# Montgomery County's MS4 Permit Implementation Strategy: Using the Watershed Treatment to meet local and Bay restoration goals

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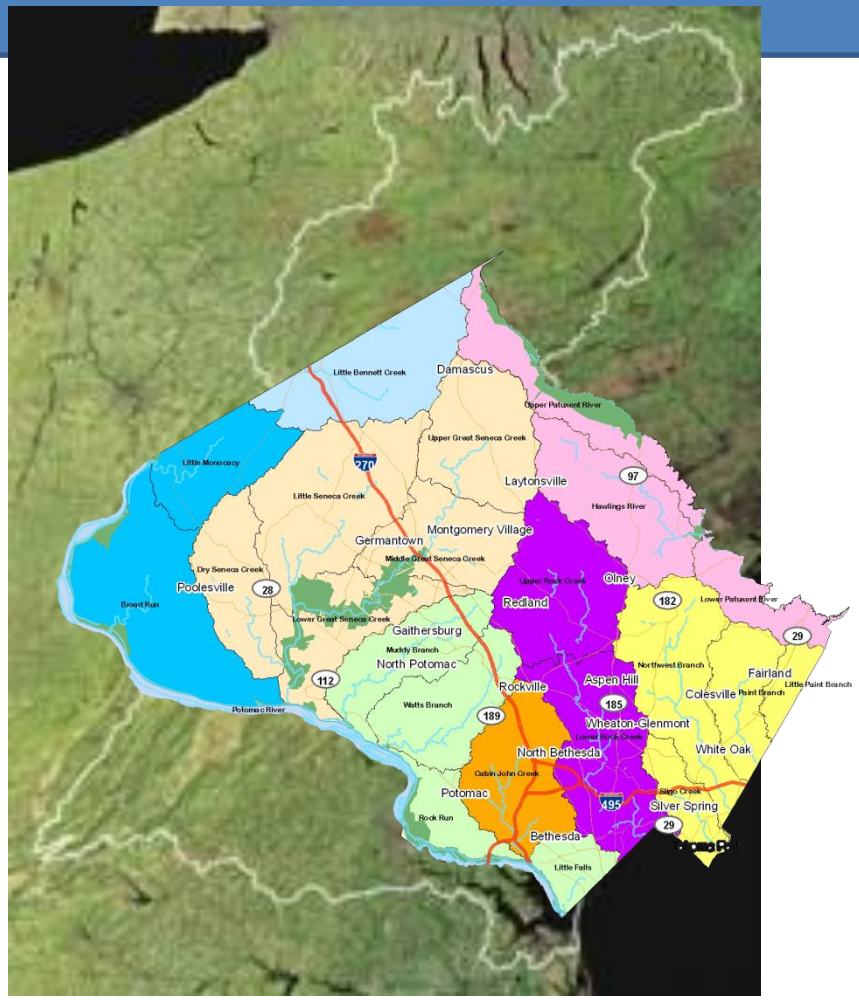
# Presentation Outline

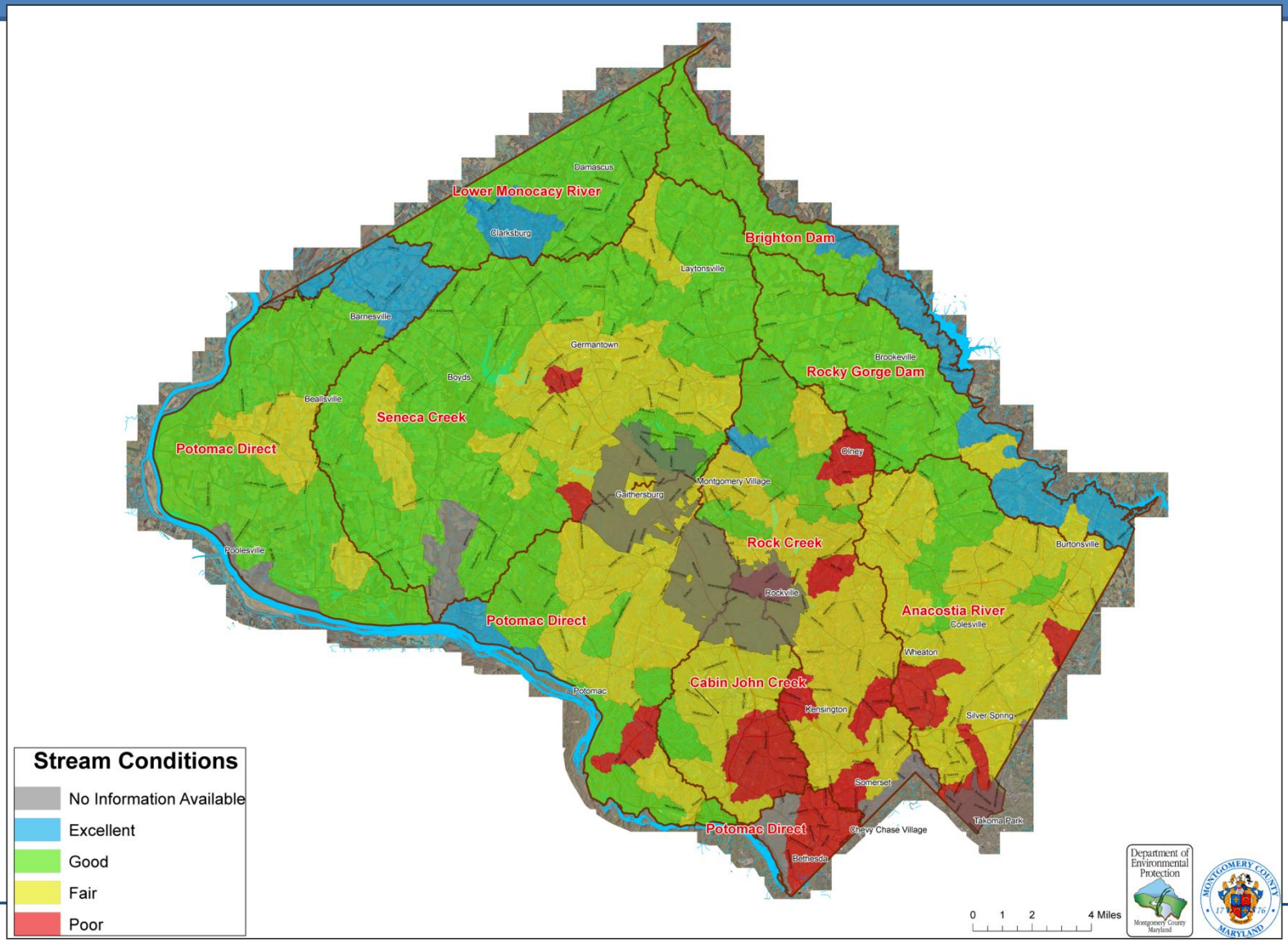
- Background
- County's MS4 Permit Implementation Strategy
- Use of WTM as Assessment Tool
- Lessons Learned and Challenges

# Montgomery County, MD

- 500 sq. miles
- 970,000 people
- About 12% impervious overall
  - About 8,500 acres
  - Equal to Area of Washington, DC
- Second only to Baltimore City within Maryland in average people per square mile
- >95% of land zoned for development has already been developed
- Two major basins: Potomac and Patuxent Rivers
- 8 major local watersheds

