Improving Adoption of Stormwater Management Practices: Integrating Social and Biophysical Dimensions

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UNIVERSITY OF MARYLAND

Sustainable Community Oriented Stormwater Management : A Sensible Strategy for the Chesapeake Bay

UNIVERSITY OF MARYLAND PROJECT TEAM

Paul Leisnham (Primary Investigator; ENST)

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Victoria Chanse (Webinar Presenter; PSLA)

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Kaye Brubaker & Allen Davis (Civil Engineering)

COMMUNITY PARTNERS AND COLLABORATORS:

Groundwork DC

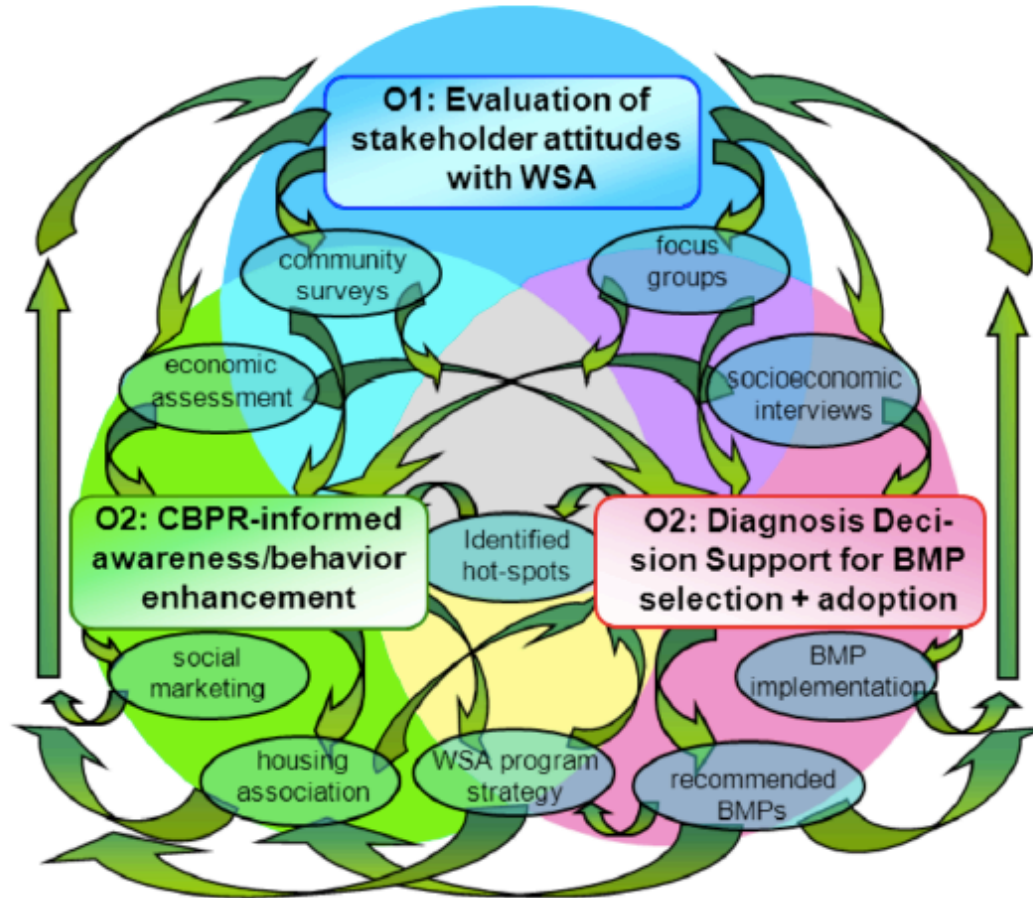Anacostia Watershed Society

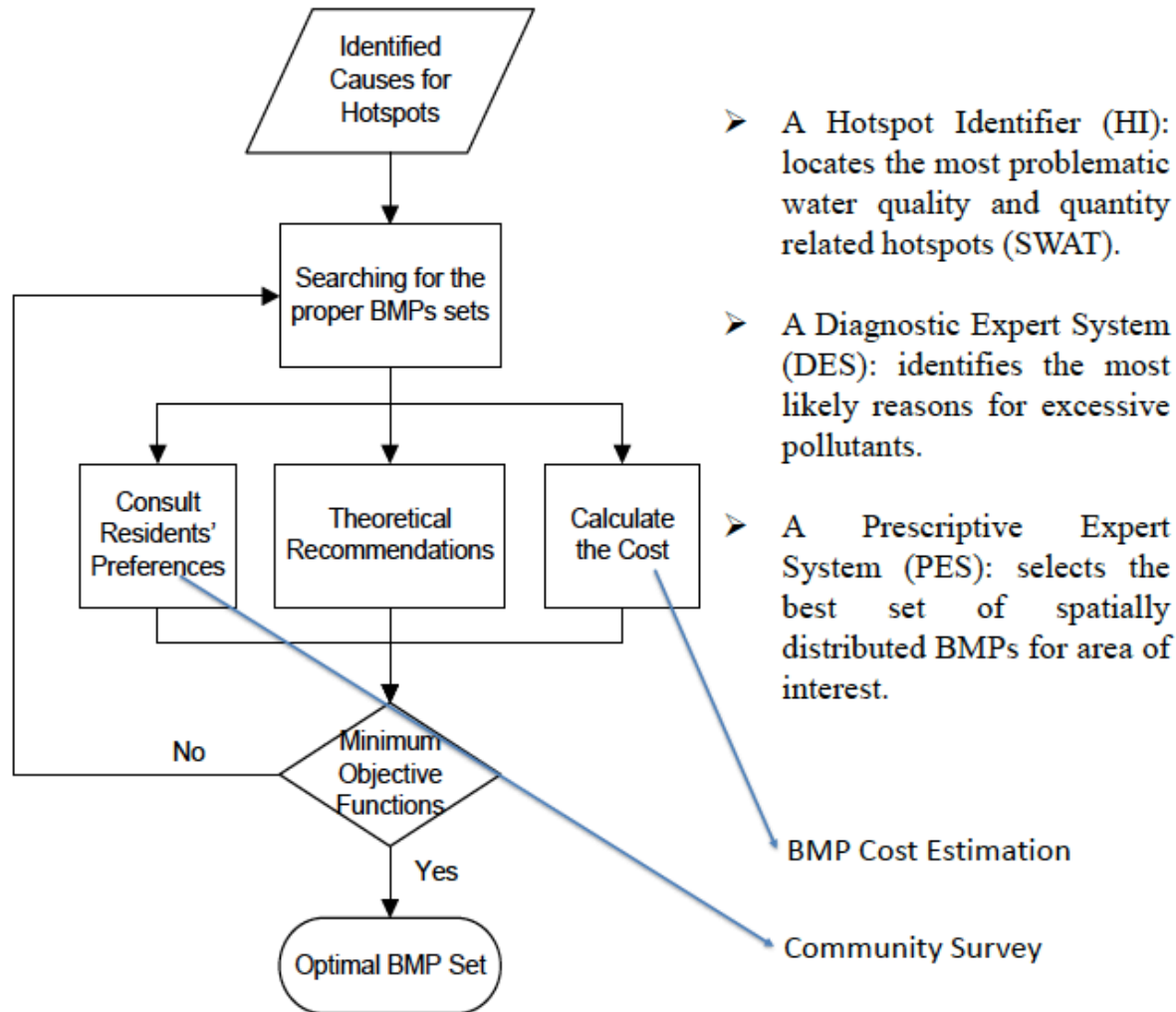Anacostia Community Museum

Columbia Association

S-COSM Research Objectives

1. **Evaluation of attitudes and behaviors**

2. Develop Diagnostic Decision support to guide BMP implementation

