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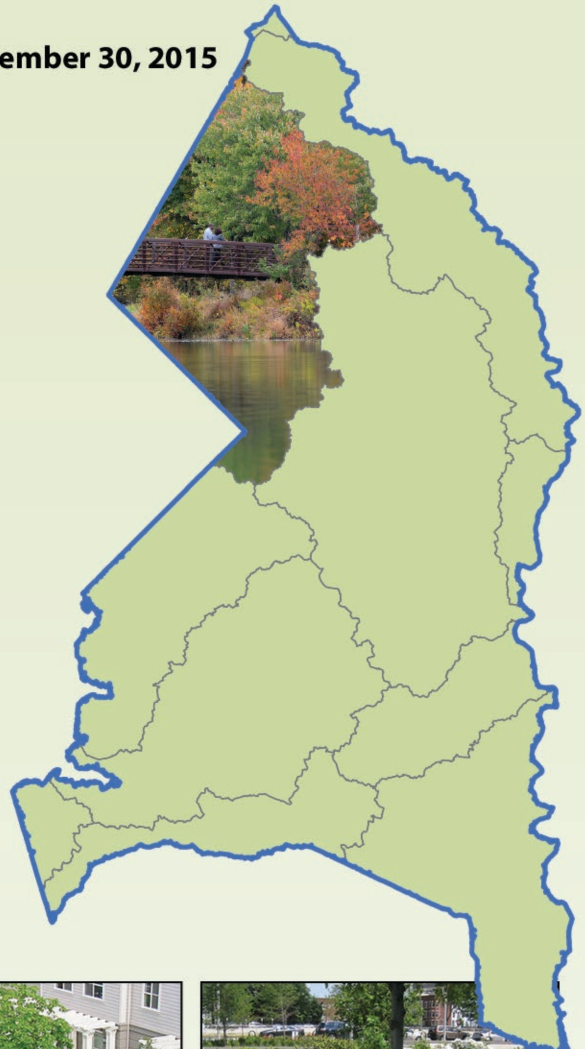
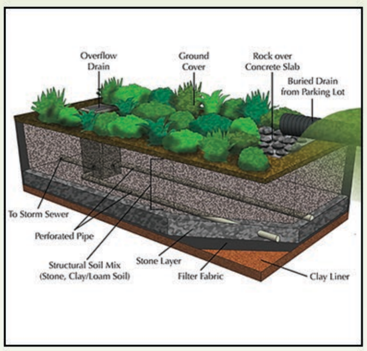
Prince George's County
DEPARTMENT OF THE
ENVIRONMENT

December 30, 2015

Restoration Plan for the Anacostia River Watershed in Prince George's County





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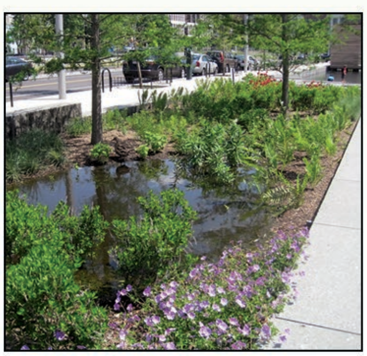

Prince George's County
ALTERNATIVE COMPLIANCE PROGRAM

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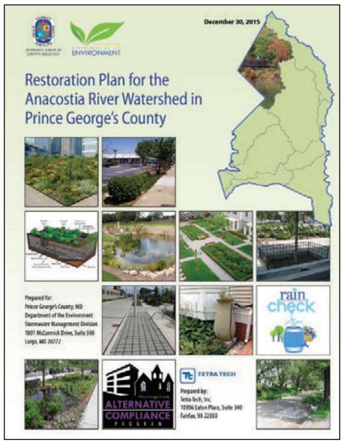

Restoration Plan for the Anacostia River Watershed in Prince George's County

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11. USEPA
12. PGC DoE
13. USEPA

Contents

Figures

Tables

ACRONYM LIST

B-IBI	Benthic Index of Biotic Integrity
BMP	best management practice
BOD	biochemical oxygen demand
CBP	Chesapeake Bay Program
CIP	Capital Improvements Program
COMAR	Code of Maryland Regulations
CWP	Clean Water Partnership
DO	dissolved oxygen
DoE	[Prince George's County] Department of the Environment
DPW&T	[Prince George's County] Department of Public Works and Transportation
EPA	U.S. Environmental Protection Agency
ESD	environmental site design
GIS	geographic information system
HOA	homeowner association
LA	load allocation
lb	pound
MAST	Maryland Assessment and Scenario Tool
MBSS	Maryland Biological Stream Survey
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
mg/L	milligrams per liter
mL	milliliters
M-NCPPC	Maryland-National Capital Park and Planning Commission
MOS	margin of safety
MPN	most probable number
MPN B	most probable number in billions
MS4	municipal separate storm sewer system
MWCOG	Metropolitan Washington Council of Governments
NEB	Northeast Branch
NPDES	National Pollutant Discharge Elimination System
NWB	Northwest Branch
P3	Public-Private Partnership Program
PCB	polychlorinated biphenyl
ROW	right-of-way
SSO	sanitary sewer overflow
STORET	STOrage and RETrieval
SWM Program	Stormwater Management Program
SWMM	Storm Water Management Model

SWPPP	stormwater pollution prevention plans
TMDL	total maximum daily loads
TNI	Transforming Neighborhoods Initiative
TSS	total suspended solids
UMCES	University of Maryland Center for Environmental Science
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WECR	Watershed Existing Conditions Report
WIP	Watershed Implementation Plan
WLA	wasteload allocation
WSSC	Washington Suburban Sanitary Commission
WTM	Watershed Treatment Model

1 INTRODUCTION

On January 2, 2014, the Maryland Department of the Environment (MDE) issued Prince George's County (the County) a new municipal separate storm sewer system (MS4) permit. An MS4 is a series of stormwater sewers owned by a municipal entity (e.g., the County) that discharges the conveyed stormwater runoff into a water body (e.g., Northeast Branch). The County's new MS4 permit requires that the County develop local restoration plans to address each U.S. Environmental Protection Agency (EPA)-approved total maximum daily load (TMDL) with stormwater wasteload allocations (WLAs). A TMDL can be seen as a *pollution diet* in that it is the maximum amount of a pollutant that a water body can assimilate and still meet water quality standards and designated uses. As a result of the County's new MS4 permit, restoration plans are being developed for all water bodies in the County that are subject to TMDL WLAs associated with the MS4 system. The County's MS4 system has been assigned WLAs in the Anacostia River watershed.

The Anacostia River watershed lies across the northwestern portions of the County, as well as portions of Montgomery County and the District (Figure 1-1). In Maryland, it includes the municipalities of Berwyn Heights, Bladensburg, Brentwood, Capital Heights, Cheverly, College Park, Colmar Manor, Cottage City, Edmonston, Fairmount Heights, Glenarden, Greenbelt, Hyattsville, Landover Hills, Mount Rainier, New Carrollton, North Brentwood, Riverdale Park, Seat Pleasant, and University Park. The watershed also contains a large area of federal land (Beltsville Agricultural Research Center and Greenbelt Park) and state-owned land (University of Maryland).

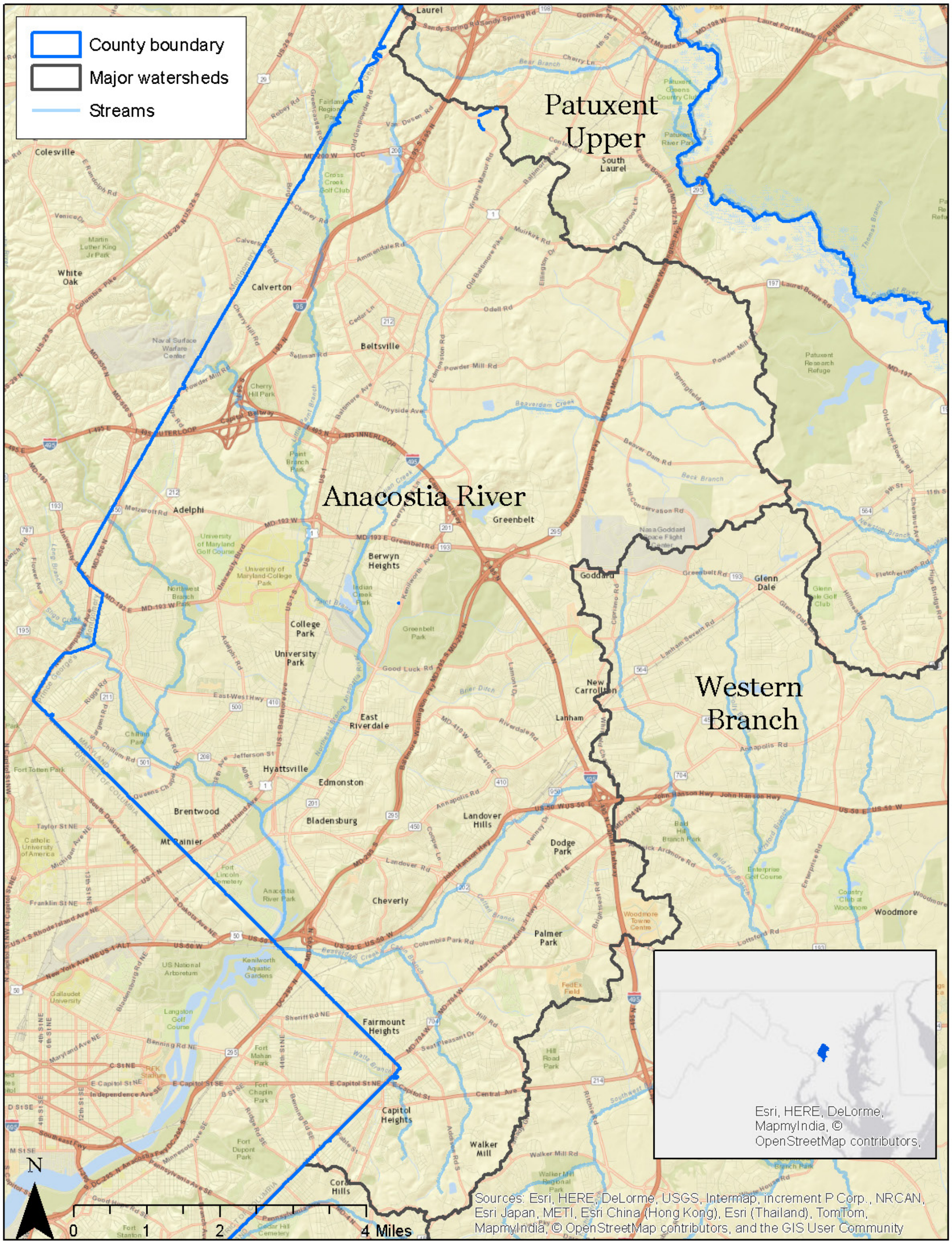


Figure 1-1. Location of the Anacostia River watershed.

1.1 Purpose of Report and Restoration Planning

1.1.1 What is a TMDL?

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (codified at Title 40 of the *Code of Federal Regulations* Part 130) require states to develop TMDLs for impaired water bodies. TMDLs provide the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of the state's water resources (USEPA 1991).

A TMDL (pollution diet) establishes the amount of a pollutant that a water body can assimilate without exceeding its water quality standard for that pollutant and is represented as a mass (e.g., pound) per unit of time (e.g., day). The mass per unit time is called the load. For instance, a TMDL could stipulate that a maximum load of 1,000 pounds of sediment per day could be discharged into an entire stream. The pollution diet for a given pollutant and water body is composed of the sum of individual WLAs for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include an implicit or explicit margin of safety (MOS) to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving water body. The TMDL components are illustrated using the following equation:

$$\text{TMDL} = \Sigma\ \text{WLAs} + \Sigma\ \text{LAs} + \text{MOS}$$

A WLA is the portion of the overall pollution diet that is assigned to permitted dischargers, such as the County's MS4 stormwater system. The County's new MS4 permit requires that the County develop local restoration plans to address each EPA-approved TMDL with stormwater WLAs.

Figure 1-2 shows a generalized TMDL schematic. A TMDL identifies the maximum amount of pollutant load that the water body can receive and still meet applicable water quality criteria. The bar on the left represents the current pollutant load (sometimes called the baseline) that exists in a water body before a TMDL is developed. The elevated load causes the water body to exceed water quality criteria. The bar on the right represents the amount that the pollutant load will need to be reduced for the water body to meet water quality criteria. Another way to convey the required load reduction is by identifying the *percent reduction* needed. Table 1-1 presents the percent reductions—as presented on MDE's *TMDL Data Center* website (MDE 2014c)—required for the water bodies in the Anacostia River watershed to meet criteria.

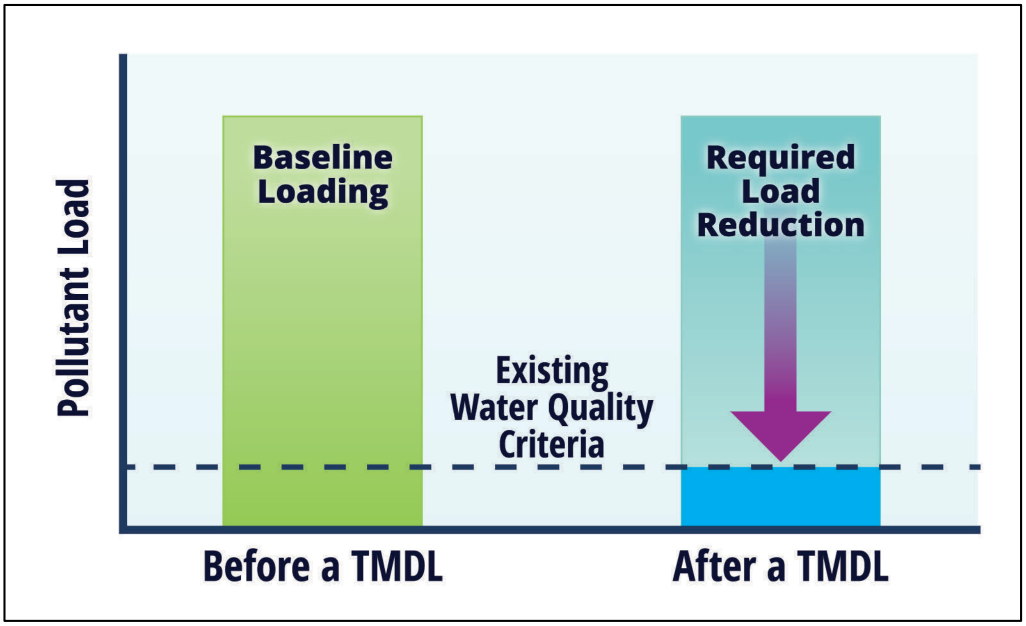


Figure 1-2. Schematic for typical pollution diet (TMDL).

Table 1-1. Required percent reductions for the Anacostia River watershed in Prince George's County

Pollutant	Percent Reduction to Stormwater
Nutrients (nitrogen, phosphorus), biochemical oxygen demand	Biochemical oxygen demand: 58% Total nitrogen: 81% Total phosphorus: 81.2%
Fecal coliform bacteria (enterococci)	Northeast Branch / Northwest Branch: 80.3% Tidal: 99.3%
Sediment, total suspended solids	85%
Polychlorinated biphenyls (PCBs)	Northeast Branch: 98.64% Northwest Branch: 98.1%
Trash	100%

1.1.2 What is a Restoration Plan?

A restoration plan is a strategy for managing the natural resources within a geographically defined watershed. For the County's Department of the Environment (DoE), this means managing urban stormwater (i.e., runoff originating from rain storms) to restore and protect the County's water bodies. Stormwater management is most effective when viewed in the watershed context—watersheds are land areas and their network of creeks that convey stormwater runoff to a common body of water. Successful stormwater management consists of both structural practices (e.g., vegetated roadway swale) and public outreach (e.g., pet waste campaigns and education) at both the public and private levels. The restoration plan development process will address changes that are needed to the County's priorities to comply with water quality regulations, to improve the health of the streams in the County, and to create value for neighborhoods in the County's watersheds.

The overall goals of restoration planning are to:

- Protect, restore, and enhance habitat in the watershed.
- Restore watershed functions, including hydrology, water quality, and habitat, using a balanced approach that minimizes negative impacts.
- Support compliance with regional, state, and federal regulatory requirements.
- Increase awareness and stewardship within the watershed, including encouraging policymakers to develop policies that support a healthy watershed.

This document represents the first stage in achieving these goals. This plan is not meant to be site-level planning, but rather focuses on watershed-based planning. For the Anacostia River watershed, the restoration planning process began with the development of the *Anacostia River Watershed Existing Conditions Report* (WECR) that reviewed available data and began the process of identifying the causes and sources of pollution. The restoration planning process seeks to:

- Identify causes and sources of pollution.
- Estimate pollutant load reductions.
- Describe management options and identify critical areas.
- Estimate technical and financial assistance needed.
- Develop an education component.
- Develop a project schedule.
- Describe interim, measurable milestones.
- Identify indicators to measure progress.
- Develop a monitoring component.

This document presents this information in six major sections:

- *Section 2 Watershed Characterization* summarizes the information from the WECR and identifies the causes and sources of pollution.
- *Section 3 Restoration Plan Goals and Objectives* outlines the specific goals and objectives for the Anacostia River watershed and describes the annual load reduction estimates needed to meet the goals and objectives.
- *Section 4 Current Management Activities* identifies the current pollution-reduction activities that the County has installed, the County's programmatic initiatives, and the estimated pollutant load reduction from these activities.
- *Section 5 Strategy Development* documents the approach for identifying and prioritizing management options.
- *Section 6 Implementation Plan* provides details on the proposed management activities, estimated costs, and load reductions, and outlines the proposed schedule, funding and technical resources, and public involvement process for implementation.

- *Section 7 Tracking and Adaptive Management* outlines the approach for tracking and monitoring implementation progress and adaptive management.

1.2 Impaired Water Bodies and TMDLs

MDE has included the Anacostia River and its tributaries on its section 303(d) list of impaired waters because of the following pollutants (listing year in parentheses):

- Nutrients (1996)
- Sediment (1996)
- Fecal coliform bacteria (2002 nontidal waters and 2004 tidal waters)
- Impacts to biological communities (2002 nontidal waters)
- Toxics (polychlorinated biphenyls [PCBs] 2002)
- PCBs in fish tissue in tidal waters (2006)
- Trash and debris (2008)

MDE developed TMDLs to address impairments caused by the violation of water quality standards for fecal coliform bacteria (*Enterococcus*), PCBs, biochemical oxygen demand (BOD), total nitrogen, total phosphorus, sediment, and trash. In addition, EPA recently (2010) developed an overall TMDL for the Chesapeake Bay watershed for nitrogen, phosphorus, and sediment. The County has developed a Watershed Implementation Plan (WIP) in response to the Chesapeake Bay TMDL (PGC DER 2012b).

This restoration plan addresses the TMDLs for nutrients, sediment, and fecal coliform bacteria. PCBs and trash are being addressed in separate plans: PCBs in *Restoration Plan for PCB-Impacted Water Bodies in Prince George's County* (Tetra Tech 2015a) and trash in *Effectiveness of Existing Trash Reduction Programs and Practices in the Anacostia Watershed: Prince George's County, Maryland* (EA 2014).

1.2.1 Water Quality Standards

Portions of the Anacostia River have the following designated uses (*Code of Maryland Regulations* [COMAR] 26.08.02.08 O):

- Use Class I: Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life
- Use Class II: Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting
- Use Class III: Nontidal Cold Water
- Use Class IV: Recreational Trout Waters

Maryland's General Water Quality Criteria states that "the waters of this State may not be polluted by…any material, including floating debris, oil, grease, scum, sludge and other floating materials attributable to sewage, industrial waste, or other waste in amounts sufficient to be unsightly; produce taste or odor; change the existing color to produce objectionable color for aesthetic purposes; create a nuisance; or interfere directly or indirectly with designated uses" [COMAR

26.08.02.03B(2)]. Specific water quality criteria also apply for the specific pollutants addressed in the TMDLs for the Anacostia River watershed; these are discussed below.

Bacteria Water Quality Criterion

Table 1-2 presents the Maryland water quality standards for bacteria applicable for all areas.

Table 1-2. Maryland bacteria water quality criteria

Indicator	Steady-State Geometric Mean Indicator Density
Freshwater	
E. coli	126 MPN/100 mL
Enterococci[a]	33 MPN/100 mL
Marine Water	
Enterococci	35 MPN/100 mL

Notes:
MPN=most probable number; mL=milliliters.
[a] Used in the Anacostia River TMDL analysis.

Nitrogen/Phosphorus Water Quality Criterion

Maryland does not have numeric criteria for nitrogen or phosphorus, so other parameters, such as dissolved oxygen (DO), are used in the TMDL process. Table 1-3 summarizes the Maryland DO criteria applicable to the nutrients and BOD TMDL.

Table 1-3. Maryland dissolved oxygen water quality criteria

Designated Use	Period Applicable	DO Criteria
MD Use I-P	Year-round	≥ 5 mg/L (instantaneous)
MD Use II: Migratory Fish Spawning and Nursery Subcategory	2/1–5/31	≥ 5.0 mg/L (instantaneous) ≥ 6.0 mg/L (7-day average)
MD Use II: Open Water Fish and Shellfish Subcategory	6/1–1/31	≥ 3.2 mg/L (instantaneous) ≥ 4.0 mg/L (7-day average) ≥ 5.5 mg/L (30-day average applicable all year) ≥ 4.3 mg/L (instantaneous for water temperature > 29 °C for protection of Shortnose Sturgeon)
MD Use III	Year-round	≥ 5 mg/L (instantaneous) ≥ 6 mg/L (1-day average)
MD Use IV	Year-round	≥ 5 mg/L (instantaneous)

Note: DO = dissolved oxygen; mg/L= milligrams per liter

Sediment Water Quality Criterion

The Maryland sediment water quality criterion is narrative for nontidal portions of the watershed. For tidal portions, the criterion is based on average Secchi disk depth of equal to or greater than 0.4 meters for the period from April 1 through October 31 of each year. Secchi depth is a measure of the clarity of water. The criterion is meant to protect submerged aquatic vegetation in the tidal portions of the watershed.

1.2.2 Problem Identification

This section provides a summary of the various problems identified in the Anacostia River watershed and the data supporting the impairment decisions. Tidal impairments and listings are discussed first, followed by nontidal impairments.

Tidal portions of the Anacostia River have been listed for sediment and nutrients, PCBs in fish tissue, and fecal coliform bacteria. For tidal portions of the Anacostia River, the Chesapeake Bay Program (CBP) provides the framework against which constituents such as nutrients, sediment, DO, and chlorophyll *a* concentration are measured to determine the health of the Chesapeake Bay and its tributaries. Long-term monitoring data collected in the Anacostia River showed violations of minimum DO concentrations, clarity standards, and chlorophyll *a* concentrations. Long-term Secchi depth growing season medians were at or above 0.4 meters, the Maryland criterion, for most upstream segments, representing water clarity conditions from the confluence of the Northeast and Northwest branches (NEB and NWB, respectively) in Maryland to the New York Avenue Bridge at approximately the Maryland–DC line. Median Secchi depths were less than the District of Columbia's (the District) 0.8-meter depth criteria in the middle portions of the tidal Anacostia, which is the most stringent downstream criteria driving reductions from the Maryland portions of the watershed.

Nontidal portions of the Anacostia River are impaired because of nutrients, sediment, impacts to biological communities, and fecal coliform bacteria. The 1993–1995 Maryland Water Quality Inventory provided the original narrative basis for the nutrients and BOD listings, indicating that erosion, sediment, and high levels of bacteria were the primary causes of impaired water quality in the nontidal portions of the watershed. Data collected since completion of the TMDL analyses indicated that, related to the nutrients and BOD listings in nontidal portions of the watershed, DO and chlorophyll *a* concentrations were not problematic. As a result, reductions in nutrients and BOD in nontidal portions are driven by levels required to meet standards in the tidal portions of the Anacostia River. Data related to sediment in the nontidal streams of the Anacostia River watershed included biological monitoring data and measurements of suspended solids in water samples.

Finally, for both tidal and nontidal waters of the Anacostia River, fecal bacteria listings were based on a comparison of the criterion value (33 most probable number [MPN] *Enterococcus*) with calculated annual and seasonal steady-state geometric means for different flow strata. The steady-state condition is defined as "unbiased sampling targeting average flow conditions and/or equally sampling or providing for unbiased sampling of high and low flows" (MDE 2006). The steady-state condition is determined through monitoring design or statistical analysis. In the case of this TMDL, the monitoring was routine (i.e., it did not stratify monitoring such that samples collected were proportional to the duration of time the watershed experiences low, medium, and high flows). The assessment process involved separating monitoring data into flow categories to calculate the steady-state geometric mean with respect to flow regimes. Data were then compared to criteria and the impairment assessment was made. As part of the TMDL process, MDE performed bacteria source tracking in the watershed, the results of which are included in Table 1-4. The main sources of bacteria are wildlife followed by pet waste, and then humans (via septic systems, sanitary sewer overflows, and municipal wastewater treatment plants). Nutrients and BOD are attributed to stormwater runoff, erosion and in-stream scour, subsurface drainages, point source discharges, and sewer overflows. Sources of sediment in the Anacostia River include agriculture, sand and gravel mining, and construction activities. Stream channel erosion is considered to be the most significant source of sediment. Tidal resuspension of bed sediments is also a factor in the tidal portions. Approximately 85 percent of sediment entering the tidal Anacostia from the nontidal portions stays there, often remaining suspended for some time before settling to the river bottom. Tidal action impedes settling and continually promotes resuspension of sediments. Model scenarios predict that with no incoming sediment loads from nontidal portions, sediment concentrations in the tidal Anacostia would approximate 5 milligrams per liter (mg/L) because of tidal resuspension alone (MDE and DDOE 2008).

Table 1-4. Bacteria source tracking results

Station	Station Name	Pets	Human	Livestock	Wildlife
		Percent			
Upstream Region					
BED0001	[Upper] Beaverdam Creek	45	15	9	32
INC0030	Indian Creek	30	23	13	33
PNT0001	Paint Branch	29	23	7	41
NEB0002sub	Northeast Branch	24	9	28	38
NWA0002sub	Northwest Branch	31	17	8	44
Downstream Region (from Northwest and Northeast Branches)					
Entire area		21.1	22.2	0.3	56.5

Source: MDE 2006.

1.2.3 Previous Studies

In 2011, the County developed a countywide Chesapeake Bay WIP in response to the 2010 Chesapeake Bay Nutrient and Sediment TMDL. The WIP was finalized in 2012 and laid out a plan for best management practice (BMP) implementation and other restoration activities through 2017 and 2025. In addition to urban stormwater runoff, the WIP covered agricultural practices and upgrades to wastewater systems (i.e., municipal wastewater treatment plants and on-site wastewater systems). Although the WIP addresses all of the County's land areas, many elements of the WIP apply to the Anacostia River and will be used to develop the restoration plan. The County's final WIP can be viewed at www.mde.state.md.us/programs/Water/TMDL/TMDLImplementation/Documents/FINAL_PhaseII_Report_Docs/Final_County_WIP_Narratives/PG_WIPII_2012.pdf.

In 2005, the Maryland Department of Natural Resources produced a series of reports on the Anacostia River watershed. These reports include: (1) *Report on Nutrient Synoptic Surveys in the Anacostia River, Prince George's County, Maryland, as part of the Watershed Restoration Action Strategy* (MD DNR 2005b); (2) *Anacostia River Stream Corridor Survey* (MD DNR 2005c); and (3) *Characterization of the Anacostia River Watershed in Prince George's County, Maryland* (MD DNR 2005a).

The first report looked at data collected during 2004 in the watershed at multiple stations. The report describes a study that found that nutrients did not appear to be a significant problem at that time; however, there were issues with low DO concentrations. The second report describes a survey that assessed the conditions of the stream channels by looking at several factors such as inadequate stream buffers, channel alterations, trash dumping, exposed pipes and pipe outfalls, and erosion. The last report was an earlier watershed characterization that covers several similar topics to this report.

A series of reports in 2009 and 2010 were developed for and by the Anacostia Watershed Restoration Partnership for 15 major subwatersheds in the Anacostia River watershed in Montgomery County, Prince George's County, and the District. Each subwatershed has a subwatershed action plan, baseline condition report, and project inventory. The subwatershed action plans and project inventories looked at the existing impervious areas and BMPs, and then evaluated and proposed potential public and private projects in each subwatershed. Table 1-5 presents a summary of selected proposed restoration activities from the subwatershed action plans. For a full list of practices, see the individual plans. The plans call for more than $1 billion in restoration activities for treating 6,500 acres of impervious land and 11,500 acres of total land area. The Anacostia Watershed Restoration Partnership estimated that implementing the plans' activities would achieve the following reductions: 81,800 pounds per year (lb/year) of nitrogen, 9,300 lb/year of phosphorus, 2,300 tons/year total suspended solids (TSS), and 2.9 million billion counts/year of bacteria. The most recommended practice was implementing bioretention systems.

Table 1-5. Summary of selected proposed restoration activities in the Anacostia Watershed Restoration Partnership's subwatershed action plans

Restoration Practice	Number of Practices	Number on Private Land	Percent on Private Land	Restoration Practice	Number of Practices	Number on Private Land	Percent on Private Land
Bioretention	1,501	612	41%	Rain garden	383	60	16%
Bioswale	202	62	31%	Reforestation	18	0	0%
Downspout disconnection	516	105	20%	Riparian buffer	29	8	28%
Dry pond	58	19	33%	Sand filter	3	1	33%
Education and outreach	14	1	7%	Signs	8	0	0%
Extended detention pond	2	1	50%	Stream restoration	168	44	26%
Filter	647	275	43%	Street sweeping	79	0	0%
Green roof	480	86	18%	Wet pond	112	36	32%
Infiltration practices	7	2	29%	Wetland	88	30	34%
Permeable pavement	244	25	10%	Wetland creation	2	0	0%
Pond modification	2	1	50%	Wetland restoration	37	9	24%
Rain barrel	201	16	8%				

The *Anacostia Watershed Forest Management and Protection Strategy* prepared by the Metropolitan Washington Council of Governments (MWCOG) Department of Environmental Programs in June 2005 (MWCOG 2005) provides strategies to protect and expand forest cover throughout the Anacostia River watershed. The document looks at various types of forest cover (e.g., riparian buffer, upland, street trees) and presents strategies to increase and protect each type of forest cover.

2 Watershed Characterization

This section provides a general characterization of the watershed. The main purpose of this section is to give the reader an understanding of different conditions in the watershed. Additional details on watershed characterization can be found in the *Anacostia River Watershed Existing Conditions Report* (Tetra Tech 2014a).

2.1 General

The mainstem of the Anacostia River is 8.4 miles long, beginning at the confluence of the NWB and the NEB and ending at the Potomac River in the District. The Anacostia River watershed spans both Maryland and the District. The nontidal reaches are predominantly in Prince George's and Montgomery counties in Maryland. The lower, tidal portions are mostly in the District; however, a portion of the tidal mainstem extends into the County. The watershed has an area of 176 square miles, 145 of which are in Maryland. In Maryland, the Anacostia River is classified as a *Wild and Scenic River*. The major drainages in the County include NEB, NWB, Lower Beaverdam Creek, Watts Branch, and the tidal drainage.

2.2 Hydrology

The Anacostia River watershed is composed of 15 subwatersheds: Briers Mill Run, Fort Dupont Tributary, Hickey Run, Indian Creek, Little Paint Branch, Lower Beaverdam Creek, NEB, NWB, Paint Branch, Pope Branch, Sligo Creek, Still Creek, Upper Beaverdam Creek, Watts Branch, and the tidal river. With the exception of Fort Dupont Tributary, Hickey Run, and Pope Branch, all of the subwatersheds have a portion in the County. The majority of the land in the watershed is drained by MS4 outfalls. In the Maryland portion of the watershed, 9,500 acres drain directly to the Anacostia River and tributaries, and the remaining 82,600 acres are drained via MS4 outfalls. The County has 44,000 acres of MS4 drainage (MDE and DDOE 2010). The tributary system of the Anacostia River is described as flashy, meaning there is a quick rise in stream level because of rainfall (MWCOG 2010). The flashiness can be attributed to the large proportion of developed and impervious land surfaces.

Weather is an important factor in the hydrology of a region and is the driving factor in stormwater runoff. For the County, the National Weather Service Forecast Office (2014b) reports a 30-year average annual precipitation of 39.74 inches. No strong seasonal variation in precipitation exists. On average, winter is the driest with 8.48 inches, and summer is the wettest with 10.44 inches (National Weather Service Forecast Office 2014a). Evapotranspiration accounts for water that evaporates from the land surface (including water bodies) or is lost through plant transpiration. Evapotranspiration varies throughout the year because of climate, but is greatest in the summer. Potential evapotranspiration (Table 2-1) is the environmental demand for evapotranspiration.

Table 2-1. Average monthly (1975–2004) potential evapotranspiration (inches)

January	February	March	April	May	June
0.60	0.86	1.69	2.74	3.86	4.30
July	**August**	**September**	**October**	**November**	**December**
4.59	4.01	2.85	1.88	0.98	0.62

Source: Northeast Regional Climate Center (NRCC) 2014.

2.3 Soils

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service has defined four hydrologic soil groups, providing a means for grouping soils by similar infiltration and runoff characteristics during periods of prolonged wetting. Poorly drained clay soils (Group D) have the lowest infiltration rates, resulting in the highest amount of runoff, while well-drained sandy soils (Group A) have high infiltration rates, with little runoff.

The majority of the watershed is underlain by hydrologic group B and C soils. Hydrologic soil group A is the least represented in the watershed. Soils in the watershed are also frequently classified as “urban land complex” or “udorthent” soils. These are soils that have been altered by disturbance because of land development activities. Soils affected by urbanization can have a higher density because of compaction during construction activities and might be more poorly drained. Natural pervious land covers on group B soils generate very little runoff compared to that from disturbed soils.

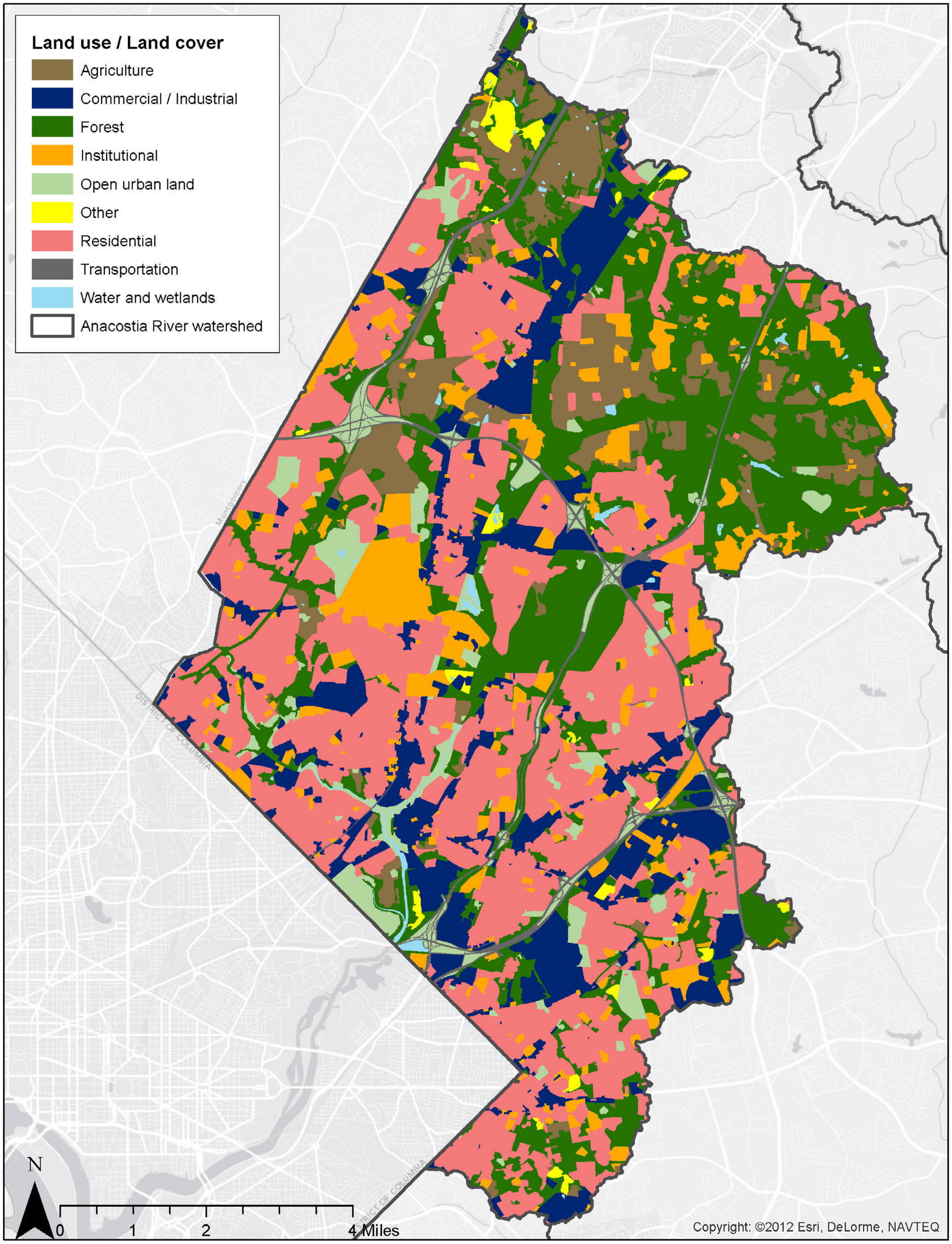
2.4 Land Use and Land Cover

Land use, land cover, and impervious area are some of the most important factors that influence the amount of pollution entering the County’s water bodies. Pollutant loadings, like nitrogen or bacteria, vary by land use (e.g., commercial, agriculture, parks). As impervious area increases, so does the amount of runoff a rain event produces, thus transporting more pollutants to a water body in a shorter period of time.

2.4.1 Land Use Distribution

Maryland Department of Planning (MDP) 2010 land use update (MDP 2010) data are available as geographic information system (GIS) data, so these data are being used in the restoration plan. Land uses are made of many different land covers, such as roads, roofs, turf, and tree canopy. The proportion of land covers in each land use control the hydrologic and pollutant loading response of such uses.

Figure 2-1 shows the 2010 MDP land use for the watershed. Table 2-2 summarizes the areas. The urban area in the watershed is largely residential land (37 percent), with the majority being low-density residential (24 percent). There are also significant areas of forested land (25 percent), institutional land (such as schools, government buildings, places of worship) (9 percent), and commercial/industrial land (12 percent). The large area of institutional land in the central part of the County is the University of Maryland at College Park. The large forest and agriculture area to the northeast is the Beltsville Agricultural Research Center.



Source: MDP 2010

Figure 2-1. Land use in the Anacostia River watershed.

