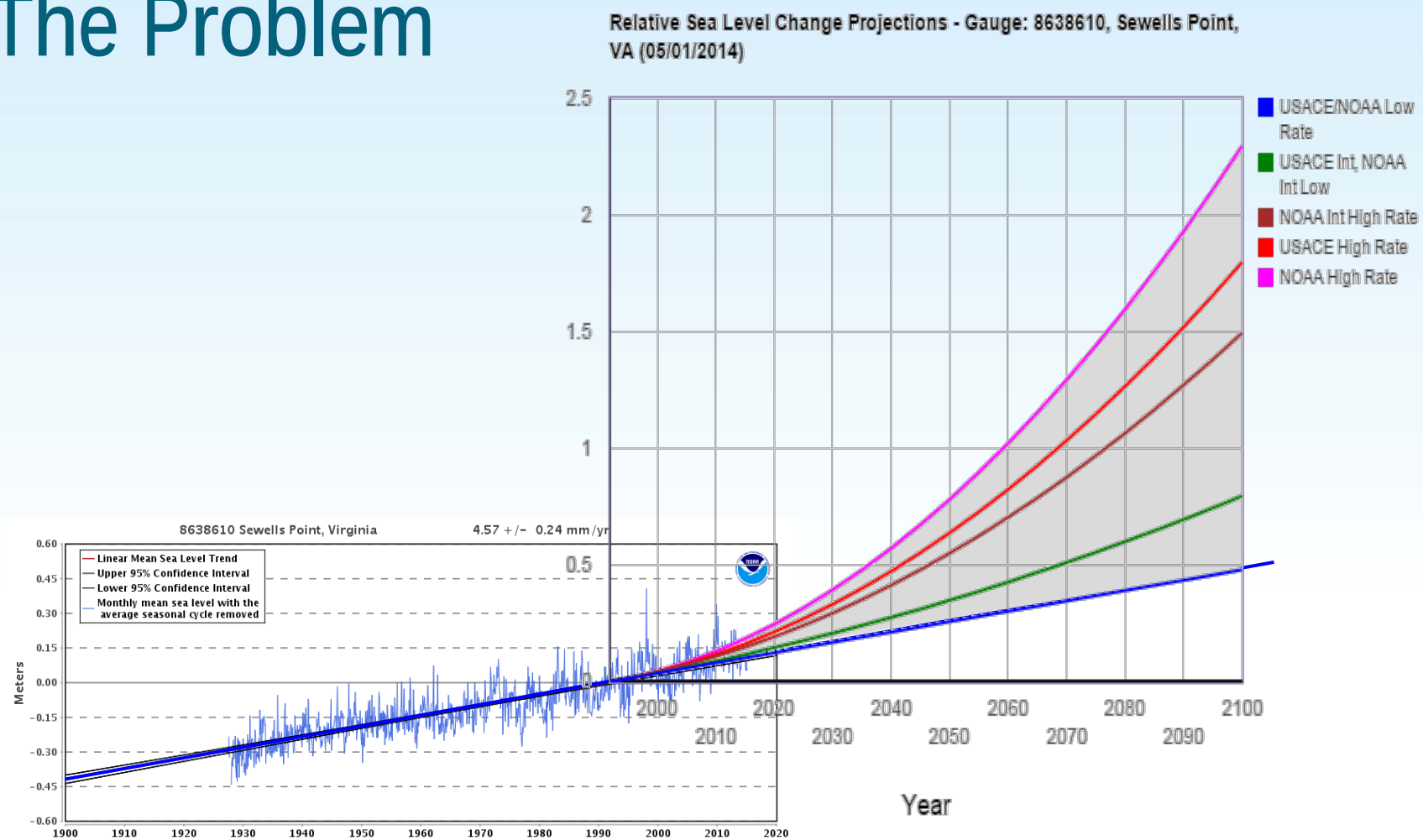
The Problem



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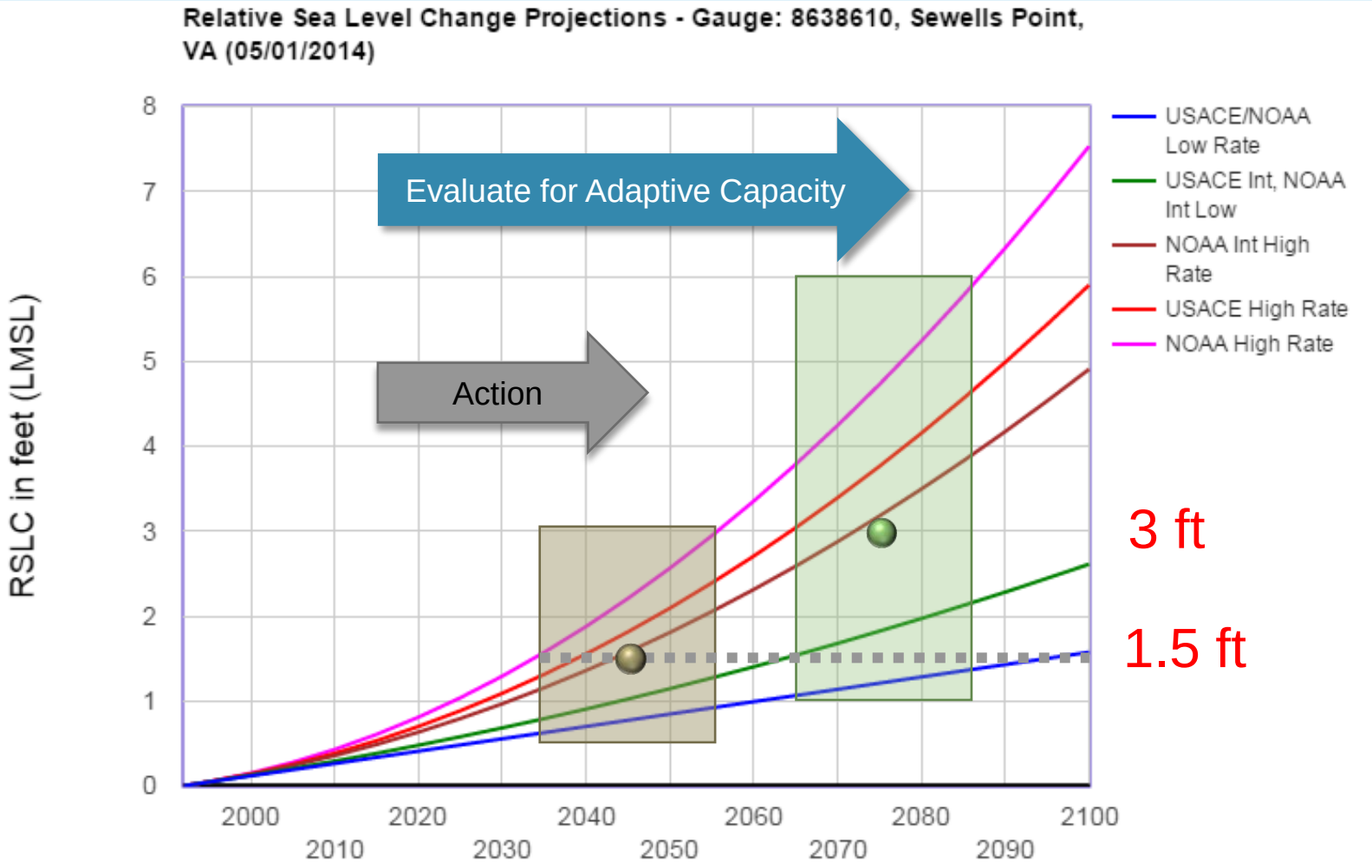
Selected Scenarios vs Federal Curves