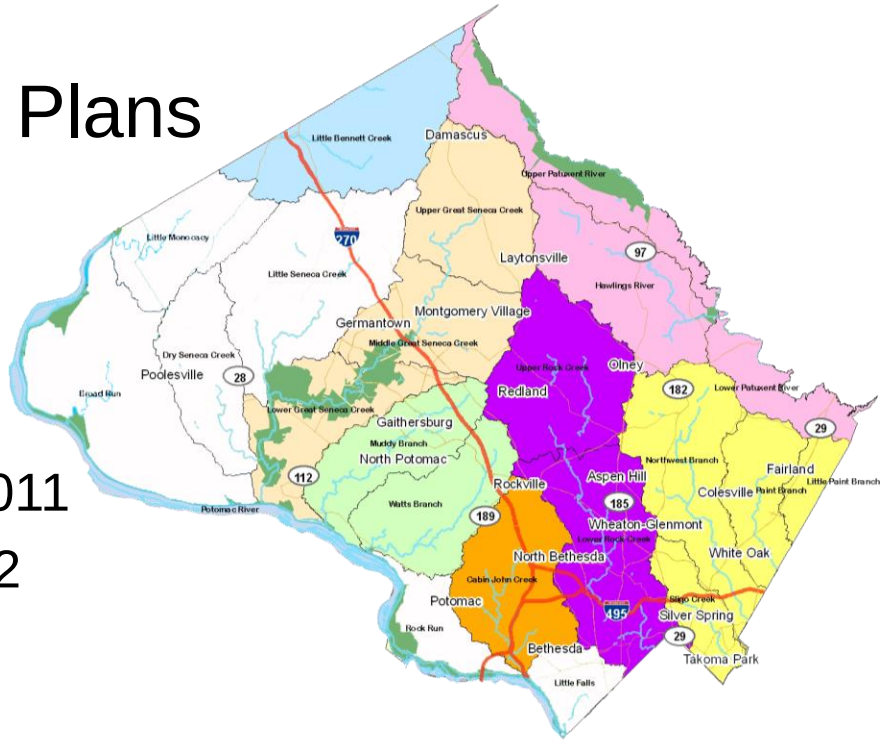


# Montgomery County Major Watersheds



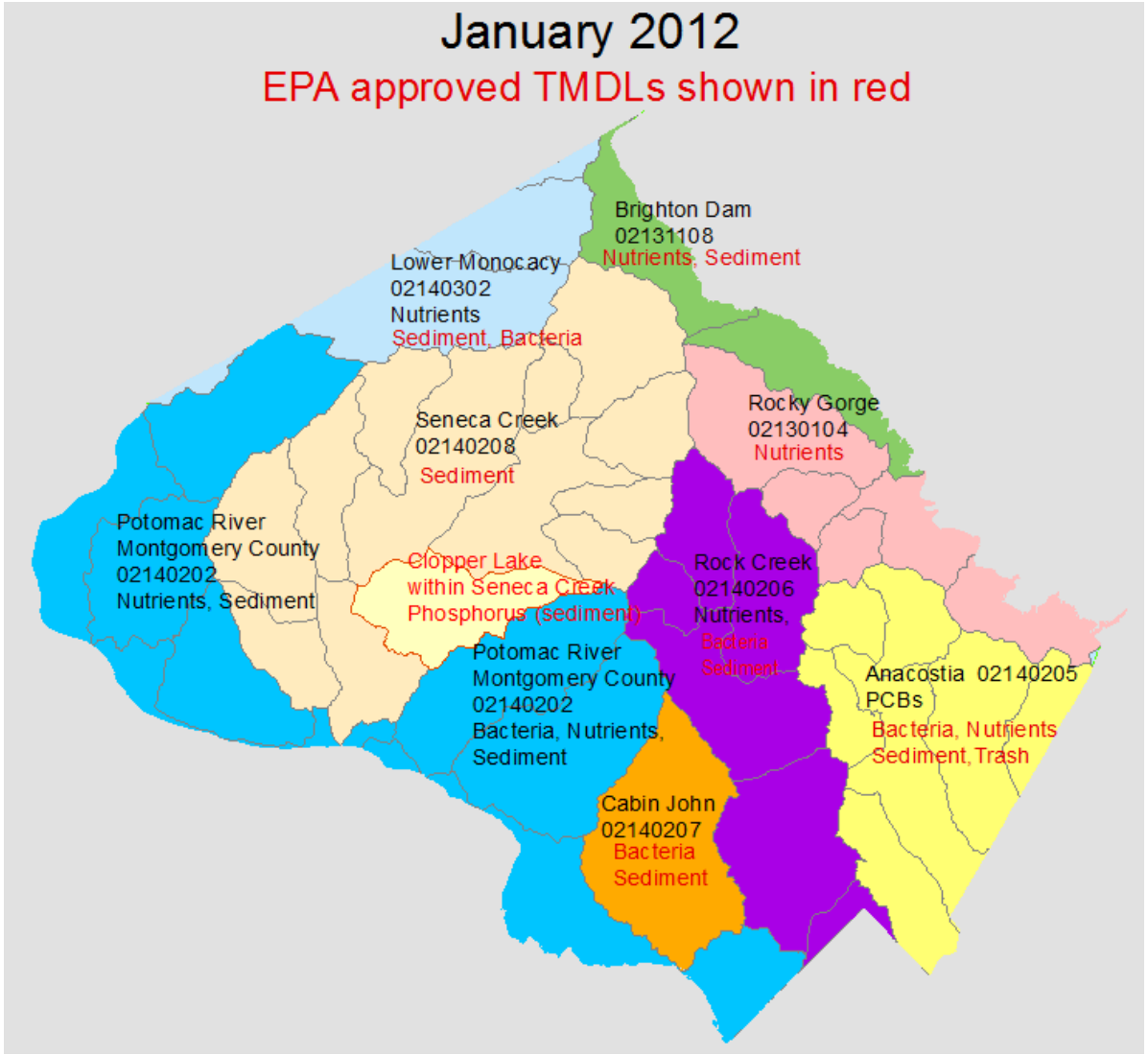
# Countywide Coordinated Implementation Strategy

- Meet MS4 permit goals
- Watershed Implementation Plans
- Bay TMDL
- Timeline
  - Began in June 2009
  - Submitted to MDE in February 2011
  - MDE approved plans in July 2012




= No Implementation Plans

# Total Maximum Daily Loads



# Primary Driver: Restoration Goal

- By February 2015, add stormwater management to an additional 20% of impervious area currently not treated to the maximum extent practicable (MEP)

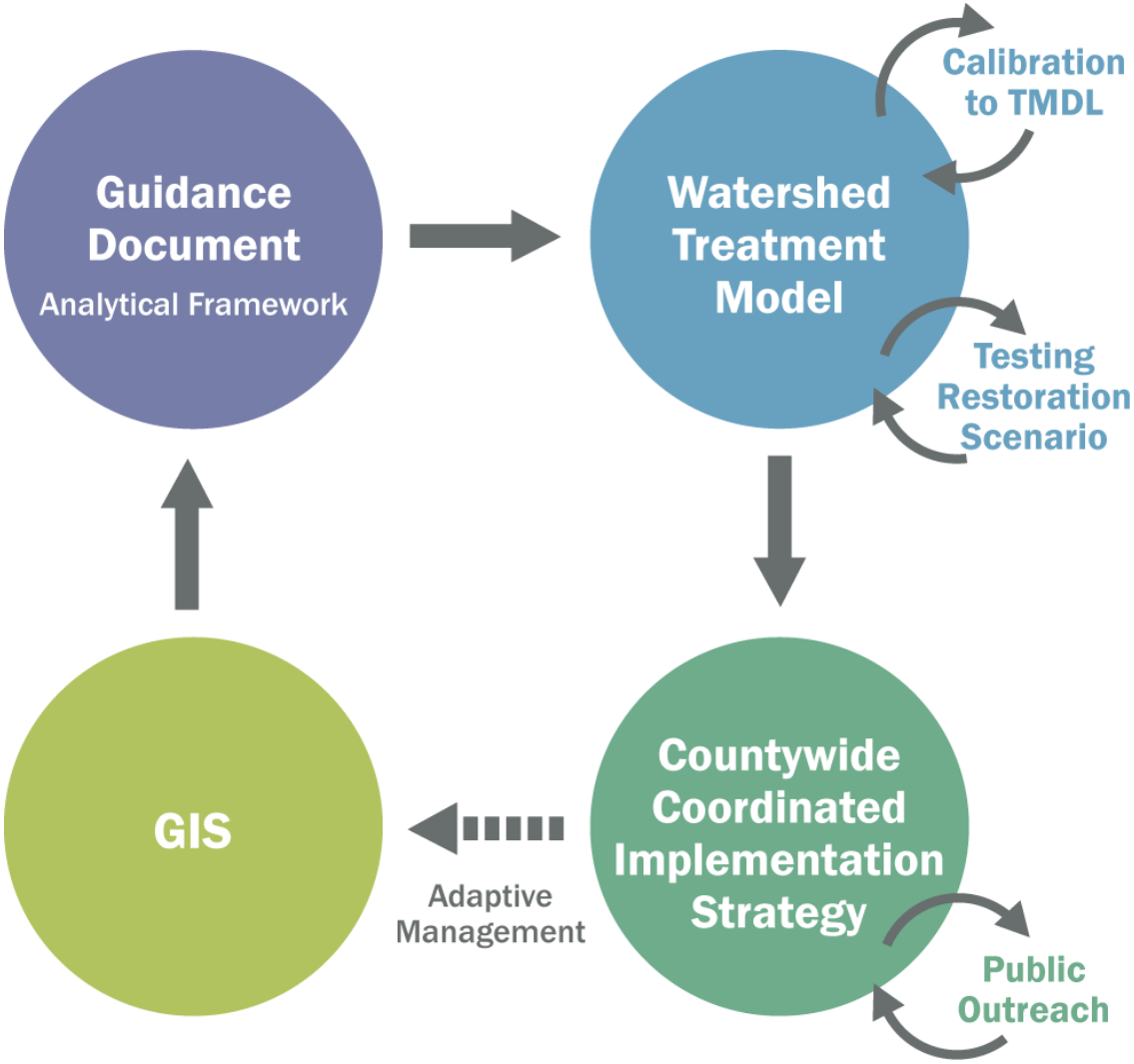
| Description | Area in Acres |
|---|---|
| Total | 324,552 |
| Total Area of Impervious Surface | 35,965 |
| County Subject to Stormwater Permit (1) | 138,649 |
| Impervious Cover Subject to Stormwater Permit | 25,119 |
| Adequately Treated Impervious Cover | 3,661 |
| Inadequately Treated Impervious Cover | 21,458 |
| **20% of Inadequately Treated Impervious Cover** | **4,292** |