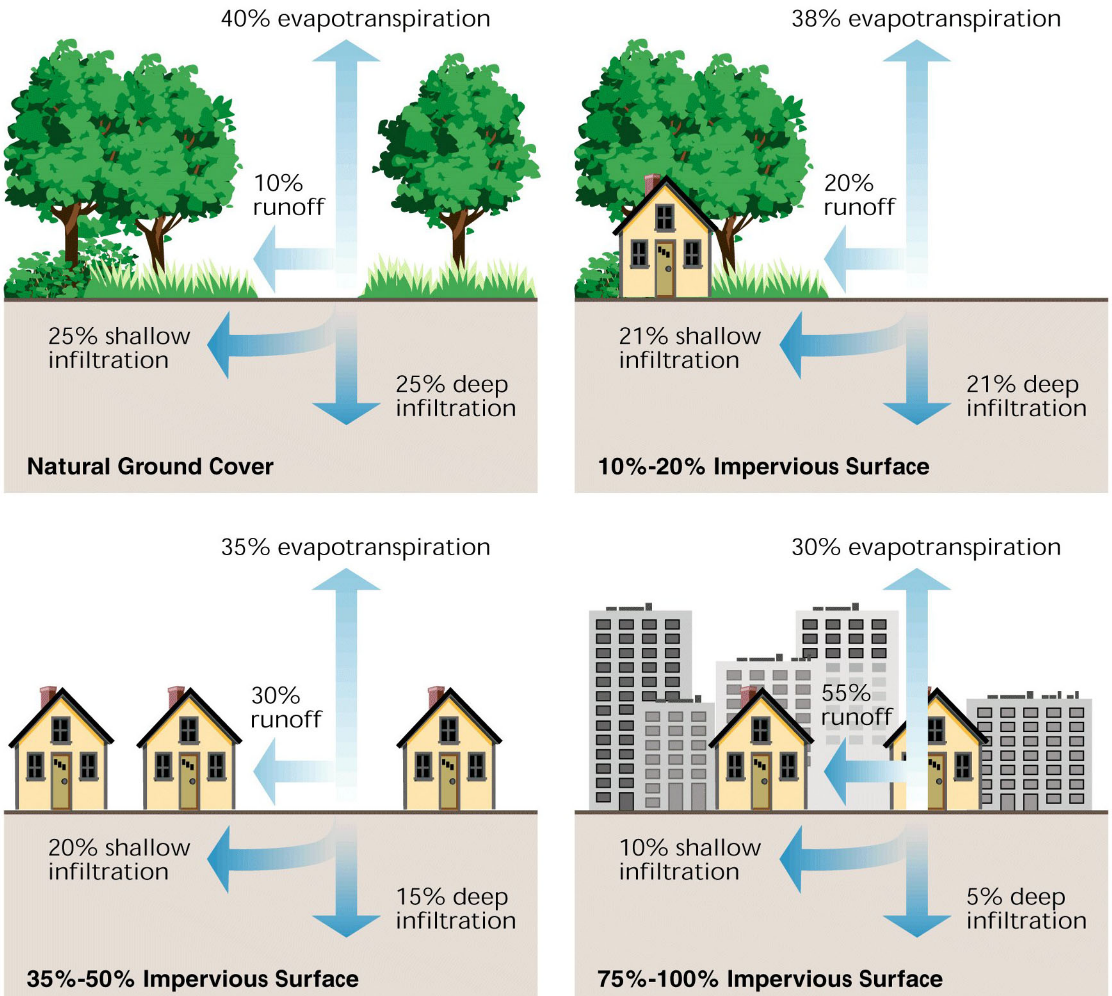
Table 2-2. Anacostia River watershed 2010 MDP land use in Prince George's County

Land Use	Acres	Percent of Total	Percent of Land Use Grouping
Agriculture	**4,520**	**8.33%**	**100.0%**
Agricultural building	0	0.00%	0.0%
Cropland	3,135	5.78%	69.4%
Feeding operations		0.00%	0.0%
Large lot subdivision (agriculture)	48	0.09%	1.1%
Orchards/vineyards/horticulture		0.00%	0.0%
Pasture	1,307	2.41%	28.9%
Row and garden crops	29	0.05%	0.6%
Forest	**13,721**	**25.30%**	**100.0%**
Brush	388	0.72%	2.8%
Deciduous forest	6,301	11.62%	45.9%
Evergreen forest	886	1.63%	6.5%
Large lot subdivision (forest)	88	0.16%	0.6%
Mixed forest	6,057	11.17%	44.1%
Other	**559**	**1.03%**	**100.0%**
Bare ground	350	0.64%	62.6%
Beaches		0.00%	0.0%
Extractive	209	0.39%	37.4%
Urban	**35,139**	**64.79%**	**100.0%**
Commercial	3,143	5.80%	8.9%
High-density residential	5,696	10.50%	16.2%
Industrial	3,315	6.11%	9.4%
Institutional	4,904	9.04%	14.0%
Low-density residential	1,173	2.16%	3.3%
Medium-density residential	13,151	24.25%	37.4%
Open urban land	2,588	4.77%	7.4%
Transportation	1,170	2.16%	3.3%
Water and Wetlands	**296**	**0.55%**	**100.0%**
Water	267	0.49%	90.2%
Wetlands	29	0.05%	9.8%

Source: MDP 2010.

2.4.2 Percent Imperviousness

According to Prince George's County Code, *impervious area* means an area that is covered with solid material or is compacted to the point at which water cannot infiltrate into underlying soils (e.g., parking lots, roads, houses, patios, swimming pools, compacted gravel areas, and so forth) and where natural hydrologic patterns are altered. Impervious areas are important in urban hydrology because the increased paved areas (e.g., parking lots, rooftops, and roads) decrease the amount of water infiltrating into the soils to become groundwater (Figure 2-2). Precipitation flows off the impervious area and is shunted quickly to the stream channels in the watershed instead of infiltrating into the ground or reentering the atmosphere through evapotranspiration. During rain events, the increased runoff flow volume not only carries additional nutrients and other pollutants, but it also increases the overall velocity of the runoff and receiving streams. Faster stream flows can erode streambanks, which contributes sediment to the water column and makes the water muddy.



Source: Learn NC (http://www.learnnc.org/lp/media/uploads/2010/02/fig3-21.jpg)

Figure 2-2. Example effects on water cycle from increased impervious surfaces.

Impervious areas include several types, including buildings (e.g., roofs), parking lots, driveways, and roads. Each type has different characteristics and contributes to increased runoff and pollutant loadings in different ways. For instance, driveways have a higher nutrient loading potential to waterways than roofs, because this runoff could include grass clippings and fertilizer that was accidentally spread on the driveway. Sidewalks will have a higher bacteria loading than driveways because people walk their dogs along sidewalks and sometimes do not pick up the dogs' waste.

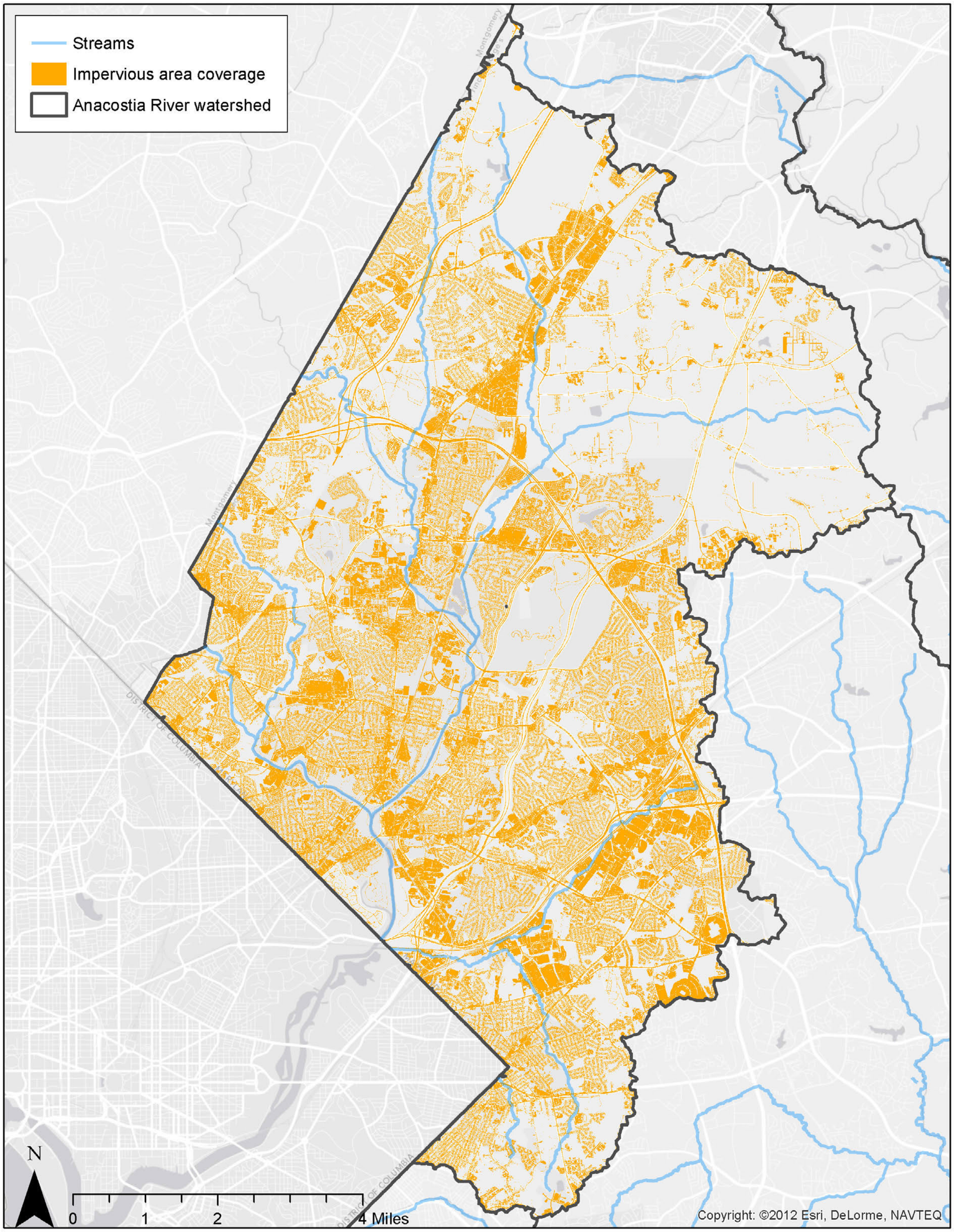
Impervious areas are further classified into two subgroups: connected and disconnected. On connected impervious land, rainwater runoff flows directly from the impervious surface to stormwater sewers, which in turn flow directly to streams. In disconnected impervious cover areas, rainwater runoff flows over grass, meadows, or forest areas before being intercepted by stormwater sewers, which then flow to streams. Directly connected impervious cover is substantially more detrimental to stream health and quality than disconnected land cover because the highly efficient conveyance system (stormwater pipes) associated with directly connected impervious cover increases the volume and rate of flow and pollutant transport to nearby streams.

Table 2-3 presents the 2009 impervious area information for the County's portion of the watershed. These totals include impervious area on state and federal land, as well as outside the MS4 area. The majority of the impervious area in the watershed is composed of buildings (28 percent of impervious area), roads (27 percent of the impervious area), and parking lots (25 percent of the impervious area). Impervious areas are most concentrated in the southwestern portion of the watershed, which corresponds to the location of most of the urban areas. Figure 2-3 shows the extent of impervious area throughout the watershed.

Table 2-3. Anacostia River watershed total impervious area in Prince George's County

Impervious Type	Area (acres)	Percent of Impervious Area	Percent of Total Watershed Area
Aviation	10.0	0.07%	0.02%
Bridges	57.5	0.37%	0.11%
Buildings	4,247.3	27.52%	7.83%
Driveways	962.2	6.23%	1.77%
Gravel surfaces	268.2	1.74%	0.49%
Other	108.6	0.70%	0.20%
Other concrete surfaces	409.4	2.65%	0.75%
Parking lots	3,833.0	24.83%	7.07%
Patios	193.9	1.26%	0.36%
Pools	22.0	0.14%	0.04%
Railroads	8.1	0.05%	0.02%
Roads and highways	4,174.1	27.04%	7.70%
Track and athletic	66.9	0.43%	0.12%
Walkways	1,074.0	6.96%	1.98%
Total	15,435.3	100.00%	28.46%

Source: 2009 impervious area from M-NCPPC 2014.



Source: 2009 impervious area from M-NCPPC 2014.

Figure 2-3. Impervious areas in the Anacostia River watershed.

2.5 Water Quality and Stream Biology

Water quality data are available from several different sources. Data used for restoration planning were obtained from the *Water Quality Portal* (www.waterqualitydata.us). This source is sponsored by EPA, the U.S. Geological Survey (USGS), and the National Water Quality Monitoring Council, and collects data from more than 400 federal, state, local, and tribal agencies. EPA's STORET (STOrage and RETrieval) Data Warehouse was also searched for additional information. MDE was contacted and provided supplemental recent data that were not found in the *Water Quality Portal* or STORET. Another important data source was the County's MS4 long-term monitoring program. Water quality data were obtained for the following parameters: fecal bacteria, BOD, DO, nutrients, and TSS. Data summaries and plots can be found in the WECR.

In addition to collecting chemical water quality data, the County also has implemented a biological monitoring program to provide credible data and valid, defensible results to address questions related to the status and trends of stream and watershed ecological conditions. Biological monitoring data are used to identify problems; document the relationships among stressor sources, stressors, and response indicators; and evaluate environmental management activities, including restoration. Since 1999 two rounds of a countywide bioassessment study have been completed, the first in 1999–2003 and the second in 2010–2013. Results of the Benthic Index of Biotic Integrity (B-IBI) sampling in the Anacostia River watershed showed that approximately 71 percent of sites are rated as biologically degraded, having B-IBI ratings of Poor to Very Poor. No sites in the Anacostia River were rated Good. Degraded stream miles account for 78 percent of total stream miles in the Anacostia River Basin. Although not statistically significant, the percent of degraded stream miles in the Anacostia River increased 9 percent from the Round 1 assessments to Round 2 assessments. The Round 2 assessment report suggests that, while the County's overall efforts to manage and restore water quality have not resulted in improvements in the Anacostia River watershed, they might have resulted in enabling streams and watersheds to "hold their own" in the face of added development and continued degradational pressures (Millard et al. 2013).

2.6 Pollutant Sources

Sources of pollutants in the watershed are varied and include point sources and nonpoint sources. Point sources are permitted through the National Pollutant Discharge Elimination System (NPDES) program. Nonpoint sources are diffuse sources that typically cannot be identified as entering a water body through a discrete conveyance at one location. Nonpoint sources can originate from land activities that contribute nutrients or TSS to surface water as a result of rainfall runoff. In the Anacostia River watershed, all sources of pollutant loading not regulated by NPDES permits are considered nonpoint sources. The majority of permitted sources in the watershed are part of the MS4. Further details regarding pollutant sources in the Anacostia River watershed can be reviewed in the WECR.

2.6.1 NPDES-Permitted Facilities

Under the NPDES stormwater program, operators of large, medium, and regulated small MS4s must obtain authorization to discharge pollutants. The Stormwater Phase I Rule (55 FR 47990, November 16, 1990) requires all operators of medium and large MS4s to obtain an NPDES permit and develop a stormwater management program. Medium and large MS4s are defined by the size of the population within the MS4 area, not including the population served by combined sewer systems. A medium MS4 has a population between 100,000 and 249,999; a large MS4 has a population of 250,000 or more. Phase II of the rule extends coverage of the NPDES Storm Water Program to certain small MS4s. Small MS4s are defined as any MS4 that is not a medium or large MS4 covered by Phase I of the NPDES Storm Water Program. Only a select subset of small MS4s, referred to as regulated small MS4s, require an NPDES stormwater permit. Regulated small MS4s are defined as (1) all small MS4s in urbanized areas as defined by the U.S. Census Bureau, and (2) small MS4s outside an urbanized area that are designated by NPDES-permitting authorities. The municipal Phase II MS4 entities in the Anacostia River watershed are:

- Berwyn Heights
- Bladensburg
- Brentwood
- Capitol Heights
- Cheverly
- College Park
- Colmar Manor
- Cottage City
- Fairmount Heights
- Glenarden
- Greenbelt
- Hyattsville
- Landover Hills
- Mount Rainier
- New Carrollton
- Riverdale Park
- Seat Pleasant
- University Park

In addition to Phase II municipalities, there currently are 10 County facilities and 9 other municipal facilities covered by the NPDES General Industrial permit, which requires a stormwater pollution prevention plan (SWPPP). The County currently conducts field verification of these facilities to ensure that each SWPPP accurately reflects the environmental and industrial operations of the facility. If deficiencies are noted in the SWPPP, the County provides the required technical support to upgrade the plan. The County also monitors all SWPPP implementation activities through its database tracking system and provides MDE with an annual report documenting the status of each County-owned facility SWPPP.

In addition to municipalities, certain federal, state, and other entities are required to obtain Phase II MS4 permits. The County is not responsible for these areas. Table 2-4 presents these permitted entities within the Anacostia River watershed. For this restoration plan development, the County considers municipal school properties and property operated by the Maryland-National Capital Park and Planning Commission (M-NCPPC) as covered under the County's MS4 permit; however, M-NCPPC will be covered under a future MS4 permit issued specifically to M-NCPPC. The County has included those properties in its impervious areas for this restoration plan, given the current cooperation between the parties. In the past, the County has partnered with both MDE and M-NCPPC to install BMPs at public schools and M-NCPPC properties to treat impervious areas.

Table 2-4. Phase II MS4 permitted federal, state, and other entities in Anacostia River watershed

Agency	Installation/Facility
Maryland Army National Guard	Multiple properties
U.S. Department of the Army	Adelphi Laboratory Center
Washington Suburban Sanitary Commission	Multiple properties
United States Department of Agriculture APHIS-PPQ	National Plant Germplasm and Biotechnology Laboratory
University of Maryland	College Park campus
Maryland Transit Administration	Multiple properties
National Aeronautics and Space Administration	Goddard Space Flight Center
Maryland State Highway Administration	Multiple (outside Phase I jurisdictions)
Washington Metropolitan Area Transit Authority	Multiple Metrorail stations
Maryland Transportation Authority	Multiple properties
U.S. Department of the Army, Reserves	Multiple properties
U.S. Department of Agriculture	Beltsville Agricultural Research Center
Maryland Department of Transportation Motor Vehicle Administration	Multiple properties

Information on other permitted facilities was available from MDE's website and EPA's Integrated Compliance Information System. Appendix C of the WECR report provides additional details on those facilities. There are 195 privately owned permitted facilities in the watershed, more than half of which are listed as discharging stormwater. Other facilities are permitted for discharging from construction sites, mining facilities, dewatering activities, refuse sites, and swimming pools. The County is not responsible for these facilities meeting their WLAs.

Wastewater facilities might include those publicly owned treatment works providing wastewater treatment and disinfection for sanitary sewer systems, or industrial facilities providing treatment of process waters. In the Anacostia River watershed, two federal facilities (USDA Eastside Wastewater Treatment Plant and USDA Westside Wastewater Treatment Plant) are permitted to discharge treated sanitary wastewater into the watershed.

County data from 2011 indicate that 43 on-site wastewater systems are within the watershed. These types of systems can contribute nitrogen loadings to nearby water bodies through their normal operation. Failing on-site systems can increase nitrogen, phosphorus, and bacteria levels.

No information is currently available as to the age, maintenance, or level of treatment of the systems.

Sanitary sewers occasionally unintentionally discharge raw sewage to surface waters in events called sanitary sewer overflows. These events contribute nutrients, bacteria, and solids into local waterways. Sanitary sewer overflows can be caused by sewer blockages, pipe breaks, defects, and power failures. Overflows often occur during and after major storm events and are symptomatic of infiltration and inflow of groundwater into sanitary sewer pipes through cracks and breaks. The same cracks allow sewage to percolate into the ground, some of which can seep directly into the streams or into adjacent stormwater collection pipes. The Maryland Reported Sewer Overflow Database contains the bypasses, combined sewer overflows, and sanitary sewer overflows reported to MDE from January 2005 through the most recent update. Data on sanitary sewer overflows in the County were obtained from the database. Since 2005 an estimated 7.4 million gallons of sanitary overflows have been reported in the County. For that period, the average amount of annual overflow has been 828,064 gallons, with a minimum of 12,840 and a maximum of 5.2 million gallons, which occurred in 2006.

2.6.2 Nonpoint Sources

Nonpoint sources can originate from rainfall runoff (in non-urban areas) and landscape-dependent characteristics and processes that contribute sediment, organic matter, and nutrient loads to surface waters. Nonpoint sources include diffuse sources that cannot be identified as entering the water body at a specific location. Because the County is considered a Phase I MS4, for TMDL purposes, all urban areas within the County are considered to be point sources and allocated loads are considered under the WLA component. Mechanisms under which urban or MS4 loads are generated are the same as other rainfall-driven nonpoint sources. Potential sources vary greatly and include agriculture-related activities, atmospheric deposition, on-site treatment systems, streambank erosion, wildlife, and unknown sources.

Atmospheric deposition occurs by two main methods: wet and dry. Wet deposition occurs when rain, fog, and snow wash gases and particles out of the atmosphere. Dry deposition occurs as gases and particles in the atmosphere settle out onto surfaces over time. Pollutants deposited through dry deposition can be washed into streams from trees, roofs, and other surfaces by precipitation. Winds blow the particles and gases contributing to atmospheric deposition over great distances, including geographical (e.g., watersheds) and political boundaries (e.g., state boundaries).

Riparian stream corridors are vulnerable to nutrient inputs from wildlife. Wild animals with direct access to streams include deer, raccoons, other small mammals, and avian species. This access to streams contributes bacteria and nitrogen to water bodies.

Development in the watershed has altered the landscape from presettlement conditions, which included grassland and forest, to post-settlement conditions, which include cropland, pasture, and urban/suburban areas. This conversion has led to increased runoff and flow into streams versus presettlement conditions, as well as streambank erosion and straightening of meandering streams. The increased erosion not only increases sediment loading to water bodies but also increases loadings of nutrients that are adsorbed to sediment particles.

3 Restoration Plan Goals and Objectives

Goals in restoration planning are general statements about the desired condition or outcome of the effort. A successful restoration planning effort also identifies definite objectives, or steps that will be taken to achieve the desired goals. Objectives provide the foundation for watershed restoration and management decisions. This section identifies the specific restoration goals and objectives for the Anacostia River watershed, describes modeling performed to assist in quantifying certain objectives, and identifies reductions necessary for compliance with regulatory requirements (i.e., TMDLs).

3.1 Watershed Goals and Objectives

The watershed goals and objectives identified here reflect the specific needs of the Anacostia River watershed and might include priorities in addition to regulatory compliance. A goal is represented by a general statement about the desired condition or outcome of the watershed management or restoration strategies. Objectives are specific statements that define what must be true or what actions must be taken for the goals to be achieved. The objectives provide the foundation for watershed restoration and management decisions.

The watershed goals include, but are not limited to, the restoration planning goals outlined in section 1.1, which apply to all watersheds in the County. The overarching goals for the Anacostia River watershed are noted below:

- Protect, restore, and enhance habitat in the watershed.
- Restore watershed functions, including hydrology, water quality, and habitat, using a balanced approach that minimizes negative impacts.
- Support compliance with regional, state, and federal regulatory requirements.
- Increase awareness and stewardship within the watershed, including encouraging policymakers to develop policies that support a healthy watershed.
- Protect human health, safety, and property.
- Improve quality of life and recreational opportunities.

The watershed objectives describe more specific outcomes that would achieve the overarching goals. The objectives for the Anacostia River watershed are to:

- Protect land that supports rare and/or threatened high quality terrestrial, wetland, and aquatic habitat.
- Restore hydrology, water quality, and habitat functions in wetlands and streams.
- Implement BMPs and programmatic strategies that restore hydrologic and water quality functions and protect downstream aquatic habitat and designated uses.
- Achieve pollutant load reductions to comply with regulatory requirements as shown in Table 1-1.
- Educate watershed stakeholders and create opportunities for active public involvement in watershed restoration.
- Integrate watershed protection and restoration in policy-making processes at the local level.

The objectives are used to guide the identification and prioritization of management options. For some management options, like structural BMPs, achievement of the hydrology and water quality objectives can be quantified to evaluate effectiveness towards meeting the goals and objectives. For other management options, like programmatic strategies and education, achievement of objectives can be evaluated with a more qualitative approach. The goals and objectives are used to communicate priorities and ensure tangible progress across all stages of restoration planning and implementation.

3.2 Watershed Treatment Model (WTM) Modeling

MDE's *TMDL Data Center* website (MDE 2014c) provides technical guidance for developing restoration plans for WLAs (MDE 2014b). Part of this guidance allows entities to calculate updated load estimates using specific land-use and other data for restoration planning. The guidance allows entities to use their own data to develop loads if they retain the percent reduction specified in the respective TMDL between baseline loads and the allocations for the applicable pollutants (MDE 2014b). Baseline conditions, as defined by MDE, represent the impaired conditions that the watershed was under during TMDL development. The percent reduction of pollutants is based on loads needed to achieve the applicable water quality standards in specific water bodies.

Using MDE's guidance, the County used a County-modified Watershed Treatment Model (WTM) to calculate new loads for the implementation model baseline. The purpose of the implementation model was not to recalculate the WLA as defined in the TMDL documents and the MDE *TMDL Data Center*, but to convert the TMDL load reduction from the original TMDL model to an implementation model (WTM) that can be effectively used in the planning of restoration activities. The level of effort (load reduction percentage) to meet water quality standards is kept the same between the two models. WTM was modified to include more specific land-use types as well as to differentiate between connected and disconnected impervious areas to calculate more precisely loads generated from different land-use types. Therefore, the modified WTM provides the County the ability to specifically identify the land uses and land covers that produce the larger loads and target BMPs and other restoration measure to those land uses. This approach will allow the County to make better decisions on where a specific type of restoration activity should be implemented and to improve implementation planning.

Because the TMDLs in the County have been established in different years, the County opted to use one set of common data to establish *implementation model* baseline loads for all pollutants addressed in this restoration plan. Therefore, *baseline loads* in this plan refers to the pollutant loads calculated using the modified WTM (implementation model) with the most recent land use (MDP 2010) and impervious cover (M-NCPPC 2009) data available. This method provides a more accurate depiction of loadings from County land and establishes a common set of baseline data, which aids in the restoration planning process. The WTM baseline loads have been compared to both Maryland Assessment and Scenario Tool (MAST)[1], and TMDL baseline loads and are discussed in a technical memorandum provided to the County (Tetra Tech 2015b). Load reductions from BMPs that have been implemented since the TMDLs were issued are only accounted for after these baseline loads have been established. Section 4.3.2 describes the process of assigning load reduction credits for currently installed BMPs.

[1] http://www.mastonline.org/ (Accessed September 2, 2014).

Building on previous work in the Piscataway Creek watershed, the County's contractor developed a methodology to provide a realistic breakdown of land cover-specific loads to facilitate the restoration planning process. It is important to understand the substantial differences between land use and land cover. *Land use* refers to how land is being used, such as for commercial or agricultural purposes. *Land cover* refers to what covers the ground, such as parking lots, buildings, or agricultural fields. Land use analysis lumps many different types of land covers into a single use category. It can be an effective measure for estimating watershed runoff responses only where the differences in land covers between land uses (e.g., commercial versus residential) are much greater than the differences in land covers within a particular land use category. For instance, industrial land covers can be quite different and range from roof-dominated warehouses to junkyards. This is often the case, particularly with institutional or industrial uses that can include a variety of different land covers. In contrast, land cover analysis can be very useful for predicting watershed runoff responses, in particular those associated with impervious areas, because impervious cover—particularly connected impervious cover—increases both flow and pollutant transport. Therefore, a vital aspect of this analysis was to develop an accurate estimate of land cover, including accurate estimates of impervious and pervious source areas. For this reason, WTM analyses that include land cover will be beneficial during BMP implementation because the ability to target specific BMPs to appropriate land covers can maximize load reductions and reduce costs. In contrast, using land use is a coarser approach. A brief discussion of the WTM process is presented below; a more detailed description was provided to the County in a technical memorandum (Tetra Tech 2015b).

In the loading analysis, the County's GIS information and WTM routines were applied together to estimate subwatershed loads at the edge of the stream. The WTM is a spreadsheet-based tool that evaluates loads from a range of sources and estimates reductions from a suite of treatment options. GIS data were used to identify different impervious and pervious source areas and to identify impervious areas as connected or disconnected (Caraco 2013).

The watershed baseline loads were calculated using a modified version of WTM (based on Ver. 2013 obtained from the Center for Watershed Protection) on a countywide scale to maintain consistency across the County. The watershed scale was used because of the number of watersheds that have current TMDLs. The model was adapted to allow for adjusting the effects of hydrology and land cover to refine runoff loading rates. Applying the WTM model in this way produces a greater degree of accuracy in subwatershed loads than would be possible with a simple approach using land use. This precision not only highlights most impaired subwatersheds with greater accuracy but also allows for detailed, BMP-specific loads to be calculated in support of the restoration planning process.

This approach followed the methodology from the County's Piscataway Watershed Report (PGC DER 2012a), which used a calibrated EPA Stormwater Management Model (SWMM) to determine runoff sources and flows and the WTM model to partition runoff into directly connected impervious areas, disconnected impervious areas, and pervious receiving areas, with separate allocations for rural and natural areas. The Piscataway SWMM results were also used to calibrate flows in the Piscataway Creek WTM model. The results from the previous Piscataway Creek model were used to adjust the appropriate parameters in the WTM model to more accurately evaluate the effects of hydrologic partitioning and of different land covers. Coefficients in the Piscataway Creek WTM model were adjusted so that the WTM-computed runoff matched the

SWMM runoff values from the Piscataway SWMM model. These coefficients were then applied in the countywide WTM model.

Loading rates and concentrations from different land covers in the countywide WTM model were derived from the literature and were then applied to obtain mass loads in each subwatershed. Initial concentrations were based on the National Stormwater Quality Database (Maestre and Pitt 2005) and data gathered by Tetra Tech (2014b) for the CBP. The WTM loads were calibrated to match the baseline loadings in MAST, which is a planning tool developed for MDE and the CBP to support implementation of the Chesapeake Bay TMDL for nutrients and sediment. These loadings were also compared to the baseline loads in the respective TMDLs for BOD and bacteria. Table 3-1 presents the final calibrated average concentrations allocated to the various land cover types and surface conditions used in the countywide WTM. In a technical memorandum to the County, Tetra Tech (2014d) provided a detailed explanation of how the concentrations were determined.

Table 3-1. Calibrated average concentrations in WTM by land cover type

Primary sources		Average Concentration				
Category	Land cover	Total nitrogen (mg/L)	Total phosphorus (mg/L)	TSS (mg/L)	BOD (mg/L)	Fecal coliform bacteria (MPN/100 mL)
Connected impervious areas	Aviation	1.90	0.15	30	5.5	200
	Drives	2.20	0.35	70	12.5	5,000
	Gravel	1.80	0.20	110	7.5	1,000
	Other	1.80	0.20	60	7.5	5,000
	Parking	2.20	0.35	60	15.0	7,500
	Railroad	1.80	0.15	100	7.5	1,000
	Roads	2.20	0.30	60	12.5	5,000
	Roofs	1.60	0.12	15	7.5	1,500
	Walks	2.20	0.30	40	12.5	7,500
Disconnected impervious areas	Aviation	3.80	0.30	60	5.5	1,000
	Drives	4.40	0.70	140	12.5	25,000
	Gravel	3.60	0.40	220	7.5	5,000
	Other	3.60	0.40	120	7.5	25,000
	Parking	4.40	0.70	120	15.0	37,500
	Railroad	3.60	0.30	200	7.5	5,000
	Roads	4.40	0.60	120	12.5	25,000
	Roofs	3.20	0.24	30	7.5	7,500
	Walks	4.40	0.60	80	12.5	37,500
Pervious areas	Turf	1.75	0.35	50	2.5	5,000
	Field	1.50	0.15	25	1.5	5,000
	Crops	10.00	0.50	250	12.0	15,000
	Woods	1.25	0.05	15	0.8	500
	Wetlands	1.00	0.05	15	0.8	2,500
	Open Water	1.50	0.05	15	0.8	200
	Barren	2.00	0.90	400	3.0	1,000

As part of the calibration process, a reduction factor was needed for bacteria. Bacteria concentrations attenuate during flow from the land cover to the water bodies, where the observed water quality data for the TMDL were taken. As a result, the edge-of-land-cover loads are more than an order of magnitude higher than the observed loadings in County water bodies, requiring that an overall reduction factor be applied to convert edge-of-land-cover bacteria loads to in-stream bacteria loads. This conversion process includes the transformations needed to account for the difference in the fecal coliform bacteria in-stream loads in the TMDL (*E. coli* or enterococci) and the fecal coliform bacteria runoff loads in WTM. The reduction factor was calculated by dividing the estimated in-stream loads by the edge-of-land-cover loads from WTM. A full description of this process is available in a technical memorandum provided to the County (Tetra Tech 2015b).

The WTM modeling method allows for a more precise determination of the loads at a subwatershed level and can be used to identify the loads originating from the different municipal, state, and federal entities. The analyses were conducted at different spatial levels. The first evaluated the subwatershed in its entirety, establishing all subwatershed loads from runoff, or the baseline loads within the County boundary. The next level of analysis focused on the urban MS4 area, which comprises the source areas regulated by the County's MS4 permit. It excludes rural and natural areas. The last level of analysis partitioned the MS4 areas into their respective county, municipal, state, and federal ownerships. In this manner, it was possible to highlight the sources of the pollutant loads, as well the loads coming from each type of ownership. This approach allows a fair allocation of the obligations needed to meet the TMDL WLAs. The calibrated WTM land-cover-specific loading model was also applied at the smaller site-level scale for a BMP drainage area, ensuring consistency in meeting the TMDL WLAs and estimating reductions that would be achieved with the planned BMPs.

Streambank Erosion

Streambank erosion can add significant amounts of sediment and phosphorus (which sorbs to sediment) within a stream network to its pour point. Nitrogen, BOD, and bacteria are not increased nearly as much due to streambank erosion. During the calibration of the Anacostia River watershed WTM model, sediment and phosphorus were calibrated to edge-of-stream loadings from MAST, which does not consider streambank erosion.[2] Modeling streambank erosion requires a continuous simulation of flows for comparison of existing conditions to predevelopment flows. It also requires monitoring to determine allowable shear stress, and the increase in shear stress from development, which is beyond the scope of this document.

To account for streambank erosion and its contribution to phosphorus and TSS loadings, the County used an MDE-recommended procedure to determine an adjustment factor to translate the edge-of-stream loadings from the WTM to loading totals that contained streambank erosion. The first step was to determine the unit loading rate for urban land in the TMDL. The next step was to find the combined urban land plus streambank erosion unit loading rate. The ratio of urban land plus erosion unit loading rate to the urban land-only unit loading rate is the adjustment factor. The

[2] As defined in the Chesapeake Bay model documentation, the "edge-of-stream (EoS) load" is the "load delivered to the represented river or stream from the land segments. … Another portion of the sediment load delivered to the Bay is the sediment load mobilized in river reaches and is defined as the difference between the EoS erosion load and the sediment load scoured and mobilized in the simulation during high flows" (USEPA 2010).

calculations are summarized in Table 3-2. The phosphorus and TSS loads reported in the remainder of this restoration plan include loads from streambank erosion.

Table 3-2. Calculation for phosphorus and TSS loadings from streambank erosion using information from TMDL reports

Calculation of Unit Loading Rate for Urban Areas Using Information from TMDL Reports					
Pollutant	**Urban Load**	**Acres**	**Urban Loading Rate**	**Notes**	
Phosphorus	54,030 lb/yr	65,005	0.83 lb/acre/yr	From Table 6 of nutrient TMDL. Totals include portions of watershed in Montgomery County.	
TSS	9,331 ton/yr	77,017	0.12 ton/acre/yr	From Table 2 of sediment TMDL. Totals include entire Anacostia.	
Calculation of Unit Loading Rate for Urban Areas + Streambank Erosion					
Pollutant	**Urban Load**	**Streambank Erosion Load**	**Urban + Streambank Load**	**Acres**	**Urban + Streambank Loading Rate**
Phosphorus	54,030 lb/yr	14,990 lb/yr	69,020 lb/yr	65,005	1.06 lb/acre/yr
TSS	9,331 ton/yr	34,250 ton/yr	43,581 ton/yr	77,017	0.57 ton/acre/yr
Calculation of Loading Rate Adjustment Factor					
Pollutant	**Urban + Streambank Loading Rate**	**Urban Loading Rate**	**Adjustment Factor**	**WTM Urban Load**	**WTM Urban Load + Estimated Streambank Erosion**
Phosphorus	1.06 lb/acre/yr	0.83 lb/acre/yr	1.28	34,952 lb/yr	44,738 lb/yr
TSS	0.57 ton/acre/yr	0.12 ton/acre/yr	4.75	3,042 ton/yr	14,450 ton/yr

Sources: MDE and DDOE 2007, MDE and DDOE 2008

A primary source of streambank erosion is the increase in runoff volume and peak flows due to increasing amounts of impervious cover and other land cover changes (Klein 1978, Booth 1990). Structural BMPs will result in a decrease in runoff volumes and velocities. Therefore, in addition to reducing loads within the BMP facility, the BMPs will also contribute to load reduction by reducing streambank erosion. This reduction is not easily quantifiable at the County scale but can be expected to be significant once many of the BMPs proposed in this restoration plan are implemented. Evaluation of full-scale BMP implementation in a 17.8-acre, 85 percent impervious watershed in Richmond, Virginia, showed that flow durations over bankfull conditions decreased by 91 percent from 99.3 to 9.2 hours with less than an inch of watershed storage (Lucas and Sample 2014). Similarly, researchers have noted substantial flow reductions due to even limited deployment of BMPs (Sands and Chapman 2011). Therefore, the significant number of BMPs that will be deployed in the Anacostia River watershed will reduce load contributions from bank erosion. This reduction is not accounted for in the WTM calculations but can be considered as an additional benefit in the restoration plan. Stream restoration measures are also employed in this plan, which will have further TSS and phosphorous load reductions by directly reducing stream bank erosion. Reductions from these measures have been accounted for in the WTM model.

3.3 Implementation Model Load Reductions

Table 3-3 presents the WTM baseline loads using recent land use and impervious data from the portions of the Anacostia River watershed that are in the County's MS4 area. The loadings in Table 3-3 do not exactly match the local Anacostia River watershed TMDLs or the Chesapeake Bay TMDL WLAs, even though WTM was calibrated to MAST and the local TMDLs. As discussed in the previous section, the loadings in this restoration plan were determined using WTM, which follows MDE guidance (MDE 2014b) allowing counties to use local data to determine urban loads for implementation purposes. This method also accounts for the loads from a more accurate and more recent urban footprint than the TMDL, so the baseline loads in this plan will not exactly match those in the TMDL documents.

Table 3-3 also presents the percent reduction from MDE's *TMDL Data Center*. This percent reduction was applied to the WTM-calculated baseline load to determine the implementation load reduction target. That target and the amount by which the loads need to be reduced (using WTM) are also presented in Table 3-3. These loads represent the urban area that is regulated by the County's MS4 permit. They represent the loads without currently implemented BMPs and programmatic efforts, and thus represent the baseline loads in the implementation model for the watershed. The loads reduced by current BMPs and other practices are discussed in the next section.

Table 3-3. WTM MS4 baseline and implementation loads for the Anacostia River watershed local TMDLs in Prince George's County

Parameter	Implementation Model Baseline from WTM	Percent Reduction from MDE *TMDL Data Center*	Implementation Model Target Load	Required Implementation Model Reduction from WTM
Total nitrogen (lb/yr)	281,378	81.0%	53,462	227,917
Total phosphorus (lb/yr)[a]	45,041	81.2%	8,467	36,573
TSS (ton/yr)[a]	14,532	85.0%	2,180	12,352
BOD (lb/yr)	1,151,816	58.0%	483,763	668,053
Fecal coliform bacteria (MPN B/yr)	4,375,323	86.4%	594,281	3,781,042

Notes:
[a] Includes loadings due to streambank erosion.
Fecal coliform bacteria WLAs have different percent reductions from the tidal area and non-tidal area. The table above combines these areas.