VB SLR Scenarios

Life Cycle Alignment	Time Horizon/ Time Period	SLR Value	Relevance	Use
Municipal Planning	20-40 years 2035-2055	1.5 ft	Comprehensive Plan & Outcomes Short end of Commercial and Utility life-cycles	Vulnerability assessment Key planning value Basis for evaluation of all adaptation strategies
Critical Infrastructure Long-term awareness Adaptive Capacity	50-80 years 2065-2085	3.0 ft	Utility Infrastructure life-cycle Transportation infrastructure lifecycles Residential structure lifecycles	Secondary vulnerability assessment to provide insight into long-term risk Basis for long-term infrastructure decisions Evaluate cost-effectiveness of additional protection for adaptable resilience strategies

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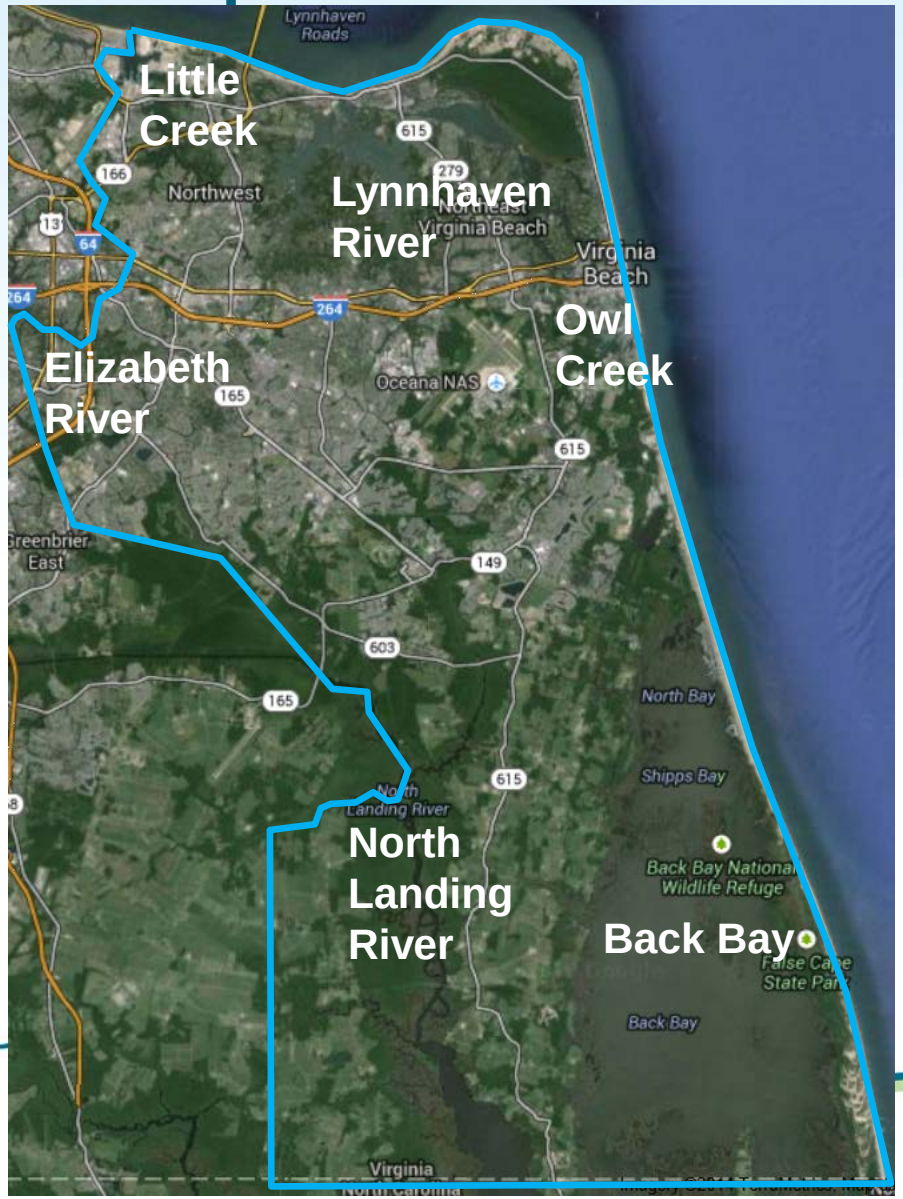
Study Conceptual Approach

3. Implementation
Planning the actions

2. Adaptation Strategies
Tailoring the solutions

1. Sea Level Rise/ Recurrent Flooding Impacts
Defining the problem

Comprehensive Master Plan Integration of multiple stormwater issues



- Stormwater management and flood mitigation
- 31 Watershed are updated
- Stormwater quality improvement
  - TMDLs (TN, TP, TSS, bacteria)
- Regulatory compliance
  - NPDES MS4, TMDLs
- Sea level rise and tidal surge
- Capital improvement planning and funding