(1) Exclusions include: Certain zoning codes, parklands, forests, municipalities with own stormwater management programs, state and federal properties, and state and federal maintained roads

# Compliance Targets

| Target Date | Compliance Target | Metric |
|---|---|---|
| 2015 | 20% impervious cover treatment requirement | ~4,300 acres of Impervious Cover |
| 2017 | Meet the interim dates and targets for the Chesapeake Bay TMDL | 9%, 12%, and 20% respectively for TN, TP, and TSS reductions from baseline conditions |
| 2020 | Meet the full compliance and targets for the Chesapeake Bay TMDL<br><br>Meet additional impervious cover treatment targets associated with next MS4 Permit cycle (assumes another 20% target) | 18%, 34%, and 37% respectively for TN, TP, and TSS reductions from baseline conditions<br><br>~3,400 acres of Impervious Cover (20% of impervious remaining after 2015) |
| 2025 | Meet additional impervious cover treatment targets associated with next MS4 Permit cycle (assumes another 20% target) | ~2,750 acres of Impervious Cover (20% of impervious remaining after 2020) |
| 2030 | Out year compliance with other watershed TMDLs | 100% compliance with MS4 Permit Area WLAs |

# Modeling Framework

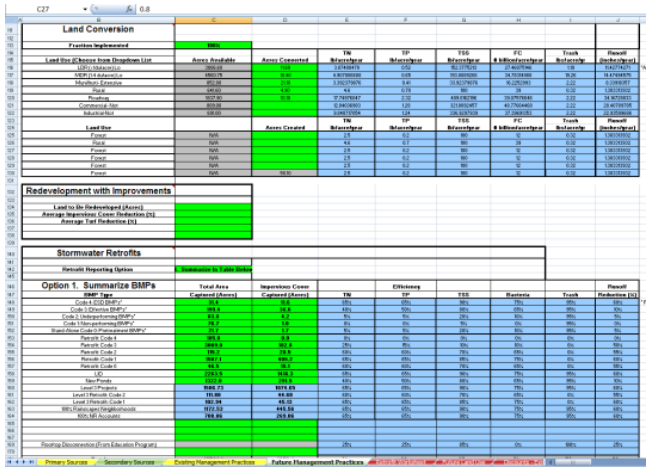


# WTM Basis

- Army Corps of Engineers used for Anacostia Study (2010)
- Started with an updated version of the WTM which included volume reduction, received from Deb Caraco (Oct 2009)

# Analytical Approach

## Watershed Treatment Model



### Land Use

- EMC (Urban)
- Unit Load (Non-urban)

### Soils & Rainfall

- Annual Runoff Volume

### Pollutant Load

- Before treatment

### BMPs

- Performance Code
- Removal Efficiency

### Discount Factors

- BMP specific
- Treatability Factor

### Pollutant Reduction

- Applied to baseline load

# WTM Process

**WTM 1.0**
- Baseline Conditions

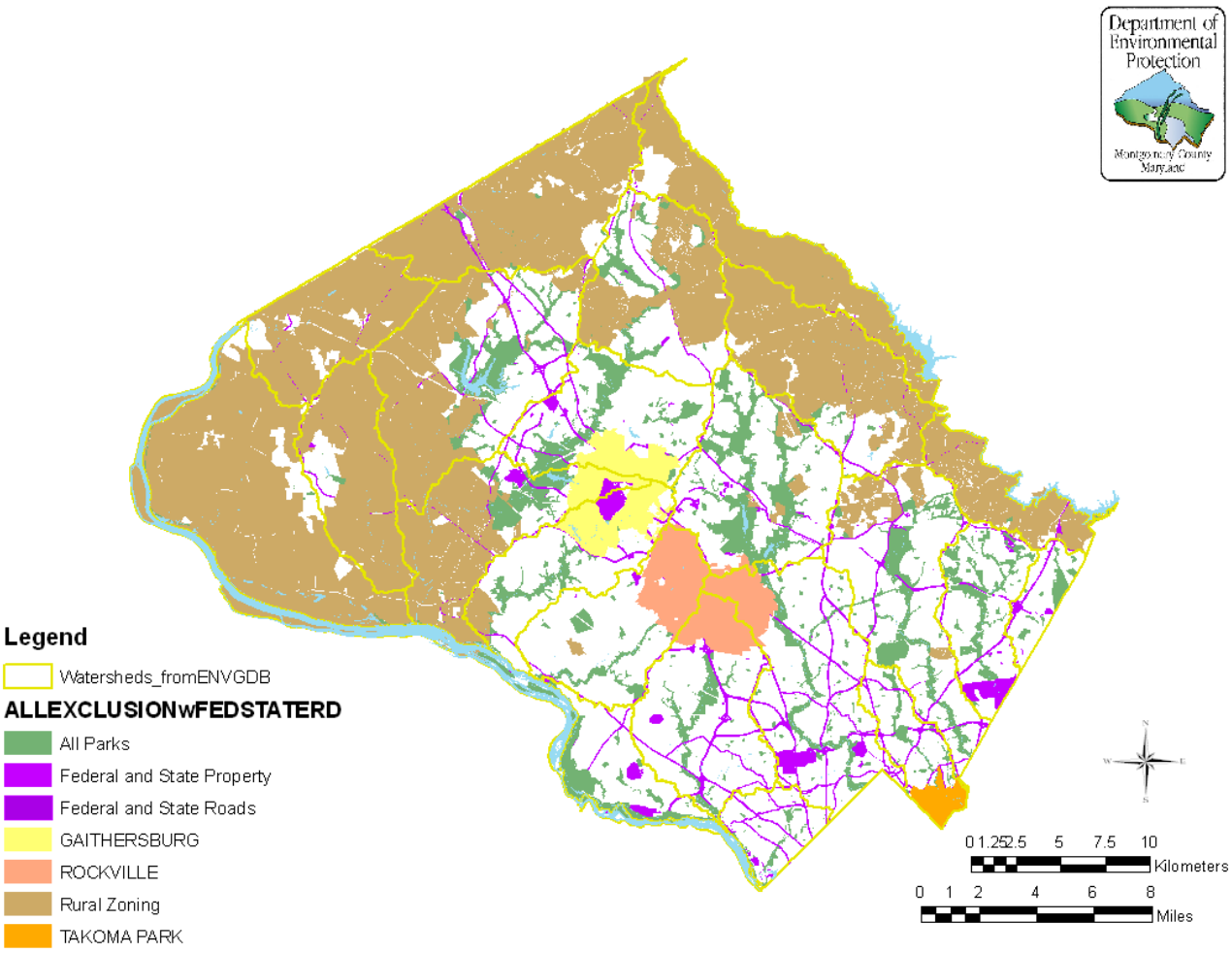
**WTM 2.0**
- Completed as of 2009; High Priority; Low Priority and Other Potential Projects