The Chesapeake Bay TMDL established load reductions for the entire Chesapeake Bay watershed, including Prince George's County, so the water quality criteria are met in the Chesapeake Bay. However, the Chesapeake Bay model did not consider local water quality during TMDL development.

The Chesapeake Bay TMDL and the local TMDL(s) each establish target load reductions for nitrogen, phosphorus, and TSS; the County is required to meet the most stringent of each of the reductions. In 2011, the County received a Chesapeake Bay WLA and percent reduction for the entire County, which can be split out among its watersheds. WTM was used to translate the countywide Chesapeake Bay WLA into loads directly comparable to the WTM loads for local TMDLs. The assessment found that the required load reductions established by the Anacostia

River local TMDL were more stringent than the required overall total nitrogen load reduction for the County's portion of the Chesapeake Bay WLA. Required load reductions from the local TMDLs would not be sufficient for the County's portion of the total phosphorus and TSS Chesapeake Bay WLAs. Therefore, the County will need to implement additional restoration activities elsewhere in the County to meet the County's phosphorus and TSS WLAs for the Chesapeake Bay TMDL.

4 Current Management Activities

When rain falls, the resulting runoff flows off roofs, lawns, driveways, and roads into a network of stormwater sewers that discharge directly to the streams. This stormwater flow picks up nutrients, bacteria, and sediments from roofs and lawns, along with bacteria, sediments, oils, greases, and metals from driveways and roadways, and transports them into the waterways of the County in areas where there is no stormwater treatment. Many areas of the County (including much of the Anacostia River watershed) were developed before the adoption of stormwater regulations and practices in the 1970s and 1980s. In these older developments, no stormwater management facilities exist. The County enacted a stormwater management ordinance in 1971 and the State adopted a statewide stormwater law and regulations in 1983. Newer development in the County, including redevelopment built since 1971, is required to provide water quality treatment for this urban runoff using a wide range of stormwater practices. During the initial years of stormwater regulation, these practices were somewhat crude and simple—such as dry ponds—but have continuously improved. Today, *environmental site design* (ESD)—the approach to stormwater management required by MDE—is based on the use of landscape-based practices such as rain gardens and bioswales, and is considered an ecologically sustainable approach to stormwater management. The County is currently installing these types of BMPs. This section details the BMPs that are installed in the County as well as current programmatic activities.

4.1 Existing BMPs

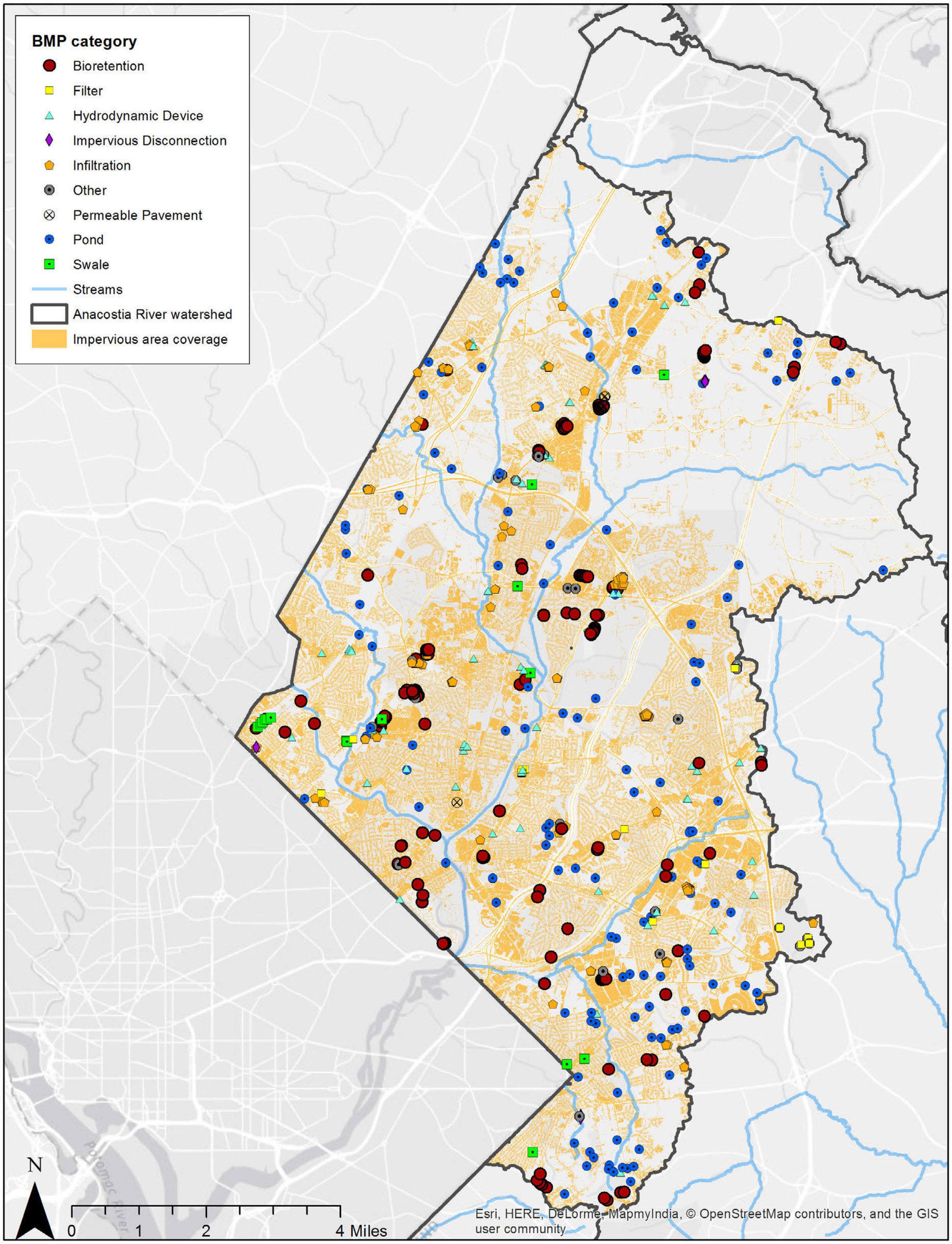
Table 4-1 presents the list of documented existing County structural BMPs in the County's portion of the Anacostia River watershed as of October 2015. Figure 4-1 presents the locations of the BMPs in the watershed. Stormwater ponds are the most-implemented BMP. Bioretention systems[3] are the second-most-implemented practices. They tend to treat smaller areas, but with greater pollutant removal efficiency. Oil and grit separators and infiltration practices are tied for the third-most-implemented BMPs, with the separators treating more total area and impervious area; however, separators have lower removal efficiencies than infiltration practices. As can be seen in Table 4-1, some BMPs do not have associated drainage areas and 11 BMPs for which the specific type is not known. The County is actively updating their BMP geodatabase with new information.

[3] A bioretention system is a green stormwater BMP that was developed by Prince George's County in 1993 and has become the most widely used stormwater practice in the nation and many other countries.

Table 4-1. List of BMP types in the Anacostia River watershed

BMP Type	Total Number	Total w/ Known DA	Total Known Acres Treated	Avg. Acres Treated
Bioretention	153	93	152.72	1.64
Filter	18	9	4.88	0.54
Hydrodynamic device	66	61	67.47	1.11
Impervious Disconnection	8	8	0.21	0.03
Infiltration	156	127	72.43	0.57
Other	29	17	44.79	2.63
Permeable Pavement	15	6	0.74	0.12
Pond	141	118	2,653.82	22.49
Swale	16	5	16.38	3.28
Total	602	444	3,013.43	32.41

Source: DoE, October 2015.
Note: DA=drainage area.



Source: BMPs (October 2015) and impervious cover (June 2014) are from DoE

Figure 4-1. BMPs in the Anacostia River watershed.

4.2 Programmatic Practices

Besides installing BMPs, the County has initiated a wide range of programmatic stormwater management initiatives over the years to address existing water quality concerns. These initiatives are grouped into the following categories: stormwater-specific programs, tree planting and landscape revitalization programs, public education programs, and mass transit and alternative transportation programs. Each grouping (and its respective individual initiatives) is further described in this section, including the contributions that these programs make to water quality protection and improvement.

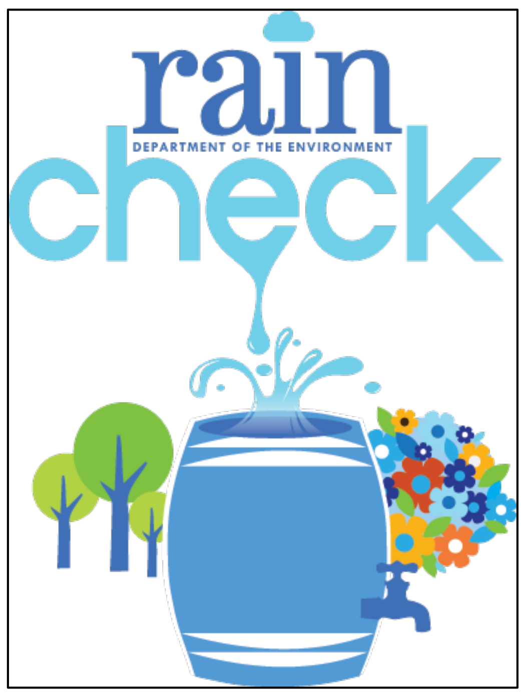
Many of the County's stormwater-related programmatic initiatives target more than one topic area. For example, in addition to promoting adoption of on-the-ground BMPs, the Alternative Compliance Program promotes stormwater education via environmentally focused sermons at places of worship. Listed below are programs administered by various departments within the County government or its partners that either directly or indirectly support water quality improvement.

- Stormwater-Specific Programs
  - Stormwater Management Program
  - Clean Water Partnership (CWP)
  - Rain Check Rebate and Grant Program
  - Alternative Compliance Program
  - Countywide Green/Complete Streets Program
  - Street Sweeping
  - Storm Drain Maintenance: Inlet, Storm Drain, and Channel Cleaning
  - Storm Drain Stenciling
  - Illicit Connection and Enforcement Program
  - Cross-Connections Elimination
- Tree Planting Programs
  - Volunteer Tree Planting
  - Tree ReLeaf Grant Program
  - Neighborhood Design Center
  - Arbor Day Every Day
- Public Education Programs
  - Master Gardeners
  - Flood Awareness Month
  - Transforming Neighborhoods Initiative
  - Animal Management
- Mass Transit and Alternative Transportation Programs
  - Commuter and Carpool Programs
  - Public Transit Programs

4.2.1 Stormwater-Specific Programs

As required under NPDES regulations, the County must operate an overall stormwater program that addresses six minimum control measures—public education and outreach, public participation/involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention/good housekeeping. To meet that requirement, the County administers various programs and initiatives, many of which have goals that will help achieve pollution reductions in response to TMDL requirements. Stormwater-specific program initiatives are designed to reduce flow volumes and pollutant loads reaching surface waters by facilitating the implementation of practices to retain and infiltrate runoff. Stormwater-specific programs include the following:

- *Stormwater Management Program (SWM Program)*. The SWM Program is responsible for performing detailed assessments of existing water quality. The SWM Program is also responsible for preparing design plans and overseeing the construction of regional stormwater management facilities and water quality control projects. These activities contribute to annual load reductions through improved planning and assessment and implementation of BMPs that reduce pollutant loading. The County is continuously improving its geospatial information for stormwater sewer locations, impervious cover, BMP locations and drainage areas, and other watershed information.
- *Clean Water Partnership* (*CWP*). This partnership was formally called the Public Private Partnership (P3) Program. The County recently initiated the CWP to assist in addressing the restoration requirements of the Chesapeake Bay WIP program. The CWP program is initially focusing on right-of-way (ROW) runoff management for older communities, which are inside the Capital Beltway. The program is expected to be responsible for providing water quality treatment for 2,000 acres of impervious land over the next 3 years at a total cost of approximately $64 million ($14 million the first year followed by $25 million each of the following 2 years). The CWP will span 30 years. The second phase of restoration activities will start after 2017 and will include new acreage goals for restoration.



- *Rain Check Rebate and Grant Program.* The Rain Check Rebate and Grant Program,[4] administered by the DoE, allows property owners to receive rebates for installing County-approved stormwater management practices and was established in 2012 through County Bill CB-40-2012 and started in 2013. Homeowners, businesses, and nonprofit entities (including housing cooperatives and places of worship) can be

[4] http://www.princegeorgescountymd.gov/sites/StormwaterManagement/RainCheck/Pages/default.aspx (Accessed August 29, 2014)

reimbursed for some of the costs of installing practices covered by the program. Installing practices at the individual property level helps reduce the volume of stormwater runoff that enters the storm drain system, as well as the amount of pollutants in the runoff. In addition, property owners implementing these techniques through the program will reduce their Clean Water Act Fee if the practice is maintained for 3 years. This program has only recently started, and thus there are no current load reductions from it. In the first year of the program, there were 40 projects identified, treating 2 acres of impervious area. The expected acreage that will be treated using this program has not yet been estimated.

- *Alternative Compliance Program.* The Alternative Compliance Program, administered by DoE, allows tax-exempt religious and nonprofit organizations to receive reductions to their Clean Water Act Fee if they adopt stormwater management practices. The organizations have three options and can use any combination to receive credits. The options are (1) provide easements so that the County can install BMPs on their property; (2) agree to take part in outreach and education to encourage others to participate in the Rain Check Rebate and Grant Program and create an environmental team for trash pickups, tree planting, recycling, planting rain gardens, etc.; and (3) agree to use good housekeeping techniques to keep clean lots and to use lawn management companies that are certified in the proper use of fertilizers. This program has only recently started, and thus there are no current load reductions from it. The acreage that will be treated using this program has not yet been estimated. The County has identified approximately 800 potential facilities that could participate in this program. As of October 2015, it had received 130 applications and was working with 30 of the applicants to identify suitable BMP opportunities. The County has been working to compile a suite of outreach materials from various sources that congregations and nonprofits can use to educate their members. In terms of targeting specific areas, Corvias Solutions—who is designing and constructing the projects under option 1 for the Clean Water Partnership—uses the following three criteria to prioritize potential target areas: 1) located in a Transforming Neighborhoods Initiative (TNI) area, 2) located in a high-priority watershed, and 3) located near other work being done by Corvias (in an effort to reduce costs). Over the next few years, the County intends to reach out to all identified facilities.
- *Countywide Green/Complete Streets Program.* The Department of Public Works and Transportation (DPW&T) initiated a countywide Green/Complete Streets Program in 2013 as a strategy for addressing mounting MS4 and TMDL treatment requirements. The program identifies opportunities to incorporate stormwater control measures, environmental enhancements, and community amenities within the DPW&T's capital improvement projects. The types of projects that can contribute to pollutant load reductions include low impact design, tree shading, alternative pavements, and landscape covers. No projects have been completed as of the date of this document; however, some projects are in the design phase and will go into construction in fiscal year 2015. The acreage that will be treated using this program has not yet been estimated.

  DPW&T has implemented a program to identify existing untreated rural roadways that might qualify for untreated impervious baseline reduction and/or water quality emulation of ESD to the maximum extent possible through existing sheetflow conditions and hydrologic disconnectedness. GIS will be used to identify the roadways that will be credited and considered removed from the County's total untreated impervious surface area. The process entails a desktop and field verification to ensure that the roadways qualify per the document, *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (MDE 2014a), which allows for watershed restoration credit for existing open section rural roadways. This program does not affect restoration planning, since the program does not produce load reductions. It reduces the number of impervious acres recognized in the MS4 permit. A portion of the projects, however, focuses on identifying additional BMP opportunities. Any new BMP opportunity can be credited towards this restoration plan once it is implemented.

- *Street Sweeping.* The County conducts street sweeping operations on select arterial, collector, and industrial streets. Residential subdivisions are swept on a request-only basis. Street sweeping can reduce the amount of debris, including sediment that reaches waterways. The street sweeping data collected for the arterial and industrial streets are recorded in four seasonal cycles, with 3 months of data recorded for each cycle. During the 2013 reporting period, 1,872 curb miles were swept countywide, collecting 1,097 tons of debris. This includes 80 miles of roads in the Anacostia River watershed. Of those, 31 miles were swept in the spring and fall, while 19 miles were only swept in the fall. The program performs street sweeping 12 times per year on the same roadways, with intermittent sweeping (approximately 500 curb miles) by specific request from communities.

  Street sweeping falls under MDE's identified programmatic practices for pollution reduction that can provide water quality benefits. These practices are called *alternative BMPs* and offer jurisdictions additional options and greater flexibility toward meeting restoration requirements outlined in MS4 permits.

  MDE has identified two approaches for calculating the pollutant load reduction associated with street sweeping: the mass loading approach and the street lane approach (MDE 2014a, Appendix D). Because the County's frequency of street sweeping does not comply with the credit requirements of the street lane approach, the mass loading approach is used to calculate the load reductions. For the mass loading approach, the street dirt collected is measured in tons at the landfill or ultimate point of disposal. The pollutant load removed is then based on a relationship between the pollutant load present in a ton of street dirt dry mass. This relationship is 3.5 pounds (lb) for total nitrogen, 1.4 lb total phosphorus, and 420 lb TSS per ton. Using the mass loading approach and the street sweeping data provided by the County, 2012 and 2013 estimates for countywide reductions to TSS, total nitrogen, and total phosphorus are provided in Table 4-2.

Table 4-2. Countywide pollutant reductions from street sweeping

Year	Debris Load (tons)	TSS Load (lb)	Total Nitrogen Load (lb)	Total Phosphorus Load (lb)
2012	1,372	576,240	4,802	1,921
2013	1,097	460,740	3,840	1,536

- *Storm Drain Maintenance: Inlet, Storm Drain, and Channel Cleaning.* These are systematic water quality-based storm drain programs where routine inspections and cleanouts are performed on targeted infrastructure with high sediment and trash accumulation rates. Municipal inspections of the storm drain system can be used to identify priority areas. DPW&T inspects and cleans 69 major channels on a 3-year cycle. In 2013, DPW&T performed maintenance on 23,396 linear feet of concrete channel and 15,281 linear feet of earthen channel.

- *Storm Drain Stenciling.* The Storm Drain Stenciling Program continues to raise community awareness and alert community members of the connection between storm drains and the Chesapeake Bay. While the County's stormwater management program requires stenciling on all new developments, this program focuses on using stencils as a means of educating the citizens in older communities (i.e., communities built before stormwater regulations went into effect). The County uses Chesapeake Bay Trust funding to purchase the paint, tools, and stencils used by the volunteers to stencil the "Don't Dump—Chesapeake Bay Drainage" message. It is difficult to estimate the load reduction from storm drain stenciling; however, it is expected to help reduce pollutant loads to local water bodies.

- *Litter Control*. The County maintains an aggressive litter control and collection program along County-maintained roadways. The litter service schedule is based on historical collection data; therefore, the most highly littered roadways are serviced as often as 24 times per year. In general, major collector and arterial urban roadways are serviced weekly, with rural roadsides served at least once per month. In 2013, the County received over 1,500 citizen requests for removal of illegal dumping through the County's 311 system. Illegal dumping in the right-of-way is removed within five working days of notification. As a result of these efforts, approximately 2,398 tons of debris and solid waste was removed from County roadways during this reporting period. In addition to storm drain inlet cleaning, the DPW&T maintains automatic bar screen cleaners at four of its Anacostia Flood Control pumping stations. These devices have proven to be very effective in removing solid wastes from stormwater entering the stations. Based on monthly reports, 315 tons of debris was collectively removed from the Bladensburg, Brentwood, Colmar Manor, and Edmonston pumping stations in 2013.
- *Illicit Connection and Enforcement Program.* In partnership with the County's Comprehensive Community Cleanup Program, DoE conducts field screening and outfall sampling. This program is designed to revitalize, enhance, and help maintain unincorporated areas of the County, providing a wide range of clean up and maintenance services to a community over a 2-week to 1-month period. Outfall sampling serves to detect and eliminate stormwater pollutants and support clean and healthy communities. DoE's *Investigation, Inspection and Enforcement Program* investigates incoming complaints on the County's Water Pollution Line (95-CLEAN). Enforcement actions associated with violations involving the improper storage of materials and/or dumping on private property are the responsibility of the Department of Permitting, Inspections,

and Enforcement as authorized under the Zoning Ordinance, Housing and Property Codes. Illegal dumping on public property is the responsibility of DPW&T. Environmental enforcement; including for disturbed areas, grading, sediment and erosion control, and pollution, is authorized under Subtitle 32 with the enforcement authority assigned to the DPW&T. The prevention of human exposure to sewage is administered by the Health Department in accordance with the on-site sewage disposal systems regulations. The control of hazardous chemicals or substances is governed by the Fire Safety Code. Where appropriate, the County also refers enforcement cases to MDE. It is difficult to estimate the load reduction from illicit discharge correction because their location and size are unknown until reported. Their correction is expected to help reduce loads to local water bodies.

- *Cross-Connections Elimination.* Another potential source of nutrients, BOD, and bacteria is the cross-connection, or a place where a dwelling's sewers are directly connected to the storm sewer instead of the sanitary sewer. These connections can be discovered by means of dye testing, smoke tracing, and chemical signatures. An aggressive program to discover and eliminate cross-connections could also substantially reduce human bacteria loads. The County has a program to detect these illicit discharges into the County's stormwater system, and thus into the County's water bodies. It is difficult to estimate the load reduction from eliminating cross-contamination because the location and size of the connections are unknown until reported. Their disconnection is expected to help reduce pollutant loads to local water bodies.

4.2.2 Tree Planting and Landscape Revitalization Programs

When localities convert urban land to forest, significant hydrologic and water quality benefits accrue. Tree planting typically occurs piecemeal across the urban landscape whereas reforestation usually occurs on a much larger scale. In either case, to claim these credits a survival rate of 100 trees per acre or greater is necessary, with at least 50 percent of the trees being 2 inches or greater in diameter at 4.5 feet above ground level (MD DNR 2009, MDE 2014a). Because contiguous parcels of 1 acre or greater might be difficult to locate for an urban tree planting program, an aggregate of smaller sites may be used.

Tree planting pollutant load reduction credit is based on the load difference when the land cover is converted from urban to forest. To qualify for the alternative credits for *Reforestation on Pervious Urban Land,* the County will need to demonstrate compliance with the credits criteria.

- *Tree ReLeaf Grant Program.* DoE's ReLeaf Grant Program has existed for about 15 years; however, the County has recently started reviving the underutilized program. The program is funded by fees-in-lieu; therefore, it only funds planting projects on public property. The program provides funding to neighborhood, civic, and community/homeowner organizations; schools; libraries; and municipalities for tree and shrub planting projects in public spaces or common areas. The County encourages planting low-maintenance, native species that thrive in Maryland's climate and are resistant to the effects of drought. Grant funding is available on a first-come, first-serve basis and must be used only for costs associated with tree and shrub planting. Goals of the program include increasing native tree canopy to improve air and water quality, provide wildlife habitat, conserve energy, and reduce stormwater runoff. Organizations can receive up to $5,000 and municipalities are eligible for grants up to $10,000. The program requires a 50 percent match. Trees must be at least 4 feet tall at the time of planting. Tree ReLeaf Program planted 374 trees in 2014, 133 trees in 2013, and 169 trees in 2012. These trees were mostly planted in Mount Rainier and New Carrollton, as well as through several homeowners associations throughout the County. The County recently started the TNI, a new effort under Tree ReLeaf, which works directly with civic associations in depressed areas to encourage planting in communities to help meet goals for both programs.

- *Volunteer Tree Planting.* DPW&T oversees volunteer tree planting in October of every year. These trees are planted by organizations (e.g., homeowners associations) on public spaces (e.g., parks, institutional areas). Approximately 2,000–2,500 trees are planted every year.
- *Neighborhood Design Center.* The Neighborhood Design Center, a local nonprofit in Riverdale, is an important partner in many County initiatives. They furnish pro-bono design and planning services to a wide variety of individuals, organizations, and low-to-moderate income communities. Their goal is to involve the entire community in the development and implementation of initiatives and projects designed to revitalize neighborhoods. The Neighborhood Design Center develops plans for parks, playgrounds, gardens, and community plantings, including wetland and rain gardens, reforestation projects, and median and shade tree plantings. Collectively, these efforts have increased the County's green space, reduced stormwater runoff, and improved water quality through the creation of natural systems to cleanse stormwater runoff.
- *Arbor Day Every Day.* A new Arbor Day Every Day program is being developed in which the County will work directly with schools to plant trees. Under the new program, schools would not have to pay up front for the trees and then be reimbursed later. With a new streamlined application, they would receive technical assistance from the Neighborhood Design Center and receive up-front grant funding to pay for the tree plantings.

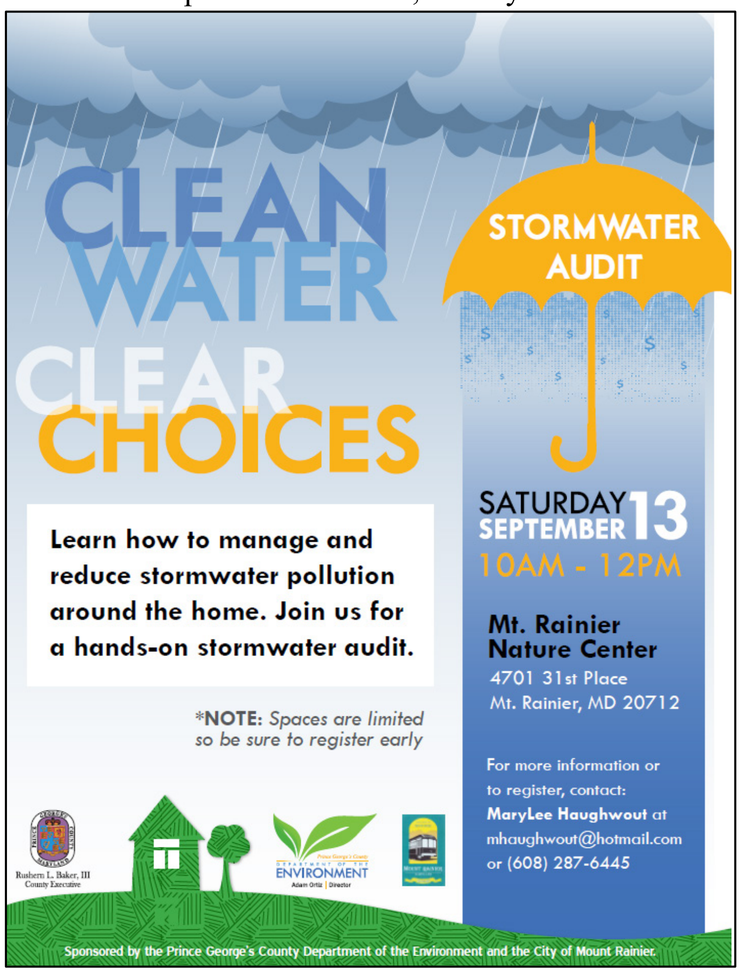
4.2.3 Tree Planting Demonstrations. *The Sustainable Initiatives Division recently began a tree planting demonstration program to increase tree canopy and promote tree care. Public Education Programs*

DoE seeks every opportunity to promote environmental awareness, green initiatives, and community involvement to protect natural resources and promote clean and healthy communities. The County also integrates water quality outreach as a vital component of watershed restoration projects. To reduce stormwater pollutants, the County is required to integrate outreach and education into County services and programs.

During the 2012 reporting year, DoE hosted 37 environmental events and participated in an additional 40 events led by regional, local, and nonprofit environmental organizations. At those events, DoE staff provided handouts, answered questions, made presentations, promoted programs such as the Rain Check Rebate and Grant Program, and displayed posters and real-world examples of stormwater pollution prevention materials (e.g., sample rain barrels, samples of permeable pavement, etc.) The County also published a series of brochures to raise stormwater pollution awareness and educate the residential, business, and industrial sectors on their role in preventing stormwater pollution. These brochures provide a brief and informative overview of a single topic, providing helpful, nontechnical information on water quality topics, including measures that can be taken to prevent harm to the County's water resources. Topics include stormwater BMPs such as rain gardens, cisterns, and pavement removal.

Provided below are details about other County-administered outreach and education efforts that have the potential to reduce stormwater pollution through BMP implementation.

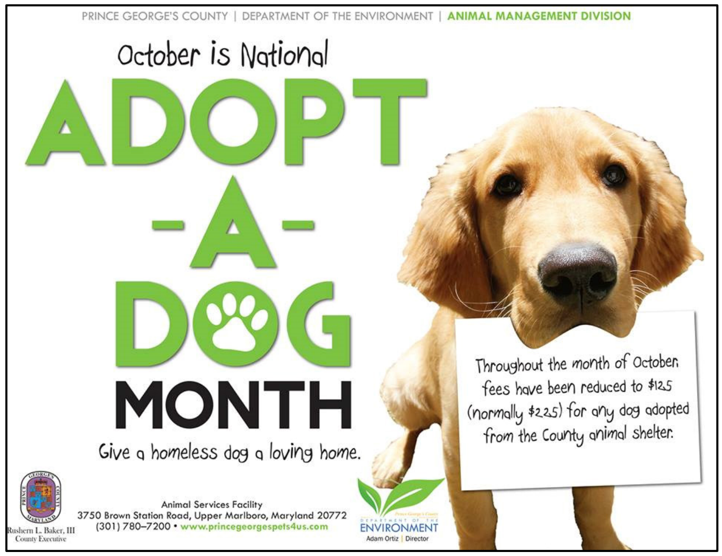
- *Interactive Displays and Speakers for Community Meetings.* In FY 15, County staff led or supported 138 outreach events (reaching approximately 7,388 people) throughout the County to provide presentations, displays (e.g., EnviroScape) and handouts, answer questions, and promote environmental stewardship. At these events, County staff provided information on the importance of trees and tree planting (including the maintenance, benefits, and funding available for tree plantings), stormwater pollution prevention, lawn care, Bayscaping, and trash prevention and cleanup. Some of the events included either a presentation or field demonstration. Of the 138 events, 18 were held in TNI areas and reached 1,336 people.
- *Stormwater Audit Program*. DoE recently began an effort to conduct stormwater audits on residential properties. The County is coordinating the effort with local municipalities. On September 13, 2014, the County, along with the City of Mt. Rainier, hosted a stormwater audit at the Mt. Rainier Nature Center to kick off the effort. Several other municipalities have



expressed interest in participating. During the audits, County staff walk the chosen properties with homeowners and make suggestions on the types and potential locations for stormwater BMPs. Ideally the audits will become one of the components in DoE's outreach toolbox. Working with homeowners one-on-one at a site is likely to spur greater adoption of BMPs because DoE staff will be available to provide technical assistance and answer the homeowner's questions immediately.

- *Master Gardeners.* Master Gardeners are volunteer educators who provide horticultural education services to individuals, groups, and communities. They also coordinate development of community gardens and school-based gardens. Participants receive 50 hours of basic training from University of Maryland faculty and other Master Gardeners, and then must complete 40 hours of required volunteer service during the first year. The mission of the Master Gardener Program is to educate Maryland residents about safe, effective, and sustainable horticultural practices that build healthy gardens, landscapes, and communities. The program has the potential to aid overall reduction of fertilizer and pesticide use, as well promote increases in stormwater practices such as installing rain gardens and using rain barrels. The Master Gardeners are a trusted group in most communities because of their ties with the University of Maryland Extension. Currently 64 Master Gardeners are active in the County; they logged 3,581 volunteer hours in 2013. The volunteers hosted 42 plant clinics, reaching 2,500 residents in 2013. Also in 2013 the program partnered with DoE to deliver information on the Rain Check Rebate and Grant Program.
- *Transforming Neighborhoods Initiative (TNI).* TNI is an effort by the County to focus on uplifting six neighborhoods that face significant economic, health, public safety, and educational challenges. Through this initiative, the County will improve the quality of life in those neighborhoods while identifying ways to improve service delivery throughout the County for all residents. The six areas that have been identified are East Riverdale/Bladensburg; Glassmanor/Oxon Hill; Hillcrest Heights/Marlow Heights; Kentland/Palmer Park; Langley Park; and Suitland/Coral Hills. The County has been investigating how to use environmental restoration, stormwater management practices, and environmental education as one of the ways to help transform the neighborhoods while also creating safer, more inviting community environments.

- *Flood Awareness.* During June, DoE works to raise awareness of flood risks and what County residents can do to protect their homes, families, and personal belongings if flooding occurs. DoE incorporates messages that encourage residents to implement flood-prevention stormwater practices (e.g., BMPs), such as using permeable pavers and rain gardens, to help prevent costly property damage caused by backyard flooding.



- *Animal Management.* The County's Animal Management Division administers programs for animal control, animal licensing, vaccination, spaying and neutering, public education, cruelty prevention, euthanasia, and other programs. The division keeps detailed records on the number and types of licensed animals in the County, as well as statistics related to the stray animal population. Spaying and neutering as well as pet adoptions can keep animals from becoming strays, which contributes to bacteria, nutrient, and BOD loadings to County water bodies. Dog license information can help determine areas on which to focus pet waste campagins.

4.2.4 Mass Transit and Alternative Transportation Programs

Each year, vehicles release hundreds of tons of harmful emissions into the air. Because atmospheric deposition of nitrogen in the region is a significant source of pollutants, people can use carpools, vanpools, bicycles, and mass transit to help to reduce emissions and protect both air and water quality. Sharing a ride, taking public transportation, and bicycling means fewer vehicles on the road, making the commute to work smoother, quicker, less expensive, easier, and cleaner for everyone. DPW&T provides many services to the residents of the County that also help reduce the amount of nitrogen deposited on the landscape. It is difficult to estimate the load reduction from these activities; however, they are expected to help reduce loads to local water bodies. The key transportation programs that have the potential to help reduce stormwater pollution are listed below.

- Commuter and Carpool Programs
    - The *Ride Smart Commuter* website, a service of DPW&T, is designed to provide commuters and employers in the County with a comprehensive list of transportation solutions available throughout the Washington Metropolitan Area.
    - The County continues to participate in the Commuter Connections Ridematching Network, a free carpool/vanpool match service available to persons living or working in the County.
    - *Prince George's County Vanpool Subsidy Program*. This program helps residents seeking to start a new vanpool with startup costs and assistance with finding passengers.
    - *Park and Ride*. The County maintains 13 free park-and-ride fringe parking lots, conveniently located throughout the County. These lots provide ideal locations for meeting a carpool, vanpool, or for connecting with *TheBus*, Metrobus, or other local transit systems like the city of Laurel's Connect-A-Ride.

- Public Transit Programs
  - *Metrobus/rail*. Operated by the Washington Metropolitan Area Transit Authority, Metrorail currently serves 86 stations throughout the Washington Metropolitan Area, 15 of which are in the County. Metrobus, also operated by the Washington Metropolitan Area Transit Authority, runs more than 25 bus routes in the County.
  - *TheBus*. TheBus is the County's public transit system that runs more than 50 routes in the County. Schedule information is available at www.princegeorgescountymd.gov or www.NextBus.com.

4.3 Estimated Load Reductions

The main purpose of implementing BMPs is to remove pollutants near their source and prevent pollutant loads from entering and degrading water bodies. Different types of BMPs remove pollutants with differing degrees of effectiveness, often called pollutant removal efficiencies. To estimate pollutant reductions achieved through BMP implementation, it is necessary to know the removal efficiency. Stormwater treatment ponds tend to have lower pollutant load removal efficiencies (but can treat stormwater drained from larger land areas), while bioretention systems and infiltration practices tend to have higher removal efficiencies (but can only treat stormwater drained from smaller land areas). The first step in determining the estimated load reduction is to determine the load reduction efficiencies. The second step is to perform the load reduction calculation.

4.3.1 BMP Pollutant Load Reduction Removal Efficiencies

MDE's *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (MDE 2014a) incorporates recent CBP recommendations for nutrient and sediment load reduction removal efficiencies associated with BMP implementation. By using these removal efficiencies in its reduction calculations, the County is consistent with regionwide efforts to meet the Chesapeake Bay TMDL. Because the MDE guidance only provides percent removal efficiencies for total nitrogen, total phosphorus, and TSS, the removal efficiencies for BOD and bacteria needed to be identified through additional research. BOD efficiencies were obtained from Harper (1995).

Unlike a conservative metric like TSS, fecal coliform bacteria grow in the environment, and often settle in sediments, generating a source of fecal coliform bacteria that persist between stormwater flow events. Bacteria loads, therefore, can be increased by certain BMPs, particularly dry ponds, where fecal coliform bacteria growth can occur. There are relatively few studies on fecal coliform bacteria removal by BMPs. The following text discusses the rational for assigning load-reduction efficiencies. This is further detailed in a technical memorandum provided to the County (Tetra Tech 2015b).

Available literature shows that overland filtering systems (e.g., filter strips, grass swales, biofiltration swales) provide some fecal coliform bacteria load reduction, but can become sources if heavily visited by animals, resulting in overall removal efficiencies of 35 percent. Wet ponds would be expected to have high removal efficiencies; however, literature indicates that reductions are less than with swales. Extended detention wet ponds have slightly improved performance.

Shallow marshes are considered more effective. The few dry ponds in the County will be converted into more efficient practices (section 5.1.1).

Stormwater flow through filtering systems (primarily bioretention systems with underdrains) can provide very high fecal coliform bacteria retention, often reported as high as 99 percent. However, fecal coliform bacteria loads can still be considerable in high flows that bypass BMPs designed to treat only the first inch of runoff, as per current design guidelines. Similarly, infiltration systems capable of 100 percent elimination of treated loads are also subject to bypass during high flows. Therefore, the fecal coliform bacteria removal efficiency was estimated to be 90 percent for infiltration practices (including porous pavement) and bioretention systems. The removal efficiency from sand filters is estimated to be 80 percent, but was adjusted to 70 percent to account for bypass during high flows. No reductions are allocated to ultra-urban hydrodynamic devices (e.g., oil and grit separators) because of their minimal retention time. The removal efficiency was set to 0 percent.

The pollutant removal efficiencies of the BMP practices (based on treating 1 inch of runoff) in the restoration plan are provided in Table 4-3. Pollutant removal efficiency increases as more runoff volume is treated. Removal efficiencies for additional treatment volumes are provided in Table 4-4. Table 4-4 also illustrates that runoff reduction practices consistently reduce pollutant loads at a higher efficiency than structural practices, at all treatment volumes. Where runoff reduction or ESD practices are used, or other acceptable runoff reduction practices predominate, the ESD/ runoff reduction curves should be used. Otherwise, the stormwater treatment or structural practices curves should be used.