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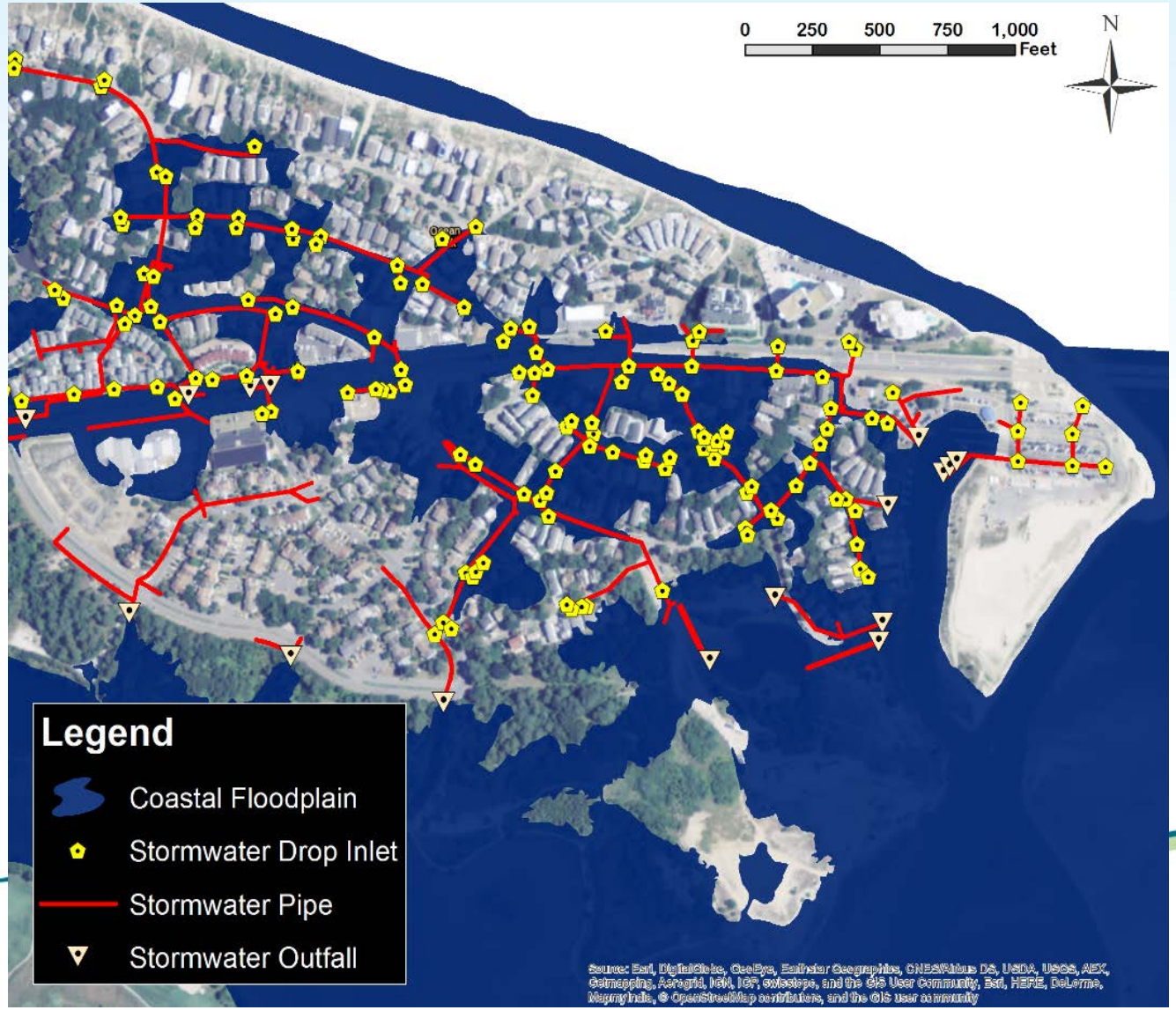
Bringing together the elements