**WTM 3.0**
- ESD Strategies and Other Structural BMPs

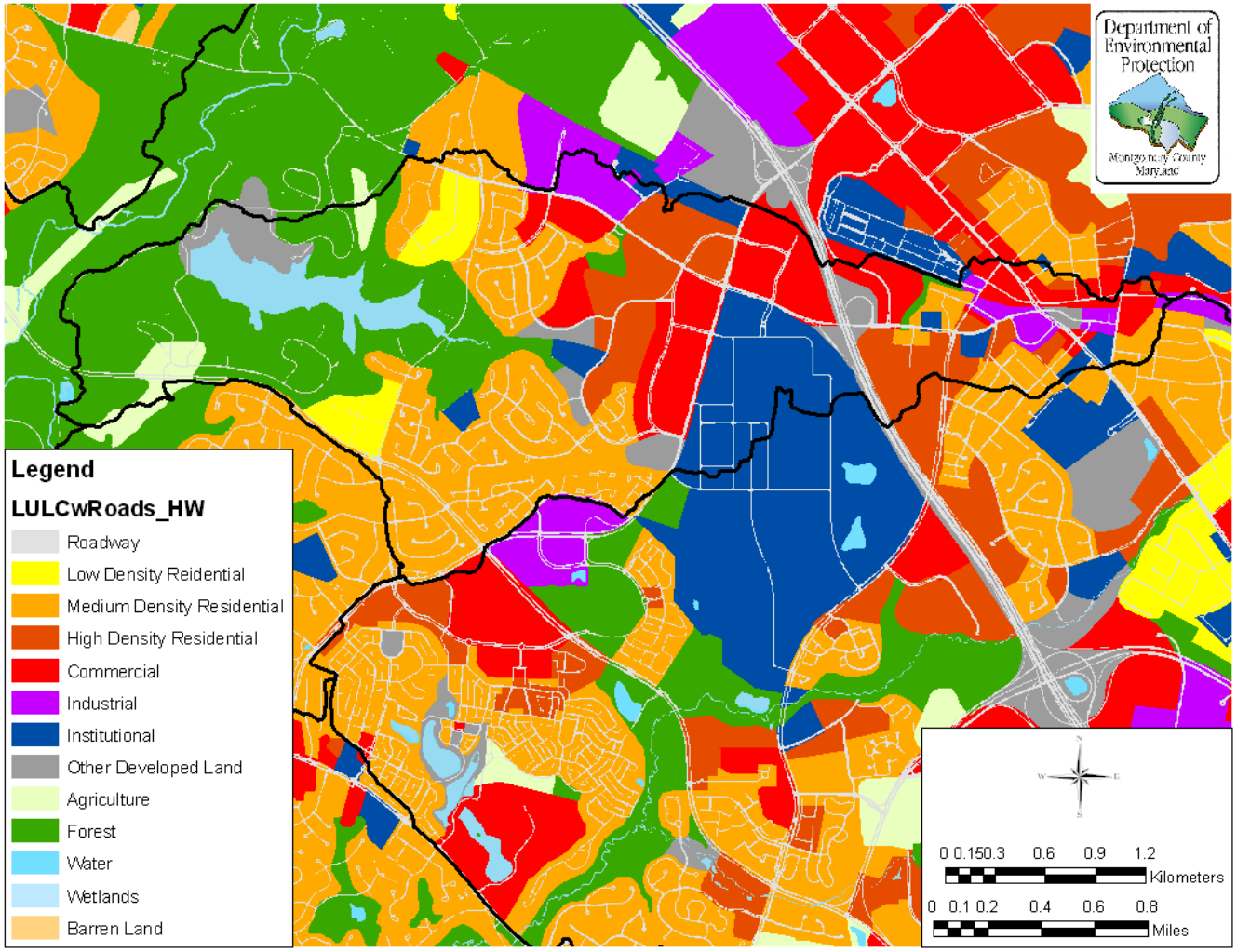
**WTM 4.0**
- Habitat Restoration

**WTM 5.0**
- MS4 Programmatic Practices

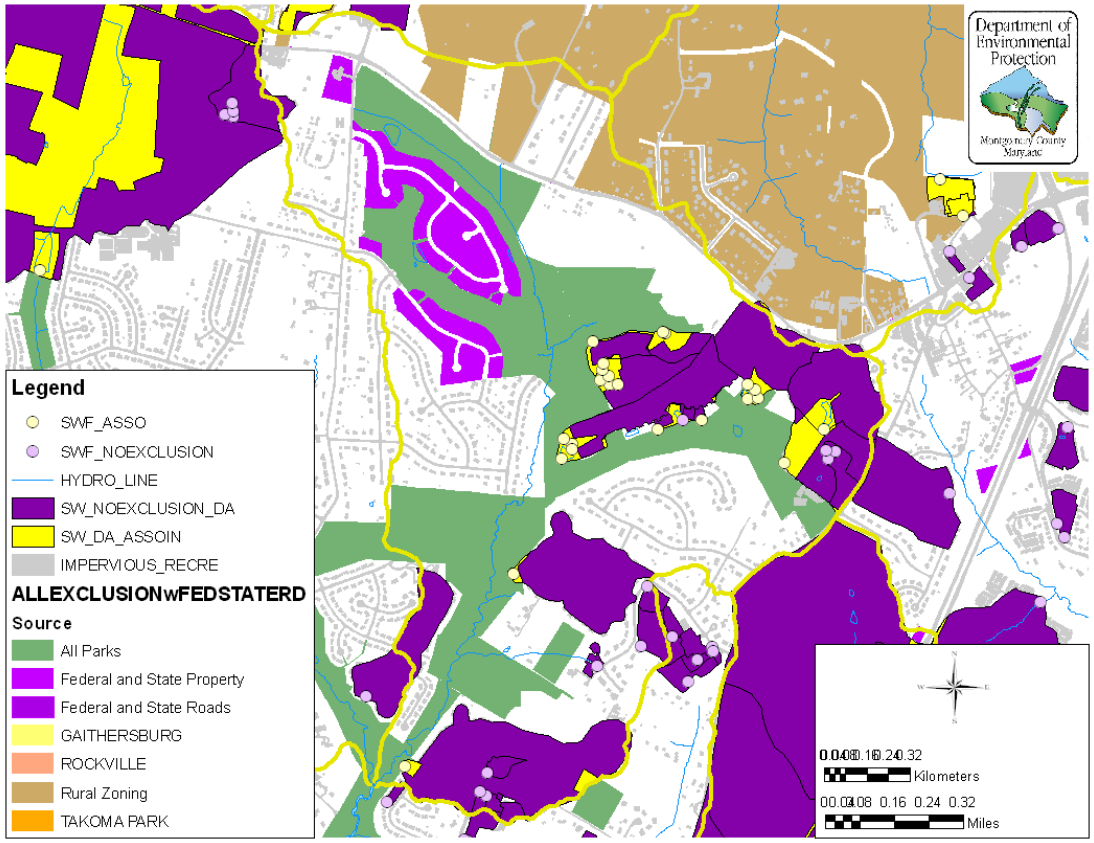
# Watersheds and Excluded Areas



# Land Use and Land Cover

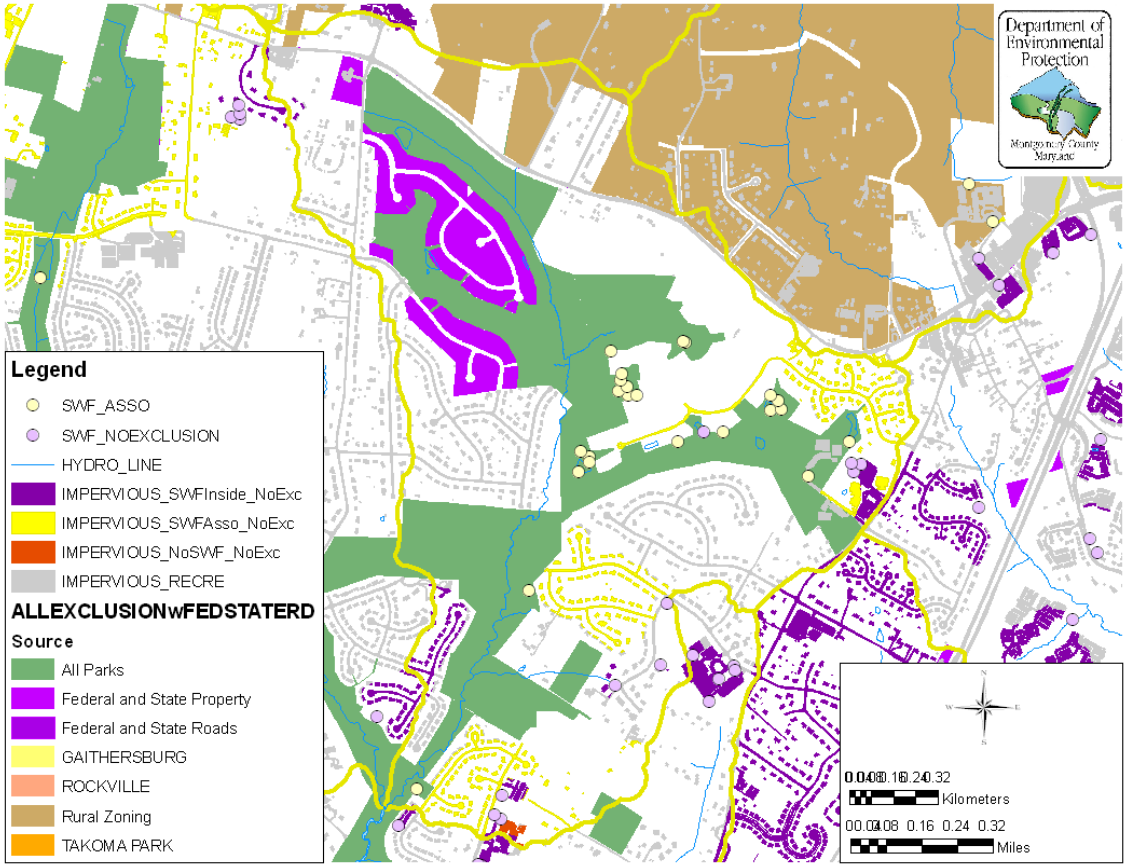


# Urban BMP Database



# Impervious Cover

- IMPERVIOUS_RECRE
  - This information was updated by DEP staff on December 10, 2009



# TMDL “Calibration”

- TMDL Onion
  - Land use discrepancies with Waste Load Allocations
  - Watershed-specific EMCs or loading rates

# Primary Sources

- The Land Use Categories were adjusted in the Primary Source tab according to the categories given in the Guidance Document.