Table 4-3. Pollutant removal efficiencies of BMPs (based on treating 1 inch of runoff)

BMP Type	ESD Practice?	Total Nitrogen	Total Phosphorus	TSS	BOD	Fecal Coliform Bacteria
Runoff reduction practices						
Green roofs	Yes	57%	66%	70%	83%	90%
Porous pavement	Yes	57%	66%	70%	83%	90%
Nonstructural practices[1]	Yes	57%	66%	70%	NA	NA
Rainwater harvesting	Yes	57%	66%	70%	NA	NA
Submerged gravel wetlands	Yes	57%	66%	70%	63%	75%
Landscape infiltration	Yes	57%	66%	70%	99%	90%
Infiltration berms	Yes	57%	66%	70%	95%	90%
Dry well	Yes	57%	66%	70%	95%	90%
Micro-bioretention	Yes	57%	66%	70%	95%	90%
Rain gardens	Yes	57%	66%	70%	95%	75%
Swales, dry	Yes	57%	66%	70%	95%	35%
Enhanced filters	Yes	57%	66%	70%	55%	90%
Infiltration basin & trench	Yes	57%	66%	70%	55%	90%
Bioretention filters	Yes	57%	66%	70%	95%	90%

BMP Type	ESD Practice?	Total Nitrogen	Total Phosphorus	TSS	BOD	Fecal Coliform Bacteria
Stormwater treatment practices						
Retention pond (wet pond)	No	33%	52%	66%	80%	25%
Wetlands[2]	No	33%	52%	66%	95%	50%
Filtering Practices[3]	No	33%	52%	66%	80%	70%
Wet Swales	No	33%	52%	66%	99%	70%
Alternative Practices						
Landscape (impervious area reduction)	No	13%	72%	84%	NA	60%
Planting trees or forestation on previous urban	No	66%	77%	57%	NA	50%
Planting trees or forestation on impervious urban	No	71%	94%	93%	NA	50%
Stream restoration	No	0.075 lb/ft/yr	0.068 lb/ft/yr	248 lb/ft/yr[4]	NA	65%
Impervious to pervious	No	66%	77%	57%	NA	NA
Regenerative step pool conveyance	No	57%	66%	70%	NA	NA
Street sweeping – mechanical	No	4%	4%	10%	NA	NA
Street sweeping – regen/vacuum	No	5%	6%	25%	NA	NA
Load reductions from street debris (lb reduced per ton of debris)						
Street sweeping – mechanical[5]	No	3.5	1.4	420	NA	NA
Street sweeping – regen/vacuum[5]	No	3.5	1.4	420	NA	NA
Catch basin cleaning[6]	No	3.5	1.4	420	NA	NA
Storm drain vacuuming[6]	No	3.5	1.4	420	NA	NA
Structural practices not meeting MDE Manual Performance Criteria. Cannot be used to meet restoration requirements.						
Detention structure (dry pond)	No	5%	10%	10%	40%	0%
Extended detention structure, dry	No	20%	20%	60%	40%	0%
Extended detention structure, wet	No	20%	45%	60%	99%	35%
Storm filter	No	40%	60%	80%	NA	0%
Oil/grit separator	No	5%	10%	10%	NA	0%
Underground storage	No	5%	10%	10%	NA	0%

Sources: MDE 2014a (nitrogen, phosphorus, TSS: except practices not meeting MDE guidance, which were obtained from MAST); Harper 1995 (BOD); Tetra Tech 2015b (bacteria).

Notes:

[1] Nonstructural practices include rooftop disconnection, disconnection of nonrooftop runoff, and sheetflow to conservation areas.

[2] Wetlands include shallow wetland, extended detention shallow wetland, pond/wetland system, and pocket wetland.

[3] Filtering practices include surface sand filter, underground sand filter, perimeter sand filter, organic filter, and pocket sand filter.

[4] The TSS load reduction for stream restoration depends on if the restoration activity is in the Coastal Plain and if the value is at the edge-of-field or edge-of-stream. For the Coastal Plain, the edge-of-stream reduction is 15.13 lb/ft/yr. The sediment delivery ratio is 0.061, making the edge-of-field load 248 lb/ft/yr. Outside the Coastal Plain, the edge-of-stream reduction is 44.88 lb/ft/yr. The sediment delivery ratio is 0.181, making the edge-of-field load 248 lb/ft/yr.

[5] These reductions are for high-density urban streets that are swept at least twice a month. These values are expected to change as the result of a recent Chesapeake Bay expert panel report, which is expected to be released in early 2016.

[6] These reductions are for high-density urban areas, where storm drains are routinely maintained.

Table 4-4. Pollutant removal rates for ESD/runoff reduction and structural practices

Runoff Depth Treated (inches)	Total Nitrogen		Total Phosphorus		TSS	
	Runoff reduction	Structural practices	Runoff reduction	Structural practices	Runoff reduction	Structural practices
0.00	0%	0%	0%	0%	0%	0%
0.25	32%	19%	38%	29%	40%	37%
0.50	44%	26%	52%	41%	56%	52%
0.75	52%	30%	60%	47%	64%	60%
1.00[1]	57%	33%	66%	52%	70%	66%
1.25	60%	35%	70%	55%	76%	71%
1.50	64%	37%	74%	58%	80%	74%
1.75	66%	39%	77%	61%	83%	77%
2.00	69%	40%	80%	63%	86%	80%
2.25	71%	41%	82%	65%	88%	83%
2.50	72%	42%	85%	66%	90%	85%

Note:
[1] Typical scenario for redevelopment projects treating 50% of existing surface area.

4.3.2 Load Reduction from Current BMPs and Load Reduction Gap

A systematic identification of current BMPs (as of October 2015) and their locations was conducted. Once identified, their load reduction was quantified. The information available for most BMPs included drainage area (i.e., total land area flowing to a specific BMP [e.g., a dry pond]). Load reductions for the existing BMPs were calculated with WTM using the BMP drainage area land cover, and land-cover-specific pollutant loading rate. This provided the loading attributed to the BMP drainage area. That loading was then multiplied by the BMP pollutant removal efficiency to determine the amount of load reduction attributed to that specific BMP.

The load reduction calculation only included BMPs that have been implemented since the TMDL water quality data were collected. For instance, the Anacostia River bacteria TMDL was developed by MDE in 2006, however, the water quality data for it were collected in 2003; therefore, any BMP or other practice implemented or established before 2003 was not included. Any BMP or practice implemented or established after 2003 was included in the load reduction calculation.

The amount of load reduction that is needed after accounting for load reductions from current practices is called the *load reduction gap*. This concept is illustrated in Figure 4-2. The load reductions from current BMPs and practices and the load reduction gap are provided in Table 4-5. Figure 4-3 shows the graphical representation of the WTM baseline loads, implementation target load, required implementation load reduction, load reduction (from baseline loads) due to current BMPs, and the reduction gap. The implementation target load and required implementation reduction equal the baseline loading (with slight differences due to rounding), while the current BMP reductions and the reduction gap equal the required reduction.

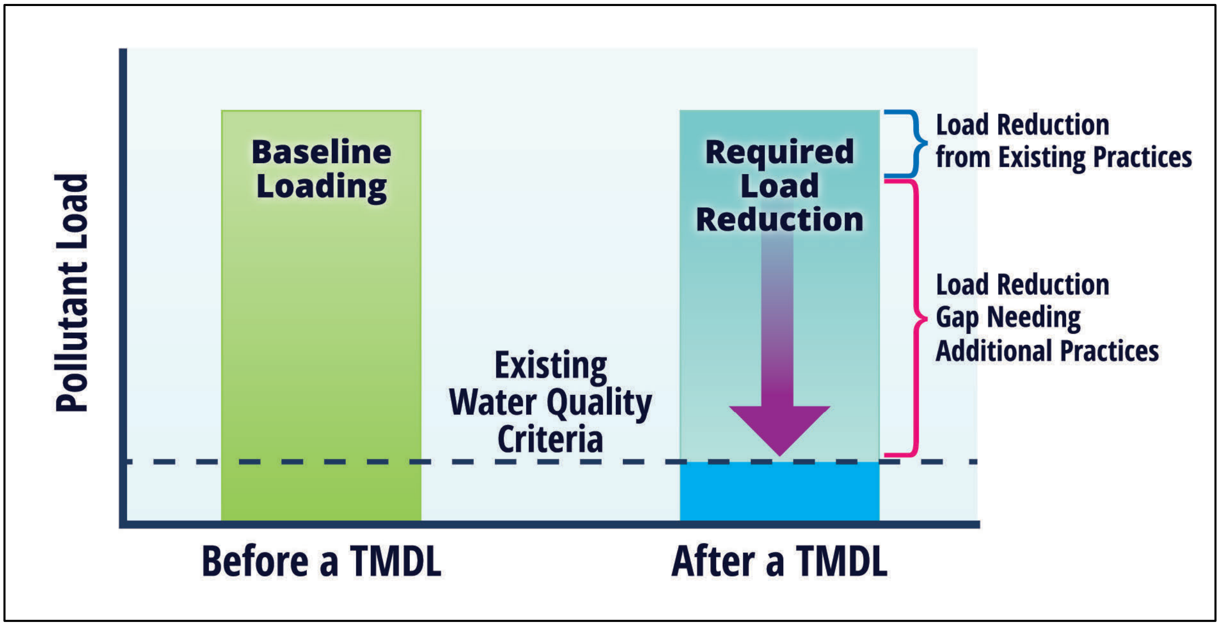


Figure 4-2. Schematic for typical pollution diet (TMDL) showing existing load reduction credits.

Table 4-5. Load reductions from current BMPs compared to required load reductions for the County's MS4 area

Parameter	Implement-ation Model Baseline from WTM	Percent Reduction from MDE *TMDL Data Center*	Implement-ation Model Target Load	Required Implementation Model Reduction from WTM	Reduction from Current BMPs	Remaining Reduction or *Reduction Gap*	Percent of Required Load Reduction Satisfied by Current BMPs
Total nitrogen (lb/yr)	281,378	81.0%	53,462	227,917	4,421	223,496	1.94%
Total phosphorus (lb/yr)[a]	45,041	81.2%	8,467	36,573	1,310	35,263	3.58%
TSS (ton/yr)[a]	14,532	85.0%	2,180	12,352	2,594	9,758	21.00%
BOD (lb/yr)	1,151,816	58.0%	483,763	668,053	36,986	631,067	5.54%
Fecal coliform bacteria (MPN B/yr)	4,375,323	86.4%	594,281	3,781,042	29,947	3,751,095	0.79%

Note:
[a] Includes loadings due to streambank erosion.
Fecal coliform bacteria WLAs have different percent reductions from the tidal area and non-tidal area. The table above combines these areas.

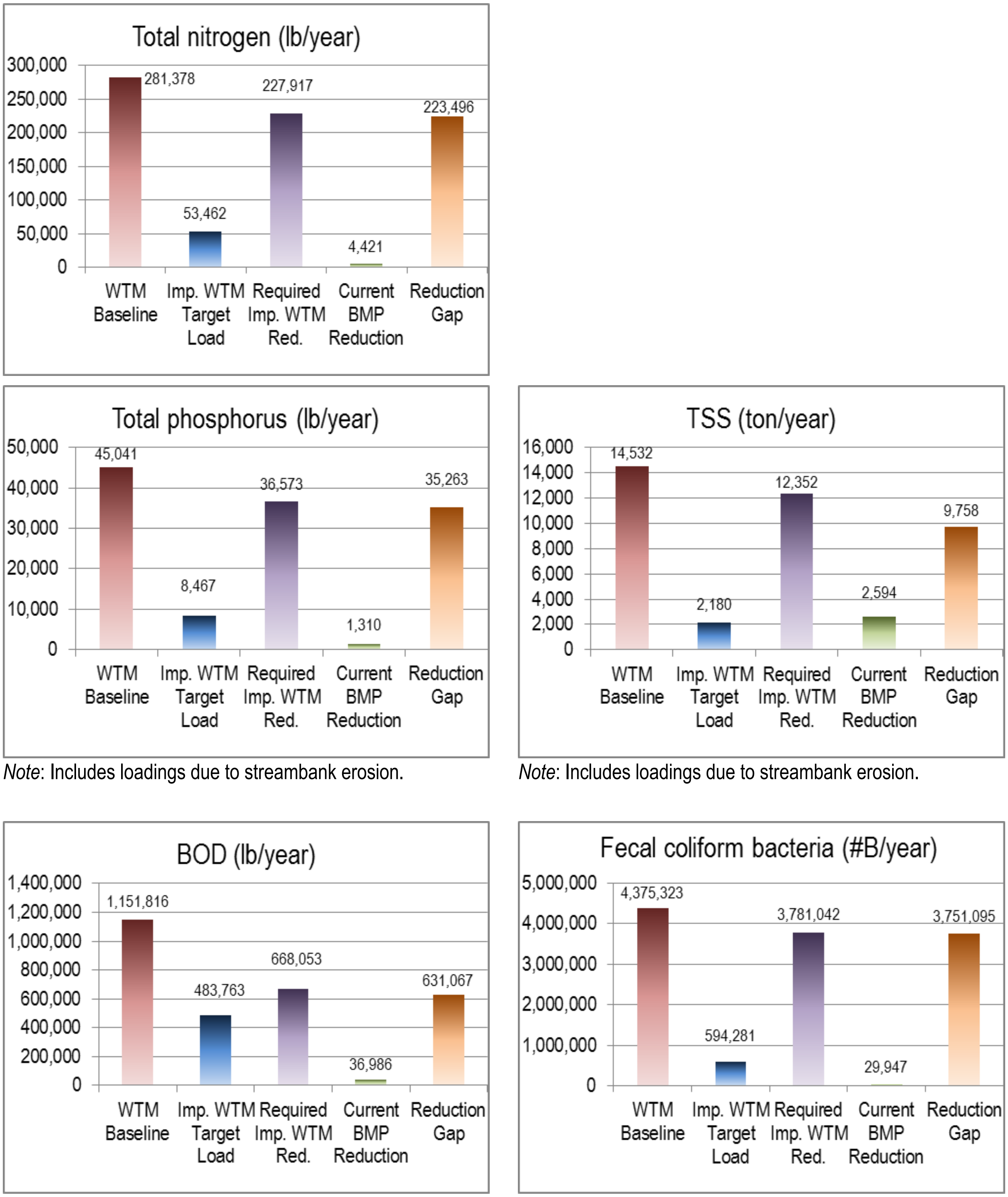


Figure 4-3. Comparisons of WTM baseline loads, implementation target load, required implementation load reduction, load reduction from current BMPs, and reduction gap for the Anacostia River watershed.

5 STRATEGY DEVELOPMENT

The watershed restoration activities in the Anacostia River watershed will require an unprecedented level of effort, which represents a very challenging and costly management approach. Consequently, the County has developed a strategy that includes five major components to achieve the goals of the restoration plan:

- Use WTM to evaluate the ability of existing BMPs and programmatic initiatives to meet the local TMDL WLAs and then identify and quantify future BMPs and programmatic initiatives necessary to meet the local TMDL WLAs.
- Develop cost estimates associated with the implementation of identified BMP practices and initiatives.
- Develop timelines associated with the deployment of identified BMP practices and initiatives to determine if the timelines required by the TMDL program can be achieved.
- Identify opportunities for BMP practices and programmatic initiatives and develop cost estimates.
- Identify the financial and technical resources required and develop achievable timelines for the deployment of BMP practices and programmatic initiatives that can best meet TMDL program requirements.

This section describes the overall restoration strategy for the Anacostia River watershed. The recommended specific planned actions, cost estimates, and a proposed schedule as well as descriptions of the financial and technical resources available to support implementation are described in section 6 of this document.

5.1 Systematic and Iterative Evaluation Procedure

The procedure summarized in Figure 5-1 was developed to provide for the systematic evaluation of the number and general location of BMPs and programmatic practices that will be required to achieve the targeted pollutant reduction by subwatershed. The flow chart is not a representation of the order in which the County will implement restoration practices, but is the procedure used to evaluate the amount of necessary restoration activities (e.g., programmatic goals, impervious area that will need to be treated) to meet load reduction goals. The major steps in the systematic evaluation procedure are:

1. Determine baseline pollutant loads from WTM (section 3.2)
2. Calculate reductions from existing BMPs implemented since TMDL water quality data were collected (section 4.1 and section 4.3)
3. Calculate reductions from existing programmatic practices (section 4.2 and section 4.3)
4. Determine proposed strategy management options and calculate their load reductions (section 5.1.1 and section 5.1.1)
    a. New programmatic strategies
    b. Existing BMP retrofits to enhance load reductions
    c. Load reductions from public ROW projects
    d. Load reductions from public institutional projects
    e. Load reductions from commercial/industrial land uses

    f. Load reductions from residential properties
5. Perform subwatershed prioritization (section 5.2)
6. Finalize the restoration plan (section 6)

The first step consists of analyzing pollutant loads using the WTM and then establishing the watershed baseline pollutant load. The TMDL-established load reduction percentages are applied to the baseline pollutant loads to calculate the implementation reductions and establish the initial gap in pollutant load targets. The results of this step are discussed in section 3.3 of this restoration plan.

The second step consists of calculating the load reductions from existing BMPs implemented since TMDL water quality data were collected. The load reductions from existing programmatic strategies are then calculated in the third step. These two load reductions are combined and subtracted from the baseline loads to generate a revised load reduction gap. The results of these analyses are discussed in section 4.3.2.

The load reductions from steps 2 and 3 were not sufficient to meet the targeted reductions, and thus it was necessary to systematically progress onwards with step 4 until the targeted removal amounts are achieved. The first step in the systematic and iterative evaluation procedure to reduce the gap between required implementation reduction and estimated WTM load reduction (Figure 5-1) is to identify new or enhanced programmatic initiatives (section 5.1.1) followed by implemented BMPs to treat stormwater runoff from impervious surfaces (section 5.1.2).

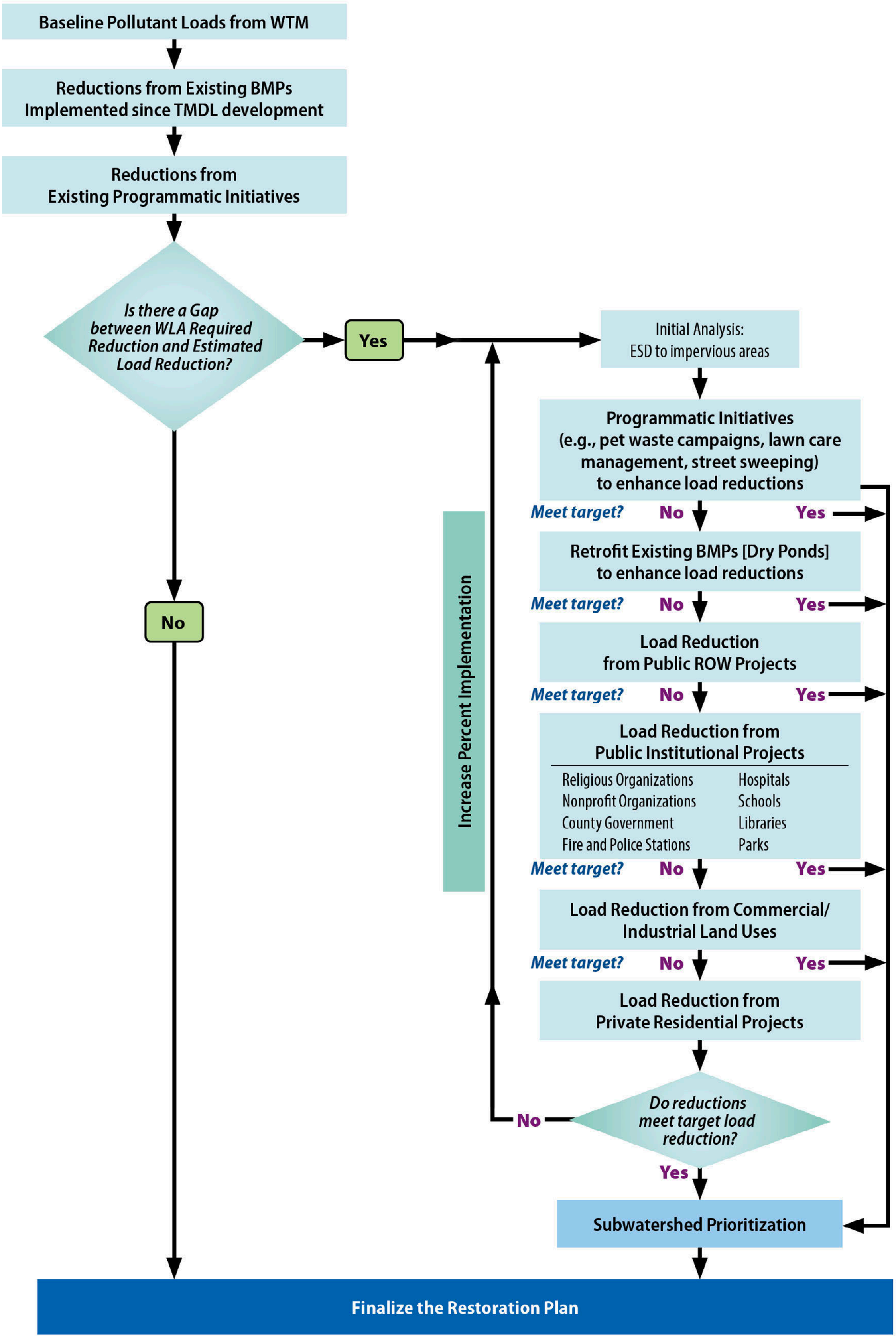


Figure 5-1. Restoration evaluation procedure.

5.1.1 Programmatic Initiatives

Current stormwater practices (section 4.2) were analyzed to determine, where possible, their contribution to the necessary load reductions. The existing programmatic practices are expected to continue and will be supplemented with additional practices to make up the programmatic strategies for this restoration plan. The additional strategies can be grouped into the following categories:

- Domestic and Urban Animal Source Control
- Household and Commercial Waste Disposal Measures
- Residential/Commercial Lawn Care Education

Domestic and Urban Animal Source Control

Population numbers play directly into determining how much pet waste is produced on a daily basis. If not disposed of properly, pet waste can contribute to significant bacteria loadings in addition to nutrient and BOD loadings to local waterways. Although pet waste is the main problem, several factors contribute to increased amounts of bacteria and will be addressed in the County's public outreach efforts. The main public outreach effort will be educating pet owners on the proper disposal of pet waste and the harmful effects pet waste can have on local water bodies. Additional public outreach will encompass ways to reduce overall animal waste. These public outreach campaigns will focus on the benefits of spaying and neutering (reducing potential for stray and abandoned animals), trap/spay/neuter events for feral cats, negative consequences of abandoning pets (e.g., public health from ticks, fleas, rabies, and uncollected waste materials), pet adoption fairs, and the health and water quality effects of providing food (intentionally or unintentionally) to nuisance wildlife (e.g., rats, pigeons) that contribute animal waste throughout the urban environment.

- *Dog Waste Program.* The most effective program for reducing bacteria and nutrient loads from dogs is an aggressive waste-pickup program. Impediments to widespread adoption of this practice are both cultural and technical. A pet waste program consists primarily of education and outreach, and includes penalties for violators. It also involves installing dog waste bag dispensers in high-activity areas. Behavior change is facilitated by public education, and requires that the County provide dog waste disposal facilities and glove baggies throughout residential areas and in parks where pets congregate.

It is relatively inexpensive, requiring staff to manage the program, staff to collect waste from dog waste containers, and funds for dispensers and waste containers specifically for dog waste to prevent leaks during rain events. A potential way to help fund the purchase and maintenance of the pet waste stations is to obtain corporate sponsors, where a station would be paid for by a sponsor (e.g., pet store or pet food company) and, in return, the company would have the right to advertise on the pet waste station. Additional sponsorships could be obtained for distributing free pet waste bags at community events and County public outreach events. To receive the free bags, the resident would need to pledge to always pick up after their pet and might receive coupons from the corporate sponsor. The County will investigate ways to partner with pet-related business (e.g., pet stores, veterinarians, rescue leagues) to promote pet waste campaigns. For instance, many rescue leagues require an application and a set of rules for the pet owner to follow. Part of the pet adoption process could include a pledge to always pick up pet waste and dispose of it properly and in a timely manner, as well as follow-up surveys to determine if people have followed through with their pledge.

The Maryland-National Capital Park and Planning Commission manages two dog parks within the Anacostia River watershed in the County—College Park Dog Park and Heurick Dog Park (Hyattsville). The Commission handles all maintenance activities needed at the parks. They provide bags and dispensers, signage, and trash cans that are serviced on a regular basis. The Commission has a system for responding to any complaints at parks (including dog parks) called the Active Citizen's Request Reports. When complaints are received by phone or email, Commission staff file a report through the system to address the complaint, which could include complaints about pet waste, lack of bags, or full trash cans. The Northern Area Maintenance Office is the office within the Commission responsible for the two dog parks.

An additional dog park in the Anacostia River watershed is the Greenbelt Dog Park, operated by the city of Greenbelt. The park is for city residents only; the residents must complete an application that states that dog owners are responsible for properly disposing of their pet's waste.

- *Cat Waste Program.* Unlike dogs, cats often defecate into litter boxes, with the contents disposed of in the garbage. This source is thus already controlled. However, some owners let their cats roam outdoors, in which case fecal matter is deposited in a random manner. Another important feline source is feral cat colonies. The general public is becoming aware of the negative implications such colonies have upon local wildlife (e.g., deaths of songbirds), and the generally adverse health effects on the cats. As a result, there has been a recent effort to aggressively trap, neuter, and release feral cats. Such programs reduce the number of feral cats over time and will be pursued. The County will investigate ways to partner with pet-related business (e.g., pet stores, veterinarians, rescue leagues) to promote spay/neuter campaigns and control the negative effects of free-roaming cats.
- *Wildlife Waste.* Urban wildlife includes deer, rats, raccoons, geese, ducks, pigeons, and other smaller mammals and birds. The bacteria and nutrient loads from those sources are not highly controllable and not directly related to the County's stormwater MS4 implementation goals, but some practices can help reduce the loadings to a small extent. Rats and other opportunistic feeders present potential health issues for County residents in the form of bacteria, parasites, and other health issues (e.g., fleas, ticks). One control method would be to ensure that all dumpsters and private trash cans are properly secured to deter nuisance wildlife. Another would be conducting public outreach and education discouraging littering (e.g., food scraps) and the purposeful feeding of nuisance wildlife. Over time, the number of nuisance wildlife should decline and not only reduce bacteria and nutrient loading, but also potentially improve community health.

Household and Commercial Waste Disposal Measures

Additional potential sources of human and pet nutrient, BOD, TSS, and bacteria include leakages from trash cans, dumpsters, and garbage trucks containing diapers (as well as pet waste); boat and recreational vehicle discharges; and secondary sources such as pool and hot tub discharges. Measures to eliminate these sources include:

- Cover dumpster location to prevent rain from entering the containers and trash from blowing out due to wind.
- Implement programs or measures to eliminate leaks from garbage trucks.
- Conduct public education regarding covering private trash cans to prevent leaks and also to prevent nuisance wildlife from using the trash as a food source.
- Rigorously enforce a program for waste management on boats and RVs.

Residential/Commercial Lawn Care Education

A lawn care management program consists primarily of outreach to educate landowners to use less fertilizer and apply it properly, as well as to educate them on other ways of keeping healthy yards that avoid the need for fertilizer in the first place. This will reduce total nitrogen and total phosphorus loads, largely by keeping applied fertilizers off paved surfaces and reducing the total volume of fertilizer applied in the watershed. The County will partner with lawn care-related businesses to promote more environmentally friendly land use practices. These promotions will be held as workshops at lawn care suppliers. The County's Alternative Compliance Program, Option 3, requires participating organizations (as part of the fee reduction program) to use state-certified landscape services.

The CBP recently convened a panel of experts to look at the removal efficiencies for urban nutrient (fertilizer) management. The panel of experts identified lawn care practices that will aid in nutrient management (Schueler and Lane 2013). The County intends to use the identified practices in its lawn care education program.

- Maintain a dense vegetative cover of grass to reduce runoff, prevent erosion, and retain nutrients.
- Set lawn mower height to at least 3 inches. Maximize use of slow-release nitrogen fertilizer, if fertilizer must be used.
- Retain grass clippings and mulched leaves on the lawn to keep them out of streets and storm drains.
- Immediately sweep off any fertilizer that accidentally lands on a paved surface.
- Adopt a reduced fertilizer application rate/monitoring strategy (e.g., apply less than a pound of nitrogen per 1,000 square feet for each individual application) or choose not to fertilize.
- Do not apply fertilizers before spring green-up or after the grass becomes dormant in the fall.
- Do not apply fertilizer within 15 to 20 feet of a water feature and consider managing this zone as a perennial planting, meadow, grass buffer, or forest buffer.
- Consult with the local extension service office, certified plan writer, or applicator to get technical assistance in developing an effective urban nutrient management plan for the property based on a soil test analysis.
- Employ lawn practices to increase soil porosity and infiltration capability, especially along portions of lawn that convey or treat stormwater runoff.

5.1.2 BMP Identification and Selection

MDE currently groups urban BMPs into two types: structural and ESD practices (MDE 2009). The MDE ESD practices are:

- *Alternative Surfaces.* Green Roofs, Permeable Pavements, Reinforced Turf
- *Nonstructural Practices.* Disconnection of Rooftop Runoff, Disconnection of Nonrooftop Runoff; Sheetflow to Conservation Areas
- *Micro-scale Practices.* Rainwater Harvesting, Submerged Gravel Wetlands, Landscape Infiltration, Infiltration Berms, Dry Wells, Micro-Bioretention, Rain Gardens, Swales, and Enhanced Filters

The MDE 2000 *Stormwater Design Manual* (MDE 2000) documents the structural BMPs, which include wet ponds, wetlands, filtering practices, infiltration practices, and swales. MDE also describes nonstructural BMPs—not to be confused with the nonstructural ESD practices—that include programmatic, educational, and pollution prevention practices that, when implemented, work to reduce pollutant loadings. Examples of nonstructural BMPs include implementation of strategic disconnection of impervious areas in a municipality (MDE 2009), street sweeping, homeowner and landowner education campaigns, and nutrient management (e.g., fertilizer usage).

The County has implemented and will continue to implement ESD, structural BMPs, and nonstructural practices to meet its programmatic goals and responsibilities including MS4 permit compliance, TMDL WLAs, flood mitigation, and others.

The steps presented in Figure 5-1 were followed when WTM (section 3.2) was used to identify specific retrofits and BMPs for treating impervious surfaces as described below.

- Existing BMP retrofits to enhance load reductions
- Load reductions from public ROW projects
- Load reductions from public institutional projects
- Load reductions from commercial/industrial land uses
- Load reductions from residential properties

The initial focus of BMP identification and selection targets retrofitting (i.e., improving) the first generation of stormwater practices—such as dry ponds, which are not very effective—and bringing them into conformance with current water quality standards. If the load reduction goals were not met, the focus shifts to treating the impervious surfaces throughout the MS4 areas of the watershed.

The impervious areas are split into four categories: public ROW, public institutional, commercial/industrial, and residential. There is a varying degree of difficulty in implementing BMPs on each type of surface. Similarly, there is a varying degree of difficulty in implementing BMPs within each type. To accommodate these variations, the County first considered which BMPs might be *relatively easy* to implement on each type of surface for the initial cycle compared to the BMPs that would be necessary for the required load reduction. The initial assumption is that 50 percent of each land use type will be retrofitted *relatively easily*. If gaps still exist in necessary load reductions after the first cycle, then in the next cycle, an additional 20 percent of each type will be retrofitted. In the third cycle, a further 20 percent will be retrofitted. If a gap still exists after the third cycle and a fourth cycle is needed, then the remaining 10 percent will be retrofitted. This process is being used solely for planning level purposes. During implementation, the County could use different percentages based on actual implementation opportunities.

The first type of impervious surface to be treated is public ROWs. If load reduction gaps still exist, then the next step is to determine if institutional properties (e.g., religious institutions, government offices, and facilities and municipally owned organizations [i.e., libraries, fire stations, and schools]) could help to fill the remaining gap. Next, the focus shifts to commercial and industrial land and finally to residential land. These land-use types were prioritized according to increasing complexity for planning and implementation of stormwater controls. For example, a ROW is least complex because it is public property and typically constitutes about 15–20 percent of total impervious area within a subwatershed. Stormwater controls within a ROW can be retrofitted with moderate effort. This process is repeated for each cycle.

The County recognizes that significant outreach, education, and establishment of standards (ordinances) and/or direct grant programs will be needed to support widespread implementation of stormwater controls on private properties (e.g., commercial, industrial, and residential).

WTM Modeling for BMP Identification

WTM (described in section 3.2) was modified to include the ability to quantify the number of acres of treated impervious area required to meet the County's implementation load reduction goals. The modifications allow WTM to use different factors—such as looking at land use in addition to land cover—that are necessary to follow the procedure laid out in Figure 5-1. For instance, the updated version of WTM accounts for load reductions and impervious area treated from current BMPs in the watershed. Other modifications account for load reductions from dry pond retrofits (along with their impervious area treated) and potential reductions from programmatic initiatives (e.g., pet waste and lawn care campaigns). These modifications established the main purpose of the modified WTM: to determine the amount of impervious area that requires treatment to meet the County's implementation reduction targets. Besides the overall load reductions from past and projected restoration activities, WTM calculates the estimated cost of the practices using the cost information discussed in section 6.2.

For implementation planning, users can first identify programmatic activities (e.g., pet waste campaigns, street sweeping, tree planting) and determine the load reductions from these practices. A description of the load reduction process is available in a technical memorandum (Tetra Tech 2015b). Next users can identify the percent of ROW impervious area for treatment. If the watershed is not meeting its reduction goals, then the user can identify a percent of institutional land impervious area for treatment, and so forth down the flow chart in Figure 5-1. These percentages are identified at the watershed scale and then disaggregated to the subwatershed scale.

The modified WTM setup allows users to assign a greater percent of ESD implementation to subwatersheds that are ranked higher, as described in section 5.2. The ranking categorizing the subwatersheds into quartiles is based on each subwatershed's generation of pollutants. In the WTM, the user can assign a different utilization factor to each quartile. For instance, the top quartile (the top 25 percent) can be assigned a utilization factor of 100 percent. If the subwatershed is slated to treat 70 percent of its 100 acres of ROW impervious area, then WTM would calculate the load reductions from 70 acres of treatment. If the same subwatershed was in a quartile with an assigned utilization factor of 80 percent, then WTM would calculate the load reduction from 56 impervious acres (100 acres × 70% overall ESD implementation for ROW × 80% utilization factor = 56 acres).

The modifications made to WTM allow the user to look at different options for programmatic activities (e.g., pet waste campaigns) and ESD placements in different land uses and different subwatersheds. They enable the user to quickly look at different options, not only to minimize the number of impervious acres in different land uses that need to be treated in each subwatershed (e.g., ROW, institutional), but also to help minimize the overall cost. As the restoration process continues, WTM can be used to help refine future activities. A detailed description of the process is available in a technical memorandum (Tetra Tech 2015b).

For the treated land cover areas, WTM separates directly connected impervious areas (direct runoff) from disconnected impervious areas. During this initial evaluation, only ESD practices that treat connected impervious surfaces and their upslope, disconnected areas were included. The disconnected impervious areas have reduced flow rates but have picked up pollutants by flowing over pervious turf surfaces. In addition to loads from the impervious surface, the runoff generally has higher pollutant concentrations, even though the volume decreases. Some of the disconnected runoff loads (particularly nitrogen) are conveyed by runoff that has infiltrated to the subsurface. During the modified WTM development, the disconnected pervious land cover concentrations were adjusted to match TMDL and MAST loadings, thus accounting for the contribution of subsurface loads.

When the BMP drainage area loads were computed, the loads from connected impervious areas are likewise separated from the disconnected areas. Although the disconnected areas treated are defined by their impervious surface area, the disconnected loads are represented by the entire disconnected area, including pervious turf cover. Most runoff from pervious surfaces follows subsurface pathways. This results in decreased effective concentrations for particulate pollutants such as phosphorus and TSS, while increasing concentrations of nitrogen, which is mostly dissolved. Therefore, the loads treated from disconnected impervious areas are both from impervious and pervious areas.

For BMP drainage areas, geospatial data shows that the proportion of pervious area is often several times that of impervious area. However, unlike disconnected impervious areas, pervious source areas have much lower runoff volumes, thus resulting in lower loads than impervious areas. Therefore, the pervious area contributions to overall load from a land use are relatively minor and are not represented in the WTM. Therefore, the load reductions by BMPs in connected impervious areas are slightly understated by WTM computations, resulting in a conservative implementation load reduction and providing an implicit margin of safety in the restoration plan.

Retrofit of Existing BMPs

Existing BMPs were evaluated to see if any practices could be retrofitted with more efficient practices to achieve larger pollutant load reductions. For example, dry ponds can be retrofitted to increase their load reductions. A dry pond reduces nitrogen only by 5 percent, phosphorus and sediments by 10 percent, and BOD by 27 percent. Converting dry ponds to the wet pond efficiency practice (providing reductions of 33 percent for nitrogen, 52 percent for phosphorus, 66 percent for sediments, and 63 percent for BOD) will improve pollution reduction. These are simple solutions that can be achieved at reasonable costs and in a short time span.

DPW&T currently implements stormwater management facility restoration and environmental enhancement projects under the Deficient Ponds Program. Prioritizing and selecting projects is based on the review of consultant inspection report findings and detailed site inspections conducted by DPW&T. The program focuses on facilities that were identified as having moderate or severe problems. Typically, these retrofits do not increase potential removal efficiencies; however, the County intends to address water quality enhancements in dry ponds identified as candidates for retrofits. Some of these ponds were designed under now-outdated design criteria. Improvements, such as retrofitting to current ESD standards, would increase their pollutant reduction potential.

Rights of Way

The ROW is public space along roads that is owned and maintained by the County. It represents a high-priority area for restoration and will be a major focus of the County watershed restoration efforts. In general, the urban densities increase inside the Capital Beltway to the Washington, DC, boundary and decrease outside the Beltway. Roads can be classified as either closed (roads bounded by curbs or gutters) or open (roads bounded by lawns and other vegetation without the presence of curbs or gutters). The local roads which serve these communities can be organized into a number of groupings which include:

- Urban open section with no sidewalk
- Urban closed section with curb and gutter, but no sidewalk
- Urban closed section with curb, gutter, and sidewalk
- Suburban open section with no curb, gutter, or sidewalk
- Suburban closed section with curb, gutter, and sidewalk

County ROWs can be present along each of these road groupings. Examples of these different groupings are presented in Figure 5-2. Each grouping has its own set of potential BMPs. Table 5-1 is a matrix of each road grouping and potential BMPs. Appendix A shows examples of select BMPs. The BMP designs will follow the criteria given in the MDE Design Manual (MDE 2000, 2009).

Urban open section with no sidewalk: Mt. Rainier–Varnum Street.

Urban closed section with curb and gutter but no sidewalk: Capitol Height–Balboa Avenue.

Urban closed section with curb, gutter, and sidewalk: Mt. Rainier–39th Place.

Suburban open section with no curb, gutter, or sidewalk: Glen Dale–Dubarry Street.

Suburban closed section with curb, gutter, and sidewalk: Kettering–Herrington Drive.

Source: Google Maps

Figure 5-2. Examples of urban road groupings.

Table 5-1. Potential BMP types per urban road grouping

Potential BMP	Urban Open Section with No Sidewalk	Urban Closed Section with Curb and Gutter but No Sidewalk	Urban Closed Section with Curb, Gutter, and Sidewalk	Suburban Open Section with No Curb, Gutter, or Sidewalk	Suburban Closed Section with Curb, Gutter, and Sidewalk
Permeable pavement or sidewalks	X	X	X	X	X
Permeable pavement shoulder instead of grass shoulder/buffer	X			X	
Curbside filter systems		X	X		X
Curb extension with bioretention or bioswale		X	X		X
Curb cuts to direct runoff to an underground storage/infiltration or detention device		X	X		X
Grass swales and bioswales				X	
Bioretention or bioswales to convert right-of-way to a green street				X	X
Infiltration trenches with underdrains				X	

For open suburban sections, MDE's requirements for nonrooftop disconnection should first be evaluated to determine if the street can be considered disconnected and thus be counted as treated.

Institutional Land Use

Existing institutional land uses also offer many opportunities for BMP retrofits. These land uses include both County and nonprofit organization properties such as schools, libraries, places of worship, parks, government buildings, fire and police stations, hospitals, and other facilities, but exclude roadways. The County has initiated discussions with the board of education and State Highway Administration to coordinate and take advantage of available land for BMP retrofits.