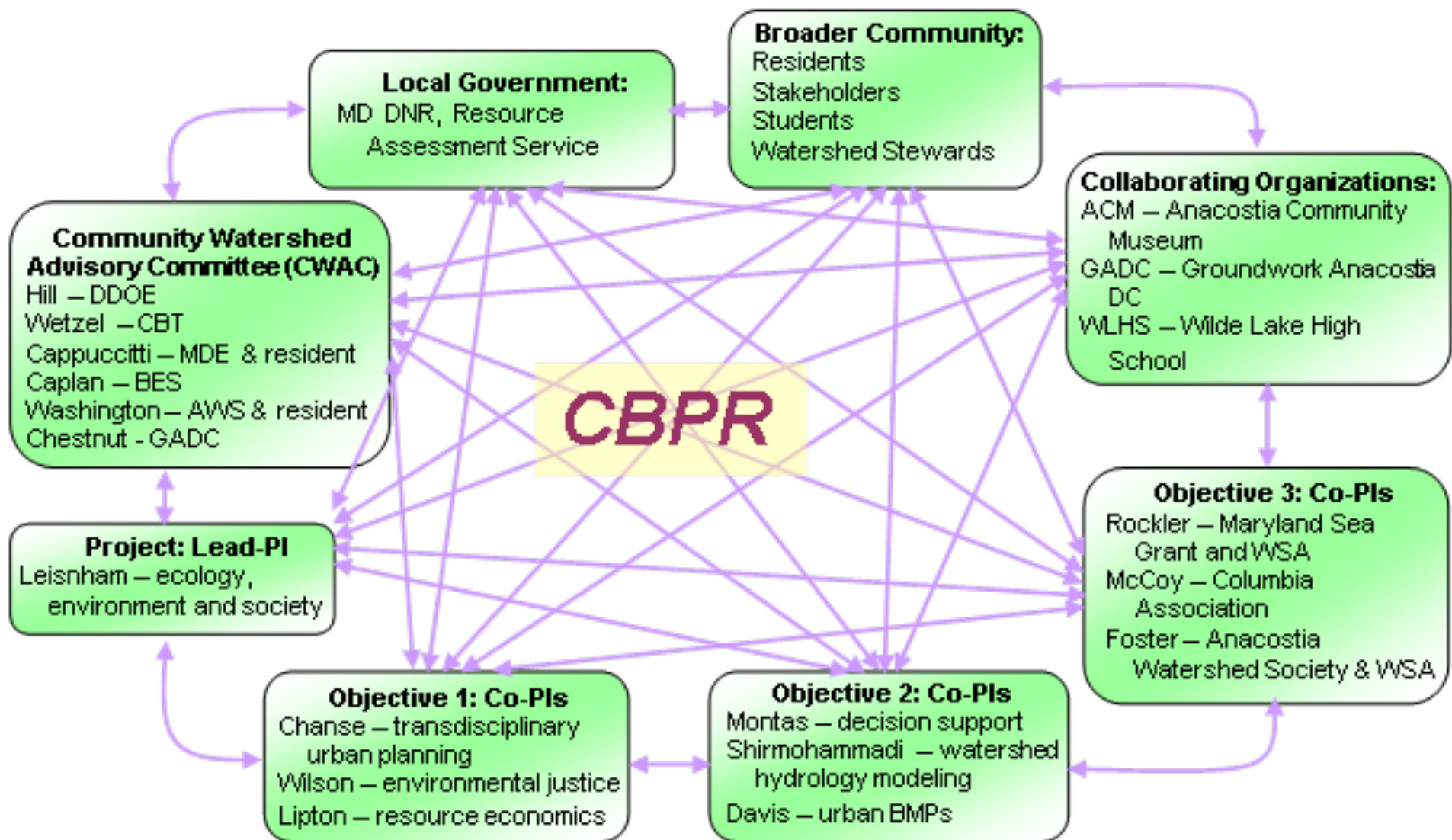3. Increase community awareness and behaviors towards water quality

Snapshot of Larger Project

Diagnostic Decision Support System

Source: Wang et al. 2014. Comparisons of BMP Selection Between Urban and Suburban Watersheds using a Diagnostic Decision Support System. (Poster displayed during poster session at the U.S. EPA NCER Kickoff Workshop on Jan. 20, 2015).