BEFORE

Green cells need to be completed by the user
Blue cells have default or calculated values but may be substituted
Grey cells should generally not be changed
Purple Cells Reflect "Bottom Line" Loads or Load Reductions

**PRIMARY SOURCES - Land Use**
Watershed

| Categorty | Detailed Description | Area (Acres) |
|---|---|---|
| Residential | LDR (<1du/acre) | |
| | MDR (1-4 du/acre) | |
| | HDR (>4 du/acre) | |
| | Multifamily | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Commercial | Commercial | |
| | | |
| | | |
| | | |
| | | |
| Roadway | Roadway | |
| | | |
| | | |
| | | |
| | | |
| Industrial | Industrial | |
| | | |
| | | |
| | | |
| | | |

AFTER

Green cells need to be completed by the user
Blue cells have default or calculated values but may be substituted
Grey cells should generally not be changed
Purple Cells Reflect "Bottom Line" Loads or Load Reductions

**PRIMARY SOURCES - Land Use**
Watershed

| Categorty | Detailed Description | Area (Acres) |
|---|---|---|
| Residential | LDR (<1du/acre) Hi | 3806.6 |
| | MDR (1-4 du/acre) Hi | 4560.75 |
| | HDR (>4 du/acre) Hi | 841.7 |
| | | |
| | LDR (<1du/acre) Lo | 3806.6 |
| | MDR (1-4 du/acre) Lo | 4560.75 |
| | HDR (>4 du/acre) Lo | 841.7 |
| | | |
| Municipal/Institutional | Muni/Insti- Intensive | 1422.8 |
| | Muni/Insti- Extensive | 852.8 |
| Commercial | Commercial- Hot | 65.7 |
| | Commercial- Not | 809 |
| | | |
| | | |
| | | |
| Roadway | Roadway | 1837.9 |
| | | |
| | | |
| | | |
| | | |
| Industrial | Industrial-Hot | 36.8 |
| | Industrial-Not | 691 |
| | | |
| | | |
| | | |

# Primary Sources

- The Impervious Cover % and Turf Cover % were adjusted in the Primary Source tab according to the values given in the Guidance Document.

BEFORE

| nd Use | | | |
|---|---|---|---|
| | Area (Acres) | Impervious Cover (%) | Turf Cover (%) |
| Detailed Description | | | |
| LDR (<1du/acre) | | 12% | 70% |
| MDR (1-4 du/acre) | | 21% | 40% |
| HDR (>4 du/acre) | | 33% | 34% |
| Multifamily | | 44% | 45% |
| | | | 0% |
| | | | 0% |
| | | | 0% |
| | | | 0% |
| | | | 0% |
| | | | 0% |
| Commercial | | 72% | 22% |
| | | | 0% |
| | | | 0% |
| | | | 0% |
| | | | 0% |
| Roadway | | 80% | 16% |
| | | | 0% |
| | | | 0% |
| | | | 0% |
| | | | 0% |
| Industrial | | 53% | 38% |
| | | | 0% |
| | | | 0% |
| | | | 0% |
| | | | 0% |

AFTER

| nd Use | | | |
|---|---|---|---|
| | Area (Acres) | Impervious Cover (%) | Turf Cover (%) |
| Detailed Description | | | |
| LDR (<1du/acre) Hi | 3806.6 | 13% | 79% |
| MDR (1-4 du/acre) Hi | 4560.75 | 25% | 61% |
| HDR (>4 du/acre) Hi | 841.7 | 37% | 48% |
| | | | |
| LDR (<1du/acre) Lo | 3806.6 | 13% | 79% |
| MDR (1-4 du/acre) Lo | 4560.75 | 25% | 61% |
| HDR (>4 du/acre) Lo | 841.7 | 37% | 48% |
| | | | |
| Muni/Insti- Intensive | 1422.8 | 35% | 51% |
| Muni/Insti- Extensive | 852.8 | 9% | 55% |
| Commercial- Hot | 65.7 | 72% | 13% |
| Commercial- Not | 809 | 72% | 13% |
| | | | 0% |
| | | | 0% |
| | | | 0% |
| Roadway | 1837.9 | 90% | 3% |
| | | | 0% |
| | | | 0% |
| | | | 0% |
| | | | 0% |
| Industrial-Hot | 36.8 | 53% | 32% |
| Industrial-Not | 691 | 53% | 32% |
| | | | 0% |
| | | | 0% |
| | | | 0% |

# Primary Sources

- The EMCs, Impervious Cover %, and Turf Cover % were adjusted in the Primary Source tab according to the values given in the Guidance Document.

BEFORE

| Concentrations | | | |
|---|---|---|---|
| TN (mg/l) | TP (mg/l) | TSS (mg/l) | FC (MPN/100 ml) |
| | | | |
| 2 | 0.26 | 55 | 20000 |
| 2 | 0.26 | 55 | 20000 |
| 2 | 0.26 | 55 | 20000 |
| 2 | 0.26 | 55 | 20000 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 2 | 0.26 | 55 | 20000 |
| | | | |
| | | | |
| | | | |
| | | | |
| 2 | 0.26 | 55 | 20000 |
| | | | |
| | | | |
| | | | |
| | | | |
| 2 | 0.26 | 55 | 20000 |
| | | | |
| | | | |
| | | | |
| | | | |

AFTER

| Concentrations | | | |
|---|---|---|---|
| TN (mg/l) | TP (mg/l) | TSS (mg/l) | FC (MPN/100 ml) |
| | | | |
| 2.5 | 0.4 | 59 | 2333 |
| 2.5 | 0.4 | 59 | 2333 |
| 2.5 | 0.4 | 59 | 2333 |
| | | | |
| 1.5 | 0.2 | 59 | 2333 |
| 1.5 | 0.2 | 59 | 2333 |
| 1.5 | 0.2 | 59 | 2333 |
| | | | |
| 1.8 | 0.22 | 18 | 1889 |
| 1.8 | 0.22 | 18 | 1889 |
| 6 | 0.6 | 150 | 1667 |
| 2.0 | 0.2 | 50 | 1667 |
| | | | |
| | | | |
| | | | |
| 2.3 | 0.3 | 53 | 1111 |
| | | | |
| | | | |
| | | | |
| | | | |
| 6 | 0.6 | 230 | 1583 |
| 1.9 | 0.24 | 65 | 1583 |
| | | | |
| | | | |

# EMC Determination

| Table B.1 EMCS for Use in WTM | | | | |
|---|---|---|---|---|
| Land Use | TSS (mg/L) | TP (mg/L) | TN (mg/L) | Bacteria[1] (MPN/100mL) |
| Residential | 59 mg/l | ALL: 0.3 | ALL 2.0 | 4200 |
| | | HI: 0.4 | HI: 2.5 | |
| | | LO: 0.2 | LO: 1.5 | |
| Commercial | ALL: 55 | ALL: 0.22 | ALL:2.2 | 3000 |
| | HOT: 150 | HOT: 0.60 | HOT: 6.00 | |
| | NOT: 50 | NOT: 0.20 | NOT: 2.00 | |
| Highway | 53 | 0.3 | 2.3 | 2000 |
| Industrial | ALL: 73 | ALL: 0.26 | ALL: 2.1 | 2850 |
| | HOT: 230 | HOT: 0.60 | HOT: 6.00 | |
| | NOT: 65 | NOT: 0.24 | NOT: 1.9 | |
| Municipal | 18 | 0.22 | 1.8 | 3400 |
| All Land Uses | 62 | 0.27 | 2.0 | 4000 |

Source: Pitt, R. 2008. National Stormwater Quality Database Version 3. University of Alabama and CWP (2003) for TN

ALL: Median for all land uses

HI: High input turf, assumed to be 50% of all residential turf

LO: Low input turf, assumed to be 50% of all residential turf

HOT: Stormwater hotspot, area defined by Property database features selected by commercial/industrial land use and water quality complaint database.

NOT: Not a stormwater hotspot, all areas not defined as HOT

[1] Concentrations shown are for fecal coliform bacteria as no stormwater monitoring data is available for enterococci (see Section 5.4)

# Existing Management Practices

- Edits performed to BMP pollutant removal efficiencies according to Guidance Document.

BEFORE

| Structural Stormwater Management Practices | |
|---|---|
| | Total Area Captured (Acres) |
| BMP Type | |
| Dry Water Quantity Pond | |
| Dry Extended Detention Pond | |
| Wet Pond | |
| Wetland | |
| Filters | |
| Green Roof | |
| Rooftop Disconnection | |
| Permeable Pavement | |
| Grass (open) Channel | |
| Dry Swale (bioswale, WQ swale) | |
| Wet Swale | |
| Raintanks and Cisterns | |
| Soil Amendments | |
| Sheetflow to Open Space (excluding riparian buffers) | |
| Bioretention with Underdrain | |
| Bioretention Without Underdrain (infiltration design) | |
| Infiltration Practices | |
| | |
| Total | 0 |
| | |
| Treatability | Capture Discount (D1) |
| #DIV/0! | 1 |

AFTER

| Structural Stormwater Management Practices | |
|---|---|
| | Total Area Captured (Acres) |
| BMP Type | |
| Code 4: ESD BMPs | 334.5 |
| Code 3: Effective BMPs | 3639.0 |
| Code 2: Underperforming BMPs | 143.4 |
| Code 1: Non-performing BMPs | 1613.6 |
| Stand-Alone Code 0: Pretreatment BMPs | 335.6 |
| Total | 6066.09 |
| | |
| Treatability | Capture Discount (D1) |
| 0.20 | 1 |