- Coastal Flooding
- Stormwater Conveyance

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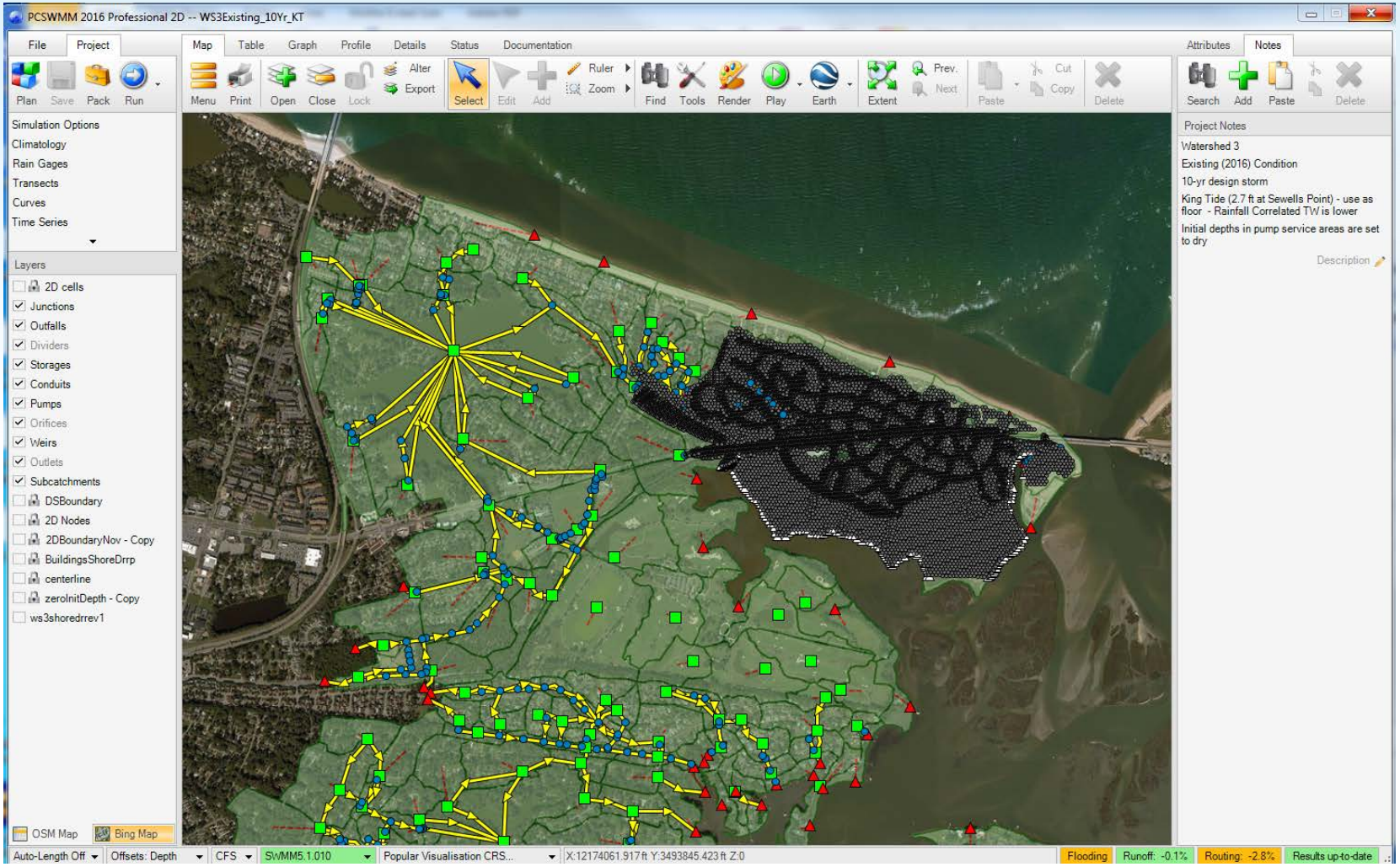
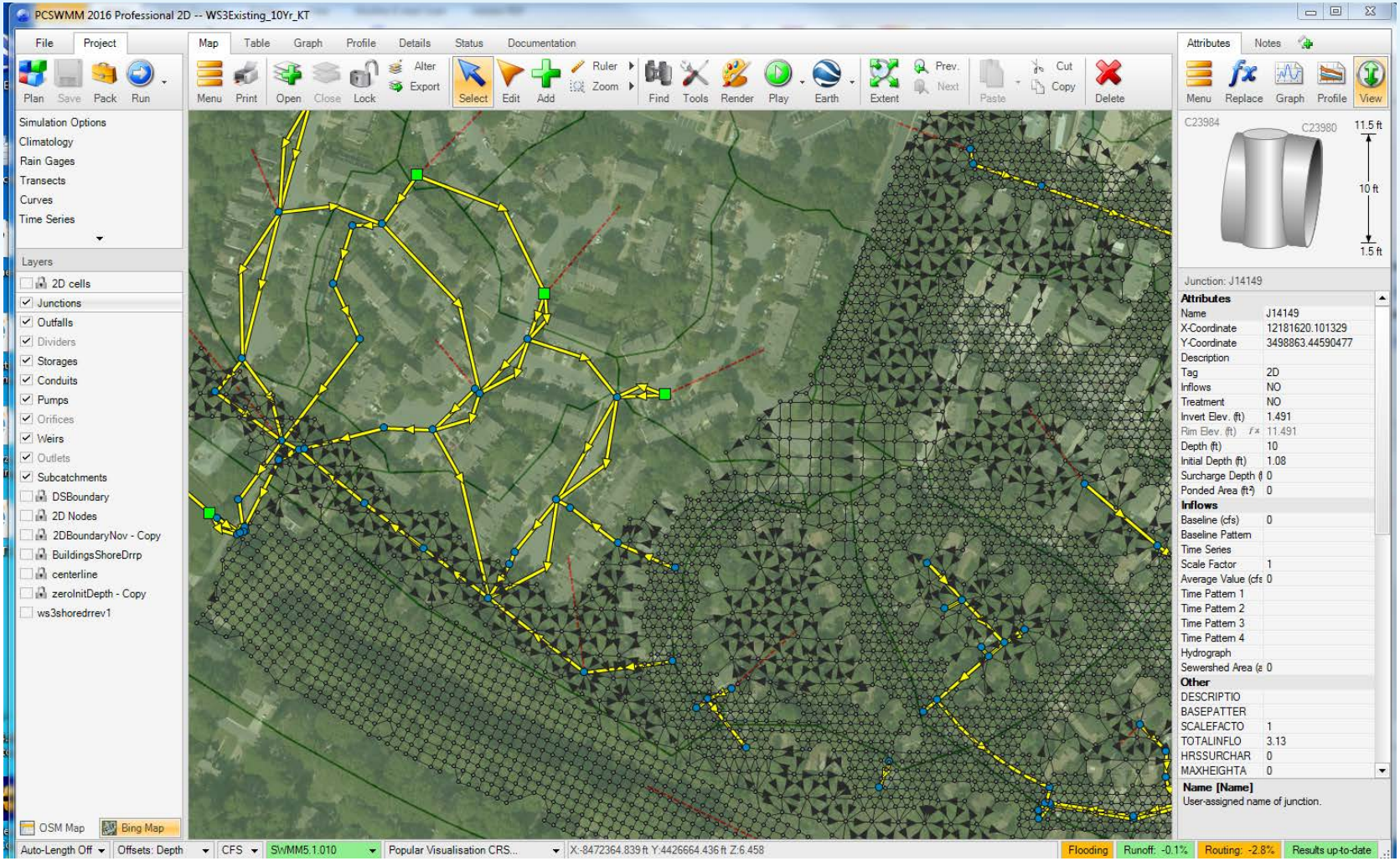
Watershed 3 SWMM Model