Slide courtesy of Dr. Paul Leisnham

Location map of the proposed study watersheds and Chesapeake Bay
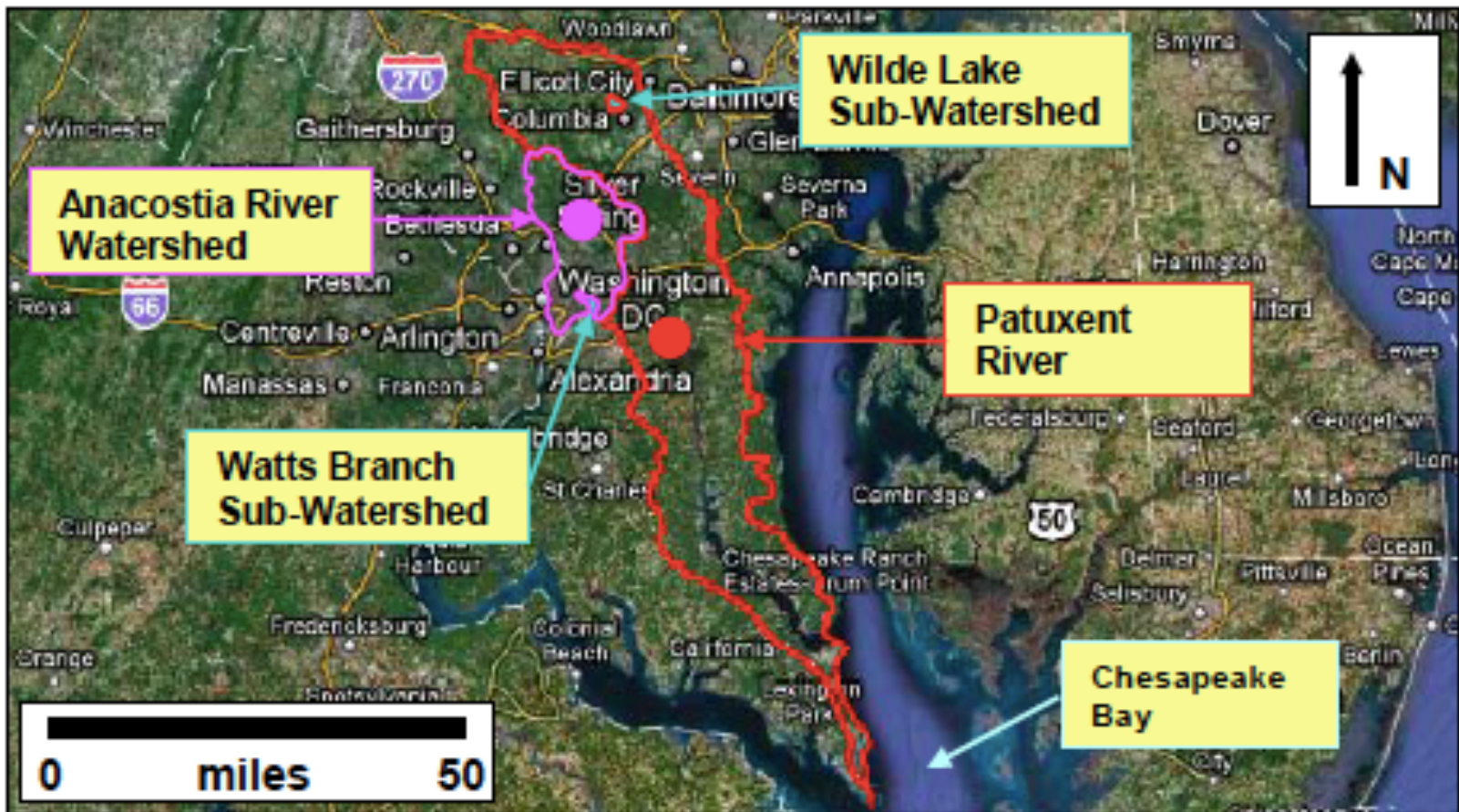
Pollution Estimates