# Existing Management Practices

- Edits performed to BMP pollutant removal efficiencies according to Guidance Document.

| Structural Stormwater Manageme | | | | | |
|---|---|---|---|---|---|
| | | Efficiency | | | Runoff Reduction (%) |
| BMP Type | TN | TP | TSS | Bacteria | |
| Dry Water Quantity Pond | 5% | 10% | 10% | 0% | 0% |
| Dry Extended Detention Pond | 10% | 15% | 55% | 30% | 0% |
| Wet Pond | 30% | 50% | 80% | 70% | 0% |
| Wetland | 25% | 50% | 75% | 80% | 0% |
| Filters | 30% | 60% | 80% | 35% | 0% |
| Green Roof | 45% | 45% | 80% | 0% | 45% |
| Rooftop Disconnection | 25% | 25% | 85% | 0% | 25% |
| Permeable Pavement | 60% | 60% | 75% | 0% | 45% |
| Grass (open) Channel | 30% | 25% | 60% | 0% | 10% |
| Dry Swale (bioswale, WQ swale) | 55% | 50% | 85% | 0% | 40% |
| Wet Swale | 25% | 20% | 70% | 0% | 0% |
| Raintanks and Cisterns | 40% | 40% | 40% | 0% | 40% |
| Soil Amendments | 50% | 50% | 75% | 0% | 50% |
| Sheetflow to Open Space (excluding riparian buffers) | 50% | 50% | 85% | 0% | 50% |
| Bioretention with Underdrain | 65% | 55% | 85% | 90% | 40% |
| Bioretention Without Underdrain (infiltration design) | 65% | 55% | 85% | 90% | 40% |
| Infiltration Practices | 55% | 65% | 95% | 85% | 50% |
| Total | 0% | 0% | 0% | 0% | 0 |

BEFORE

AFTER

| Structural Stormwater Manageme | | | | | | |
|---|---|---|---|---|---|---|
| | | Efficiency | | | | Runoff Reduction (%) |
| BMP Type | TN | TP | TSS | Bacteria | Trash | |
| Code 4: ESD BMPs | 65% | 65% | 90% | 75% | 95% | 60% |
| Code 3: Effective BMPs | 40% | 50% | 80% | 65% | 95% | 10% |
| Code 2: Underperforming BMPs | 5% | 5% | 20% | 10% | 95% | 5% |
| Code 1: Non-performing BMPs | 0% | 0% | 5% | 0% | 95% | 0% |
| Stand-Alone Code 0: Pretreatment BMPs | 5% | 5% | 20% | 10% | 95% | 5% |
| Total | 40% | 48% | 77% | 62% | 95% | 15% |

# BMP Codes

| Table B.16 General BMP Coding of Montgomery County BMP Database | |
|---|---|
| Performance Code | Structure Type |
| Code 0: Pretreatment BMPs | Baysaver (BAYSAV), Interceptor (INT), Vortechnics (VORTEC), Oil/grit separator (SEP), Stormcepter (STC), Flowsplitter (FS), Plunge Pool (PP), V2B1 (V2B1), Vegetated Pool (VP), Aquaswirl (AQSW) |
| Code 1: Non-performing BMPs | Control Structure underground (CS), Pond-dry quantity control (PDQN), Underground detention (UG), Underground with stone bottom (UGINF), Pond-dry quantity control and extended detention (PDQNED) |
| Code 2: Under-performing BMPs | Pond-dry quantity control and sand filter base (PDQNSF), Pond-infiltration basin quality control (PDIB), Pond-infiltration basin with extended detention (PDIBED), Pond-infiltration basin quantity control (PDIBQN), Stormfilter (STFIL), Aquafilter (AQFIL) |
| Code 3: Effective BMPs | Pond-wet quantity control and extended detention (PDWTED), Pond-wet quantity control and extended detention (PDWTQNED), Pond-infiltration basin quantity control and extended detention (PDIBQNED), Sand filter (SF), Sand filter quantity control (SFQN), Oil/grit separator and sand filter (SEPSF), Sand filter underground (SFU), Pond-wetland (PDWD), Pond-wetland with extended detention (PDWDED), Pond-wetland quantity control and extended detention (PDWTQN), Pond-wet quality and quantity control (PDWT), |
| Code 4: ESD BMPs | Dry swale (DS), Bioretention quality control (BR), Bioretention quantity control (BRQN), Infiltration trench quality control (INF), Infiltrator (INFIL), Infiltration trench quality and quantity control (INFQN), Infiltration trench quality control underground (INFU), Infiltration trench quality and quantity control buried non-surface fed (INFUQN), Level Spreader (LS), Peat sand filter (PSF), and Vegetated Swale (VS). |

# Removal Efficiencies

| Performance Category | RR[1] (%) | Discount Factor[2] | TSS[3] (%) | TN[4] (%) | TP[5] (%) | FC[6] (%) |
|---|---|---|---|---|---|---|
| 0 - Pretreatment BMPs | 5 | 0.15 | 20 | 5 | 5 | 10 |
| 1 - Non-performing BMPs | 0 | 0.05 | 5 | 0 | 0 | 0 |
| 2 - Underperforming BMPs | 5 | 0.15 | 20 | 5 | 5 | 10 |
| 3 - Effective BMPs | 10 | 0.75 | 80 | 40 | 50 | 65 |
| 4 - ESD Practices | 60 | 1.0 | 90 | 65 | 65 | 75 |

(from Schueler, 2010)

[1] RR: percent annual reduction in post development runoff volume for storms

[2] Discount Factor: Fraction of contributing impervious acres effectively treated to the Water Quality Volume, used to rate BMP treatability

[3] TSS: Sediment Removal rate

[4] TN: Total Nitrogen Removal Rate

[5] TP: Total Phosphorus Removal Rate

[6] FC: Fecal Coliform Removal Rate

# Future Management Practices

- Post-TMDL BMPs from the Urban BMP database

| Stormwater Retrofits | | |
|---|---|---|
| Retrofit Reporting Option | 1. Summarize In Table Below | |
| **Option 1. Summarize BMPs** | **Total Area Captured (Acres)** | **Impervious Cover Captured (Acres)** |
| BMP Type | | |
| Code 4: ESD BMPs* | 31.4 | 11.6 |
| Code 3: Effective BMPs* | 199.4 | 36.6 |
| Code 2: Underperforming BMPs* | 83.8 | 4.2 |
| Code 1: Non-performing BMPs* | 76.7 | 1.0 |
| Stand-Alone Code 0: Pretreatment BMPs* | 21.7 | 1.7 |
| Retrofit: Code 4 | 185.8 | 0.0 |
| Retrofit: Code 3 | 3009.0 | 182.8 |
| Retrofit: Code 2 | 115.2 | 28.5 |
| Retrofit: Code 1 | 1587.1 | 405.2 |
| Retrofit: Code 0 | 46.5 | 15.1 |
| LID | 2263.5 | 1416.3 |
| New Ponds | 1322.0 | 291.5 |
| Level 3 Projects | 1506.73 | 1074.65 |
| Level 3 Retrofit: Code 2 | 111.80 | 44.60 |
| Level 3 Retrofit: Code 1 | 102.94 | 45.13 |
| 100% Rainscapes Neighborhoods | 1172.53 | 445.56 |
| 100% NR Accounts | 708.06 | 269.06 |

# Future Management Practices

- Restoration Sites BMPs (WTM 2.0)

| Stormwater Retrofits | | |
|---|---|---|
| | | |
| Retrofit Reporting Option | 1. Summarize In Table Below | |
| | | |
| **Option 1. Summarize BMPs** | Total Area | Impervious Cover |
| BMP Type | Captured (Acres) | Captured (Acres) |
| Code 4: ESD BMPs* | 31.4 | 11.6 |
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| 100% NR Accounts | 708.06 | 269.06 |
| | | |

# Future Management Practices

- and Additional Retrofit opportunities (WTM 3.0) which include County lands (schools, buildings, roads, and parking lots) and targeted neighborhoods

| Stormwater Retrofits | | |
|---|---|---|
| | | |
| Retrofit Reporting Option | 1. Summarize In Table Below | |
| | | |
| **Option 1. Summarize BMPs** | Total Area | Impervious Cover |
| BMP Type | Captured (Acres) | Captured (Acres) |
| Code 4: ESD BMPs* | 31.4 | 11.6 |
| Code 3: Effective BMPs* | 199.4 | 36.6 |
| Code 2: Underperforming BMPs* | 83.8 | 4.2 |
| Code 1: Non-performing BMPs* | 76.7 | 1.0 |
| Stand-Alone Code 0: Pretreatment BMPs* | 21.7 | 1.7 |
| Retrofit: Code 4 | 185.8 | 0.0 |
| Retrofit: Code 3 | 3009.0 | 182.8 |
| Retrofit: Code 2 | 115.2 | 28.5 |
| Retrofit: Code 1 | 1587.1 | 405.2 |
| Retrofit: Code 0 | 46.5 | 15.1 |
| LID | 2263.5 | 1416.3 |
| New Ponds | 1322.0 | 291.5 |
| Level 3 Projects | 1506.73 | 1074.65 |
| Level 3 Retrofit: Code 2 | 111.80 | 44.60 |
| Level 3 Retrofit: Code 1 | 102.94 | 45.13 |
| 100% Rainscapes Neighborhoods | 1172.53 | 445.56 |
| 100% NR Accounts | 708.06 | 269.06 |

# Future Management Practices

- Expanded number of Land Conversion rows to accommodate different land types.