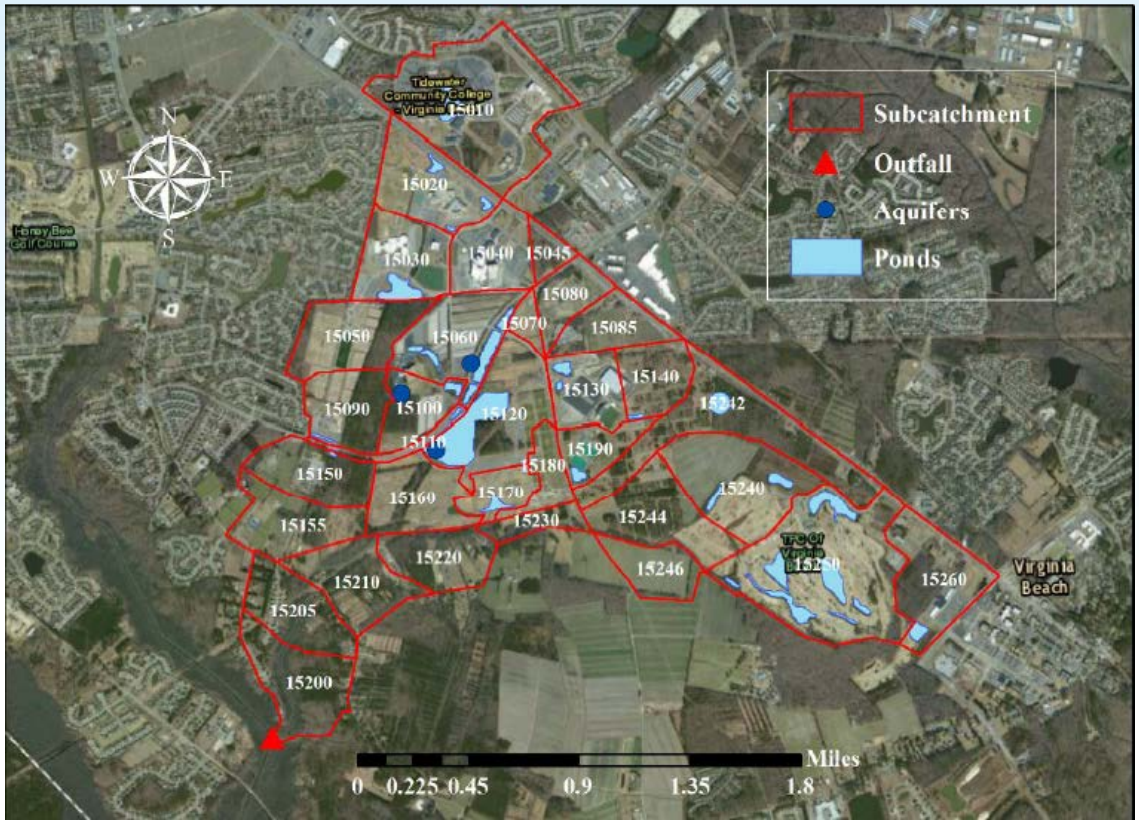


Watershed 3 SWMM Model



Lake Ridge – Quality Trial Model

- Supported 2005 Lake Ridge Master Drainage Plan for 500 acre watershed
- Focus of the comparison is Storage Node 920



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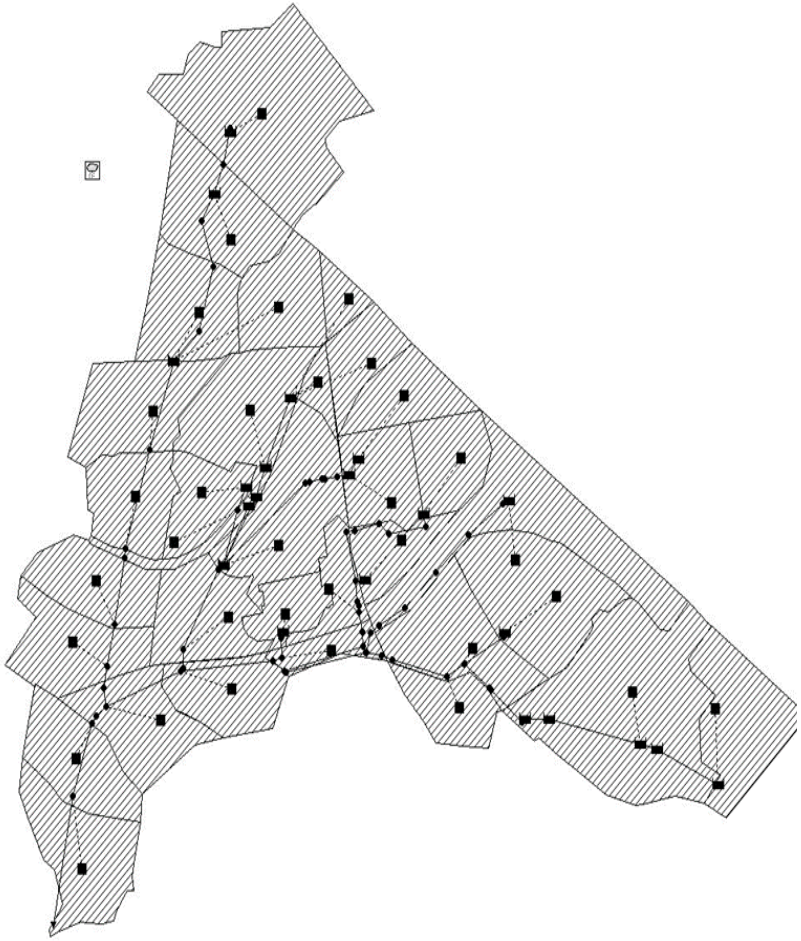
Lake Ridge Updated Model

- Update to SWMM 5 by Dr. Sample with Virginia Tech's research group in Spring 2015
- Revisions required to develop updated drainage plan
- New development projects proposed in Lake Ridge

Existing and Post Development Models

Current Conditions



Developed Conditions

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Existing and Post Development Model Comparison

Event	Current Conditions (cfs)	Developed Conditions (cfs)
Weir 920-921		
10-yr	111.02	87.3
25-yr	170.79	129.87
Conduit 15921		
10-yr	123.88	87.3
25-yr	190.37	162.36

Water Quantity/Quality metric:	Existing Conditions	Developed Conditions
TN reduction	44%	41%
TP reduction	86%	47%
TSS reduction	53%	40%
Runoff Volume, gal	40%	37%
P load, lb/yr	22.2	128.7
Unit P load, lb/ac/yr	0.05	0.25

Sites evaluated by SWWM Methodology

Site	Scale	Land Use	BMPs														
			Rooftop Disconnection	Sheetflow to Open Space	Grass Channels	Soil Restoration	Vegetated Roofs	Rainwater Harvesting	Permeable Pavement	Infiltrative Practices	Bioretention	Dry Swale	Wet Swale	Filtering Practices	Constructed Wetland	Wet Pond	Extended Detention/Dry
Bow Creek Rec Center and Golf Course	Large	Multipurpose			●											●	
College Park Elementary	Small	Schools	●	●	●		●	●		●	●						
Harpers Rd. School Bus Facility	Medium	Commercial/industrial	●				●				●					●	
Independence Rd.	Medium	Linear project														●	●
Joint Use Library	Medium	Schools	●	●												●	
Kellam High School	Large	Schools	●	●				●	●	●	●					●	
Little Neck Fire Station	Small	Commercial/industrial	●							●							●
Lynnhaven Mall Ponds	Large	Commercial/industrial														●	
Nimmo Rd.	Large	Linear project														●	
Seatack Recreation Center	Small	Multipurpose										●					
Thalia Rd.	Small	Linear project									●						
Williams Farm	Medium	Multipurpose	●	●												●	