The first step for each identified facility is to evaluate whether the impervious area disconnection credits apply or can be applied with a simple BMP retrofit. Most of the facilities have substantial areas of impervious cover—including rooftops, driveways, and parking areas—that offer opportunities for cost-effective retrofits. A BMP retrofit priority matrix is applied to these sites on the basis of the impervious cover type, as shown in Table 5-2. Table 5-2 looks at practices that are suitable for micro-scale BMPs. For example, it would be unusual to implement a pond or wetland BMP to treat a small roof area, but most of the MDE ESD practices identified in the table would be appropriate for that use. The retrofit priority matrix will help in the selection process and identify the practices that offer the highest pollutant removal at the lowest cost.

Table 5-2. Impervious Area BMP retrofit matrix for institutional areas

BMP Description	Impervious Cover Elements				
	Roofs	Driveways	Parking	Sidewalks	Other[a]
ESD to the MEP from the *Manual*					
Green roofs	X				
Permeable pavements		X	X	X	X
Reinforced turf		X	X		
Disconnection of rooftop runoff	X				
Disconnection of nonrooftop runoff		X	X	X	X
Sheetflow to conservation areas		X	X		
Rainwater harvesting	X				
Submerged gravel wetlands			X		
Landscape infiltration	X	X	X		X
Infiltration berms					
Dry wells	X				
Micro-bioretention		X	X		X
Rain gardens		X	X		
Grass, wet, or bioswale		X	X		X
Enhanced filters	X	X	X	X	X
Structural Practices					
Hydrodynamic structures	X		X		X
Dry extended detention ponds			X		X
Wet ponds/wetlands			X		X
Infiltration practices			X		X
Filtering practices		X	X	X	X
Tree Planting and Reforestation					
Impervious urban to pervious		X	X		X
Impervious urban to forest					
Planting trees on impervious urban		X	X		X
Tree planter		X	X	X	X

Note:
[a] Includes miscellaneous other impervious surfaces (e.g., basketball courts, tennis courts, patios).

Commercial/Industrial Land Use

Numerous commercial and industrial properties are present throughout the County. Because those areas are privately owned, the County has implemented the Rain Check Rebate and Grant Program (section 4.2), administered by DoE, which allows property owners to receive rebates for installing Rain Check-approved stormwater management practices. Homeowners, businesses, and nonprofit entities (including housing cooperatives and places of worship) can recoup some of the costs of installing practices covered by the program. Like the institutional areas, the commercial and industrial areas are characterized by large areas of impervious cover, including roofs, driveways, parking lots, and other paved areas. The majority of commercial and industrial facilities are privately owned and some have their own stormwater discharge permits. The County has limited influence on the use of BMPs on commercial and industrial properties to achieve retrofit objectives on these properties, with the exception of the public roads that serve these uses. However, the County has incentives associated with reducing the property's Clean Water Act (stormwater) fee in exchange for the design, construction, and/or maintenance of BMP facilities on these properties. These areas have similar BMPs to those for institutional areas as shown in Table 5-2.

Commercial and industrial properties are constantly undergoing renovation and redevelopment processes in response to current trends and requirements. The County plans to develop a survey of these properties to identify redevelopment trends, which, through partnerships, could be incorporated into the TMDL restoration strategies.

Residential Land Use

Residential areas include varying amounts of impervious cover, such as roof area, driveway and walks, and patios. Because those areas are privately owned, the County has implemented the Rain Check Rebate and Grant Program (section 4.2), administered by DoE, which allows property owners to receive rebates for installing Rain Check-approved stormwater management practices. Homeowners, businesses, and nonprofit entities (including housing cooperatives and places of worship) can recoup some of the costs of installing practices covered by the program. Installing practices at the individual property level helps reduce the amount of polluted stormwater runoff that enters the storm drain system. In addition, property owners implementing these techniques through the program will reduce their Clean Water Act Fee.

Residential areas make up 37 percent of the watershed (Table 2-2 and Figure 2-1). It is difficult to implement BMPs on residential areas because they are privately owned. There are opportunities for the County to form partnerships with apartment/condominium communities to install BMPs on common areas on the properties. Many of the practices in Table 5-2 could be used on residential land. The most common practices for individual homeowners would be permeable pavement, rooftop disconnection, rainwater harvesting (e.g., rain barrels), landscape infiltration, rain gardens, and planting trees. For row houses, the most common practices would be permeable pavement (on sidewalks leading to home and alleyways), rooftop disconnection, rainwater harvesting (e.g., rain barrels), and rain gardens. Apartment/condominium communities could install any of the practices listed in Table 5-2.

Evaluation of Impervious Area Disconnection Opportunities

A group of practices and strategies that emerged from the 2000 and 2009 *Stormwater Design Manual* (MDE 2000, 2009) is referred to as nonstructural BMPs and includes:

- Rooftop disconnection
- Nonrooftop disconnection
- Disconnection to a conservation buffer

A number of existing opportunities in the County currently qualify for the impervious area disconnection credits but are not accounted for in the BMP database. These opportunities include buildings, both public and private, whose rooftops drain to pervious areas, or conservation areas and rural road sections with open sections that drain to roadside swales or other pervious areas. Impervious area disconnection is included in the WTM modeling as an ESD practice.

A desktop GIS analysis can identify many of these opportunities. In addition, the analysis can identify buildings and structures that do not currently meet all of MDE's criteria but could easily be retrofitted to meet the criteria. DPW&T has an effort underway to identify disconnected roads and areas in the County that could be easily retrofitted.

Urban and urbanizing watersheds consist of a variety of land use types that include residential, parks and open space, institutional, commercial, and industrial. Typically the land use type with the largest area is residential, which ranges from high-density residential (such as apartments and townhouses) to low-density residential (lots with 2 or more acres).

5.2 Subwatershed Prioritization

The subwatersheds were ranked and prioritized to aid in the selection of BMPs in the areas with the highest required pollutant loading reductions.

The County prioritized the subwatersheds by ranking the necessary total load reductions for each TMDL parameter and then averaging the individual ranks to obtain an overall rank for the subwatershed. Although not included in this restoration plan, PCBs are also included in the subwatershed ranking. The prioritization process ranked the 43 subwatersheds in the Anacostia River watershed, with number 1 being the highest priority ranking.

Table 5-3 presents the results of the subwatershed ranking evaluation, along with the available untreated impervious cover acres in each subwatershed. These areas are available for BMP implementation. Figure 5-3 shows the subwatershed rankings spatially for the Anacostia River watershed. The highest ranked watersheds tended to be in areas with the largest amount of impervious cover. Subwatershed AR-9, which is at the headwaters to Beaverdam Creek, had the highest ranking for all parameters, and thus is the highest ranked subwatershed as a whole. That area is bounded by industrial and residential properties, as well as some institutional properties that could be used for BMP implementation. The available impervious cover in Table 5-3 represents the impervious area that contributes to the County's MS4 loadings and is available to the County for BMP implementation; therefore, it does not include impervious cover on state or federal land.

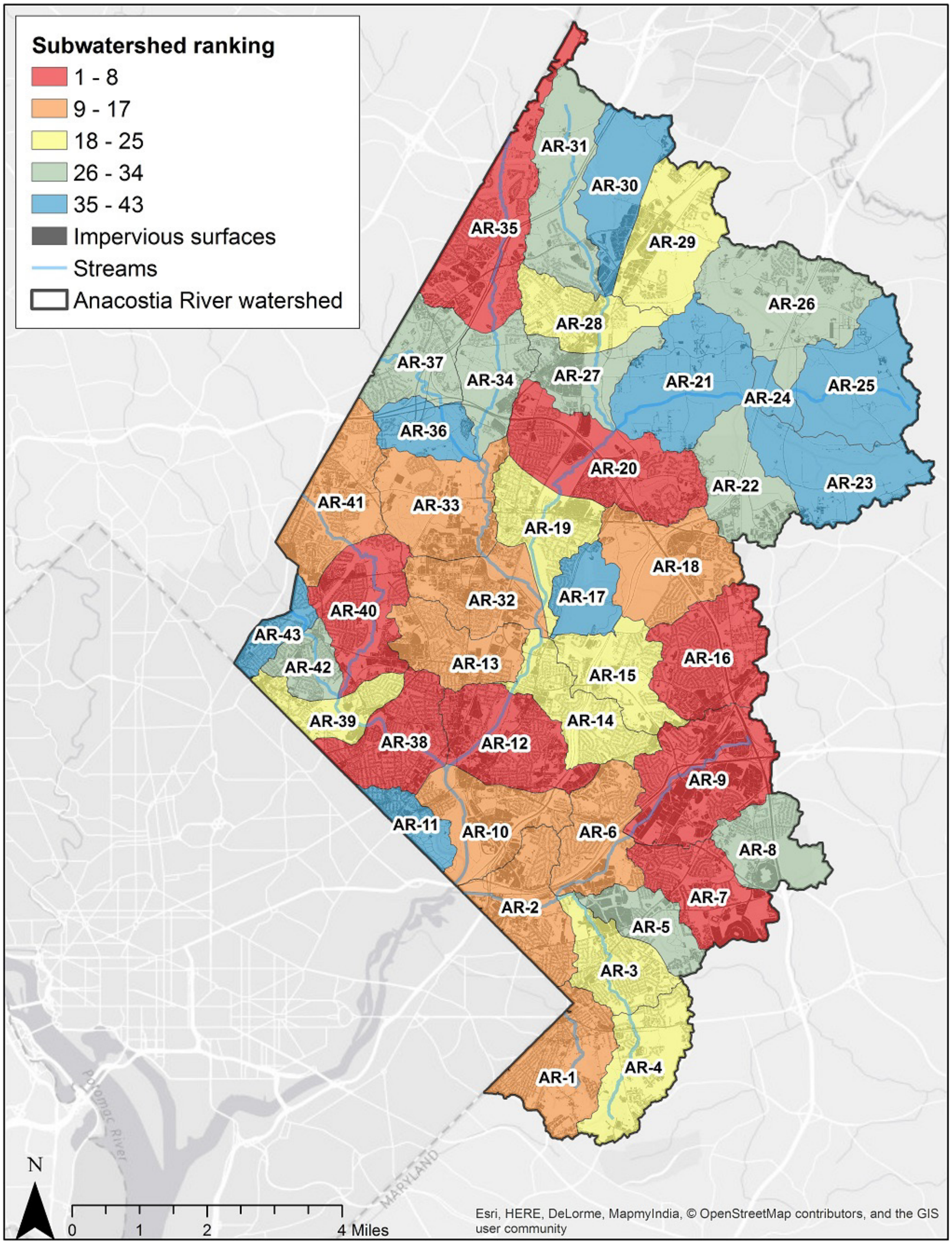
Table 5-3. Subwatershed prioritization ranking

Sub-watershed ID	Pollutant Rank (Baseline Loadings)							Available Impervious Cover (acres)				
	TN	TP	TSS	BOD	FCB	PCB	Average	Total	ROW/ Trans.	Institutional	Commercial & Industrial	Residential
AR-1	13	14	15	17	9	6	12	389.7	15.1	26.8	45.9	301.9
AR-2	11	12	9	12	18	2	11	424.8	39.1	30.2	151.1	204.4
AR-3	20	20	20	20	19	7	18	367.6	13.2	21.9	83.0	249.5
AR-4	24	23	23	25	24	8	21	243.7	16.7	22.0	47.7	157.3
AR-5	29	29	29	27	29	10	26	254.7	12.1	26.8	145.5	70.3

Sub-watershed ID	Pollutant Rank (Baseline Loadings)							Available Impervious Cover (acres)				
	TN	TP	TSS	BOD	FCB	PCB	Average	Total	ROW/ Trans.	Institutional	Commercial & Industrial	Residential
AR-6	14	15	13	15	16	5	13	388.8	34.7	21.2	108.1	224.8
AR-7	7	6	7	5	6	3	6	474.1	24.5	58.3	133.9	257.4
AR-8	27	27	27	26	27	9	24	223.0	5.5	15.7	59.1	142.8
AR-9	1	1	1	1	1	1	1	722.2	71.7	32.6	414.8	203.1
AR-10	15	13	12	9	13	4	11	395.7	25.6	21.5	218.1	130.5
AR-11	36	36	36	36	31	11	31	124.9	5.3	24.8	31.3	63.5
AR-12	2	2	2	2	3	12	4	663.5	42.4	47.8	241.2	332.1
AR-13	16	17	18	14	14	15	16	365.6	19.7	27.3	121.3	197.4
AR-14	18	19	19	19	17	20	19	345.6	10.3	24.7	46.5	264.1
AR-15	23	24	24	24	21	23	23	256.4	6.8	34.0	31.0	184.6
AR-16	4	4	4	4	4	17	6	533.4	15.7	47.1	86.7	383.9
AR-17	40	40	41	40	41	38	40	44.3	0.3	0.0	0.0	44.0
AR-18	17	16	16	13	15	19	16	330.3	12.8	21.1	99.7	196.7
AR-19	19	18	17	18	20	18	18	358.4	19.1	23.5	132.1	183.7
AR-20	3	3	3	3	2	14	5	470.9	20.6	30.6	67.9	351.8
AR-21	39	39	39	39	40	39	39	15.6	1.4	1.4	0.0	12.9
AR-22	34	34	35	34	33	33	34	72.5	0.2	11.3	0.3	60.7
AR-23	41	41	40	41	39	41	41	16.0	1.1	4.9	0.0	10.0
AR-24	43	43	43	43	43	43	43	0.3	0.0	0.0	0.0	0.3
AR-25	42	42	42	42	42	42	42	1.1	0.3	0.0	0.0	0.8
AR-26	28	28	28	30	28	29	29	137.4	2.4	11.9	0.3	122.8
AR-27	31	31	30	29	32	32	31	216.9	21.7	6.4	165.5	23.3
AR-28	22	22	22	22	25	30	24	298.0	20.6	9.3	118.6	149.5
AR-29	21	21	21	21	22	31	23	350.8	28.0	7.1	229.9	85.7
AR-30	35	35	34	32	37	34	35	163.2	18.9	1.2	133.2	9.8
AR-31	32	32	32	35	35	35	34	133.8	7.5	12.5	41.4	72.4
AR-32	10	7	8	8	5	16	9	259.6	29.0	54.9	30.2	145.5
AR-33	12	11	14	16	10	21	14	165.9	7.2	16.5	51.9	90.3
AR-34	33	33	33	33	34	28	32	120.7	2.7	0.4	50.7	66.8
AR-35	6	5	5	6	12	24	10	417.3	11.6	44.0	94.4	267.4
AR-36	38	38	38	38	38	37	38	48.3	0.0	0.0	0.0	48.2
AR-37	26	26	26	28	26	27	27	163.6	2.7	13.6	3.3	143.9
AR-38	5	8	6	7	7	13	8	463.6	18.7	13.8	62.6	368.5
AR-39	25	25	25	23	23	25	24	236.4	14.5	17.6	53.5	150.8
AR-40	8	10	11	10	8	22	12	401.8	11.1	17.3	68.8	304.7
AR-41	9	9	10	11	11	26	13	416.7	8.8	33.8	43.6	330.5
AR-42	30	30	31	31	30	36	31	186.1	7.8	19.4	21.7	137.3

Sub-watershed ID	Pollutant Rank (Baseline Loadings)							Available Impervious Cover (acres)				
	TN	TP	TSS	BOD	FCB	PCB	Average	Total	ROW/ Trans.	Institutional	Commercial & Industrial	Residential
AR-43	37	37	37	37	36	40	37	125.8	0.8	1.2	19.7	104.1
Total								11,789.2	628.2	856.4	3,454.6	6,850.0

Notes: Subwatersheds are ranked 1 through 43, with 1 being the highest priority subwatershed.
TN=total nitrogen; TP=total phosphorus; TSS=total suspended solids; BOD=biological oxygen demand; FCB=fecal coliform bacteria; PCB= polychlorinated biphenyl; Trans=transportation.



Note: Subwatersheds are ranked 1 through 43, with 1 being the highest priority subwatershed.

Figure 5-3. Subwatershed prioritization in the Anacostia River watershed in Prince George's County.

6 Implementation Discussion

This section describes the County's implementation processes to improve water quality and meet the goals and objectives of the restoration plan. It includes specific planned actions, cost estimates, and a proposed schedule, as well as descriptions of the financial and technical resources available to support and implement the restoration plan. This section also describes how the public will be involved throughout implementation, both in terms of keeping the public informed and by involving them directly in the implementation actions. As part of this plan's adaptive management strategy (section 7.3), DoE will perform a biennial review of programs starting in 2015 to assess restoration progress and public involvement. Part of the review will be to identify ways to improve community involvement and increase the rate of restoration activities (both BMPs and programmatic initiatives).

6.1 Proposed Management Activities

This section presents the implementation portion for the Anacostia River watershed restoration plan, which is focused on achieving the load reductions presented in section 3.3. Using the procedure outlined in section 5.1, this restoration plan proposes both BMP implementation and programmatic initiatives. The restoration plan creates the overall blueprint for restoration activities in the Anacostia River watershed. Although BMP types and locations are not explicitly specified, the plan will allow the County the flexibility to identify specific locations and to work with partners (e.g., to install BMPs on institutional or private land). It also will allow the flexibility of selecting suitable ESD practices on the basis of factors such as costs, land availability, feasibility, and pollutant-removal efficiencies. Figure 6-1 presents conceptual art of a city block with different ESD practices on institutional, commercial, and residential property. Note that this figure includes some practices that are not specifically mentioned in the plan, but that could be incorporated into it on the basis of County priorities and future goals, as well as MDE approval.

Credit: EPA OWOW.

Figure 6-1. Conceptual city block with ESD practices.

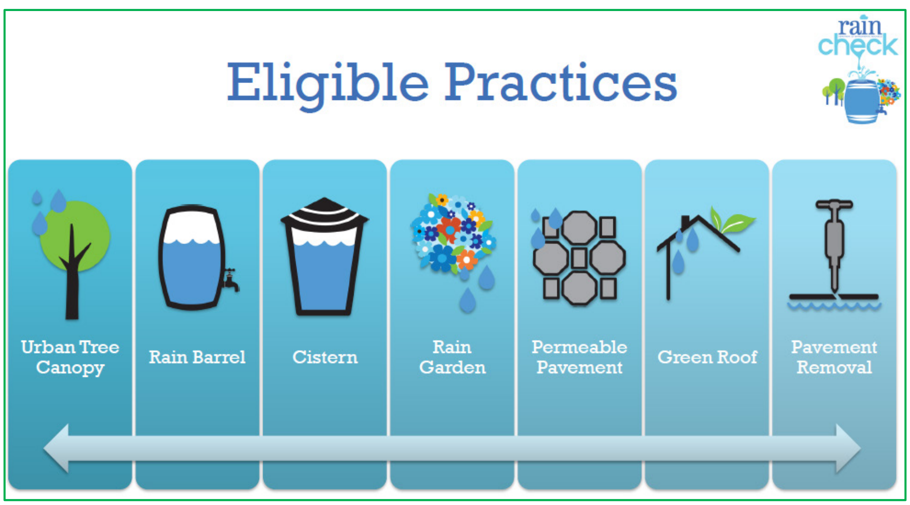
6.1.1 Restoration Plan Programmatic Initiatives

As previously stated, the County's existing programmatic practices are expected to continue and will be supplemented with additional practices to make up the programmatic strategies for this restoration plan. Many of these strategies rely on public education and outreach. Section 6.6 of this restoration plan deals specifically with public involvement in the restoration implementation process, which includes public education. These activities will first focus on the areas in the watershed that have the most need for load reduction and then will continue throughout the watershed. Load reduction progress will be monitored throughout restoration plan implementation. Programmatic strategies will be modified as needed to ensure continued load reduction. One potential method for feedback on the implementation is conducting surveys to see where public behavior has changed regarding lawn care or pet waste disposal practices. If the behavior has not changed as much as anticipated, then more outreach could be enacted in another form or by using a slightly different public engagement approach.

Existing Practices (from Section 4.2)

The existing practices that could have a quantifiable effect on water quality are in this section. There are other practices listed in section 4.2, however, not all of them have quantifiable load reductions.

- *Clean Water Partnership* (*CWP*) *Program*. The CWP initially focuses on ROW runoff management for older communities, which are inside the Capital Beltway (Interstate 495). The program is expected to be responsible for providing water quality treatment for up to 2,000 acres of impervious land over the next 3 years at a cost of approximately $64 million ($14 million the first year, followed by $25 million each of the following 2 years); however, these numbers might be adjusted. Any BMPs installed as a result of this program would be credited towards the ROW BMPs identified in section 6.1.2.
- *Rain Check Rebate and Grant Program.* This program started in 2013. Forty properties have received the rebate to date. However, for these practices to receive credit for this TMDL restoration plan, they will need to be verified by the County. The acreage that will be treated using this program has not yet been estimated. The restoration plan calls for additional public outreach to inform County residents of this program. Outreach could target homeowner associations, community groups, or neighborhood associations. The County has allocated $3 million for the implementation of the Rain Check Rebate and Grant Program. Currently, rebates are capped at $2,000 for residential properties and $20,000 for commercial properties, multifamily dwellings, nonprofit, and not-for-profit groups.[5] The program is currently setup to provide rebates for up to 500 practices per year. If interest in the program results in the possibility of this maximum number being exceeded, the County could increase the 500 per year limit by shifting more funds to cover administrative costs. Any BMPs installed as a result of this program would be credited towards the appropriate BMP group identified in section 6.1.2.



- *Alternative Compliance Program.* This program has only recently started; thus, there are no current load reductions from it. The restoration plan calls for additional outreach to

[5] http://www.cbtrust.org/site/c.miJPKXPCJnH/b.9146461/k.6D3F/Prince_George8217s_Rain_Check_Rebate.htm. (accessed September 2014).

inform County nonprofit organizations of this program. Approximately 10 percent of the religious organizations that agree to provide easements on their properties are expected to install BMPs annually. The Clean Water Act fee database includes an estimated 860 accounts (one religious facility can have multiple accounts) for religious organizations that are eligible for this credit in the Anacostia River watershed. These organizations' properties include approximately 350 acres of treatable impervious area. Therefore, using the 10 percent estimation, about 35 acres of impervious area could be treated annually under the Alternative Compliance Program. Any BMPs installed as a result of this program would be credited towards the institutional BMPs identified in section 6.1.2.

- *Countywide Green/Complete Streets Program.* No projects have been completed as of the date of this document; however, some projects are in the design phase and will go into construction in fiscal year 2015. The acreage that will be treated using this program has not yet been estimated. Any BMPs installed under this program would be credited towards the ROW or institutional BMPs, as identified in section 6.1.2.
- *Street Sweeping and Storm Drain Maintenance.* DPW&T is in the process of evaluating the street sweeping program to improve program tracking, capture water quality efficiencies, and report programmatic achievement for alternative BMP watershed restoration credit reporting. As the first step in the analysis, the roads serviced during this reporting period have been mapped. This information will be used to improve water quality efficiencies and potentially shift the roads swept to more sensitive watersheds, increase sweep cycles, or add more resources with additional roads. Programmatic improvements also under consideration include:
  - Servicing fewer roads and increasing the sweeping frequency to achieve the full level of credit. MDE requires that roadways be swept a minimum of twice per month for full credit. Currently DPW&T is servicing roads about once a month.
  - Shift services to roads in sensitive subwatersheds within the Anacostia River watershed to help address the trash TMDL.
  - Add additional roads swept in sensitive subwatersheds.
  - Use ARCGIS to link all cycle data to the map and data table. This will improve documentation for NPDES reporting and eliminate duplicative entry in a separate Excel spreadsheet.

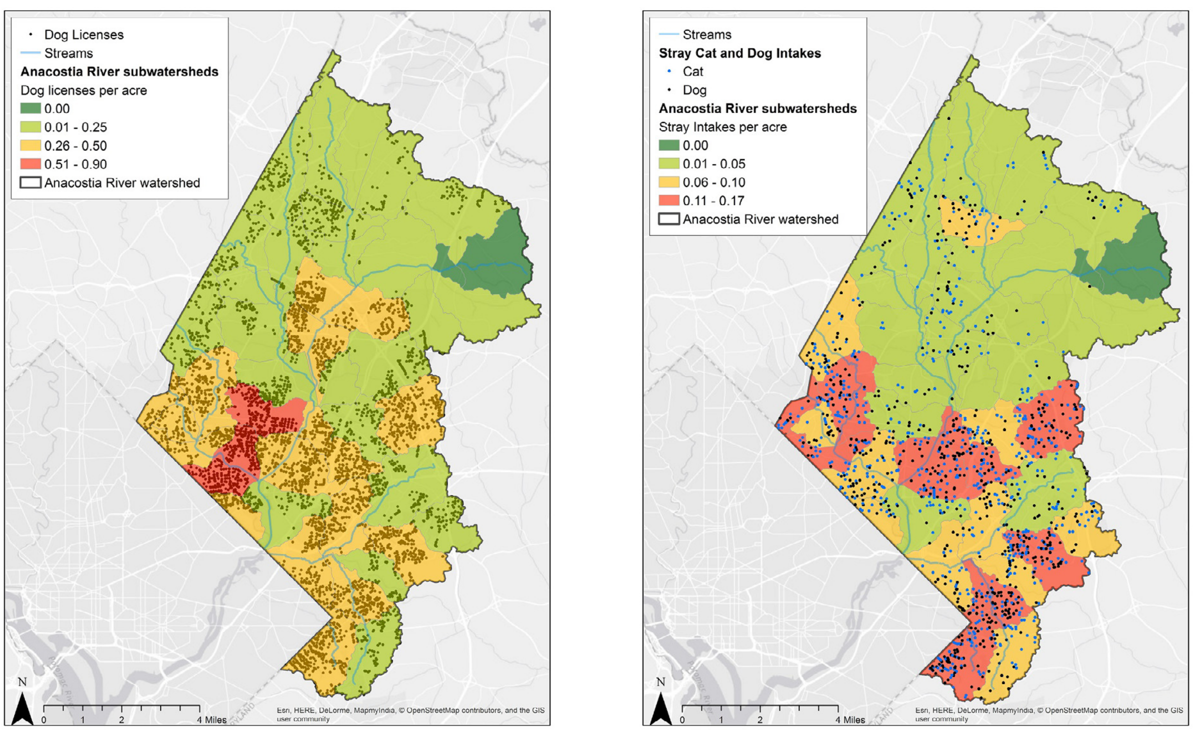
  The street sweeping program's mission was not originally intended for water quality credit, therefore, a further analysis of the costs involved and the benefits derived for targeting the program will need to be fully evaluated.
- *Illicit Connection and Enforcement Program.* As part of its BMP inspection and maintenance programs, the County has recently established an illicit discharge detection and elimination initiative. This initiative can have substantial benefits in pollutant reduction. The progress of this initiative will be reported annually and identified locations will be geo-referenced to be accounted for in the County's TMDL restoration plan.
- *ReLeaf Grant Program.* The County anticipates increasing funding for the program next year, and will reevaluate the program and adjust funding accordingly on the basis of

available funds and community participation. The additional funds for the next year will result in approximately 1,400 new trees being planted in the County.

- *Volunteer Tree Planting.* Approximately 2,000–2,500 trees are planted every year through this initiative. Tree plantings are being quantified and located to determine yearly TMDL benefit by watershed. This credit will be applied for net-gain projects such as the *Right Tree – Right Place* program and capital improvement road and bridge projects.
- *Litter Control.* The County will increase its litter control practices in the Anacostia River watershed because of the trash TMDL restoration plan currently in place (EA 2014). There are expected to be nutrient, TSS, BOD, and bacteria load reductions associated with litter control, however, these could not be quantified. The load reductions will come from reducing improperly disposed of food waste (which in turn feeds nuisance wildlife that deposit bacteria in fecal matter) and other organic materials available to enter the storm sewer system and eventually settle to stream beds.
- *Master Gardeners.* The program has the potential to aid in the overall reduction of fertilizer and pesticide use, as well as to promote increased use of stormwater practices such as rain gardens and rain barrels. The acreage that will be treated using this program has not yet been estimated. Any BMPs installed as a result of this program would be credited towards the residential BMPs identified in section 6.1.2.
- *Flood Awareness.* This program encourages implementing flood-prevention stormwater practices (e.g., BMPs) such as permeable pavers and rain gardens to help prevent costly property damage that can result from backyard flooding. The acreage that will be treated using this program has not yet been estimated. Any BMPs installed as a result of this program would be credited towards the residential or commercial BMPs identified in section 6.1.2.
- *Transforming Neighborhoods Initiative (TNI).* This initiative has the potential to use environmental restoration, stormwater management practices, and environmental education as tools to help transform depressed neighborhoods while also creating safer, more inviting community environments. The acreage that will be treated using this program has not yet been estimated. Any BMPs installed as a result of this program would be credited towards the residential BMPs identified in section 6.1.2.
- *Animal Management.* The Animal Management Division will continue with its current programs, including adoption events, spay and neuter clinics, and public education events. These activities help reduce the number of stray animals in the County, thus reducing the amount of animal waste that is not properly disposed of. The Division tracks the number of stray animals that are taken to County facilities. This information can help determine if the overall stray population is decreasing. The Animal Management Division is also responsible for removing dead animals from roadways. This prevents nutrients loads from the decomposing animals from entering the stormwater network, and thus the County's water bodies. These load reductions, however, are not able to be determined.

Proposed Enhancements (from Section 5.1.1)

- *Domestic and Urban Animal Source Control.* If not disposed of properly, pet waste can contribute to significant bacteria loadings in addition to nutrient and BOD loadings to local waterways. An effort is currently underway to develop a pet waste outreach campaign. When developing the campaign strategy, the County will determine exactly what methods and materials will be used to reach target audiences about proper disposal of pet waste. The County will be specifically looking at ways to increase the amount and use of pet waste bag dispensers throughout priority subwatersheds. Being able to track bag usage will tie into already established approaches for calculating pollutant load reductions from pet waste education programs, such as the one implemented by the District of Columbia Department of Environment. The strategy will also identify ways the County will evaluate the effectiveness of pet waste outreach efforts to get a better sense of the level of behavior change the public has adopted. Evaluation methods could include a phone survey, intercept surveys at pet adoption events, email surveys of workshop/meeting attendees, online website visitor surveys, data on the number of pet waste bags used monthly at dog parks, and other potential ways to determine if citizens are following through with pet waste pickup. Figure 6-2 presents the locations of known dog licenses and where stray dogs and cats have been found since 2010; this information provides a guide to areas that should be targeted by the County. Future dog parks should contain pet waste disposal stations and should be sited away from water bodies. This approach will allow a greater flow path for treatment of the nutrient- and bacteria-enriched runoff from the dog park. The addition of a grass or brush buffer would provide additional treatment of the stormwater runoff.



Source: DoE 2014

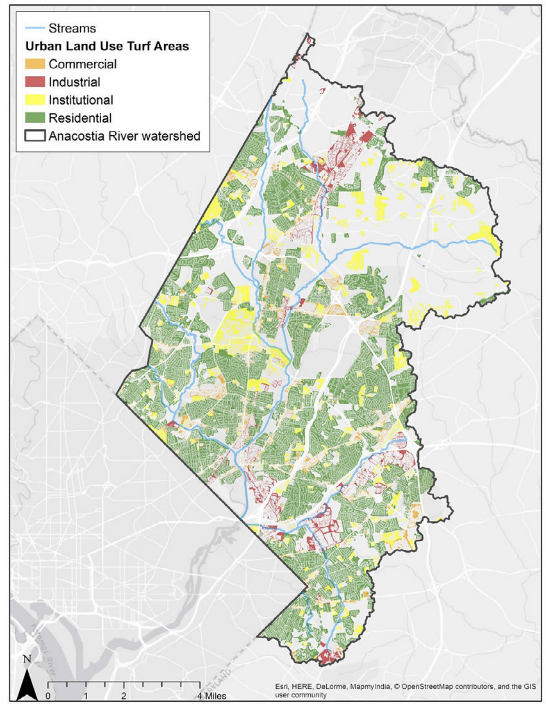
Figure 6-2. Locations of dog licenses and stray animal intake sites.

- *Household and Commercial Waste Disposal Measures.* There are other potential human and pet nutrient, BOD, TSS, and bacteria sources as well. These are primarily comprised of leaky trash cans, dumpsters, and garbage trucks containing diapers (as well as pet waste); boat and recreational vehicle discharges; and secondary sources such as pool and hot tub discharges. The County intends to explore initiatives to:

- Create a program to encourage covering dumpsters to prevent rainwater from entering (which would then leak out, carrying nutrients and bacteria) and trash from blowing out due to wind.
- Research ways to eliminate leaks from garbage trucks.
- Provide public education regarding covering private trash cans to prevent leaks and also to prevent nuisance wildlife from using the trash as a food source.
- Enforce waste management on boats and recreational vehicles to prevent sanitary waste from entering County water bodies.

Dumpsters can be a source of nutrients, oxygen demanding substances, and bacteria. Improperly covered dumpsters and waste containers collect rainwater that can discharge with elevated levels of pollutants through leaks and holes in the bottom of the receptacles and then enter storm drains. Commercial dumpsters can contain food waste and rodent droppings, while residential receptacles and dumpsters can contain food waste, diapers, or pet waste. Leaks can also occur when the waste receptacles are emptied or when the receptacles are washed. Washing facilities (e.g., vehicles, equipment, dumpster concrete pads) can contribute nutrients, oxygen demanding substances, and bacteria to the County's MS4 network. Washwater should be directed to sanitary sewers, where it can be treated. Several municipalities have dumpster and waste receptacle management, and washing facility outreach programs (ADES 2014, City of Knoxville 2012, DPWES 2014). The city of Knoxville issues fines for leaking dumpsters (City of Knoxville 2012). These ordinances and outreach materials will be reviewed to develop a program for the County. Some activities will include having property owners inspect dumpsters for leaks, properly cover waste receptacles (e.g., receptacle covers or stored in covered areas), and employ berms when conducting washing activities to keep runoff out of storm sewers.

- *Residential/Commercial Lawn Care Education*. A lawn care management program consists primarily of outreach to educate landowners to use less fertilizer and apply it properly as well as on other ways to maintain healthy yards that do not need fertilizer in the first place. The County will initiate a lawn care program that emphasizes the lawn care practices identified in the Chesapeake Bay Program's expert panel on urban nutrient (fertilizer) management (Schueler and Lane 2013). These practices are listed in section 5.1.1 and described in *Recommendations of the Expert Panel to Define Removal Rates for Urban Nutrient Management* (Schueler and Lane 2013). This program will reduce total nitrogen and total phosphorus loads, largely by keeping applied fertilizers off paved surfaces and reducing the total volume of fertilizer applied in the watershed. Figure 6-3 shows the turf areas in the watershed identified by each major urban land use category. Turf areas were estimated from 2010 MDP land use information and the County's 2009 impervious information. The geospatial information in the figure will be used to help prioritize where to focus public education and outreach activities.



Sources: MDP 2010; M-NCPPC 2014

***Figure 6-3*. Locations of turf areas.**

- *Outfall Stabilization and Restoration Projects*. DPW&T will evaluate locations where outfalls are eroding and need to be stabilized. MDE will allow up to 2 acres of impervious area retrofit credit for stabilizing outfalls and restoring stream areas immediately below the outfall. This will also help to reduce pollutant loadings. DPW&T has numerous opportunities to pursue these types of projects but permitting obstacles have slowed progress.

6.1.2 Restoration Plan BMPs

Given the preceding programmatic measures, a substantial amount of the loads can be removed before allocating structural BMPs. After programmatic initiatives were applied, the general approach in the strategy development was to first upgrade dry ponds (which have a low pollution-reduction efficiency), then install ESD BMPs at public ROW and public areas, such as County government buildings, parks, and schools. If additional load reduction is needed, this restoration plan suggests that the County form partnerships with other entities (e.g., places of worship, commercial centers, industries, and apartment/condominium communities) to install BMPs on private land. Section 5.1.1 identified the potential types of BMPs appropriate for specific land uses.

Table 6-1 presents the number of impervious acres that are projected to require treatment using dry pond retrofits and ESD BMPs in the Anacostia River watershed. Appendix B presents the impervious acres for each subwatershed. In addition to the ESD practices, this restoration plan identifies 75,000 linear feet of stream restoration in the watershed. The number of linear feet was derived by reviewing past annual stream restoration totals (up to 3,000 acres per year) and adding a renewed focus on stream restoration to estimate an average of 5,000 linear feet of stream restoration per year.

Even though the restoration strategy first looked at ROWs, the County can install BMPs on any land-use type as opportunities arise. In other words, the restoration plan does not limit the County to install BMPs on ROWs to the maximum capacity before moving onto other types of properties. The restoration strategy initially suggests installing BMPs on public ROWs, but the County can choose to install similar BMPs to treat other land uses (e.g., County facilities) to obtain similar load reductions. In addition, BMPs installed for other purposes, such as redevelopment, can be counted towards the totals in Table 6-1. However, the totals in Table 6-1 represent almost the entire impervious area—including commercial, industrial, and residential areas—within the County's MS4 area in the Anacostia River watershed. Because it is not feasible to treat all the impervious area in the watershed, the County will look for other options, as described in the Adaptive Management Approach (section 7.3). The Anacostia Watershed Restoration Partnership's subwatershed action plans are a good source of potential BMP types and locations that the County will reference during the implementation phase of this restoration plan.

Table 6-1. Needed acres of impervious area treated by dry pond retrofits and ESD practices

Watershed portion	Number of Dry Pond Retrofits	Dry Pond Retrofit (Impervious Acres Treated)	ESD (Impervious Acres Treated)			
			ROW	Institutional	Commercial/ Industrial	Residential
NEB/NWB	16	100.0	1,728.0	402.6	1,789.1	2,794.6
Downstream	17	66.8	820.3	196.4	1,136.0	1,095.2
Total	33	166.9	2,548.3	599.0	2,925.1	3,889.8

Note: It is assumed that 1 ESD BMP will treat 1 acre of impervious area.

6.1.3 Estimated Load Reductions

Calculations to determine the load reductions from BMPs and programmatic initiatives were added to the WTM spreadsheet that was used to determine the implementation load reduction goals (section 3.2). This load reduction analysis was performed using the steps presented in section 5.1. After each step, the estimated load reductions were compared to implementation load reduction goals to determine the remaining load reduction gap. The steps were followed and repeated until the implementation load reduction goal was met by the estimated load reductions. The steps were:

1. Load reductions from current BMPs, along with their impervious drainage area, were input into the WTM and subtracted from the necessary load reduction and available impervious area, respectively.
2. The load reductions from existing programmatic initiatives were subtracted from the necessary load reductions.

3. The load reductions from recommended programmatic initiatives were subtracted from the necessary load reductions.
4. The load reduction difference between dry ponds and wet ponds was subtracted from the necessary load reductions.
5. Proposed BMPs and their associated load reductions and impervious area treated were subtracted from the necessary load reductions. This was first done for ROWs, then institutional land, followed by commercial and industrial land, and lastly residential land.

The resultant final load reductions (from programmatic initiatives and BMP implementation) are presented in this section. Load reductions from current BMPs are presented in section 4.3.2.

Programmatic Initiatives

Estimating potential load reductions from programmatic initiatives is challenging since some of the initiatives require public participation and a change in long-standing behaviors. Therefore, several assumptions are required. The County has accounted for the need to reevaluate the estimated load reductions in the future in its adaptive management approach (section 7.3). This section discusses load reductions from several of the programmatic initiatives. Some of the programmatic initiatives result in BMPs being installed. These programs are not discussed in this section because their impacts are reflected in the load reductions from BMPs, as shown later in this section. These BMP-related programs are the Stormwater Management Program, CWP, Rain Check Rebate and Grant Program, countywide Green/Complete Streets Program, Alternative Compliance Program, Flood Awareness campaigns, and Transforming Neighborhoods Initiative.