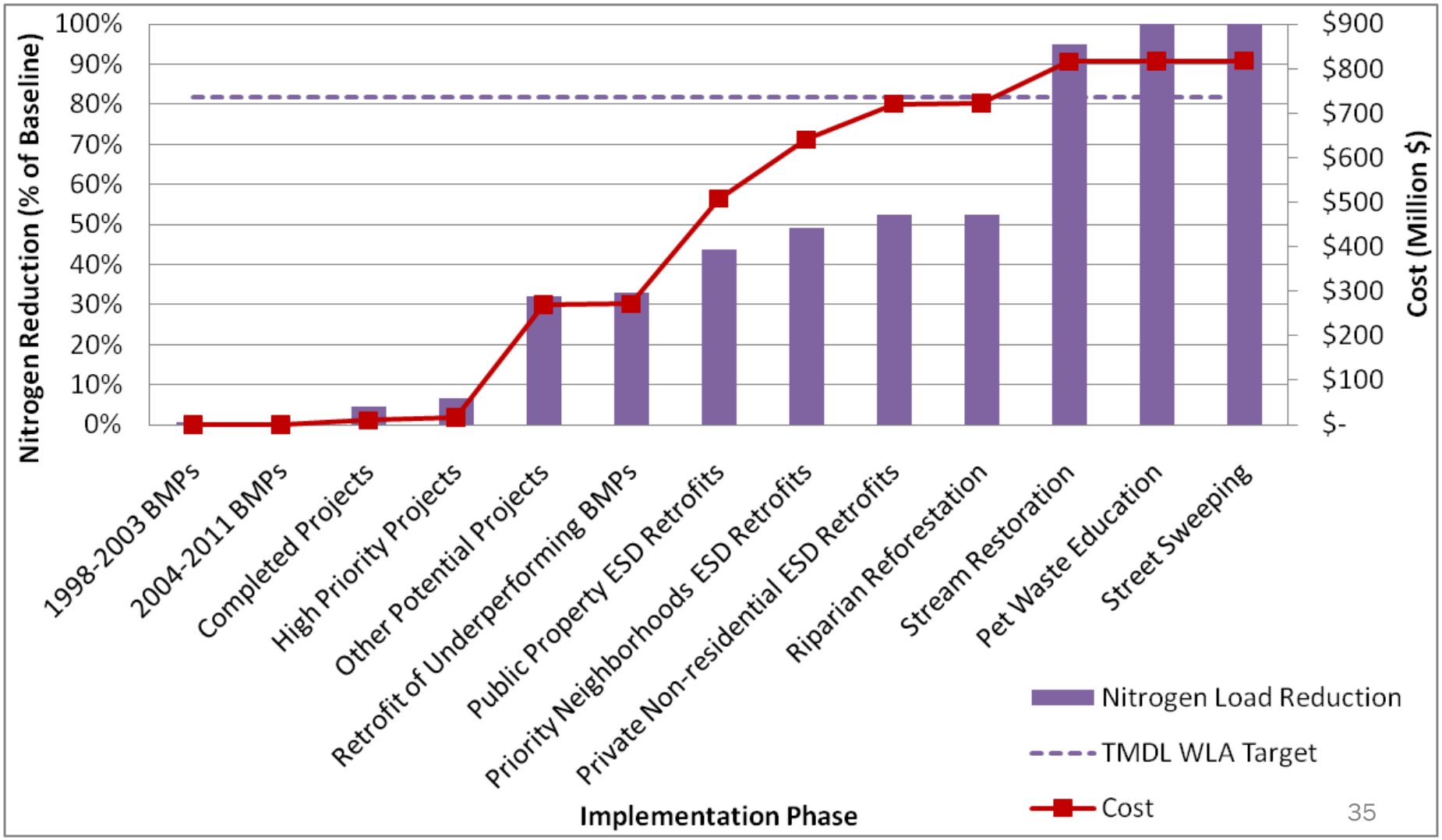
| | | | | | |
|---|---|---|---|---|---|
| Awareness of Message (Fraction of Population) | | | | | |
| Fraction willing to change behavior | | | | | |
| **Land Conversion** | | | | | |
| Fraction Implemented | 100% | | | | |
| Land Use (Choose from Dropdown List | Acres Available | Acres Converted | TN lb/acre/year | TP lb/acre/year | |
| LDR (<1du/acre) Lo | 3806.60 | 11.60 | 3.87400478 | 0.52 | |
| MDR (1-4 du/acre) Lo | 4560.75 | 10.40 | 4.907006608 | 0.65 | |
| Muni/Insti- Extensive | 852.80 | 21.10 | 3.392379876 | 0.41 | |
| Rural | 641.60 | 4.90 | 4.6 | 0.70 | |
| Roadway | 1837.90 | 10.10 | 17.74976047 | 2.32 | |
| Commercial- Not | 809.00 | | 12.84036983 | 1.28 | |
| Industrial-Not | 691.00 | | 9.848717054 | 1.24 | |
| Land Use | | Acres Created | TN lb/acre/year | TP lb/acre/year | |
| Forest | N/A | | 2.5 | 0.2 | |
| Rural | N/A | | 4.6 | 0.7 | |
| Forest | N/A | | 2.5 | 0.2 | |
| Forest | N/A | | 2.5 | 0.2 | |
| Forest | N/A | | 2.5 | 0.2 | |
| Forest | N/A | 58.10 | 2.5 | 0.2 | |

IMPORTANT NOTE: These blue cells reference data from the Level4 Projects Tab.

# Other Restoration Practices

| Table B.20. Nutrient and Sediment Removal Rates for Non-Retrofit Practices | | | | |
|---|---|---|---|---|
| Practice | TN Removal | TP Removal | TSS Removal | Reporting Units |
| Riparian Forest Planting | 25% | 50% | 50% | Acres |
| Upland Planting (on Turf) | A | A | A | Acres |
| Septic Denitrification | 55 | 0 | 0 | Systems |
| Septic Pumping | 5 | 0 | 0 | Systems |
| Septic connections/hookups | 55 | 0 | 0 | Systems |
| Emergent marsh restoration | 42 | 55 | 75 | Acres |
| Palustrine Forest wetland restoration | 43 | 58 | 75 | Acres |
| Stream restoration | 0.20 lbs | 0.068 lbs | 310 lbs | Linear Ft. |
| Riparian forest buffers (ag) | 60 | 70 | 75 | Acre treated |
| Stream fencing and off-stream watering | 60 | 60 | 75 | Acres treated |
| Residential Nutrient Management | B | B | B | Acres |
| Hotspot Management | C | C | C | Acres |
| Enhanced Street Sweeping | 5 | 15 | 20 | Acres |
| Note A: Shift from turf to forest cover in WTM and change EMC to forest (from turf)<br>Note B: Shift from hi input EMC to low input turf EMC within WTM<br>Note C: Shift from hotspot EMC to not hotspot EMC within WTM | | | | |