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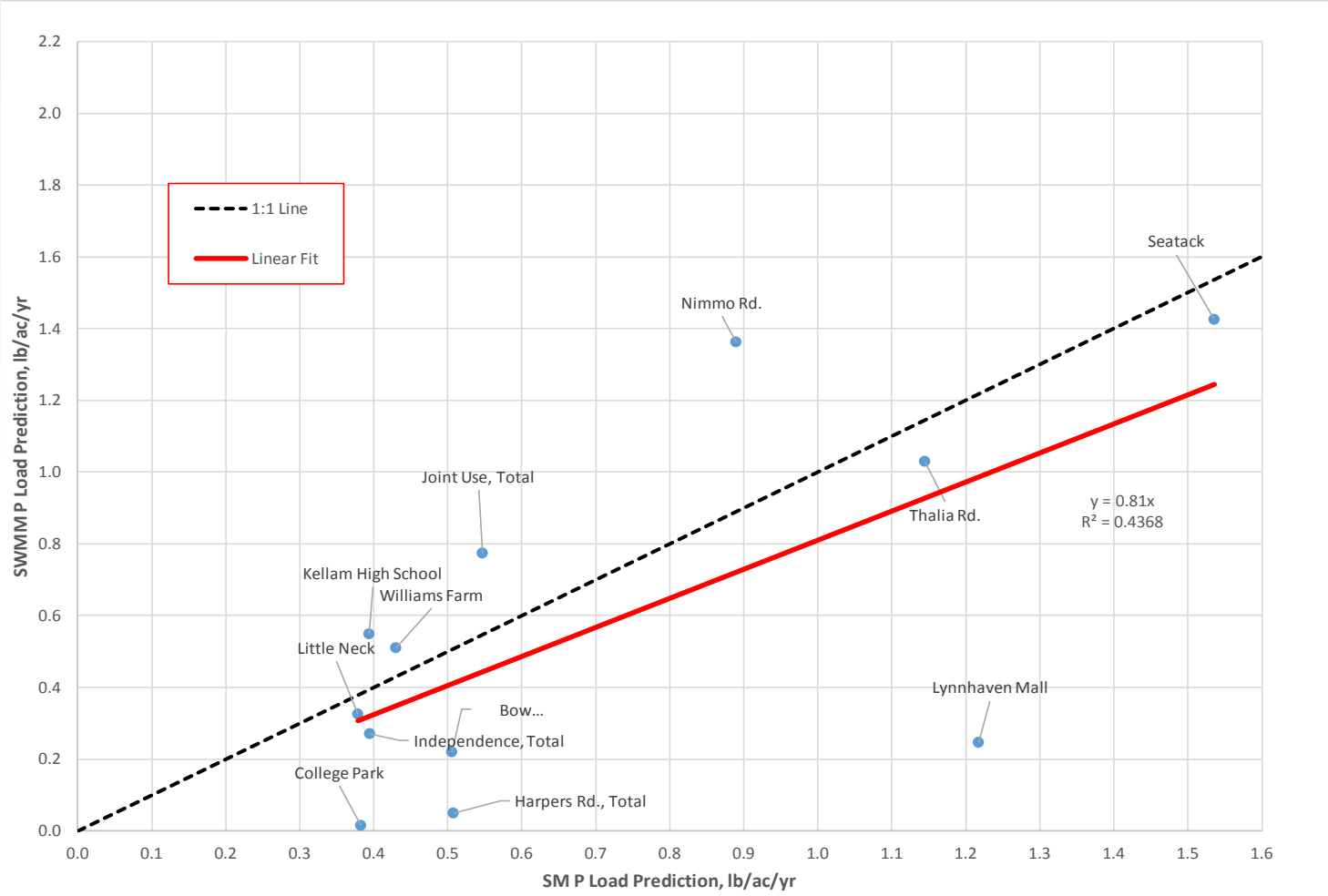
Phosphorus Loading
SWWM vs Simple Method



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Phosphorus Loading
SWWM vs Runoff Reduction