	Watts Branch	Wilde Lake
Nitrogen Load (lbs/mi^2/year)	5,400	5,300
Phosphorus Load (lbs/mi^2/year)	730	360
TSS Load (tons/mi^2/year)	93	210
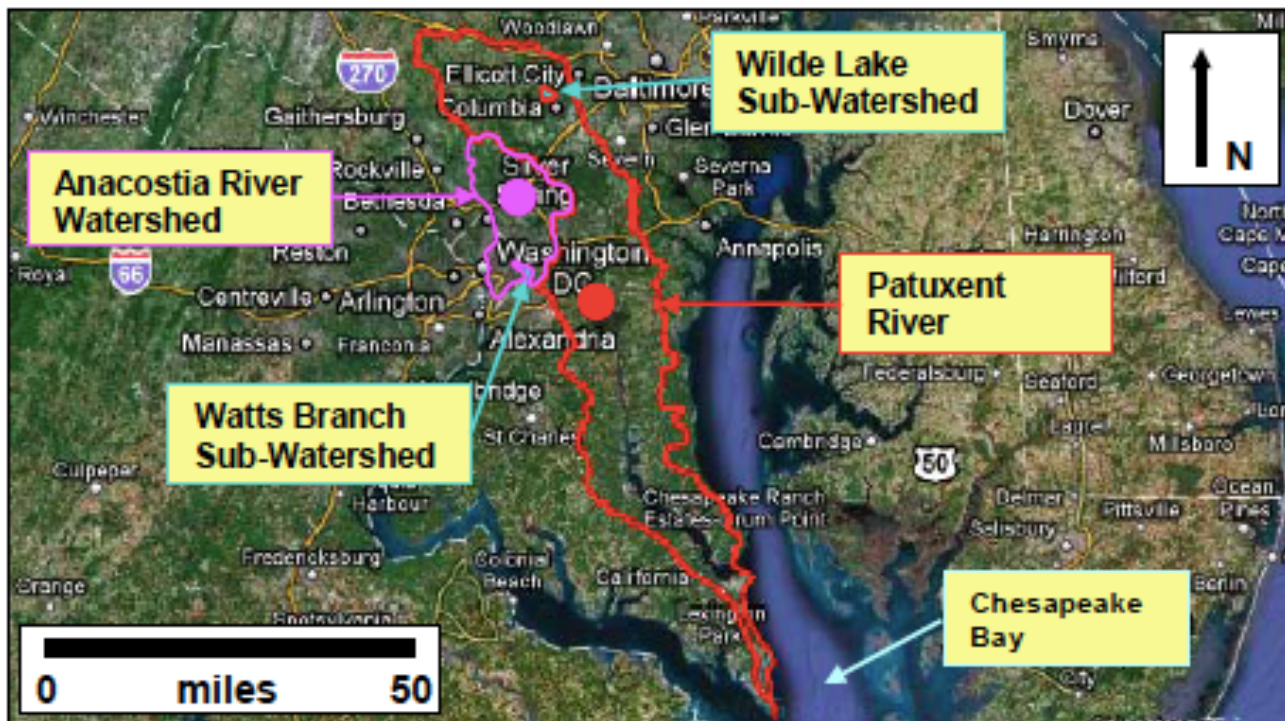
Physical Characteristics

Watts Branch

- 3.8 mi^2
- 70% Residential
- 29% Impervious Surfaces

Wilde Lake

- 1.9 mi^2
- 64% Residential
- 32% Impervious Surfaces
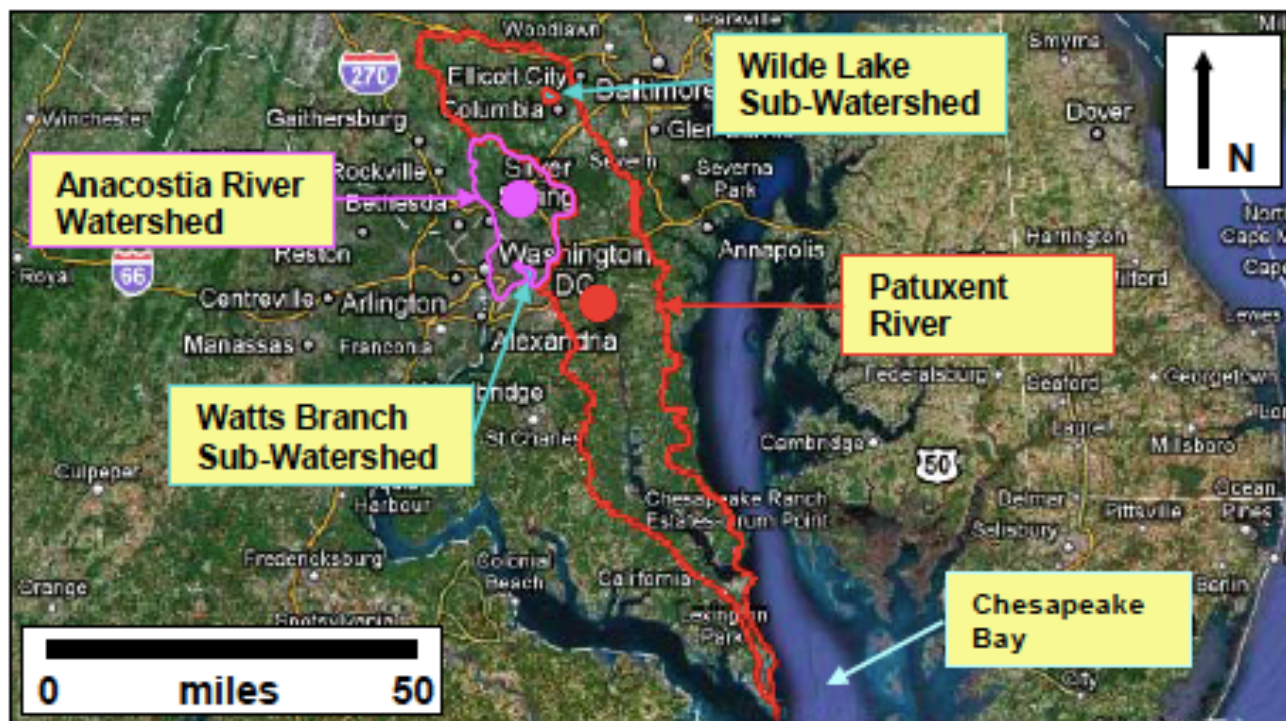
Demographics