Specific programmatic initiatives include:

- *Street Sweeping, Catch Basin Cleaning, and Storm Drain Vacuuming.* MDE has identified ways to calculate the pollutant load reduction associated with street sweeping through the mass loading approach and the street lane approach (MDE 2014a, Appendix D). Because the County's frequency of street sweeping does not meet the credit requirements of the street lane approach, the mass loading approach is used to calculate the load reductions. For the mass loading approach, the street dirt collected is measured in tons at the landfill or ultimate point of disposal. The pollutant load removed is then based on a relationship between the pollutant load present in a ton of street dirt dry mass. This relationship is 3.5 lb for total nitrogen, 1.4 lb total phosphorus, and 420 lb TSS per ton if the same piece of road is swept 25 times per year (MDE 2014a).[6] During 2013, 80 miles of roads in the watershed were swept by the County, but that value fluctuates from year to year. This practice calls for increased street sweeping in the Anacostia River watershed. DoE will work with DPW&T to increase their street sweeping efforts. While developing the assumptions for this practice, DoE consulted DPW&T and reviewed past street sweeping practices. Based on its analysis, DoE calculates that 12,000 miles would be swept a year. The same stretch of road would have to be covered more than once to receive credit for load reductions. Therefore, DoE determined that 808 miles would need to be swept every other week to reach this goal.

[6] In November 2015, a Chesapeake Bay Program expert panel proposed new street sweeping guidelines and load reductions. The panel expected to have their recommendations approved in early 2016. Any change in load reductions will be addressed in future revisions and the adaptive management of this restoration plan.

In addition, the Country will increase the amount of catch basin cleaning/storm drain vacuuming being done in the Anacostia River watershed. In October 2015, this information was not being tracked by DPW&T. DoE will work with DPW&T to develop methods for tracking and reporting it. While developing the assumptions for this practice, DoE consulted DPW&T and reviewed the available data. Based on that past data, the County has cleaned an average of 10,000 inlets per year through the County Community Inlet Clean Up, Municipal Inlet Clean Up, and Emergency Inlet Response Clean Up programs. However, the actual amount of sediment collected is unknown and was estimated based on other sources. The reduction values from the August 2014 MDE stormwater WLA guidance (MDE 2014a) were used to determine the loads reduced. The County plans to use a combination of inlet cleaning and storm drain vacuuming, but the percentage of each activity is still being determined. To determine the amount of load reduction possible, DoE used a Center for Watershed Protection report specifying that 0.007 cubic feet daily average sediment accumulates in an inlet (CWP 2008). DoE assumed that a cubic yard of dry material is approximately 900 pounds,[7] which means that, for the 5,000 inlets cleaned twice a year, 212 tons of material is collected. The stormwater WLA guidance was used to determine the load reductions for nitrogen, phosphorus, and TSS (MDE 2014a).

- *ReLeaf Grant Program* and *Volunteer Tree Planting.* The load reductions from increasing the tree canopy is only applicable if there is a survival rate of 100 trees per acre or greater and at least 50 percent of the trees are 2 inches or greater in diameter at 4.5 feet above ground level (MD DNR 2009, MDE 2014a). The current restoration plan calls for 3,000 trees throughout the watershed. Any additional trees will help in the adaptive management of the restoration plan if other strategies fall short of their goals.
- *Pet/Animal Waste Campaigns.* For this programmatic initiative, the estimated load reductions assume significant compliance with pet waste education measures by the County citizens. For the restoration plan, it was assumed that there will be a 65-percent compliance rate. These reductions will be due to increased public education and access to pet waste stations and bags. Additional load reductions can be achieved if stray dog and cat populations are reduced by 50 percent using spay and neuter campaigns (for either pet or stray animals), fines for abandoning pets, and adoption fairs. Because these are low-cost efforts with the potential for large load reductions (Table 6-7), efforts to promote pet waste education, pet waste regulations, and stray pet controls will be aggressively approached in the initial phases of the implementation of this restoration plan. The number of newly issued dog licenses (11,954) and stray intake animals (3,000) from 2010 to 2013 for the watershed was obtained from DoE's Animal Management Division. The exact number of animals is expected to be greater, thus providing a conservative estimate of the number of dogs and stray animals in the watershed.

  DoE has retained a contractor to develop a public outreach and education campaign on pet waste. This program will be conducted over multiple years. At the end of the program, the County will be able to estimate the loading reductions achieved. Differences between those reductions and the reductions used in this restoration plan will be addressed as part of the adaptive management of this plan. Addressing urban nuisance wildlife is another way to reduce nutrient, BOD, and bacteria loads. By reducing food

[7] http://www.swaploader.com/wp-content/uploads/2015/02/Cubic_Yardage_Chart.pdf.

sources, the nuisance wildlife population is expected to decrease, thus reducing nutrient, BOD, and bacteria loadings to local streams. A decreased population offers additional public health benefits from the reduction of sources of ticks, rabies, and other public health concerns. This reduction is difficult to quantify and estimate, partly because of the lack of information on current animal populations, locations, and the amount of involvement of County residents and businesses will have on the reduction strategies. No load reductions from wildlife are provided in this restoration plan.

- *Residential/Commercial Lawn Care Education.* The CBP recently convened a panel of experts to look at the removal efficiencies for urban nutrient (fertilizer) management (Schueler and Lane 2013). During this process, Maryland chose to rely on its fertilizer legislation and subsequent regulations to receive (1) the statewide 25 percent total phosphorus reduction removal efficiency, (2) the 9 percent total nitrogen reduction removal efficiency for the total acreage of lawns managed by commercial applicators, and (3) the 4.5 percent total nitrogen reduction removal efficiency for residential lawn areas managed by homeowners. The credits are good for 3 years, after which the County must show reduction in phosphorus and nitrogen using 2 years of fertilizer sales data. The expert panel did not specify how tracking and reporting would be done; however, these practices and reduction credits are included in this plan. MDE recommended that the County collect data on homeowner fertilizer application within its current MS4 permit cycle to verify or revise the expected nutrient load reductions in this restoration plan for fertilizer management. The expert panel reviewed 15 studies about homeowners' use of fertilizer and found that a majority of residential lawns (50−83 percent) were fertilized. Of the homeowners that fertilized, less than 20 percent consulted professional services, while the remainder applied the fertilizers themselves. Low- and high-risk categories were assumed in the Chesapeake Bay model with the 20/80 percent split, irrespective of fertilization regime (i.e., including non-fertilized lawns). These findings were used in this restoration plan. An estimated 60 percent of grass was considered fertilized, with 80 percent assumed to be in the low-risk category using the percent reductions described above. The acres of turf (16,000 acres) in the watershed was determined from WTM using County land use and land cover geospatial data (Tetra Tech 2015b).
- *Household and Commercial Waste Disposal Program.* The loads from dumpsters and washing facilities that are discharged directly into the MS4 system can be considerable. These loads will be addressed with a comprehensive program to upgrade dumpsters and trash bins to make them leakproof and to add covers. Additionally, uncontrolled washing facilities will be identified and controlled. It is assumed that a 65-percent adoption rate of such programs will be obtained in the Anacostia River watershed. An estimated 2,200 dumpsters were used in the modified version of WTM (Tetra Tech 2015b).

Although percent removal efficiencies can be determined for BMPs and some programmatic activities, it is not possible to estimate the load reduction capabilities of other programmatic activities, such as storm drain stenciling or litter control. The cumulative effects of these activities will help reduce loads entering local water bodies, thus improving their health. The impacts of these activities are not calculated as part of this plan, however, these activities do form an important part of this plan. Most of them serve to educate the public on how they can help improve water quality. The improvements in water quality from these activities will be reflected through adaptive management, where the County will assess the cumulative improvements in the water quality and health of water bodies under the restoration plan.

Proposed BMP Implementation

Table 6-2 represents the load reductions achieved with the dry ponds retrofits (to more efficient BMPs) and with ESD practices implemented on each urban land use type. Appendix B presents the estimated load reduction for each subwatershed by land use. Dry pond retrofits do not provide much load reduction. Institutional land represents the fewest opportunities for load reduction. Almost half of all load reductions are estimated to be obtained from residential land.

Table 6-2. Total Anacostia River watershed load reductions

Parameter	Dry Pond Retrofit	ESD Practices on				Total
		ROW	Institutional	Commercial/ Industrial	Residential	
Total nitrogen (lb/yr)	612	29,884	8,142	35,539	75,117	149,294
Total phosphorus (lb/yr)[a]	215	6,079	1,582	6,948	11,693	26,517
TSS (ton/yr)[a]	34.6	2,276.5	534.9	2,598.4	3,751.6	9,196
BOD (lb/yr)	7,999	239,395	51,937	249,764	317,308	866,404
Fecal coliform bacteria (MPN B/yr)	15,591	659,220	188,311	629,812	1,570,699	3,063,632

Note:
[a] Includes loadings caused by streambank erosion.

It is expected that some of the ROW BMPs will be installed by the CWP. The CWP is expected to treat 2,000 acres of impervious areas within the next 3 years countywide, but will focus on the older sections of the County, which are inside the Capital Beltway. Similarly, some of the institutional BMPs will be installed as part of the County's Alternative Compliance program, while some BMPs on commercial, industrial, and residential land will be installed as part of the County's Rain Check Rebate and Grants Program. Since these programs have been launched recently, the County does not have long-term data on the estimated number of BMPs or the estimated load reductions from the programs. Once more data is available in subsequent years, such as, installed BMPs, treated land use types, and level of public participation, estimates will be made on the load reductions from these programs.

Estimated Overall Load Reductions

Table 6-3 presents the load reductions for the different restoration activities (BMPs and programmatic initiatives), while Table 6-4 presents the overall load reductions. Appendix C presents these loadings against the loadings from the Chesapeake Bay TMDL. The most reductions will be obtained by implementing ESD practices on impervious land. Pet waste campaigns will achieve almost half of the bacteria reductions. This campaign assumes that 65 percent of pet owners pickup and properly dispose of their pet's waste. Stream restoration and street cleaning will be an important part of reducing TSS in the watershed. Urban nutrient management (e.g., fertilizer reductions) will have an unknown effect on TSS, BOD, and bacteria loads due to lack of documentation. Similarly, stream restoration will have unknown effects on BOD and bacteria loads.

Table 6-3. Comparisons of total load reductions by restoration strategies

Parameter	Dry Pond Retrofit	ESD Practices	Pet Waste Campaign	Urban Nutrient Management	Street Sweeping/ Inlet Cleaning	Stream Restoration	Tree Planting	Dumpster and Washing Programs
Total nitrogen (lb/yr)	612	148,682	24,575	441	14,940	5,625	187	88
Total phosphorus (lb/yr)	215[a]	26,302[a]	878	1,818	2,620	5,100	13	14
TSS (ton/yr)	34.6[a]	9,161.4[a]	14.5	0[b]	1,012.6	9,282.8	12.0	0.3
BOD (lb/yr)	7,999	858,404	115,647	0[b]	161,342	0[b]	0[b]	450
Fecal coliform bacteria (MPN B/yr)	1,791	3,048,042	1,735,758	0[b]	29,413	0[b]	0[b]	165,845

Notes:
[a] Includes loadings caused by streambank erosion.
[b] Information on the removal efficiency for this parameter from this activity is not known.

Table 6-4. Total load reductions in the Anacostia River watershed in Prince George's County

Parameter	Implementation Model Baseline from WTM	Percent Reduction from MDE *TMDL Data Center*	Implementation Model Target Load	Required Implementation Model Reduction from WTM	Reduction from Current BMPs	Remaining Reduction or *Reduction Gap*	Reduction from Restoration Plan Strategies	Remaining Reduction
Total nitrogen (lb/yr)	281,378	81.00%	53,462	227,917	4,421	223,496	195,150	10.07%
Total phosphorus (lb/yr)[a]	45,041	81.20%	8,467	36,573	1,310	35,263	36,960	0.00%
TSS (ton/yr)[a]	14,532	85.00%	2,180	12,352	2,594	9,758	19,518	0.00%
BOD (lb/yr)	1,151,816	58.00%	483,763	668,053	36,986	631,067	1,143,84	0.00%
Fecal coliform bacteria (MPN B/yr)	4,375,323	86.40%	594,281	3,781,042	29,947	3,751,095	4,980,849	0.00%

Notes:
Fecal coliform bacteria WLAs have different percent reductions from the tidal area and nontidal area. The table combines these areas.
[a] Includes loadings caused by streambank erosion.

6.1.4 Additional Measures

Other measures, noted below, can further reduce loads of nutrients, BOD, TSS, and bacteria. However, these measures are not considered part of the County's MS4 WLA requirements and, therefore, load reduction estimates were not calculated. Similarly, they are not included in the cost estimate or implementation schedule.

On-Site Disposal System Repair and Replacement

Nutrient and BOD loads from failing septic tanks are not part of the County's stormwater MS4 load reductions. Upgrading septic systems or connecting houses to a sanitary sewer system will help the overall achievability of the TMDLs. However, it is difficult to accurately predict the number of failing septic systems or the number of failures addressed through septic system upgrades or removal (after homes are connected to sanitary sewers). If the number of failing septic systems (or even the number of septic systems in general) is reduced significantly, it might help reduce the number of stormwater BMPs that are required for water bodies to meet applicable water quality criteria in the watershed. This would be determined through monitoring and the restoration plan's adaptive management approach. Load reductions associated with septic system maintenance, enhancements, and conversions can be used by local governments as alternative practices for meeting NPDES stormwater permit requirements as per MDE guidance (MDE 2014b).

Sewer Repair and Rehabilitation

One source of fecal coliform bacteria to stormwater is aging sewer lines and manholes. There are more than 850 miles of sanitary sewers in the Anacostia River watershed. Of those, there are more than 100 miles of sewers that were installed before 1940 and another almost 300 miles that were built in the 1940s and 1950s. In extreme cases, aging sewer lines result in sanitary sewer overflows, which are quantified in the *Anacostia River Watershed Existing Conditions Report* (Tetra Tech 2014a). As a result, the single most effective measure to reduce sanitary sewer overflows is to repair and rehabilitate existing sewer lines. The Washington Suburban Sanitary Commission (WSSC) is under a 2005 consent decree with EPA to overhaul its sewer lines to reduce sanitary sewer overflows (SSOs) under their Sewer Repair, Replacement and Rehabilitation Program. As part of that program, improvements to leaky sewer lines could dramatically reduce human bacteria loads, along with nutrients, BOD, and sediment. Because this effort is not administered by the County, it is difficult to determine how much rehabilitation would be involved. Its cost would be borne by WSSC. However, loads from sewer overflows and leaks are not part of the County's MS4 load reductions. Loadings from SSOs and other sewer leaks are reflected in water quality monitoring data. These data were used in TMDL development, meaning that loads from SSOs and other sewer leaks are assumed to contribute to the overall load from urban areas (e.g., the County's MS4 area). The WSSC program is mentioned here as part of the overall plan to help the Anacostia River meet its water quality criteria. The correction of SSOs and other sewer leaks will help the overall achievability of the nutrient, BOD, and bacteria TMDLs.

Atmospheric Deposition Reductions

Data and modeling results analyzed for the Chesapeake Bay TMDL show that atmospheric deposition is the largest single input load of nitrogen to the Bay watershed. They also indicate that during the 1985 to 2005 Bay modeling period, those input loads were declining. The Chesapeake Bay TMDL (which includes the entire Anacostia River watershed) includes load allocations for atmospheric deposition of nitrogen. Analysis of atmospheric deposition for the Bay TMDL separated air deposition nitrogen into two parcels: (1) atmospheric deposition occurring on the land and nontidal waters in the Bay watershed, which is subsequently transported to the Bay; and (2) atmospheric deposition occurring directly onto the Bay tidal surface waters.

The Bay TMDL considers deposition on land as part of the jurisdictions' allocated loads because it becomes mixed with nitrogen loads from other land-based sources, is controlled in the same way as other land-based sources, and is indistinguishable from other land-based sources. The Bay TMDL assumes that implementation of Clean Air Act measures through 2020 will result in significant emissions reductions that will, in turn, reduce the amount of nitrogen deposited on land surfaces. These are nitrogen reductions that are expected to take place and therefore will not require additional BMPs. Explicit analysis of expected reductions for the Anacostia River watershed are not available; however, Appendix L of the Chesapeake Bay TMDL presents model scenario results of total nitrogen delivered to the Chesapeake Bay (millions pounds per year) from the nine major river basins under different key atmospheric deposition model scenarios. For the Potomac River watershed, which includes the Anacostia River watershed, modeling suggests that from 2002 to 2020, air deposition of nitrogen is expected to decrease from 72.2 million pounds per year to 68.3 million pounds per year, a decrease of approximately 5.5 percent.

6.2 Cost Estimates

The cost estimates in this section are intended to provide the County and its watershed partners with a general sense of the expenditures and staff resources, within an order of magnitude accuracy, that might be anticipated over the period of implementation. The costs do not account for inflation over the lifetime of this plan. Given the iterative and adaptive nature of the restoration plan and the potential for modifications of proposed activities, the cost estimate should be considered preliminary for the year estimated and in later years should be revisited as the implementation period moves forward and new data become available.

6.2.1 Programmatic Initiatives

Cost for programmatic initiatives are more difficult to determine than BMP costs. Some of the programmatic initiatives are extensions of current County practices. For instance, the ReLeaf Grant Program is one of the County's existing programs with an existing budget. For the CWP, the costs are included in the BMP analysis; the only additional cost to the County is the staff time needed to administer and coordinate the program as part of regular duties. Other programs do not have costs factored into the current County budget.

Provided below are the estimated resources needed for various outreach-related programmatic initiatives that support watershed restoration. Resources will be prorated and split among the different local TMDL restoration plans. Many of the existing County programs are expected to be maintained at their current levels. Some programs are still in the initial phases, so the programmatic costs for those activities will increase. Only County programs that will have increased programmatic funding are discussed in this section. The County programs that are not addressed below include those for which any increase in programmatic costs is only due to annual salary increases, not to any increase in activity level.

- Current Outreach Initiatives
  - *Clean Water Partnership* (*CWP*) *Program*: As discussed in section 4.2.1, the CWP, which focuses on ROW runoff management, will have a total cost of approximately $64 million ($14 million for the first year followed by $25 million for each of the following 2 years). The program operating costs for this program will include three staff engineers for 100 percent of their time.

- *Rain Check Rebate and Grant Program*: As discussed in section 6.1.2, the County has allocated $3 million to implement the Rain Check Rebate and Grant Program. Funding comes entirely from the revenues generated under the Clean Water Act Fee Program. In addition to the costs for the rebates themselves and County staff time needed to run the program, it is anticipated that the County will need to continually reach out to the public to promote the program and encourage participation. This will primarily be done though community workshops. This program costs the County $300,000 annually in administration.
- *Alternative Compliance Program*: There is opportunity for DoE staff working on this program to cross-market outreach with other related programs such as the Rain Check Rebate and Grant Program and other County programs. The County plans to use two full-time County staff members to reach out and work with 100 nonprofit organizations each year. The County staff will contact prospective nonprofit organization partners and track the program's progress.

- New Outreach Initiatives
  - *Pet Waste Program*: An effort is currently underway to develop a pet waste outreach campaign. However, because campaign strategy is not yet developed, costs for this program can only be preliminarily estimated. The County estimates it will provide $50,000 in the first year of the pet waste campaign towards costs for installation of pet waste stations, and for County staff to operate this program. The current strategy is to target this program to homeowner associations (HOAs) only. The HOAs will be responsible for day-to-day upkeep of the stations. Bag dispenser stations generally range from $120 to $500, plus installation costs. The County will also look for partners to support installation or provide other assistance to help reduce the costs of this program. The operating costs for this program will include one staff member for 25 percent of their time.
  - *Lawn Care Program*: The County will initiate a lawn care program that emphasizes good lawn care practices. The costs associated with this program will include County staff, public education materials (e.g., pamphlets), media campaigns, and outreach events or workshops held at lawn care suppliers. The program operating costs for this program will include one staff member for 25 percent of their time.
  - *Household and Commercial Waste Disposal Program:* The County will initiate a public outreach program to educate the public on pollution from leaking dumpsters and trash bins in addition to encouraging the use of leakproof containers. The outreach campaign will also emphasize ways to prevent washwater from entering the County's MS4. The costs associated with this program will include County staff and public education materials. The program operating costs for this program will include one staff member for 5 percent of their time.

Each program has annual operational costs that include staff salaries, outreach materials, and publicity for the program. In addition, the new programs have kick-off year costs for designing the outreach program and its materials. Table 6-5 provides the estimated annual costs for the expanded or new programs, estimated additional costs for the initial year, and the method by which the costs will be prorated among the watersheds.

Table 6-5. Programmatic costs for the Anacostia River watershed

Program	Prorating Method	Countywide: Annual Cost	Watershed Share: Annual Cost	Countywide: Additional Initial Year Cost	Watershed Share: Additional Initial Year Cost
CWP	Total cost prorated by impervious acres of the ROW that will be treated.	$360,000	$242,004	$0	$0
Rain Check Rebate and Grant Program	Total cost prorated by impervious acres of the residential areas that will be treated.	$300,000	$228,700	$0	$0
Alternative Compliance Program	Total cost prorated by impervious acres of the institutional areas that will be treated.	$225,000	$170,006	$0	$0
Pet Waste Program	Total cost prorated by the approximate number of pets in the watershed.	$35,000	$23,528	$75,000	$50,417
Lawn Care Program	Total cost prorated by the area of turf in the watershed.	$35,000	$31,433	$25,000	$22,452
Household and Commercial Waste Disposal Program	Total cost prorated by the approximate number of dumpsters in the watershed.	$6,000	$4,037	$15,000	$10,093
Total		**$961,000**	**$699,708**	**$115,000**	**$82,962**

Note: This table does not include costs to implement BMPs. Costs are for staff and outreach materials and publicity.

6.2.2 BMP Implementation

The cost data presented in Table 6-6 are based on the University of Maryland Center for Environmental Science (UMCES) Technical Report Series No. TS-626-11, *Costs of Stormwater Management Practices in Maryland Counties*, prepared for MDE (King and Hagan 2011).[8] These unit cost estimates (capital and operations and maintenance [O&M]) were developed for the proposed BMPs presented in section 6.1 by land use type.

[8] The cost-estimating framework used in the report develops full life cycle cost estimates using the sum of initial project costs (preconstruction, construction and land costs) funded by a 20-year county bond issued at 3 percent, plus total annual and intermittent maintenance costs over 20 years. Annualized life cycle costs are estimated as the annual bond payment required to finance the initial cost of the BMP (20-year bond at 3 percent) plus average annual routine and intermittent maintenance costs.

Table 6-6. BMPs costs by application

BMP Type	Life Span (years)	Preconstruction & Construction Cost/Impervious Acre	O&M Unit Cost/ Impervious Acre	Total Life Costs	Annualized Cost/ Impervious Acre
Pond retrofit	20	$11,700	$1,232	$36,340	$1,817
ROW: open section	20	$52,758	$984	$72,240	$3,622
ROW: closed section	20	$55,929	$2,379	$90,213	$5,175
Institutional	20	$51,368	$1,386	$100,949	$3,954
Commercial/industrial	20	$51,368	$1,386	$100,949	$3,954
Residential	20	$17,477	$309	$23,665	$1,183
Stream restoration	20	$50,000	$891	$67,820	$3,391

Stream restoration costs were taken directly from the King and Hagan (2011) report. The remaining BMP group type costs are averages of different specific BMP types. The following is a discussion on the methods used to determine the BMP type costs presented in Table 6-6.

- *Pond Retrofit Costs*. The UMCES cost data provides information for new dry pond construction, but not for retrofitting a dry pond to improve water quality. Pond retrofits would focus on retrofitting dry ponds to wet ponds. For the pond retrofit cost, it was assumed to be equivalent to 30 percent of the cost of a new pond construction.
- *ROW: Open Section*. As previously described, a number of ESD practices can be used on an open section ROW. These were ranked from the lowest cost (impervious disconnection) to the highest cost (permeable pavement). Because this restoration plan does not specify which ESD practices will be used, the final costs were weighted according to an estimated proportion for each practice to arrive at the final cost. There are 1,266 acres of open road section in the County. Based on professional judgment and experience in the County and the State, of that total acreage, 20 percent was assumed to qualify for impervious disconnect credit, 30 percent could be treated with swales or bioswales, 40 percent could be treated with vegetated open channels, and 10 percent would require a permeable pavement practice. Because the UMCES report does not have any values for impervious disconnection, the urban grass filter cost was used as a surrogate. This generated a weighted annualized unit cost of $3,622/impervious acre.
- *ROW: Closed Section*. A similar analysis was conducted for the closed ROW section. The ranking of potential ESD practices ranged from the lowest (tree box) to the highest (permeable pavement). The lowest cost ESD practice, the tree box, will generally not meet the performance criteria as a stand-alone practice, but will need to be coupled with other practices, such as bioretention/rain garden practices. Based on professional judgment and experience in the County and the State, it was projected that this combination of practices could manage 40 percent of closed ROW acres and that another 40 percent might require a hydrodynamic device or a similar practice. In addition, it was projected that approximately 15 percent of the areas would require an urban filter, and 5 percent would require a permeable pavement solution. This generated a weighted annualized unit cost of $5,175/impervious acre.

- *Institutional*. The institutional land-use applications were subject to a similar analysis. As previously described, the institutional land-use applications have a much larger grouping of ESD practice options. The ranking by cost was the same as for open ROW section. The institutional applications also usually have more space available for stormwater practices. In addition, roof areas could be treated using impervious area disconnection coupled with storage devices such as dry wells, landscape planters, or rain gardens. This accounts for 30 percent of the total institutional impervious area. Based on professional judgment and experience in the County and the State, another 45 percent could be treated with landscape-based practices, such as bioretention. In addition, urban filtering practices might make up 20 percent and another 5 percent could require the use of permeable pavement in parking areas. This generated a weighted annualized unit cost of $3,954/impervious acre.
- *Industrial/Commercial*. The analysis of industrial and commercial applications revealed that these have opportunities similar to the institutional land uses; therefore, the same unit costs developed for the institutional areas apply to industrial and commercial land areas.
- *Residential*. The residential land use has a well-defined range of on-site BMP practices that can be used to manage stormwater. They include all the nonstructural practices documented in the MDE ESD manual (MDE 2009), as well as swales, rain gardens, and permeable pavement for driveways, walks, and patios. Based on professional judgment and experience in the County and the State, it was estimated that practices in the following percentages could be used;
  - Rooftop disconnection 25%
  - Nonrooftop disconnection 10%
  - Bioswales 20%
  - Rain gardens 40%
  - Permeable pavement 5%

  This generated a weighted annualized unit cost of $1,183/impervious acre for residential applications. However, since the amount of impervious cover for various residential types ranges from 3,000 square feet for 1-acre lots to 1,500 square feet for ⅛-acre lots, the following preconstruction and construction and annualized unit costs for the various lot sizes were obtained and used in this cost analysis:

Lot Size	Preconstruction & Construction Costs	Annualized Unit Cost
1 acre	$ 1,165	$ 79
½ acre	$ 794	$ 54
⅓ acre	$ 728	$ 49
¼ acre	$ 728	$ 49
⅛ acre	$ 603	$ 41

- *Life Cycle.* Although individual life cycles can range from 10 to 50 years, the lifetime of on-the-ground BMPs is generally considered to be about 20 years. This period is also reasonable for programmatic strategies because significant changes can occur to a program or practice over its 20-year life span.

Cost estimates for each subwatershed were developed using the selected palette of on-the-ground BMP and programmatic strategies, targeted based on land use types. Cost estimates of on-the-ground BMPs could include costs related to land acquisition, scaled construction, design and permitting, and operation and long-term maintenance. Cost estimates have been established using published Maryland data (in MAST) and local project knowledge to develop County-specific implementation costs. The MAST unit costs ($ per impervious acre treated) were used to develop restoration costs.

6.2.3 Final Costs

The final costs per restoration activity are shown in Table 6-7, along with the estimated load reductions and cost per pound (or billions of organisms in the case of bacteria) of pollutant reduced. Because of the large percent reductions, many different restoration activities will be needed. In this restoration plan, stream restoration will provide the most reductions for nitrogen, phosphorus, and sediment, followed by ESD BMP implementation. Pet waste campaigns will provide the largest reductions for bacteria. Programmatic initiatives are usually more cost-effective.

Table 6-7. Total BMP implementation and programmatic initiatives cost and load reductions by the restoration strategy

Parameter		Dry Pond Retrofit	ESD Practices	Pet Waste Campaign	Urban Nutrient Management	Street Sweeping /Inlet Cleaning	Stream Restoration	Tree Planting	Dumpster and Washing Programs
Total cost ($M)		$0.36	$357.53	$0.07	$0.05	$3.40	$37.50	$2.50	$0.01
Load reduction	Nitrogen (lb/yr)	612	148,682	24,575	441	14,940	5,625	187	88
	Phosphorous (lb/yr)	215[a]	26,302[a]	878	1,818	2,620	5,100	13	14
	TSS (ton/yr)	34.6[a]	9,161[a]	15	0[b]	1,013	9,283	12	0.3
	BOD (lb/yr)	7,999	858,404	115,647	0[b]	161,342	0[b]	0[b]	450
	Bacteria (MPN B/yr)	1,791	3,048,042	1,735,758	0[b]	29,413	0[b]	0[b]	165,845
Cost per Unit	Nitrogen ($/lb)	$596	$2,405	$3	$122	$228	$6,667	$8,039	$160
	Phosphorous ($/lb)	$1,694	$13,594	$83	$30	$1,298	$7,353	$113,636	$1,032
	TSS ($/ton)	$10,536	$39,026	$5,045	$0[b]	$3,358	$4,040	$125,000	$45,463
	BOD ($/lb)	$46	$417	$1	$0[b]	$21	$0[b]	$0[b]	$31
	Bacteria ($/MPN B)	$204	$125	$0	$0[b]	$116	$0[b]	$0[b]	$0

Notes:
[a] Includes loadings due to streambank erosion.
[b] Information on the removal efficiency for this parameter from this activity is not known.

6.3 Funding Sources

Implementation of the management activities within the proposed schedule will depend largely on available funding and financing options. Funding refers to sources of revenues to pay for annual operating expenditures, including maintenance and administrative costs; to pay for management activities directly out of current revenues; and to repay debt issued to finance capital improvements. Financing is defined as the initial source of funds to pay for management activities. A comprehensive list of available funding and financing options were reviewed, and the most applicable approaches are summarized in this section.

The County is considering a number of different ways to finance its restoration projects. Typically, the County has issued tax-free municipal bonds to fund projects, which is the preferred method to obtain funding. Optionally, the County can also use private financing and/or group financing. Another option that the County might consider is selling stormwater bonds, where the residents can invest in the program by buying bonds. Although a good option, establishing and administering stormwater bond sales is a time-intensive process and could be cost-prohibitive as a result.

Currently, the County is funding projects through its annual Capital Improvements Program (CIP), which is supported primarily through the sale of bonds. The CIP contains project construction budget projections for the next 6 years. Depending on the project commitments in the CIP, the County purchases bonds to match CIP cost demands. In addition, the stormwater ad valorem tax is collected throughout the County (except for Bowie, which is its own entity) as part of property taxes to help fund stormwater management programs. The tax is applied in two taxing districts: (1) District 1 generally covers the urban portions of the County and has a tax rate of $0.054 per $100 of assessed property value, and (2) District 2 generally covers the rural portions of the County and has a tax rate of $0.012 per $100 of assessed property value. The County uses these funds to predict the amount of annual CIP expenditures using the generated funds. The ad valorem tax annually collects approximately $7 million; however, that total varies year to year on the basis of assessed property values. Not all of this money is available for stormwater restoration projects. Some of the collected funds are used to support the Department of Permitting, Inspection, and Enforcement; DPW&T's gray infrastructure projects (infrastructure for stormwater conveyance), and salaries for DoE staff.

In 2013, the County enacted a Clean Water Act Fee that provides a dedicated revenue source for addressing stormwater runoff and improving water quality for regulatory mandates such as the Chesapeake Bay WIP, TMDL Restoration Plans, and the NPDES MS4 Permit (independent of the ad valorem tax and General Fund). The fee is based on a property's assessed impervious surface coverage and provides a mechanism to equitably allocate the fee based on a property's stormwater contribution. Thus, each property contributes a fair and equitable share toward the overall cost of improving water quality and mitigating the impact of stormwater runoff. The fee is expected to collect roughly $14 million of dedicated funding annually. Depending on the rate of restoration activities completed by the CWP and County CIP efforts, the County might reevaluate funding options in the future.

Table 6-8 presents the current CIP budgets for stormwater-related treatment projects countywide. Although the CIP lists some specific projects, many listings are for general restoration activities and do not list specific restoration activity locations; therefore, the CIP expenditures for the entire County, rather than watershed-specific activities, are listed. Some additional funds are dedicated but are not listed in the CIP. The largest of these is the CWP, which will be run by DoE. The program is expected to be responsible for providing water quality treatment to 2,000 acres of impervious land over the next 3 years at a total cost of approximately $64 million ($14 million in the first year, followed by $25 million in each of the following 2 years).

Table 6-8. Current capital improvement project (CIP) budget for Prince George's County

Project Type	FY 14	FY 15	FY 16	FY 17	FY 18	FY 19	FY 20
	Allocated Cost ($1,000s)						
Local TMDL restoration activities	0	650	1,000	1,700	1,700	1,700	1,700
NPDES compliance	3,398	8,287	8,230	6,670	6,670	6,670	2,170
Chesapeake Bay WIP-related water quality	1,453	6,728	0	0	0	0	0
DPW&T stormwater management	16,996	10,250	12,010	13,160	14,260	14,260	14,260
Stream restoration	2,481	1,650	1,000	0	0	0	0
Other identified project	2,550	2,415	3,190	490	0	0	0
Contingency fund	1,000	1,000	1,000	1,000	1,000	1,000	0
Total	**27,878**	**30,980**	**26,430**	**23,020**	**23,630**	**23,630**	**18,130**
Project Type	**FY 14**	**FY 15**	**FY 16**	**FY 17**	**FY 18**	**FY 19**	**FY 20**
	Funded by Grants ($1,000s)						
NPDES compliance and Restoration (including WIP)	12,122	26,185	18,810	.15,070	14,770	14,770	14,770
DPW&T stormwater management	23,000	14,800	16,000	17,000	17,000	17,000	17,000
Stream restoration	2,150	1,800	175	4,600	2,100	2,100	010,100
Contingency fund	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Total	**24,000**	**15,800**	**17,175**	**22,600**	**20,100**	**34,870**	**42,870**

Note: FY = fiscal year, which runs July through June. For example, fiscal year 2014 ran July 1, 2013, through June 30, 2014.

Besides funds from the Clean Water Act Fee, stormwater ad valorem tax, and CIP budget, grants (federal, state, or other) are expected to be an essential contribution to funding; a list is provided in Appendix D. The County has successfully obtained various grants in the past and expects that the trend will continue. The County will continue to aggressively pursue grant opportunities available for restoration projects. In addition to grants, federal and state loans (e.g., state revolving fund) might be an option for helping to fund part of the TMDL restoration process. In addition, the County encourages government entities (e.g., municipalities) and private organizations (e.g., watershed groups, nonprofits) to identify and apply for grant opportunities.

It is expected that the current funding sources and funding will remain consistent over the life of this restoration plan. Projecting the current and projected 5-year capital budget (2014–2019), the County expects to have $21 million a year from the Clean Water Act fees and ad valorem tax (or $105 million total over the 5-year period) for restoration activities. The County will sell bonds as needed and will use revenues to pay the interest. The available money will need to be split across multiple restoration plans, including the Chesapeake Bay WIP; however, many of the activities in the WIP can be counted towards the local restoration plans. Similarly, the PCB-impacted water body restoration plan has restoration activities that overlap with the Anacostia River, Mattawoman

Creek, and Piscataway Creek restoration plans.[9] The MS4-responsible budgetary requirements of the different restoration plans are:

- Anacostia River watershed: $401 million
- Piscataway Creek watershed: $39 million
- Mattawoman Creek watershed: $14 million
- Upper Patuxent River watershed: $4 million
- Rocky Gorge Reservoir watershed: $0.2 million
- PCB-Impaired water bodies: $69 million (Potomac River portion only)
- Chesapeake Bay WIP (countywide): $727 million (for comparison to local plans)

For the purposes of this plan, funding by the County can be allocated proportionally to the funding required by each restoration plan. The County reserves the right to shift funding, in certain years, to areas in other watersheds that require large amounts of load reductions or where restoration opportunities arise. By doing so, the County will shift year-to-year reduction goals, but will not change the final restoration activity completion date, which was determined using the estimated annual budget for restoration activities.

6.4 Implementation Schedule

This section provides the implementation schedule for the BMP and programmatic strategy necessary to meet the TMDL compliance milestones. The timeframe to secure the necessary funding for each individual BMP is not incorporated in the implementation schedule. There is no mandated end date to the local TMDL restoration plans; however, the County understands that the public prefers an expedited restoration process. The County also shares the urgency. However, the lack of new BMPs with better efficiencies and site opportunities for restoration activities that can occur each year might be limited. Regardless, the County and its watershed partners are committed to finding site opportunities and to expediting the planning, design, and construction phases for management activity to the maximum extent practicable.

Several factors contribute to the overall schedule. First, the County is bound by its permit requirements to retrofit (e.g., treat) 20 percent of the untreated impervious area in its MS4 area by the end of the permit cycle (current permit ends on January 2, 2019). Another factor in the implementation schedule is the Phase II WIP for the Chesapeake Bay TMDL. In addition, the County has initiated the CWP, which is initially focusing on ROW runoff management for older communities, which are inside the Capital Beltway. The program is expected to be responsible for providing water quality treatment to 2,000 acres of impervious land over the next 3 years. The County also anticipates restoring an additional 2,000 acres through its CIP and other efforts. These will form the basis of the main interim milestones of this restoration plan.

Planning for public education and outreach campaigns will begin when this restoration plan is finalized. To be successful, the campaigns will need to be ongoing and not be one-time activities. The County is already launching a pet waste campaign. Pet waste campaigns will initially focus on the areas with the highest concentrations of pets. Similarly, good lawn care education will begin in

[9] For more information on the PCB-impacted water body restoration plan, see *Restoration Plan for PCB-Impacted Water Bodies in Prince George's County* (Tetra Tech 2015a).

areas with the most residential turf. The County will aim to target its entire area by the end of its current permit cycle.

Another major factor in the implementation schedule is the availability of funding. From Table 6-8, the annual countywide planned water quality improvement expenditures range from $18 million to $31 million. However, these funds will be spread across watersheds because the County is responsible for implementing the Chesapeake Bay WIP and the restoration plans for the Anacostia River, Piscataway Creek, Mattawoman Creek, Rocky Gorge Reservoir, Upper Patuxent River, and PCB-impacted watersheds. Therefore, the annual projected impervious acres that will be treated will be spread throughout the County.

To help determine the schedule, the total required impervious acres to be treated were totaled for all the local restoration plans. The percent total acres for each restoration plan was then calculated (Table 6-9) so that implementation would be proportionally done on the basis of required impervious area retrofits. The County estimates, that on average, 1,000 impervious acres per year will be treated (after an initial ramp up period); therefore, these annual acres will be split between the different TMDL watersheds. However, the County reserves the right to prioritize specific watersheds to address areas with higher load reduction requirements first. For instance, the CWP will be focusing on the older areas of the County; since they were developed before stormwater management controls were enacted. As a result, the percentages in Table 6-9 were adjusted for the initial years and the remaining years were then proportioned on the basis of remaining impervious areas to be treated (Table 6-10).