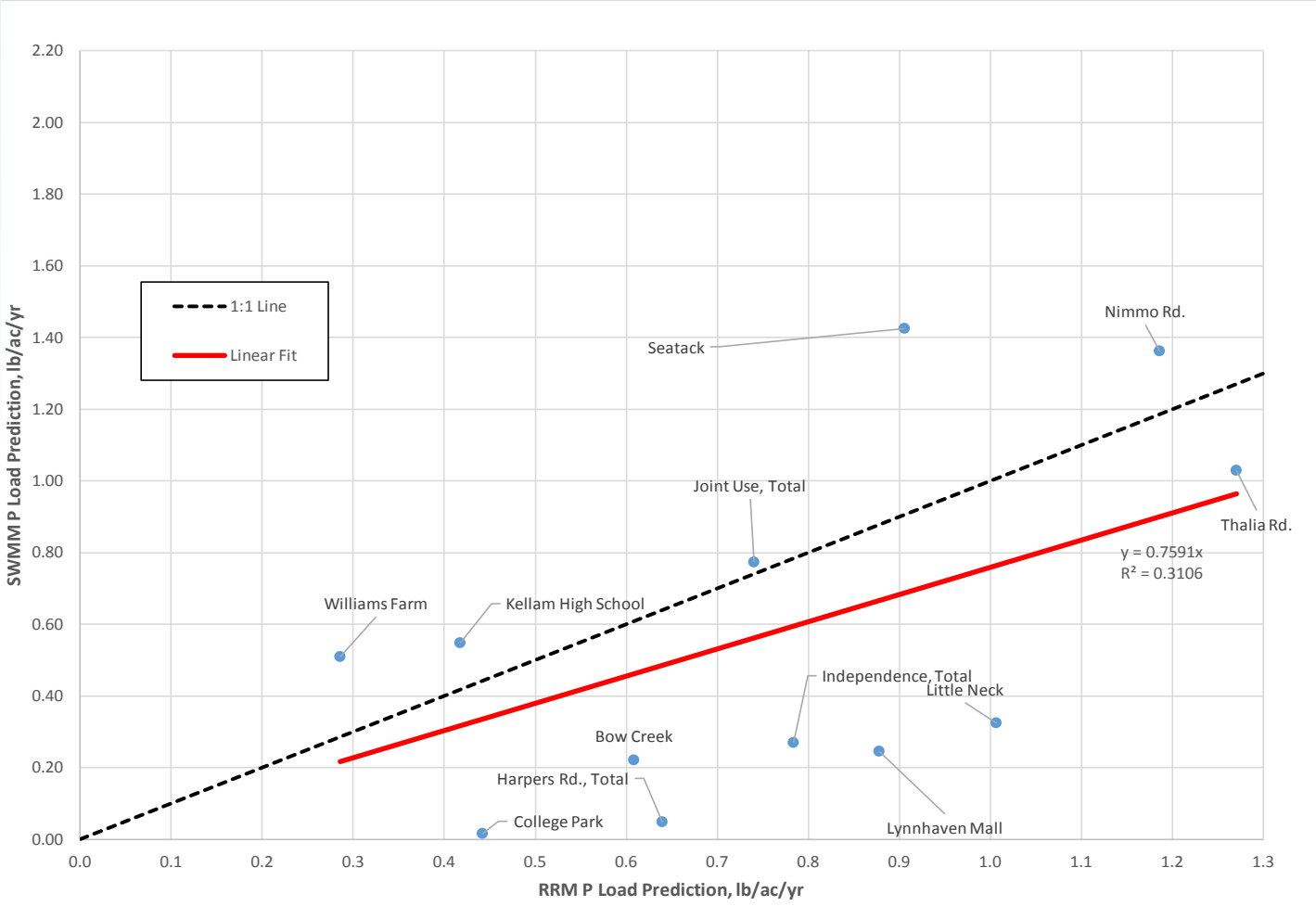

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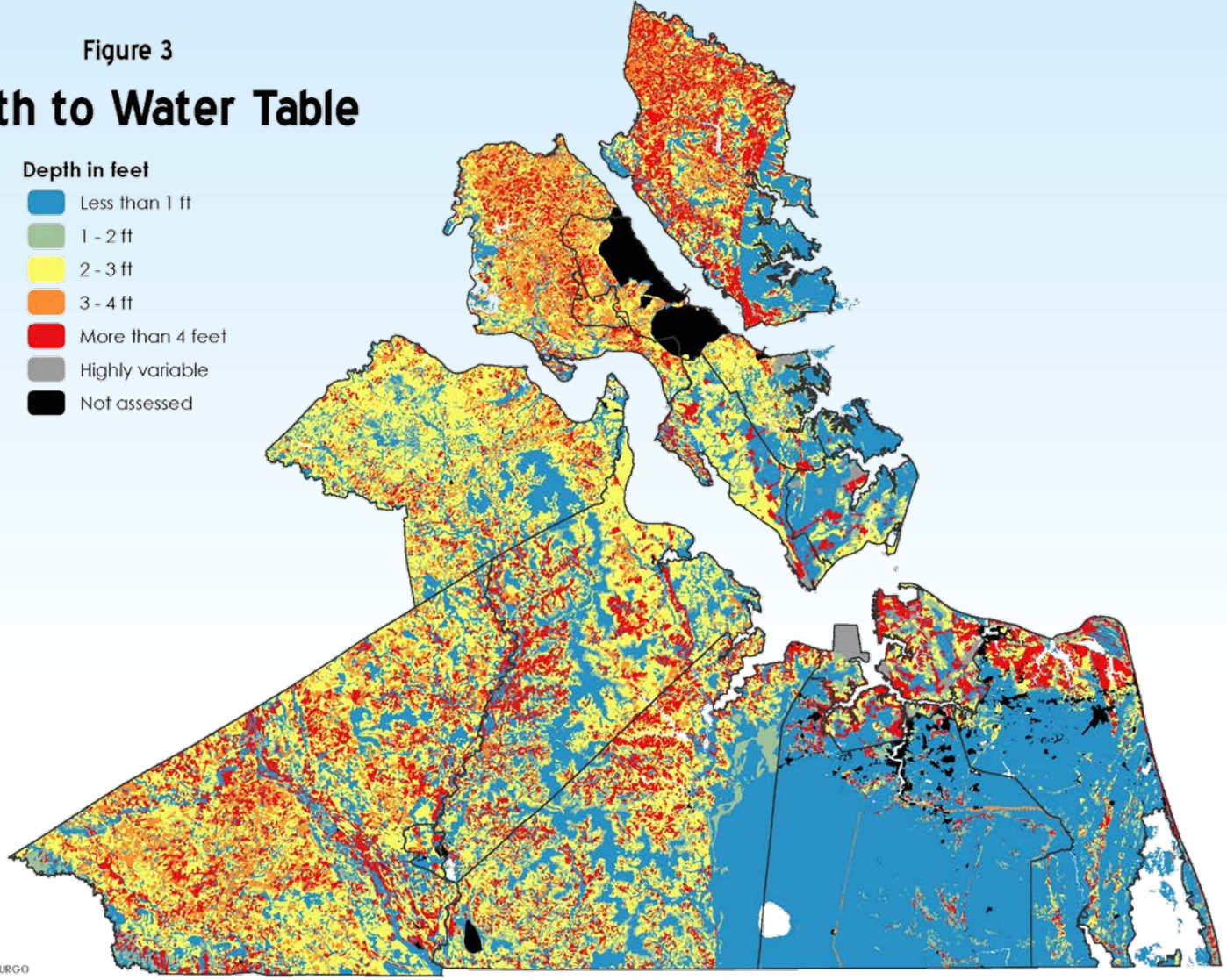
Figure 3

Depth to Water Table



Data Source: USDA SSURGO

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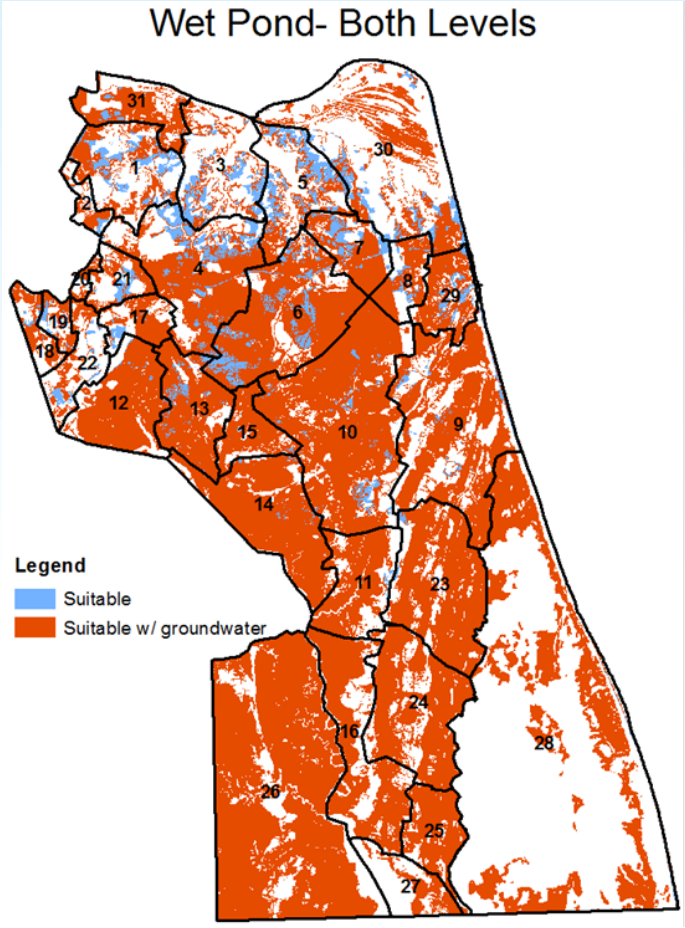
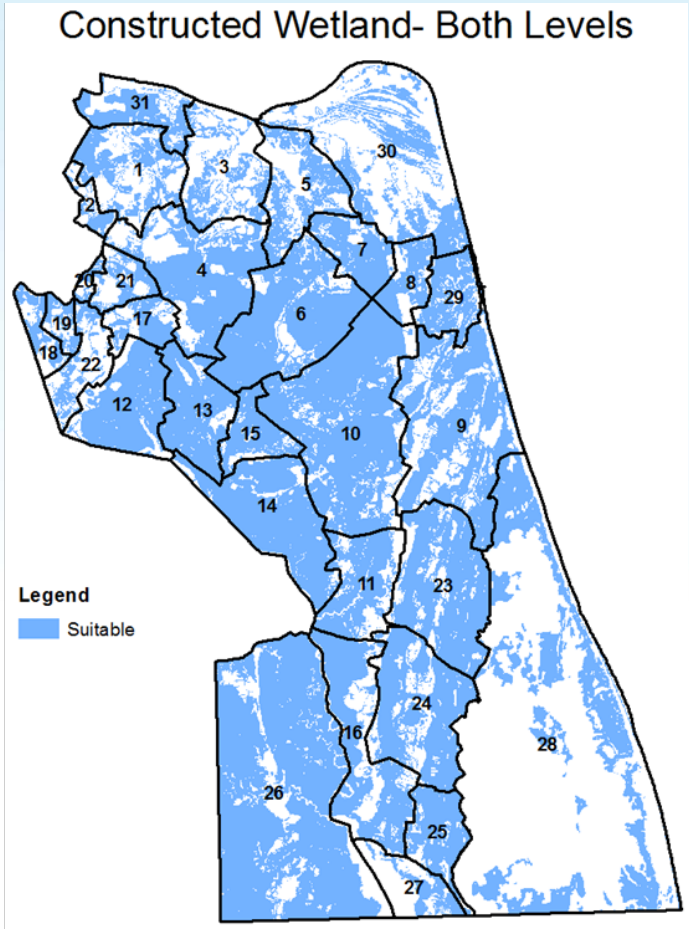
Most Suitable BMPs