	Watts Branch	Wilde Lake
Population Density (mi^2)	7,553	4,309
Predominant Ethnicity	95.2% (African American)	67% (White)
Median Household Income ($1999)	$45,071	$70,691

Center for Watershed Protection 2005, U.S. Census, AWRP 2009

Stormwater Education and Management Structure

Watts Branch

- ***Education & Outreach***: Anacostia Watershed Society's Watershed Stewards Academy (in addition, also started a faith-based wsa); 1 full-time staff, most recently also + an intern
- ***Stormwater Rebates & Fees***: Washington, D.C. District of the Environment & Maryland Prince George's County

Wilde Lake

- ***Education & Outreach***: Howard County Watershed Stewards Academy, all-volunteer
- ***Stormwater Rebates & Fees***: Stormwater Rebates & Fees: Howard County

S-COSM Objective 1:
Methods to Identify Stakeholder Attitudes & Behaviors

1) Interviews of key stakeholders
2) **Photovoice**
3) **Watershed Attitude and Behavior Survey**
4) Related-Added dimension-coordinate with AWS Watershed Steward Academy

S-COSM Photovoice

- 18-27 photos
- Select 10 photos to describe
  - Does the photo *represent* where you live, play, go to school, or something else?
  - *What* is *happening* in this photo?
  - *Why* did you take a photo of *this*?
  - *What* is this photo *telling* us?
  - Select the "thumbs up" or "thumbs down" to show if you have a positive or negative *association with this photo*
- Qualitative and Quantitative Analysis
  - Coding of visual and textual elements

Slide courtesy of graduate student Amina Mohamed

S-COSM Photovoice Method

- Preview
  - Review photographs and textual accompaniment
  - Participant's intent and perspective

- Review
  - Photographs and textual accompaniment
  - Researcher perspective: connections, interpretations, meanings
  - Code information for visual elements and textual characteristics
  - Notes

- Cross-Photo Comparison
  - Comparing photographs and text
    - Participant's original intent and perspective
    - Researcher perspective
  - Themes and trends as a whole
  - Notes
  - Analyzing quantified visual elements and textual characteristics

- Theorizing
  - Drawing conclusions within each watershed and as a whole
    - Photographs and textual accompaniment
    - Quantified visual elements and texts

Slide courtesy of graduate student Amina Mohamed

(Oliffe et al. 2008), (Plunkett 2013, 160)

Focus Areas

Watts Branch

- N = 221 photographs

- Background
  - 3.8 mi^2
  - 70% Residential
  - 29% Impervious Surfaces

Wilde Lake

- N = 247 photographs

- Background
  - 1.9 mi^2
  - 64% Residential
  - 32 % Impervious Surfaces

Stormwater Infrastructure Regulations, Preventive Measures and Best Management Practices (BMPs): Watts Branch

"This shows a sponge blocking the front of the sewer."

"This shows trash and other waste build up inside a water sewer. With the build up no water is going to be able to get through causing floods. I took this to tell the people if we do not act now something drastic will happen to our ecosystem in the near future."

Stormwater Infrastructure Regulations, Preventive Measures and Best Management Practices (BMPs): Wilde Lake

"A long orange plastic netting is obstructing the view near a woodland path."

"Least Favorite- This netting has been standing for **four years, serving no visible purpose and disrupting** and **endangering** the **environment**."