Factoring the implementation of the other restoration plans, this restoration plan will be fully implemented by FY2030. The impervious acres identified in this plan will have been treated with BMPs and all programmatic activities will have been implemented by FY2030. Table 6-10 presents the estimated annual goals (milestones) for impervious area treated. While, the County estimates it will annually treat 1,000 impervious acres (after an initial ramp up period), there will be slight fluctuations in the annual amount with the annual average of 1,000 impervious acres. The County will aim to exceed the annual average so that restoration efforts can be completed prior to FY2030.

Table 6-11 presents the average annual estimated load reductions by year from BMP implementation in the watershed. There will be slight fluctuations in the annual load reductions due to the types of BMPs used and the land uses they treat, but the County will aim to meet or exceed the annual goals.

Table 6-12 presents the overall target milestone timeline for this restoration effort. This schedule will be continuously monitored by the County to access ways to increase the rate of implementation and to ensure practices are occurring as planned.

Table 6-9. Impervious area goals to be treated by local restoration plan

	Anacostia River	Mattawoman Creek	Upper Patuxent River	Piscataway Creek	Rocky Gorge Reservoir	PCB Watersheds[a]	Total
Impervious area goals to be treated in MS4 areas	10,129	388	140	1,000	4	2,027	13,688
Percent of total impervious (connected and disconnected) in MS4 areas	74.0%	2.8%	1.0%	7.3%	0.0%	14.8%	100%

Note:
[a] Because the PCB watersheds overlap with several other watersheds, the acres in this table only includes impervious areas that are not in the other watersheds.

Table 6-10. Annual impervious area (acres) goals/milestones to be treated by local restoration plans

Fiscal Year	Annual Impervious Acres	Anacostia River	Mattawoman Creek	Upper Patuxent River	Piscataway Creek	Rocky Gorge Reservoir	PCB Watersheds[a]	Cost ($M)
2016	750	562.5	20.4	7.3	52.7	0.2	106.8	$28.99
2017	850	637.5	23.2	8.4	59.7	0.3	121.0	$32.85
2018	950	712.5	25.9	9.3	66.7	0.3	135.3	$36.72
2019	1,000	737.7	28.6	10.3	73.7	0.3	149.3	$38.60
2020	1,000	737.7	28.6	10.3	73.7	0.3	149.3	$38.60
2021	1,000	737.7	28.6	10.3	73.7	0.3	149.3	$38.60
2022	1,000	737.7	28.6	10.3	73.7	0.3	149.3	$38.60
2023	1,000	737.7	28.6	10.3	73.7	0.3	149.3	$38.60
2024	1,000	737.7	28.6	10.3	73.7	0.3	149.3	$38.60
2025	1,000	737.7	28.6	10.3	73.7	0.3	149.3	$38.60
2026	1,000	737.7	28.6	10.3	73.7	0.3	149.3	$38.60
2027	1,000	737.7	28.6	10.3	73.7	0.3	149.3	$38.60
2028	950	700.8	27.2	10.3	70.0	0.3	141.9	$36.67
2029	800	590.2	22.9	8.3	58.9	0.3	119.5	$30.88
2030	388	286.2	11.1	4.0	28.6	0.1	58.0	$14.98
Total	13,688	10,129	387.9	140	1,000	4.3	2,027	$528.50

Note:
[a] Because the PCB watersheds overlap with several other watersheds, the acres in this table only includes impervious areas that are not in the other watersheds.

Table 6-11. Estimated annual load reductions from BMP implementation and stream restoration

Fiscal Year	Total Nitrogen (lb/year)	Total Phosphorus[a] (lb/year)	TSS[a] (ton/year)	BOD (lb/year)	Fecal Coliform Bacteria (MPN B/year)
2016	8,603.0	1,755.7	1,026.2	48,113.2	170,130.0
2017	9,750.0	1,989.8	1,163.0	54,528.3	192,814.0
2018	10,897.1	2,223.9	1,299.8	60,943.4	215,498.0
2019	11,282.9	2,302.7	1,345.8	63,101.0	223,127.2
2020	11,282.9	2,302.7	1,345.8	63,101.0	223,127.2
2021	11,282.9	2,302.7	1,345.8	63,101.0	223,127.2
2022	11,282.9	2,302.7	1,345.8	63,101.0	223,127.2
2023	11,282.9	2,302.7	1,345.8	63,101.0	223,127.2
2024	11,282.9	2,302.7	1,345.8	63,101.0	223,127.2
2025	11,282.9	2,302.7	1,345.8	63,101.0	223,127.2
2026	11,282.9	2,302.7	1,345.8	63,101.0	223,127.2
2027	11,282.9	2,302.7	1,345.8	63,101.0	223,127.2
2028	10,718.7	2,187.5	1,278.5	59,946.0	211,970.8
2029	9,026.3	1,842.1	1,076.7	50,480.8	178,501.7
2030	4,377.8	893.4	522.2	24,483.2	86,573.3
Total	154,919	31,617	18,479	866,404	3,063,632

Notes:
[a] Includes loadings due to streambank erosion.
This table does not include annual projected load reductions from programmatic activities.

Table 6-12. Countywide target timeline for local TMDL restoration plans

Target	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030
Public Outreach															
Increase public outreach for Rain Check Rebates, Alternative Compliance, and other programs. (Continuous outreach that rotates throughout the County)	✓	✓													
Establish public outreach campaigns for pet waste and lawn care	✓	✓													
Public outreach (e.g., campaigns for pet waste and lawn care, education and outreach on Alternative Compliance and Rain Check Rebates)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Measure progress/reevaluate public outreach campaigns		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BMP Implementation															
BMP planning and design	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BMP implementation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NPDES MS4 Permit															
MS4 requirement: 20% of untreated impervious cover	✓	✓	✓	✓	✓										
Projected MS4 requirement: 20% of untreated impervious cover						✓	✓	✓	✓	✓					
Monitoring															
Complete Round 3 of the countywide biological monitoring.	✓	✓	✓			✓	✓	✓			✓	✓	✓		
Complete selection of water quality representative chemical monitoring station in Anacostia watershed	✓														
Results of representative chemical monitoring in Anacostia watershed		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tracking and Reporting															
Update County geodatabase with new BMP, programmatic, and monitoring information	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MS4 Annual Report	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

6.5 Technical Assistance

Overall success of the restoration will depend on the concerted effort of the County as well as many regional agencies, municipalities, community leaders, and local landowners. Each watershed partner (e.g., federal, state, and local governments, nonprofits, business owners, and private landowners) has its own important role to play in the restoration process. The proposed management actions will require significant time and resources on behalf of all of these organizations. Technical and other in-kind assistance from the watershed partners and the public will be an important component of the plan implementation. Technical assistance will be especially important for addressing impediments to implementation, including permitting challenges, technological limitations, lack of available BMP and ESD sites, and poor public compliance with pet waste and lawn care campaigns. In addition, new BMP technologies are being developed that will help lower costs, decrease the BMP footprint, and increase removal efficiencies. Some of this research is being performed by Dr. Allen Davis at the University of Maryland. These technologies need to be approved and assigned removal efficiencies by MDE and the CBP in a timely manner. In addition to approving new BMP technologies, the County looks to MDE to continue issuing grants for stormwater restoration activities and to help in performing water quality monitoring in high-priority watersheds in the County.

Many sites that are suitable for BMP implementation are not County-owned. Without forming partnerships and being granted access, the County will only be able to install BMPs on property it has direct access to, such as ROW or on County government-owned land. The County will need to seek partnerships with other organizations (e.g., nonprofit organizations, businesses) to perform restoration on private lands. For example, a shopping center owner could partner with the County to gain assistance with installing BMPs. This could range from technical assistance to partnering to install a BMP that treats the parking area of the shopping center and the County ROW. In addition to County-owned and private land, some federal and state properties are available within the County. These state and federal agencies have their own load reductions they will need to meet. The County will explore ways to work with state and federal agencies to conduct joint restoration activities that will help reduce loadings from both County land and either state or federal land.

The County will involve the public in the restoration process (section 6.6). The County welcomes and appreciates any ideas the public can provide; after all, people who live and work in the watersheds are the most familiar with it. They can act as the eyes and ears of the County on a day-to-day basis. During the implementation of the restoration plans, the County will work closely with community leaders to ensure that they participate in the selection of projects to improve water quality in their communities. The County will look into having regular meetings with interested parties. The meetings will be used to obtain feedback on the restoration strategies as well as information on restoration opportunities. The public can further stay informed on the County's progress through the County's annual MS4 report to MDE. This report will be posted on the County's website and will contain information on BMP implementation, public outreach events, and other County programs that will help meet TMDL goals. In addition, the County welcomes public ideas on restoration activities, as well as potential BMP types or locations. The BMPs identified by the Anacostia Watershed Restoration Partnership are in the restoration toolbox of potential restoration activities and thus, they will be considered for implementation on a case-by-case basis as the restoration process moves into the implementation phase.

Besides staying informed, the public has a very important role to play in the restoration process. Homeowners could take pledges to clean up after pets and practice environmentally friendly lawn care. In addition, the public can participate in the Rain Check Rebate and Grant Program and nonprofits can participate in the Alternative Compliance Program. Nonprofit organizations and private landowners can aid in the restoration process by installing BMPs (e.g., rain barrels, rain gardens, permeable pavement) on their properties and following recommendations on pet waste and lawn care to help minimize their impact to the overall pollution loading to the County's water bodies. Installing BMPs on private properties decreases the owners Clean Water Act fee. Although these small practices might seem insignificant, the overall load reductions can be significant if enough nonprofit organizations and private landowners aid in the restoration process. Business owners can help by promoting pet waste campaigns. For example, pet stores could donate pet waste bag dispensers to apartment complexes (in exchange for advertising rights on the pet waste stations); pet stores, kennels, pet rescue leagues, and veterinarians could allow public outreach brochures and signage at businesses; or veterinarians could speak to pet owners about the importance of pet waste cleanup and spaying or neutering pets. Similarly, lawn care companies and suppliers could aid in public outreach regarding lawn care. Organizations such as homeowners associations, neighborhood associations, and business organizations can also help by promoting the programmatic initiatives outlined in this restoration plan.

The County has already initiated several projects, including:

- *Engagement and Collaboration with Civic and Homeowner Associations.* DoE will continue to reach out to local civic and HOAs through presentations and other outreach tactics. For example, DoE recently conducted several environmentally focused presentations for civic associations that focused on the Rain Check Rebate and Grant Program and Tree ReLeaf. In addition, presentations at local libraries in targeted communities are also fostering participation in these programs by homeowners. HOAs are an important part of the process and the County is committed to engaging them. The County has an agreement with the Chesapeake Bay Trust to provide grants and to work with HOAs to figure out their needs and the programs that would directly benefit them.
- *Stormwater Stewardship Grant Program.* To reduce stormwater pollution from residential areas, particularly urban and suburban areas, it will be critical that DoE find ways to build partnerships and collaborate more with HOAs. Through the Prince George's County Stormwater Stewardship Grant Program, the Chesapeake Bay Trust currently funds implementation requests for construction of water quality improvement projects. The Trust also funds citizen engagement and behavior change projects implemented by a variety of nonprofit groups, including HOAs. Grants ranging from $20,000 to $200,000 are available for water quality projects; grants from $5,000 to $50,000 are available for citizen engagement and behavior change projects. Projects must accomplish on-the-ground restoration that will result in improvements in water quality and watershed health (reduction in loads of nutrients or sediment) or significantly engage members of the public in stormwater issues by promoting awareness and behavioral change. Another goal of the grant program is to encourage participation by multicultural communities on projects that improve watershed health and expand ecological awareness.

- *Technical Assistance for the Alternative Compliance Program.* The County's Alternative Compliance Program allows qualified tax-exempt religious organizations or other 501(c) nonprofit organizations to qualify for a reduction in the Impervious Area Fee portion of the Clean Water Act Fee for the property owned by the organization. There are three options that the organizations can use to receive the fee reduction:

  - *Provide Easements.* For a 50 percent reduction in the fee, the property owner provides a temporary right-of-entry agreement to the County to install BMPs on property owned by the organization. To continue receiving the impervious area fee credit, installed BMPs must be maintained by the property owner of record and are subject to inspection by the DoE. DoE is conducting three pilot studies at places of worship.
  - *Outreach and Education.* For a 25 percent reduction in the fee, the property owner agrees to take part in the County's outreach and education campaign to encourage other property owners to participate in the County's Rain Check Rebate and Grant Program for restoration. The property owner also agrees to create an environmental green team or ministry. Some examples of activities that an environmental green team or ministry could perform include tree planting, trash pickup, on-site recycling and better waste management, rain garden planting, and good housekeeping efforts to maintain clean lots.
  - *Green Care and Good Housekeeping.* For a 25 percent reduction in the fee, the property owner agrees to use lawn management companies that are certified in the proper use and application of fertilizers in connection with their green areas and lawns. The property owner also agrees to conduct good housekeeping practices for ensuring clean lots. This option requires participating organizations to use state-certified landscape services.

At the time of this document's publication, 55 organizations had applied for the Alternate Compliance Program; most expressed interest in participating in all three options. The County is working with eight of them to identify suitable BMP opportunities. For each option, the applicant must sign a memorandum of understanding that explains the agreement with the County.

6.6 Public Outreach and Involvement

To both supplement and support the on-the-ground BMPs and cross-agency programmatic efforts, the County will need to have a robust public outreach and involvement program that spans all the divisions within DoE and incorporates activities by other County agencies and departments. Public outreach can increase public awareness of stormwater issues and ultimately change pollution-generating behaviors to pollution-preventing behaviors, promote the voluntary installation of stormwater practices by property owners, and foster partnerships with other local agencies and organizations to maximize pollutant-reduction achievements. Public outreach can also increase support for BMP retrofits, stream restoration projects, and other on-the-ground work. Public involvement in the implementation activities will also help to ensure that the most appropriate BMP locations, amounts, and types are selected to meet project needs and communities' and stakeholders' wishes.

As part of the public outreach and involvement in the restoration planning, the County has set up a website (http://www.princegeorgescountymd.gov/sites/StormwaterManagement/Services/Streams-Watersheds/Restoration-Planning/Pages/default.aspx) and held public meetings on the restoration process. Two public meetings were held in July 2014 to introduce the restoration planning process and to seek public feedback and suggestions. In addition, the County held a public hearing in November 2015 to present the restoration plans to the public and to receive public comments.

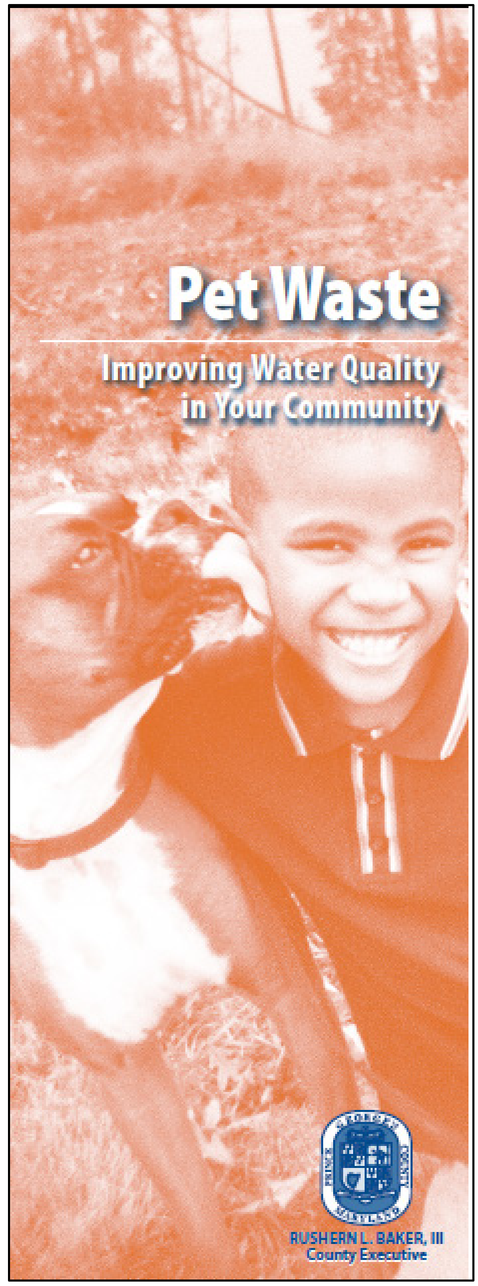
Current outreach programs are discussed in section 4.2, and proposed outreach and education activities are specified in section 6.1.1. Beyond these targeted efforts, the County will work with watershed partners to ensure that the public is informed of implementation progress and that active public involvement is pursued throughout the process.

6.6.1 Outreach to Support Implementation Activities

Outreach should specifically target TMDL pollutants and pollutant-generating behaviors, and will be carried out using the following broad methods:

- *Target Audience Analysis.* The County is made up of a diverse population in terms of age, race, culture, language, education, and income. The County will be looking at different languages and cultures throughout the County trying to learn how those populations best receive information, what events they attend, etc. The County will be focusing on the best way to reach diverse groups with different messaging and methods to make sure that they are getting the message and acting on it.

The County will seek ways to conduct research about various target audiences to learn what barriers (perceived or actual) exist that currently prevent more widespread adoption of pollutant-reducing behaviors. Understanding the audience you are trying to reach is invaluable. In addition, information gained from the research will help establish baseline conditions, such as what the public knows or does not know, what the public does or does not do, and, most importantly, what the County might be able to do to encourage change. Research can be carried out through surveys, interviews, focus groups, and literature reviews. Having a better understanding of what kinds of messages and methods are best for each audience and each pollutant will help ensure that the outreach undertaken has a greater likelihood of success.



Plans are underway to conduct a countywide public survey to learn more about the community's level of environmental awareness and people's concerns. Questions aimed at understanding existing stormwater awareness, behaviors, and obstacles will be included in that survey at a minimum. The types of questions that could be asked in the survey include:

- Do you currently take steps to reduce runoff from your property?
- How often do you fertilize your yard?
- Do you fertilize your yard yourself or do you hire a company to do it?
- How many dogs live in your household? How do you dispose of your dog's waste?
- Have you heard about the Rain Check Rebate and Grant Program? If so, how did you hear about it?
- Of the following list of reasons, which is the primary reason you have not taken steps to reduce stormwater runoff?
  - Stormwater runoff is not a problem in my community
  - Too much work
  - Too expensive
  - I don't know what to do
  - Practices are not attractive
  - HOA would not approve

- *Inventory Existing County Outreach Programs.* The County has initiated the planning for the creation of an inventory of existing programs in and around Prince George's County that are working towards the shared goals of environmental stewardship or stormwater pollution reduction and already have ongoing or planned outreach efforts. The County's inventory will be categorized by mission, geographic coverage, specific focus issue(s), partnership status and potential, mutual benefits, and other elements. This inventory will not only keep the County from duplicating efforts of other groups or agencies, but will also help identify and fill in any noticeable gaps in issues or geographic coverage of existing programs and partners.

- *Develop and Implement Targeted Outreach Components as Part of an Outreach Toolbox.* Campaigns and materials that focus specifically on the following topics could be developed:
  - Residential and community stormwater management and implementation (including roof and parking area runoff).
  - Lawn stewardship to reduce runoff and chemical and fertilizer use, address leaves and grass clippings, and explain proper mower heights. This includes outreach to increase participation in the Rain Check Rebate and Grant Program, which will need to be increased significantly.
  - Car washing and car care.
  - Pet waste pickup.
  - Tree canopy expansion.
  - Alternative compliance (aimed at following up with places of worship and other nonprofit organizations to promote participation).

  Each campaign will include, at a minimum, goals, objectives, target audiences, key messages, delivery techniques, metrics, potential partnerships, and priority neighborhoods. The campaigns will include messages on what citizens should be doing (e.g., using fertilizer only if soil tests dictate a need) and also what they should not be doing (e.g., spilling fertilizer on sideways and driveways). Messages will also emphasize points that show how even small actions can add up to large problems, and, vice versa, to large solutions. A contractor work order to support campaign development is in the planning stage.
- *Enhance and Grow Partnerships.* The County's numerous partnerships with groups such as Master Gardeners, Chesapeake Bay Trust, and MWCOG will continue to be fostered and supported so that outreach efforts piggybacking on the efforts undertaken by these groups can continue to grow. In addition, new partnerships with groups such Anacostia Watershed Society, Potomac Riverkeepers, landscapers and nursery supply chains, HOAs, local boy or girl scout chapters, veterinarians, and others will be developed or fostered to help broaden stormwater outreach and reach citizens that have not been reached in the past.

Although the results of outreach and involvement efforts are very difficult to quantify in terms of pollutant reductions, these activities will make a difference by slowly changing the mindsets and behaviors of County residents over time. In the future, some assumptions about pollutant reductions associated with pet waste pickup, for example, might be developed based on public surveys, observational studies, or other methods. Reductions gained from changes in residential or commercial fertilizer use might be calculated by looking at changes in fertilizer sales across the County.

6.6.2 Public Involvement to Support Implementation Activities

The public is an important part of the restoration process and can personally become involved in many ways.

Community organizations and citizens groups can participate in restoration activities in several ways. They can get involved with local nonprofit groups with which the County is currently partnering. The County will be using nonprofits to help find grant opportunities so the non-profits do not have to wait for the County programs. The additional funding will enable quick upgrades or installation of BMPs throughout various municipalities. In addition, groups can help by identifying potential projects and assisting with public outreach on a variety of water quality topics, such as the upcoming litter and pet waste campaigns. Groups can meet with homeowner associations and other civic leaders to relay the messages that will be pushed with the campaigns and participate in community trash pickups or the Rain Check Rebate Program.

This section lists several recommendations that the County could either implement itself or seek community partners to implement to cut down on the demand on the County's resources and staff's limited time.

- *Identify and Promote Opportunities for Organizations and Citizens' Groups to Become More Involved in Implementation Efforts*. During the public involvement process for the development of this restoration plan, the County heard from several citizens and watersheds groups that are very interested in providing on-the-ground support for BMP implementation projects, programmatic initiatives, or other outreach efforts to support implementation. To this end, the County proposes one of the follow two options:
  - Option 1: A quarterly meeting in which the County invites representatives from watershed groups and local active civic associations for a "Community Collaboration Day." Up to five groups will be invited to each meeting (different groups will be invited to each meeting). At these meetings, the County will provide details on what has been accomplished thus far, what projects they are currently underway, and the County's plans for the next 6 months to a year. Each group in attendance will be asked to give a snapshot of their activities and their plans. Each group will be given the opportunity to have the County's ear privately for 20 minutes to collaborate with County staff and make some preliminary plans for working together. Groups could be provided a 1-page worksheet upon arrival at the meeting to fill out to help make the focused discussion more productive. For example, the Anacostia Watershed Society's Watershed Stewards Academy requires that each student take a 12-session course and then complete a capstone neighborhood project to become a Master Watershed Steward. The County could work with the society to identify priority areas and BMPS for such capstone projects. While each group meets separately with the County, the other groups can meet and discuss how they can work together on various projects.
  - Option 2: A brief email survey developed by the County to send to all local watershed/citizen groups asking them to select specific items on which they need

from the County in order to make progress toward stormwater pollution reduction goals. Sample questions are listed below:

- Check the topics on which your citizen group could use professional advice:
  - BMP siting in a specific community/neighborhood
  - Best practices for stream cleanups
  - Technical support for GIS applications

- In addition, the County will identify several different ways in which citizens and organizations can support implementation directly, such as the following:

Monitoring

- Suggest specific locations for biological or water quality monitoring activities to be carried out based on surrounding land uses/changes, historic water quality problems, public desires, etc.

BMP Installation

- Civic or environmental groups can work directly with an organization or commercial business that has a significant amount of untreated impervious surface such as large parking lots, large building footprint, etc. The groups can help obtain a commitment from the business to participate in the Rain Check Rebate and Grant Program, Alternative Compliance Program, or otherwise install stormwater BMPs on the property. Group members can offer technical assistance and volunteer labor hours to support installation and/or maintenance. The participating civic or environmental group should discuss the selected location and BMP type with the County prior to working with the property owner.
- Citizen groups can seek out and secure commitments from neighborhood/homeowner associations to designate at least one common area such as a park, walking trail, or playground in which to incorporate a stormwater BMP through the Rain Check Rebate and Grant Program or otherwise. Groups can follow up with property owners to ensure that they are following through with plans and, once installed, keeping up with maintenance and publicizing the practices and the Rain Check Rebate and Grant Program to property owners/residents.
- Citizen volunteers can provide technical support for the County's Rain Check Rebate and Grant Program by assisting in visual inspections of residential properties on which BMPs have been installed. Citizen volunteers can be trained to complete the inspection checklist used for the postinstallation site visits. In addition, volunteers can also provide maintenance checkups on a yearly basis.
- Citizens can organize or participate in volunteer tree planting efforts either working with civic associations or schools, or one-on-one with property owners. Grants are available through the County's ReLeaf Grant Program.
- Apply for grants to implement projects under the Chesapeake Bay Trust's Stormwater Stewardship Grant Program.

- Citizens can inform the County about development issues in their area, so that the County can help communities identify and install the best erosion and settlement control BMPs for the areas.

The County welcomes any suggestions from the public regarding potential BMP types or locations. The BMPs identified by the Anacostia Watershed Restoration Partnership are in the restoration toolbox of potential restoration activities and thus, they will be considered for implementation on a case-by-case basis as the restoration process moves into the implementation phase.

Community Outreach

- Organize storm drain stenciling projects. Work with the County to identify areas to target (e.g., neighbors that lack storm drain stencils or plaques in priority watersheds). The County could provide supplies to support the project.
- Publicize and promote the Rain Check Rebate Program, Tree ReLeaf Program, Alternative Compliance Program, pet waste outreach campaign (when developed), and other programs in organization newsletters and by word of mouth at meetings and events.
- Organize/participate in stream cleanup events and litter campaigns, including those supported by the County's Volunteer Neighborhood Cleanup Program or the Alice Ferguson Foundation (AFF). The next planned cleanup event is slated for April 2015. Citizens can become Site Leaders for the cleanup event by contacting Udoma Ohiri at 301-883-5829 or ucohiri@co.pg.md.us; or Alfred Titus-Glover at 301-883-7164 or ATitus-Glover@co.pg.md.us.
- Volunteer or suggest locations for stormwater audits carried out by the County.

- *Form Watershed Action Teams.* The County could develop watershed-specific advisory teams to garner support in identifying places for green infrastructure practices and retrofits, review plans, help identify partners and volunteers for monitoring, or conduct other watershed-specific tasks. Such teams would help meet goals related to outreach, implementation, and public involvement.
- *Semiannual Public Meetings to Inform Citizens of Implementation Progress and Results.* Similar to the July 2014 public meetings held in Laurel and Largo to announce the start of the restoration plan development process, the County could hold semiannual meetings after the restoration plans are developed and are being implemented. The meetings would inform interested parties about restoration progress. Members of the community could be tapped to lead the teams. Team leaders would be responsible for activities such as setting up meetings, communicating with members, and taking notes during meetings. These meetings could be held as informal morning *coffee chats* at a local coffee shop, library, or outside at a public park. Meetings could also be held at a BMP installation site to unveil a newly installed BMP and inform the public of implementation progress. Such meetings could be viewed as ribbon-cutting ceremonies, drawing in members of press for more widespread coverage.

- *Online Transparent Progress Reporting.* Pictures are worth a thousand words. The County could consider developing an infographic, updated quarterly, which provides program statistics such as the number of BMPs installed or retrofitted in a certain period and cumulatively. When citizens click on the infographic they could then be asked if they have a comment or other feedback they would like to provide via email to the County about its progress and results. Progress information could also be provided through County Click (311) and email blasts. In addition, as mentioned in section 7.1, the County is developing a new geo-referenced database for project installation, location, type, etc. This database will be online and available for citizen groups to gain a better sense of how best to dovetail on-the-ground efforts.
- *Pilot a Neighborhood EcoTeam in East Riverdale/Bladensburg Area (which is one of the TNI communities).* The County could identify a well-respected, active community member to spearhead a voluntary stormwater effort that could focus on both on-the-ground BMPs as well as behavioral changes such as reducing fertilizer use or picking up pet waste. This approach has been proven effective by the Livable Neighborhood Water Stewardship Program in Falls Church, Virginia. Volunteer leaders recruited their neighbors to form household EcoTeams to help each other become better water stewards. The teams adopt behaviors such as creating a rain garden and reducing the use of household chemicals. The team aspect provides the motivation to carry out the actions while establishing relationships that help create a livable neighborhood. Studies indicate that such programs are successful in sustaining significant behavior change at the neighborhood level. Once a team is off and running, the team members can serve as messengers and promoters to help spark interest in additional neighborhoods.
- *Conduct a Resource Capacity Analysis.* The County could analyze what staffing and resources would be needed to implement one or more of the above recommendations. Then, the County could determine which activities are feasible in the short-term, medium-term, and long-term timeframes. Finally, to reduce the burden on County resources while also increasing project ownership at the community level, the County could consider which activities could be supported by existing or new partners.

7 Tracking and Adaptive Management

Through its permit, the County is required to "[e]valuate and track the implementation of restoration plans through monitoring or modeling to document the progress toward meeting established benchmarks, deadlines, and stormwater WLAs." The County will address this requirement through its annual MS4 report and through additional environmental monitoring. The overall intent of the County is to go beyond simply tracking implementation of this restoration plan; instead, the County will evaluate how well the implemented plans are resulting in improved conditions. The County's monitoring and assessment approach will include three parts, which are further described in this section:

(1) Implementation tracking will document restoration activities, such as BMP installation or public outreach.

(2) Biological monitoring will evaluate the effectiveness of the TMDL/watershed restoration in providing the environmental characteristics that allow overall ecological conditions to improve.

(3) Water chemical monitoring will document how well those techniques are controlling stressors and reducing pollution.

7.1 Implementation Tracking

To assess reasonable compliance, the County will need to develop an effective process to track and report load reductions to gauge progress towards meeting overall load-reduction goals. The main way to track and report BMP implementation and programmatic initiatives is through the County's MS4 Annual Report. DoE submits this report yearly to MDE with material collected in partnership with DPW&T and the Department of Permitting, Inspections, and Enforcement. The County's permit specifies the information that is to be included in the annual report, which includes BMP implementation, illicit discharge detection and elimination, trash and litter control measures, public outreach and education initiatives, watershed assessments, and funding. The annual report will continue to be the main tracking and reporting mechanism to MDE.

With the approval of the restoration plans, the County is required to include additional information in the annual report regarding TMDL compliance. With each annual report, the County will report progress towards meeting its MS4 WLAs by describing how it measured the effectiveness of the program. The annual report will include the estimated net change in pollutant load reductions from all completed structural and nonstructural water quality improvement projects and enhanced stormwater management programs. Estimated load reductions will be calculated in a manner that is consistent with the loads used in this restoration plan. The report will also compare load reductions and costs to benchmarks and milestones, revised cost estimates, and plans for increasing implementation or activities if benchmarks and milestones are not being met. Therefore, the County will be able to determine if it is meeting its restoration goals and, if not, adjust its program accordingly.

The annual report is accompanied by supplemental data about BMPs, funding, and water quality. Urban stormwater BMPs are included as part of the annual report in a geo-referenced database that is submitted to MDE. The database includes details such as the project locations, types of BMPs, drainage area delineation, and acres of impervious surface treated. County staff will update the database as new projects are completed and approved. The annual report also includes a geo-referenced database for all stream restoration and streambank stabilization projects. It includes the location, details, phase, drainage area, and impervious area treated for each project. DPW&T is responsible for tracking street sweeping and inlet cleaning activities. The number of curb miles swept and tons of waste collected through street sweeping are tracked and reported in the MS4 Annual Report. The County also tracks and annually reports the number of inlets cleaned. The annual report also lists the education and outreach activities from the previous year. The County will post its MS4 report and appendices for the public to view after the report is submitted to MDE each year in early January.

The County will track all future restoration activities (including public outreach activities) and will enter location information into the geodatabase for viewing on a map. Currently, some restoration practices (e.g., tree planting) are not included in the geo-referenced database. A geodatabase to track stormwater implementation policy decisions, maintenance responsibilities, watershed location, and types of BMPs will help the County make critical decisions on stormwater controls during a project's concept plan stage. In addition, the County hopes to develop a data center where all of these activities can be reported. While that process could take a couple of years to build and put into operation, once it is completed, this tool will be centralized so that all partners—nonprofits, community organizers, cities, and towns—can report on their progress in installing BMPs, so the County can account for all activities.

7.2 Monitoring Approach

DoE recognizes that effective environmental monitoring requires long-term commitment to routine and consistent sampling, measurement, analysis, and reporting. Although some of the monitoring requirements for implementation of these TMDLs originated with MDE, others are the result of the County's interest in providing additional meaningful information to policymakers and the public. Biological indicators will continue to be used to document and communicate ecological conditions at subwatershed and countywide scales (Tetra Tech 2014a). Other types of monitoring will contribute to understanding whether restoration activities are leading to the elimination, reduction, or otherwise effective management of pollutants within the County; helping meet interim restoration plan load reductions; and demonstrating if changes should be made to the County's restoration strategies. All monitoring will be performed in accordance with a quality assurance project plan (including sample collection standard operating procedures) to ensure that the data are of known quality for use in restoration planning. The purpose of the monitoring is to track progress in addressing watershed concerns and improving watershed conditions through restoration plan implementation. The County will evaluate options for the appropriate monitoring program in consultation with MDE. Regardless of the County's monitoring program, the official monitoring for the state's Integrated Report assessments and impairment status will remain MDE's responsibility. MDE conducts cyclic watershed monitoring on a 5-year schedule.

7.2.1 Biological Monitoring

Biological condition, as measured by routine sampling and subsequent analyses with the Maryland Department of Natural Resources' benthic index of biotic integrity (B-IBI), reflects cumulative characteristics of stream ecosystem conditions. It is often impossible to understand and isolate the effects of single, individual stressors (i.e., external factors that cause stress to exposed organisms);

however, eliminating, reducing, or otherwise managing stressors and their sources will lead to overall healthier streams. 'Cumulative,' in the sense used here, implies a buildup of physical, chemical, and hydrologic stressors in the watershed over time. The biota present in streams reflects those organisms with the capacity for survival and reproduction in the presence of that cumulative stressor load.

Since 1999 the County has been implementing biological monitoring and assessment of streams and watersheds countywide. Sampling at an individual stream location includes benthic macroinvertebrates, physical habitat quality, and *in situ* water quality (pH, conductivity, temperature, and dissolved oxygen). The first round of monitoring (Round 1) was from 1999–2003, and sampled those indicators at each of 257 sites throughout the County (approximately 50–55 sites per year). Round 2 sampling (2010–2013) occurred for the same number of sites distributed throughout the County, but at different individual locations. Site locations were selected for each round using a stratified random process. The variables used to stratify sites were wadeable, nontidal streams, generally first through fourth order based on the Strahler system and 1:100,000 map scale. Distribution of sample locations were more heavily weighted to smaller first and second order streams.

The approach presented here assumes continuation of routine, countywide monitoring of biological condition for wadeable streams into Round 3 and beyond with potentially additional effort being applied to data analyses related to physical habitat characteristics, altered hydrology, and water chemistry. This will not only provide insight into those stressors most likely causing biological degradation, but could also help in identifying sources of stressors where additional BMP or green infrastructure would be beneficial.

The stepwise progression presented below can be applied to any watershed in the County. The County will focus its efforts on areas of rapid BMP implementation through the CWP. Additional and more detailed analyses of conditions and data in individual subwatersheds can help associate stream biological health with implementation of BMPs (and programmatic initiatives) so that the County can adjust its restoration strategy, if needed. The evaluation of changes in biological health is focused on the County's framework of subwatersheds, although for assessments it is possible to group into the broader scales of the major watersheds (Patuxent River [Lower, Middle, and Upper], Anacostia River, Mattawoman Creek, Piscataway Creek, and Potomac/non-Anacostia River, and Western Branch), as well as countywide.

- *Step 1*. Record percent biological degradation of subwatershed A from the most recent biological assessment report (Round 2 [R2] in Millard et al. [2013]), noting intensity of impairment and known or most probable sources of pollution or other stressors.
- *Step 2*. Compare percent biological degradation of subwatershed A from subsequent monitoring (Round 3 [R3]) and determine whether there has been positive change/an improvement (A:R2 > A:R3), negative change/further degradation (A:R2 < A:R3), or no change (A:R2 = A:R3). Use 90 percent confidence intervals as provided in biological assessment reports to document relative significance of changes. This procedure constitutes a trend analysis for assessing changes in biological condition.

Countywide biological monitoring is a routine part of the County's current monitoring strategy and occurs in 3-year cycles, for which funding is in place for 2015–2017. The monitoring is currently part of the County's standard budget expenditures, and countywide costs range from $175,000 to $200,000 per year of each cycle. The County plans to continue with its 3-year cycle approach and will have a 2-year gap between cycles until after restoration activities are completed, which is expected to be in 2030. As a result, the last round of biological monitoring should occur in 2035–2037. After that, biological monitoring should occur at 5-year intervals. During the life of this restoration plan, the total cost for countywide biological monitoring and assessment would be between $2.6 and $3 million. In addition, the Maryland Department of Natural Resources conducts the Maryland Biological Stream Survey (MBSS) (a qualitative fish survey) and, in the spring, the MWCOG conducts fish surveys to provide additional biological health measurements for Anacostia River tributaries.

7.2.2 Water Quality Monitoring

Measurement and analysis of physicochemical factors will complement the biological monitoring and will help identify those stressors most likely causing degradation. The contaminants of most concern in the County are total nitrogen, total phosphorus, TSS, BOD, fecal coliform bacteria, and PCBs. These data will be collected using MDE-approved methods and laboratories. Both dry-weather and wet-weather water quality monitoring will be conducted.

Monitoring will not be conducted on a specific BMP to assess its load reduction. The proposed BMP types have established pollutant removal efficiencies and only new and innovative BMPs will need to be individually monitored to assess their load reduction capabilities. Instead, water quality monitoring will be conducted at a subwatershed scale at a stream site downstream of restoration practices. Currently, the County does not have the resources to perform water quality monitoring in each subwatershed. If monitoring were to be conducted for each subwatershed, then funding availability for implementing restoration activities would be substantially reduced. For this reason, the subwatersheds with the highest amount of predicted load reductions (Table 5-3), and thus with the most potential for restoration practices, will be assigned the highest priority for this monitoring.

The County will request that MDE aid in the monitoring as well as request permission to move its current NPDES monitoring locations in Bear Branch watershed (part of the Upper Patuxent River watershed) to a subwatershed in the Anacostia River watershed. The monitoring will occur downstream of multiple planned restoration activities (e.g., ESD practices, stream restoration, street sweeping, public outreach).The NPDES-required chemical monitoring is currently part of DoE's annual budget. The monitoring currently includes nitrate plus nitrite, total Kjeldahl nitrogen, total phosphorus, BOD, TSS, and *E. coli* bacteria. Although it is desirable to monitor the farthest downstream location in a subwatershed, several factors must be considered, including location of potential restoration activities, site accessibility, presence of stream flow gages, and proximity to prior water quality monitoring stations (which can be advantageous in helping establish long-term trends).

This plan recommends the monitoring of one priority subwatershed. Monitoring at the selected subwatershed should begin within 1 year of finalizing this plan. Field reconnaissance and final selection of the monitoring location should be completed within 6 months of finalizing the Plan. For any given subwatershed monitoring location, once water quality standards have been met or restoration practices have been in place for 5 years, the County might consider discontinuing monitoring of the chemical water quality for that subwatershed.