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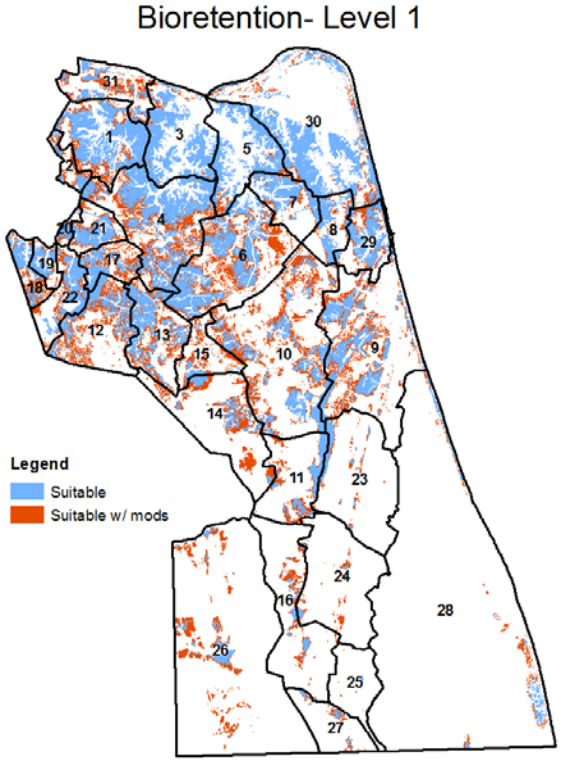
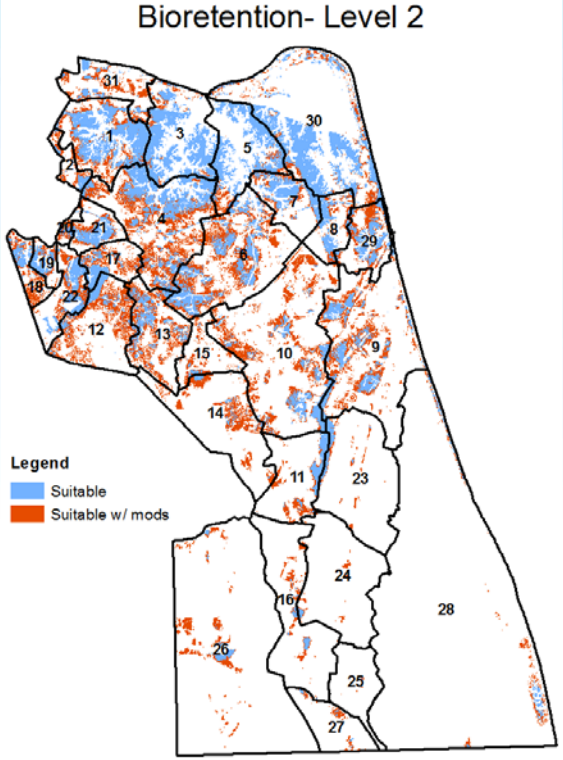
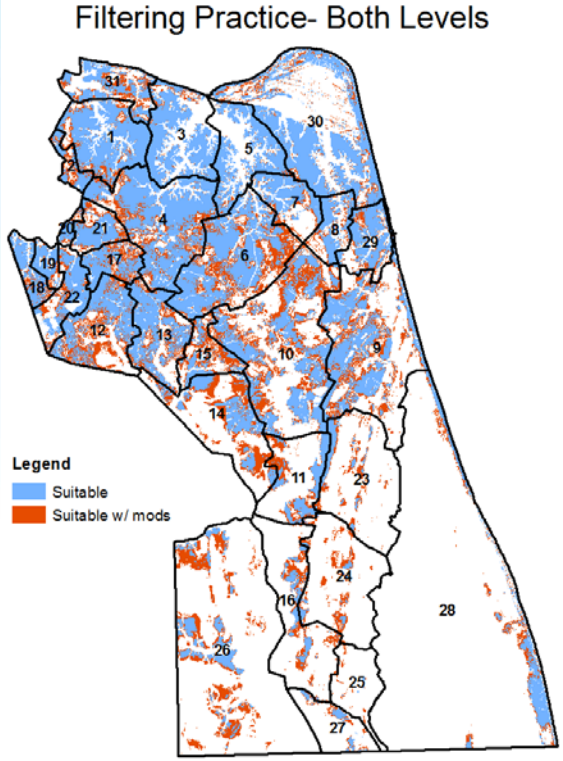
Applicability with Coastal Modifications







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Tidewater Hydrology

Tidewater Hydrology

Questions or Comments?