Findings

Watts Branch

- N = 221 photographs

- Attitudes associated to photos:
  - Thumbs Up: 29.9%
  - Thumbs Down: 17.6%
  - Blank: 52%
  - Up/down: 0.5%

- Locations
  - School: 12%
  - Live: 23%
  - Other: 12%
  - Blank: 53%

Wilde Lake

- N = 247 photographs

- Attitudes associated to photos:
  - Thumbs Up: 46.6%
  - Thumbs Down: 21.5%
  - Blank: 32%

  - Locations:
    - School: 3%
    - Live: 22%
    - Other: 16%
    - Blank: 59%

Slide courtesy of graduate student Amina Mohamed

Findings: Differences

Watts Branch

- Greater number of images:
  - Impervious surfaces
  - Residential buildings
  - Manholes, stormwater sewer inlets, etc.
- Identified **"people"** and **"community"**
  - Responsible for current state
- Attitudes of community
  - apathy
- More adamant for need to clean up

Wilde Lake

- Greater number of images:
  - Lake
  - Woods
  - Concrete channels, stormwater sewer outlets
- Woods
  - Pleasant aesthetic quality
  - Sense that individuals could navigate larger area, diversity of paths

Slide courtesy of graduate student Amina Mohamed

Student Associations to Self-Selected Photographs

	Anacostia	*Patuxent*
Positive	62.6%	68.5%
Negative	36.4%	31.5%
Both positive & negative	0.9%	0%

Watts Branch, Example of a Positive Association

Watts Branch, Example of Negative Association

Wilde Lake, Example of a Positive Association

Wilde Lake, Example of Negative Association

Comparison of Narrative Content Analysis

Anacostia Themes	Word Frequency	Patuxent Themes	Word Frequency
Trash,	43 times	**Water**	**47 times**
Water	**38 times**	Lake	28 times
Flood, -s, -ing, -ed	18 times	Stream, -s	23 times
Sewer	18 times	Nature	21 times
Pollute, -ing, -ed	**14 times**	Flow, -s, -ing	19 times
Drain, -s	14 times	Tree, -s	19 times
People	10 times	Watershed	18 times
Problem, -s	10 times	River	17 times
Litter, ing-	9 times	Creek	16 times
Community	8 times	Environment, -s, enviros	16 times
		Pollution, -ing, -ed	**13 times**
		Path	11 times
		Area	11 times

Resident Survey
(N=252+; initial findings)

- Mailout and door-to-door (door to door much more effective)
- Behavior
- Attitudes
- Knowledge
- Barriers and Incentives identified from semi-structured interviews
  - Stakeholders-complexity, issue
  - Lack of awareness about rebates
  - Aesthetics

Assumptions

- The reasons for limited stormwater bmp implementation are either <u>financial</u> (expensive), <u>technical</u> (too much trouble/ complex), <u>aesthetic</u> (considered ugly), or a <u>combination</u> of the above.

Previous Research

- Environmental attitudes seem to play a factor in stormwater BMP adoption (Ando and Freitas 2011).

- Locational factors: Rain barrel distribution sites also seem to be a factor in rain barrel implementation were adopted. However, local flooding did not seem to be a factor (Ando and Freitas 2011).

S-COSM Diagnostic Decision Support System re: distributed BMP recommendations by Watershed

Watts Branch. The DDSS distributed BMP modeling found that **native landscaping** and **green roofs** are found to be the **most useful**, with **rain barrels** and **pervious pavement** but **not** rain gardens as much.

Wilde Lake. Native landscaping and **rain barrels** are the **most useful**. Rain gardens are also useful (but not the most useful).

Source: Wang et al. 2014. Comparisons of BMP Selection Between Urban and Suburban Watersheds using a Diagnostic Decision Support System. (Poster displayed during poster session at the U.S. EPA NCER Kickoff Workshop on Jan. 20, 2015).