# Anacostia Nutrient TMDL: removal per Strategy

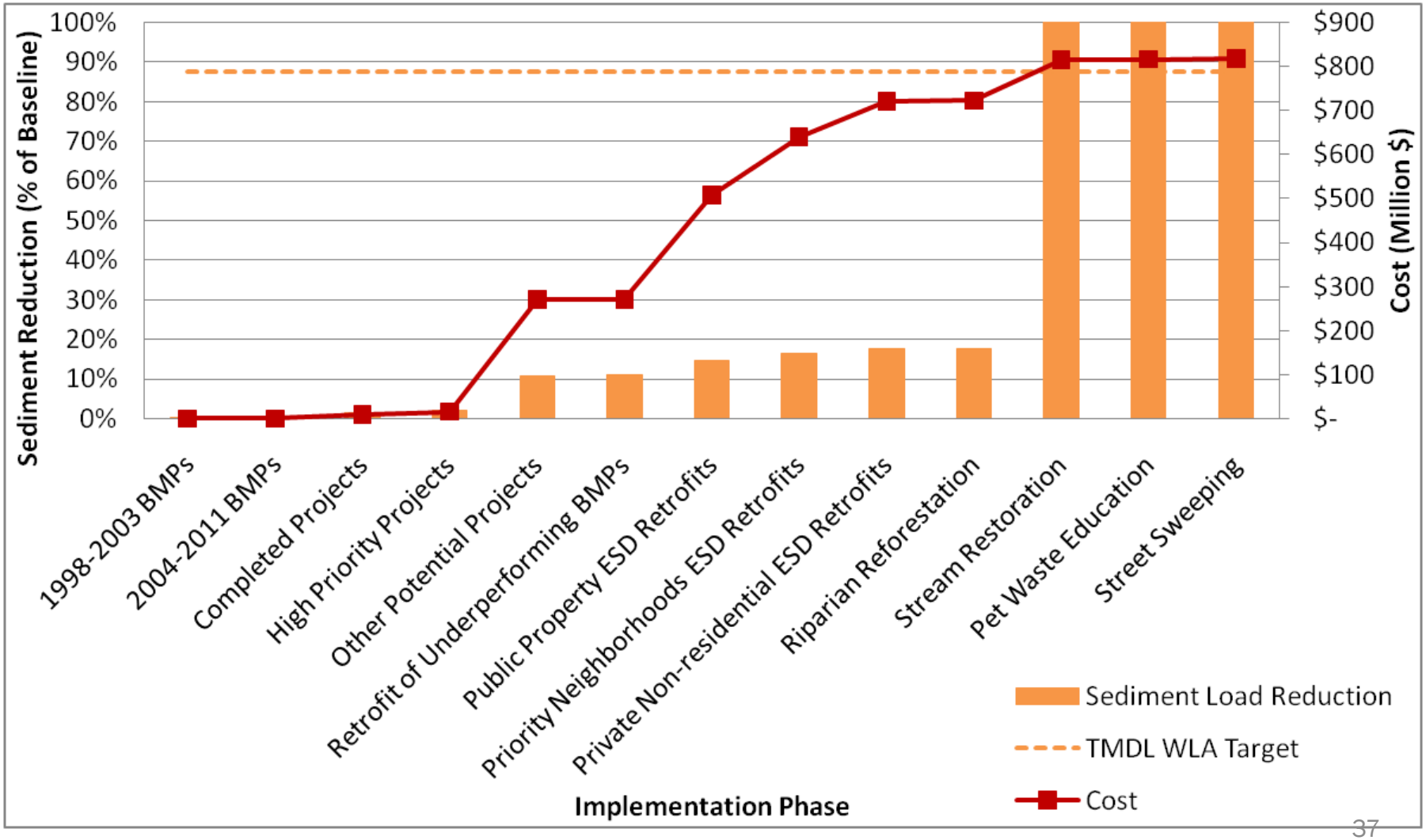


# Anacostia Nutrient TMDL: removal per unit cost

Most reduction per unit cost

| Rank | Restoration Strategy | TN reduction | Incremental Cost | Unit Cost |
|---|---|---|---|---|
| | | lbs/yr | Million $ | lbs/Million $ |
| 1 | Pet Waste Education | 15,169 | 0.88 | 17,193 |
| 2 | Retrofit of Underperforming BMPs | 1,769 | 1.20 | 1,475 |
| 3 | Stream Restoration | 72,423 | 93.04 | 778 |
| 4 | Completed Projects | 6,643 | 9.48 | 701 |
| 5 | High Priority Projects | 3,260 | 6.35 | 513 |
| 6 | Low Priority and Other Potential Projects | 43,276 | 254.30 | 170 |
| 7 | Habitat Restoration | 224 | 1.41 | 158 |
| 8 | Public Property ESD Retrofits | 18,270 | 236.55 | 77 |
| 9 | Priority Neighborhoods ESD Retrofits | 9,271 | 132.78 | 70 |
| 10 | Private Non-residential ESD Retrofits | 5,594 | 80.18 | 70 |
| 11 | Street Sweeping | - | 1.24 | - |

# Anacostia Sediment TMDL: removal per Strategy



# Anacostia Sediment TMDL: removal per unit cost

Most reduction per unit cost

| Rank | Restoration Strategy | Sediment reduction | Incremental Cost | Unit Cost |
|---|---|---|---|---|
| | | tons/yr | Million $ | tons/Million $ |
| 1 | Street Sweeping | 800 | 1.24 | 645 |
| 2 | Stream Restoration | 25,057 | 93.04 | 269 |
| 3 | Retrofit of Underperforming BMPs | 25 | 1.20 | 21 |
| 4 | Completed Projects | 97 | 9.48 | 10 |
| 5 | High Priority Projects | 47 | 6.35 | 7 |
| 6 | Low Priority and Other Potential Projects | 660 | 254.30 | 3 |
| 7 | Public Property ESD Retrofits | 272 | 236.55 | 1 |
| 8 | Priority Neighborhoods ESD Retrofits | 139 | 132.78 | 1 |
| 9 | Private Non-residential ESD Retrofits | 84 | 80.18 | 1 |
| 10 | Habitat Restoration | 2 | 1.41 | 1 |
| 11 | Pet Waste Education | - | 0.88 | - |

# Countywide Strategy: Implementation and Pollutant Reductions

## *Countywide Watersheds*

**Summary of Implementation Plan schedule with expected MS4 permit area WLA compliance endpoints**

| | 2015 | 2017 | 2020 | 2025 | 2030 | Permit/ TMDL Targets 2017 | Permit/ TMDL Targets 2020 |
|---|---|---|---|---|---|---|---|
| Impervious Area Treated (acres) | 4,302 | 6,014 | 7,722 | 10,518 | 11,154 | 6,008 | 7,723 |
| % of Impervious Area Treated by ESD | 18% | 34% | 47% | 60% | 63% | | |
| Impervious Area Treatment Cost (Million $) | 305 | 622 | 987 | 1,687 | 1,884 | | |
| % of Cost for ESD | 53% | 66% | 70% | 80% | 80% | | |
| Nitrogen (% Reduction) | 18% | 25% | 36% | 46% | 51% | 9% | 20% |
| Phosphorus (% Reduction) | 17% | 23% | 34% | 44% | 46% | 12% | 34% |
| Sediment (% Reduction) | 23% | 34% | 54% | 60% | 62% | 20% | 37% |
| Bacteria (% Reduction) | 11% | 15% | 20% | 28% | 30% | | |
| Trash (% Reduction) | 18% | 26% | 33% | 41% | 42% | | |

*Assumptions:*
*1. Does not inclde repeated Outreach and Education costs beyond FY2015*
*2. Does not include an inflatoin multiplier*

NOTE: Subsequent to Strategy publication in February 2011, Maryland revised timelines for Bay TMDL targets to meet 60% implementation by 2017 and 100% implementation by 2025

# What did WTM not include?

- Secondary Sources
  - Channel Erosion
  - SSOs, CSOs, Septic (not applicable, WSSC)
  - Livestock (not applicable, NRCS)
  - Marinas (not applicable)
  - Road Sanding
  - Point Sources (not applicable)

# Challenges and Lessons Learned

- Sharpen your accounting pencils
- Sequential analysis is useful
- Target pollutants may require external analysis
- Non-structural strategies rely on limited research findings

# Challenges and Lessons Learned (MAST-related)

- MS4 permit area (acres)
- Land cover (impervious vs pervious)
- Pollutant Loadings and Total Loads
- BMP assumptions
  - Acres with some control
  - Type
  - Reduction Efficiency

# Questions?

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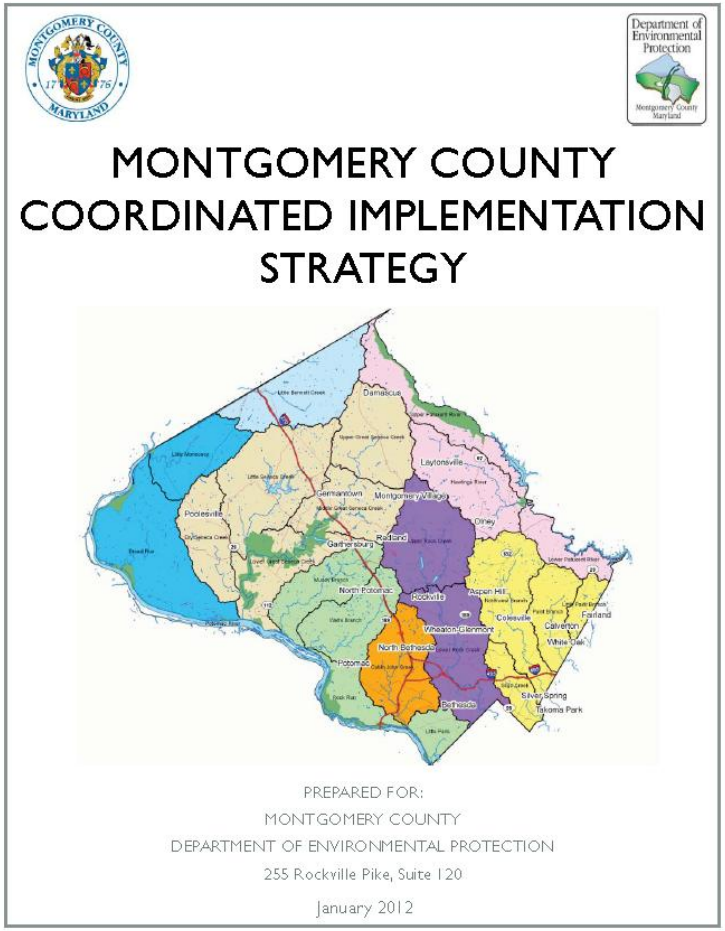


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