Awareness of Local Stormwater BMP Rebates Programs

	Watts Branch	Wilde Lake
Yes	5.38%	15.46%
No	51.61%	48.45%
Not Certain	43.01%	36.08%

Stormwater BMP Perception- Watts Branch

	Rainbarrels	Rain Gardens	Downspout Disconnect	Lawn Infiltration	Lawn Depression	Lawn Replacement	Reducing Fert	Pervious Pavers	Pet Waste
Unfamiliar	60.22%	68.82%	61.83%	62.37%	77.42%	30.65%	31.18%	72.58%	51.08%
Not attractive	7.53%	0.54%	2.69%	2.15%	3.76%	3.76%	6.45%	2.15%	6.45%
Diff to install	1.08%	3.23%	1.61%	2.69%	1.61%	2.69%	0.54%	3.76%	1.08%
Expensive Maintenance	3.76%	4.84%	1.08%	4.84%	1.61%	8.60%	1.08%	7.53%	5.91%
Difficult	3.23%	2.15%	2.69%	5.91%	4.84%	8.06%	3.23%	2.69%	2.15%
Is cost effective	21.51%	10.22%	15.05%	6.45%	3.23%	25.81%	26.34%	9.68%	13.98%
easy maintain	16.67%	13.98%	19.89%	15.05%	6.99%	34.41%	30.65%	15.05%	27.42%
saves money impervious	14.52%	6.99%	3.23%	4.84%	2.69%	6.99%	10.22%	2.69%	2.69%

Stormwater BMP Perception-Wilde Lake

	Rainbarrels	Rain Gardens	Downspout Disconnect	Lawn Infiltration	Lawn Depression	Lawn Replacement	Reducing Fert	Pervious Pavers	Pet Waste
Unfamiliar	32.99%	39.18%	62.89%	65.98%	67.01%	20.62%	15.46%	48.45%	40.21%
Not attractive	14.43%	1.03%	1.03%	2.06%	3.09%	2.06%	3.09%	1.03%	7.22%
Diff to install	5.15%	7.22%	2.06%	1.03%	3.09%	8.25%	1.03%	15.46%	5.15%
Expensive Maintenance	4.12%	15.46%	2.06%	4.12%	3.09%	14.43%	0.00%	16.49%	4.12%
Difficult Is cost	6.19%	11.34%	0.00%	1.03%	3.09%	4.12%	1.03%	1.03%	5.15%
effective easy	29.90%	17.53%	13.40%	11.34%	10.31%	29.90%	37.11%	14.43%	15.46%
maintain saves money	26.80%	26.80%	20.62%	14.43%	11.34%	41.24%	40.21%	21.65%	18.56%
impervious	13.40%	13.40%	6.19%	5.15%	3.09%	7.22%	7.22%	6.19%	4.12%

Rainbarrels/Cisterns as a BMP: Comparative Perceptions

	Watts Branch	Wilde Lake
Unfamiliar	60.22%	32.99%
Not attractive	7.53%	14.43%
Diff to install	1.08%	5.15%
Expensive	3.76%	4.12%
Maintenance Difficult	3.23%	6.19%
Is cost effective	21.51%	29.90%
easy maintain	16.67%	26.80%
saves money impervious	14.52%	13.40%

Rain Gardens as a BMP: Comparative Perceptions

	Watts Branch	Wilde Lake
Unfamiliar	60.22%	39.18%
Not attractive	7.53%	1.03%
Diff to install	1.08%	7.22%
Expensive	3.76%	15.46%
Maintenance Difficult	3.23%	11.34%
Is cost effective	21.51%	17.53%
easy maintain	16.67%	26.80%
saves money impervious	14.52%	13.40%

Downspout Disconnection as a BMP: Comparative Perceptions

	Watts Branch	Wilde Lake
Unfamiliar	61.83%	62.89%
Not attractive	2.69%	1.03%
Diff to install	1.61%	2.06%
Expensive	1.08%	2.06%
Maintenance Difficult	2.69%	0.00%
Is cost effective	15.05%	13.40%
easy maintain	19.89%	20.62%
saves money impervious	3.23%	6.19%

Percent of BMPs Installed by Watershed

	Watts Branch	Wilde Lake
Rainbarrels	4.78%	6.54%
Rain Gardens	1.99%	3.92%
Downspout Disconnect	**31.08%**	**18.30%**
Lawn Infiltration	5.58%	9.80%
Lawn Depression	2.79%	4.58%
Lawn Replacement	16.33%	20.92%
Reducing Fert	**29.88%**	**30.07%**
Pervious Pavers	7.57%	5.88%

Barriers to residential BMP implementation

- Some of the biggest challenges appears to be lack of familiarity with different types of BMPs, lack of awareness for the voluntary BMPs rebate programs, and issues with aesthetics.

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