Flow measurements are necessary for calculating pollutant loads from water quality sample concentrations. Higher-cost methods entail installing electronic stream stage measuring devices at each location, then generating a stage/discharge rating curve by measuring flow throughout a large storm event. Mid-cost methods entail installing a staff gage on a nearby bridge footing; however, a stage/discharge rating curve would still be needed. Low-cost methods entail manually measuring flow at the time of a grab sample. The best option would be to colocate the water quality station with an existing flow measurement station. Coarse estimates of flow can be developed by comparing stage and drainage area to that of a nearby USGS gaging station. Additionally, if in the future a rating curve is developed for that site, then historical stage and pollutant concentration data can be used to calculate historic pollutant loads without using the high-cost method. These flow options will be considered when selecting a water quality monitoring station.

The County will use the monitoring data to access the overall load reductions from upstream activities in a watershed with a large amount of planned activity. The data will also be reviewed to access trends, for example:

- Was improvement gradual?
- Did loadings significantly decrease in one year?
- What were the practices installed in the previous year and how do they relate to load reductions in the stream?

There is natural variability in stream water quality. Looking into smaller watersheds with less amounts of implementation activities could make it difficult to separate improvements from natural variability. By looking at a watershed with larger scale implementation, the improvements as a direct result of the implementation should be more easily identified. The County can look at the observed load reductions in the stream, compare them to the projected load reductions from WTM, and adjust the restoration strategies, as needed. The adjustments would not only be for the monitored watershed, but also would be applied countywide in the restoration plans. Adjustments could take the form of additional BMPs, using different types of BMPs, or adding more education and outreach.

7.3 Adaptive Management Approach

The implementation process represents the BMPs and strategies that will address current restoration needs of the watershed using the best available information. As implementation progresses, the adaptive management strategy will respond and change as part of the iterative adaptive management approach. It will be important for the County, MDE, and watershed partners to work together on this adaptive management approach to ensure successful implementation. Adaptive management is important in addressing the fecal coliform TMDL. In the TMDL document (MDE 2006), MDE recognized that:

> As previously stated, water quality standards cannot be met in all subwatersheds using the MPR [maximum extent possible] scenario. This may occur in subwatersheds where wildlife is a significant component, or in subwatersheds that require very high reductions of fecal bacteria loads to meet water quality standards. Therefore, MDE proposes a staged approach to implementation of the required reductions, beginning with the MPR scenario, as an iterative process that first addresses those sources making the largest impacts on

> water quality and creating the greatest risks to human health, with consideration given to ease and cost of implementation.

and that:

> The uncertainty of BMP effectiveness for bacteria, reported within the literature, is quite large. As an example, pet waste education programs have varying results based on stakeholder involvement. Additionally, the extent of wildlife reduction associated with various BMP methods (e.g., structural, nonstructural, etc.) is uncertain. Therefore, MDE intends for the required reductions to be implemented in a staged process that first addresses those sources with the largest impact on water quality and human health risk [e.g., hot spots], with consideration given to ease of implementation and cost. The iterative implementation of BMPs in the watershed has several benefits: tracking of water quality improvements following BMP implementation through follow-up stream monitoring; providing a mechanism for developing public support through periodic updates on BMP implementation; and helping to ensure that the most cost-effective practices are implemented first.

The adaptive management approach for this restoration plan involves testing, monitoring, evaluating applied strategies, analyzing and interpreting biological assessments at multiple spatial scales, and incorporating new knowledge into management approaches that are based on scientific findings. Adaptive management allows for fine-tuning of actions to increase effectiveness and for adopting new, more-effective strategies (in terms of both removal efficiencies and cost) as they become available. WTM (section 3.2) will aid in evaluating different management scenarios and can be updated to run scenarios using revised BMP efficiencies or different programmatic assumptions.

The County expects to use that strategy in implementing this restoration plan. As shown in Table 6-4, the total nitrogen WLAs will not be met through current technologies, despite the different programmatic activities and nearly 100 percent of its impervious area treated with BMPs. In addition, bacteria WLA for the tidal portions of the watershed will not be met, although the combined NEB, NWB, tidal total WLA will be met. The County is required to reduce nutrients by 80 percent and bacteria in its tidal portion by 99.3 percent; however, the current total nitrogen BMP removal efficiencies are low at 57 percent for BMPs designed to treat a 1-inch storm and 72 percent for BMPs designed to treat a 2.5-inch storm. BMPs designed to treat a 2.5-inch storm usually require a large area and are not always feasible, especially on ROWs and residential properties. To help fill the reduction gap, the County will look for more efficient BMPs. In addition, other activities can help reduce nutrients and bacteria; however, their impacts cannot be quantified. Those activities include reductions from WSSC's Sewer Repair, Replacement and Rehabilitation Program; removal of illicit connections; on-site disposal system repair and replacement; and atmospheric deposition.

The interim milestones defined in the implementation schedule (section 6.4) will help guide the adaptive management process. To evaluate whether interim milestones have been achieved, expected load reductions from implementation progress will be compared to monitoring results and BMPs listed in the tracking database. If the expected improvements have been achieved (i.e., reduced loads), then implementation will continue as planned. To continue project implementation and increase public support, the County will publicize existing projects' success and accomplishments. If the monitoring does not show the expected improvements, then the implementation plan will be reevaluated and new actions will be identified to more successfully achieve pollutant reductions.

In the case of the Anacostia River watershed, adaptive management is used to assess whether the actions identified as necessary are the correct ones and whether they are working to solve the identified obstacles to the plan implementation. Although the restoration plan was developed using the best available data, unanticipated circumstances might arise. For instance, the installed BMPs might not operate at the level of pollutant removal that was expected (e.g., either higher or lower removal efficiencies are seen). In addition, a natural disaster could affect the plan's implementation. If BMPs are being implemented at a slower rate than is called for in the restoration plan, the adaptive management process will look at the reasoning behind the lag in implementation and either correct it or propose additional activities to compensate for the lag. Potential reasons for the lags could be a lack of available land, delays in obtaining the necessary permits to construct BMPs, being denied permission to build a BMP on private land, and lapses in funding. In addition, this restoration plan depends on public and private entities modifying some of their behaviors with regard to trash, nutrient management, and pet waste. Without the support of the public and private entities in certain initiatives, the County will need to adapt and revise this restoration plan.

Several aspects of this restoration plan will aid in the adaptive management process:

- This restoration plan was developed using subwatersheds. The smaller area in individual subwatersheds provides a more defined area to identify where BMPs should be implemented and to plan for public outreach activities. The smaller watersheds also make it easier to adjust and modify the restoration plan, if needed, and to identify additional local measures.
- This plan has ambitious expectations regarding the cost and timeframe to install BMPs and implement strategies. Part of the adaptive management strategy is to help reduce the schedule and long-term costs. It is anticipated that future advances in technology will provide more effective reduction measures or that will reduce the schedule and cost of existing measures, thus reducing the long-term cost of this plan.
- The County will use adaptive management to use the most appropriate restoration practices at the best locations. This means that the County will look across land uses to determine locations to get cost-effective load reductions. The County reserves the right to use alternative restoration activities, such as land preservation, if the opportunity arises and the alternative practice will produce greater load reductions than ESD practices or a similar load reduction at a lower cost.
- The County expects that future BMP-related research could result in revised pollution reduction efficiencies or many advances in technology in the coming years due to new regulations. These advances could decrease cost, decrease the footprint of the BMP, and increase load reduction efficiencies. Some of the advances could come from proprietary technologies, which the County will consider using on the basis of their cost and performance.

- Several unknown sources of bacteria and nutrients exist that are difficult to quantify. These sources include illicit sewer connections, SSOs, cross-connections, septic leaks, and atmospheric deposition. Nutrient and bacteria load reductions would be expected from activities that address these sources which are, however, not quantifiable. These activities include (but are not limited to) reductions from WSSC's Sewer Repair, Replacement, and Rehabilitation (SR3) Program; the removal of illicit connections; and reductions of emissions that lead to atmospheric deposition. Load reductions from these activities will decrease the overall amount of BMPs that will need to be installed, thus potentially decreasing cost and moving forward the date of compliance.
- The biological assessment results will be interpreted at multiple spatial scales as *degraded/not degraded* (for specific stream sites) and *percent degradation* (for subwatersheds, basins, and countywide). The County will use these results as the principal indicator of stressor reduction effectiveness. A lack of positive response will be taken as evidence that stressor loads continue to affect the stream biota and that additional or more intensive stormwater management is necessary to achieve ecologically meaningful pollutant reductions.

An additional advantage of this adaptive management approach is that it provides a logical means of reprioritizing funding to areas of the County where water bodies need more attention. That is, where stressor (i.e., pollutant) sources are active and controls have not been attempted or are less than successful, increased effort at stressor control can be targeted. Regular and routine monitoring by the County, MDE, and watershed partners will help make these determinations.

There are BMPs in the County where drainage area, type, and/or installation data are unknown; once the information is available, load reductions from those BMPs could also be counted toward the County's overall load reduction goal. During BMP credit calculations, BMPs without known drainage areas were given the average drainage area for that BMP type. As a result, some drainage areas could have been either slightly over- or underestimated, and correction to the credit calculations will result in more defensible numbers. If updated credit calculations lead to reconsideration of certain aspects of this restoration plan, the County will make the required modifications. The reconciliation process will be part of the adaptive management approach and changes will be made to the plan as necessary.

Restoration plan progress will be formally reviewed by MDE. All responsible parties and partnership organizations will be convened to review progress, receive feedback from MDE, and discuss any necessary adjustments to the implementation process. County departments will meet on a more frequent basis to discuss progress, obstacles, successes, and changing needs so that adaptation strategies can be continually refined. The County will reevaluate this plan during its next permit cycle. This evaluation will take advantage of an updated BMP inventory, new BMP technologies, experiences with the new programmatic initiatives, and more recent water quality data.

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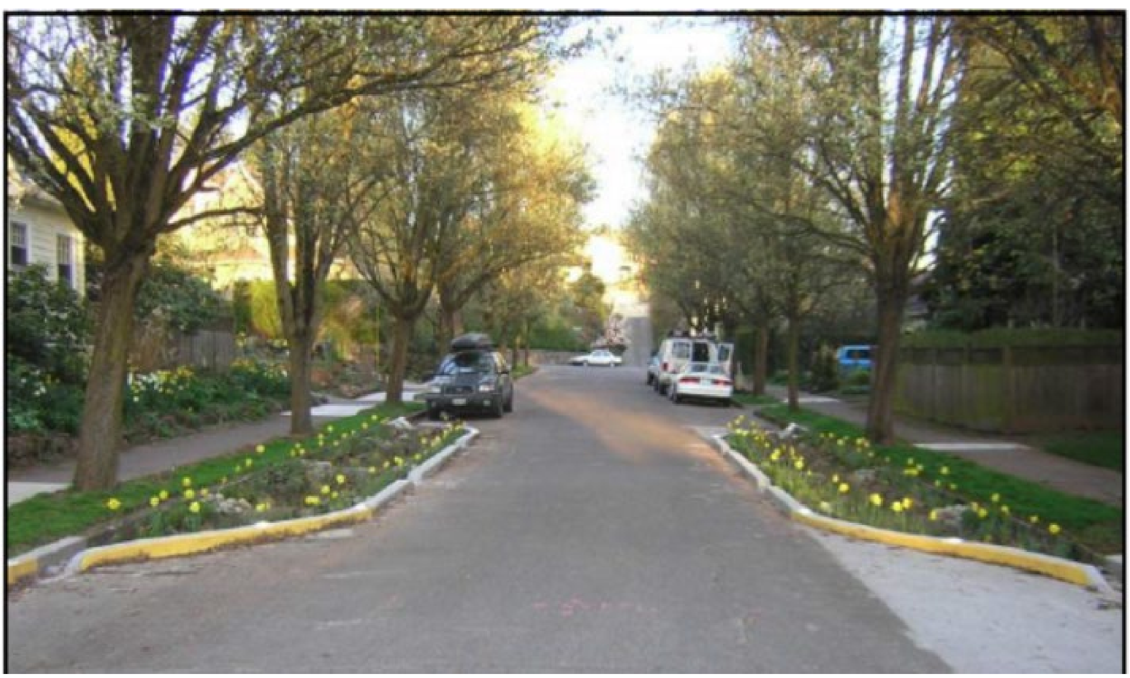
APPENDIX A: BMP EXAMPLES

Bioretention or bioswales to convert right-of-way to a green street

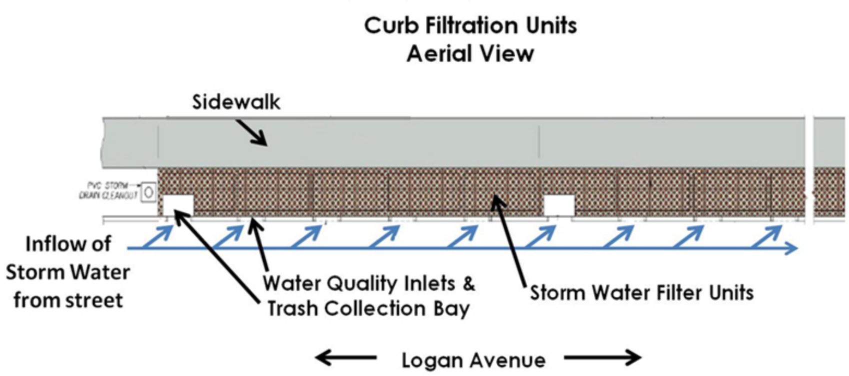
Source: U.S. Environmental Protection Agency (top); New York City Department of Environmental Protection (middle and bottom)

Curb extension with bioretention or bioswale



Source: U.S. Environmental Protection Agency (top); Portland Bureau of Environmental Services (bottom)

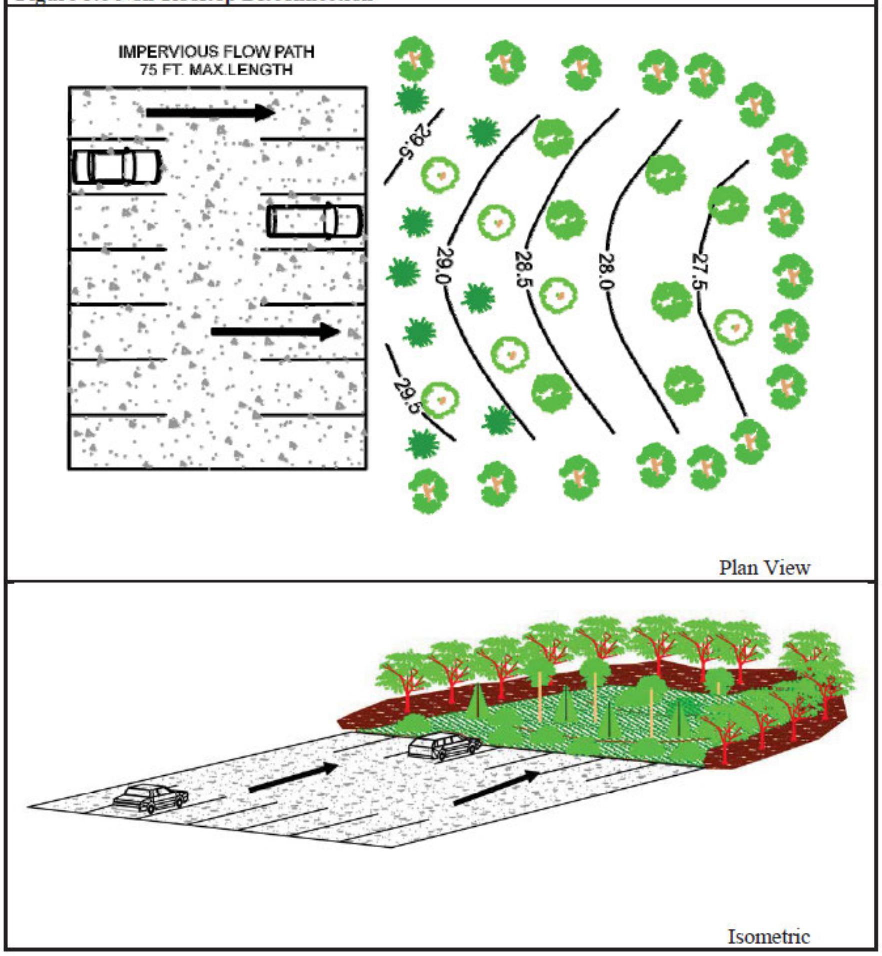
Curbside filter systems



Source: Delaware Department of Transportation (top); City of San Diego (middle); City of Portland (bottom)

Disconnection of non-rooftop runoff

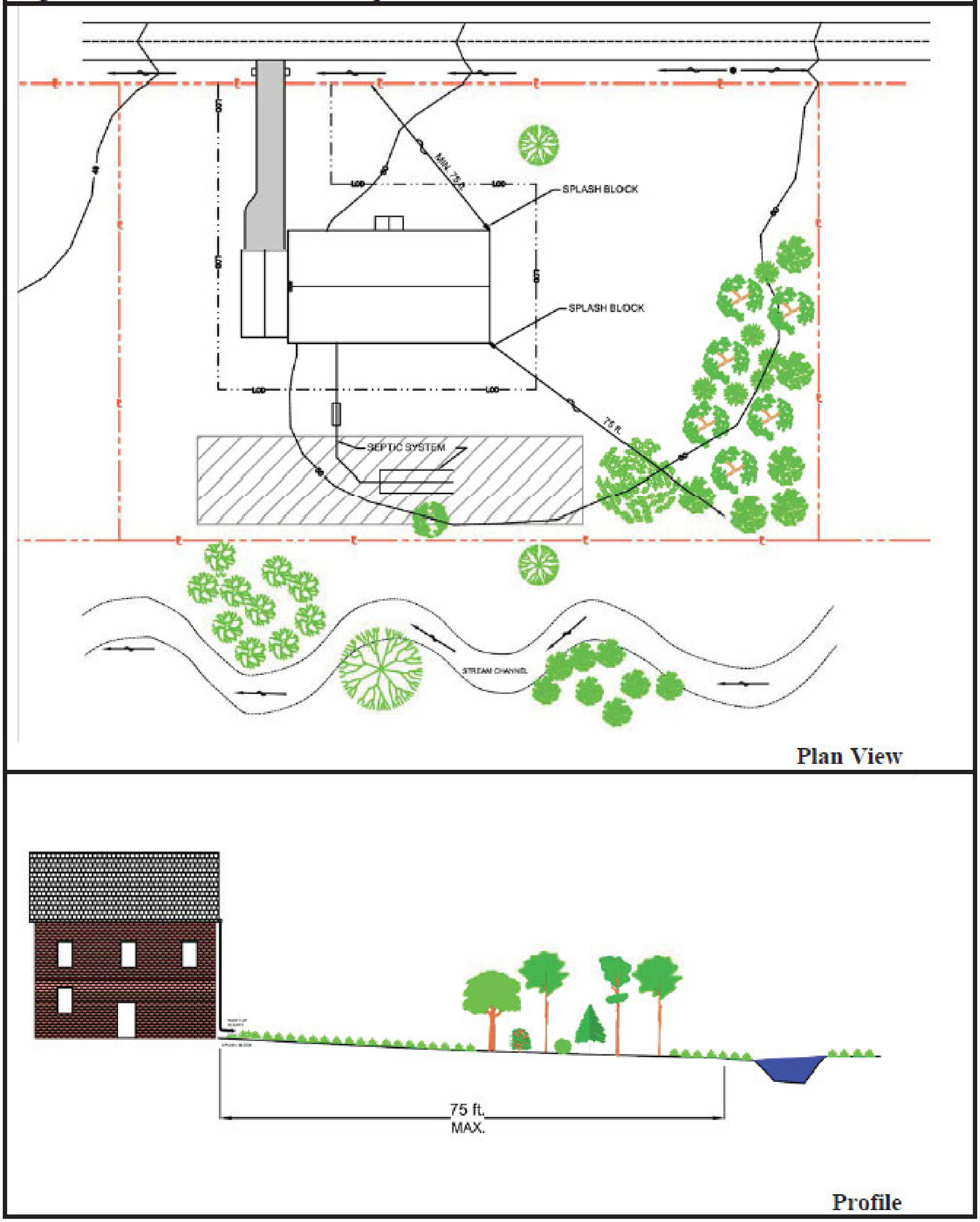
Figure 5.6 Non-Rooftop Disconnection



Source: Maryland Department of the Environment (top); Ecosite, Inc. (bottom)

Disconnection of rooftop runoff

Figure 5.4 Disconnection of Rooftop Runoff

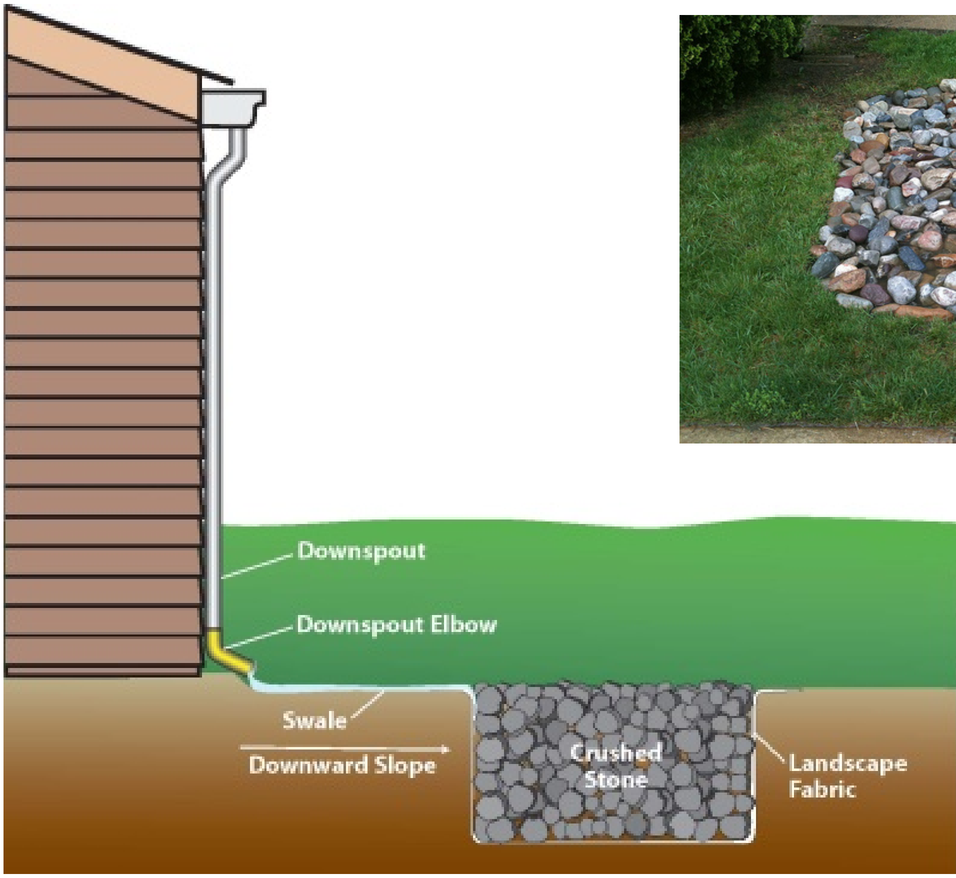


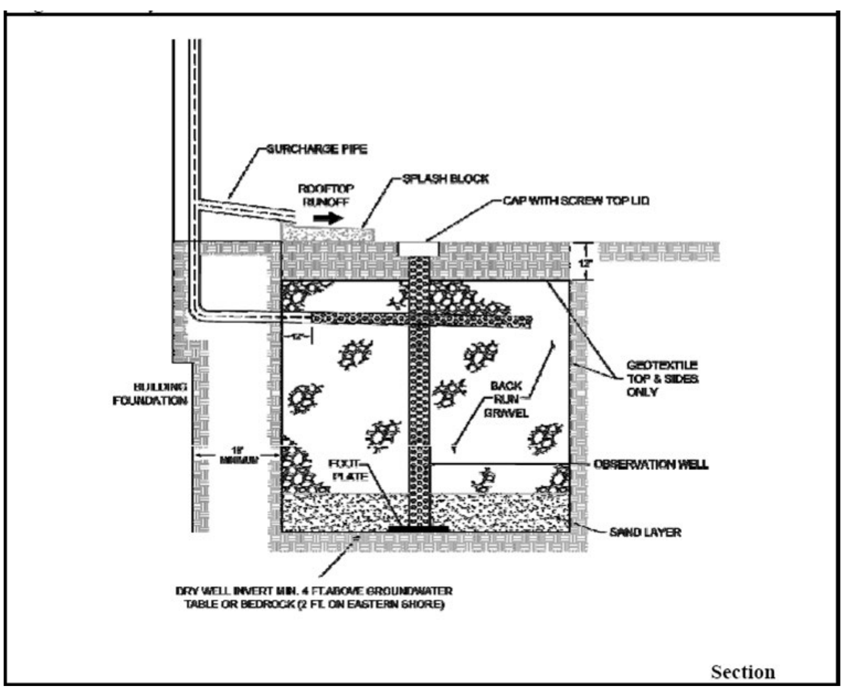
Source: Maryland Department of the Environment

Dry extended detention ponds

Source: Tetra Tech, Inc.

Dry wells

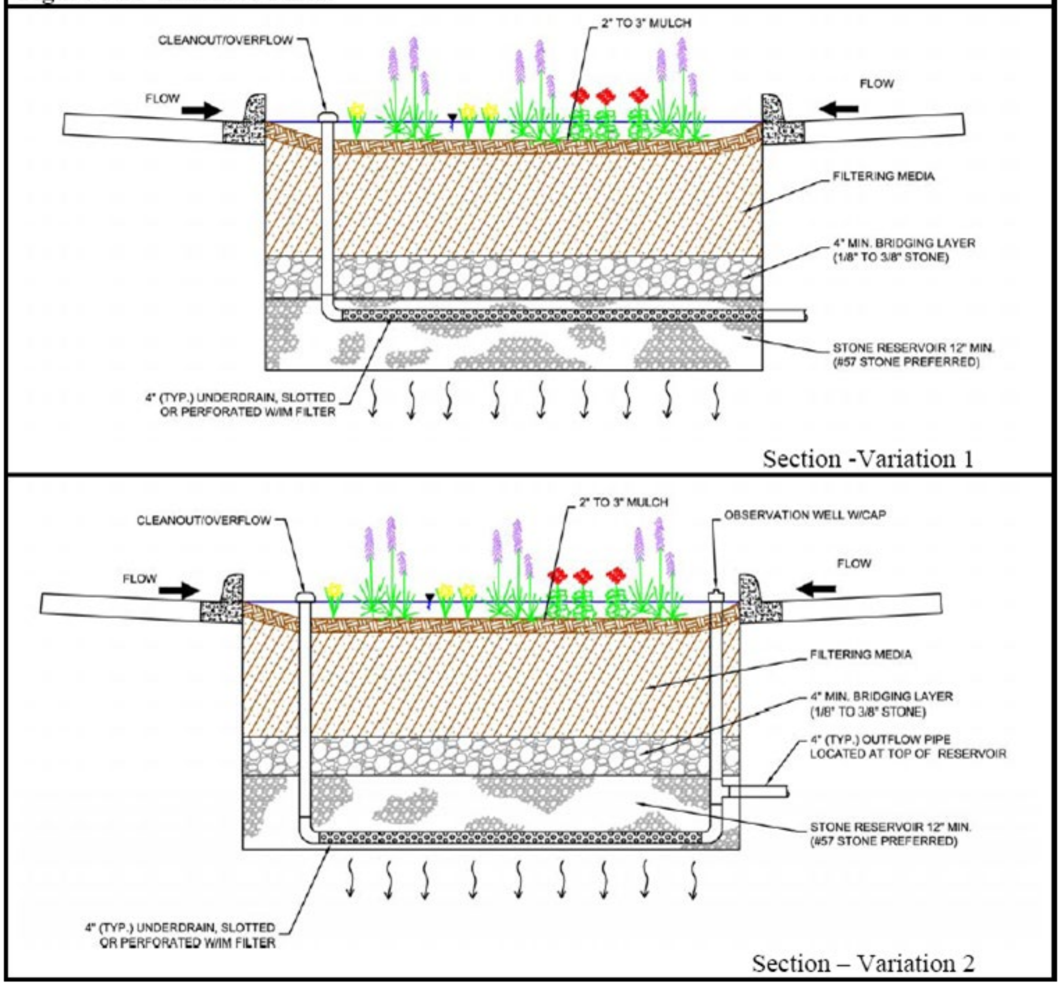




Source: Philadelphia Water Department (top); Maryland Department of the Environment (top right and bottom)

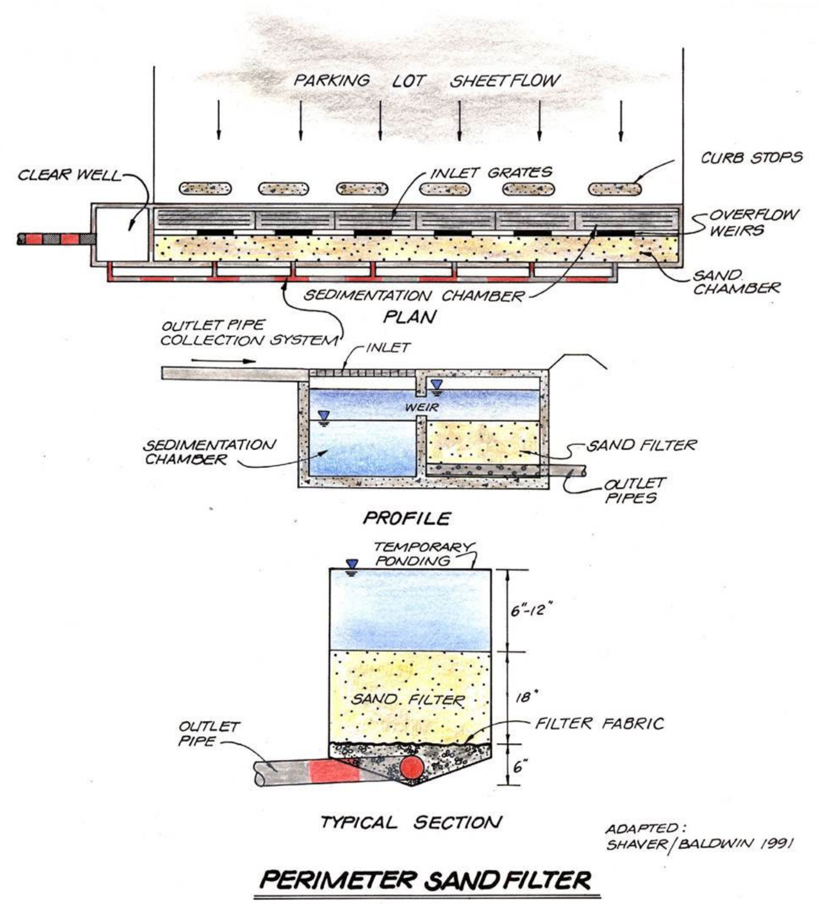
Enhanced filters

Figure 5.20 Enhanced Filters



Source: Maryland Department of the Environment

Filtering practices



Source: Maryland Department of the Environment

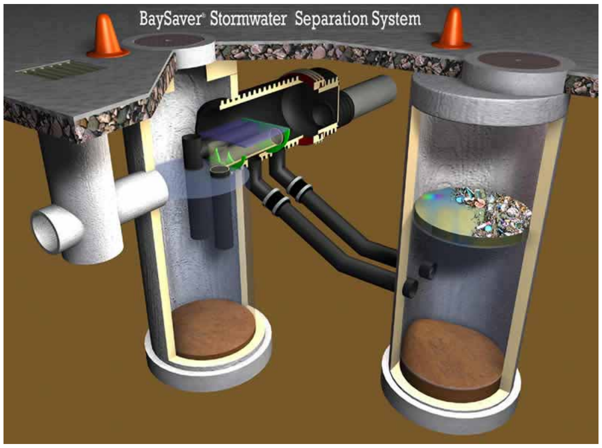
Grass, wet, or bioswale

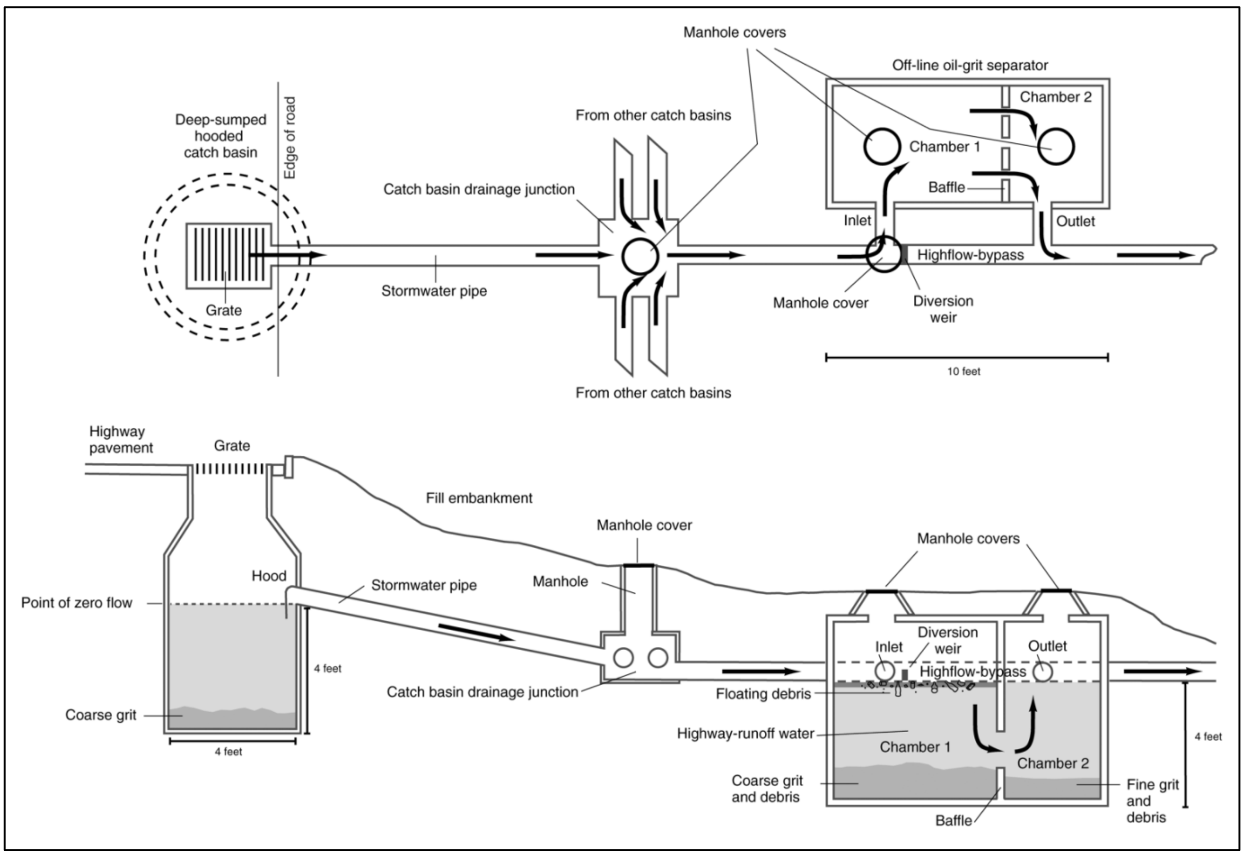
Source: Tom Liptan, Portland Bureau of Environmental Services (***top***); U.S. Environmental Protection Agency (bottom)

Green roofs

Source: Tetra Tech, Inc.

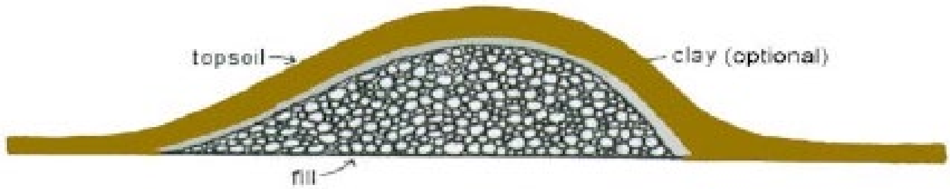
Hydrodynamic structures



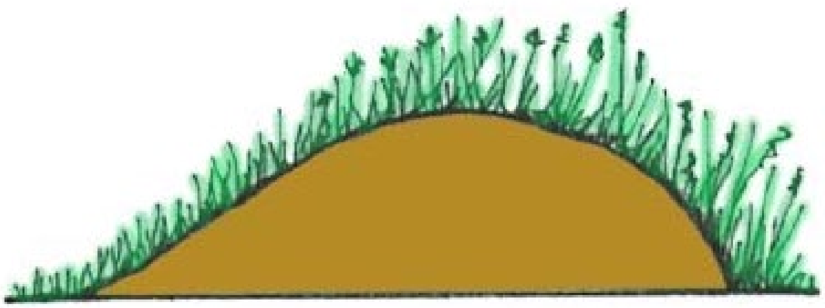


Source: Baysaver Technologies, Inc. (top left) and Contech Engineered Solutions (top right); U.S. Geological Survey (bottom)

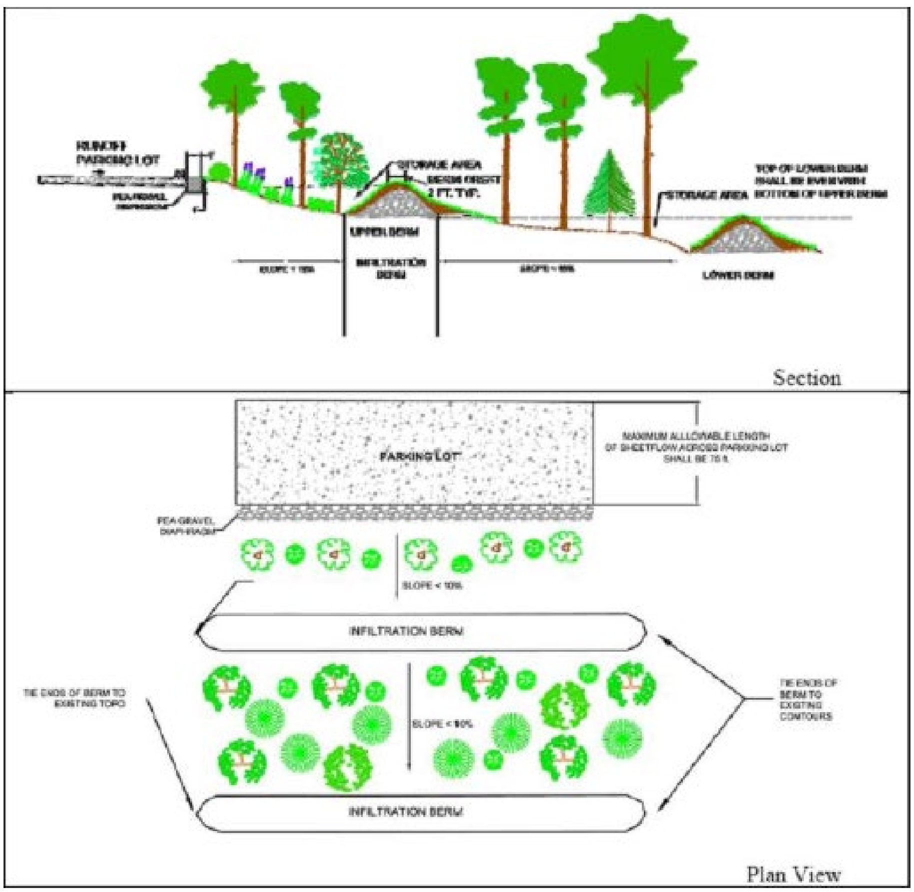
Infiltration berms



ideal substrate layers for a berm

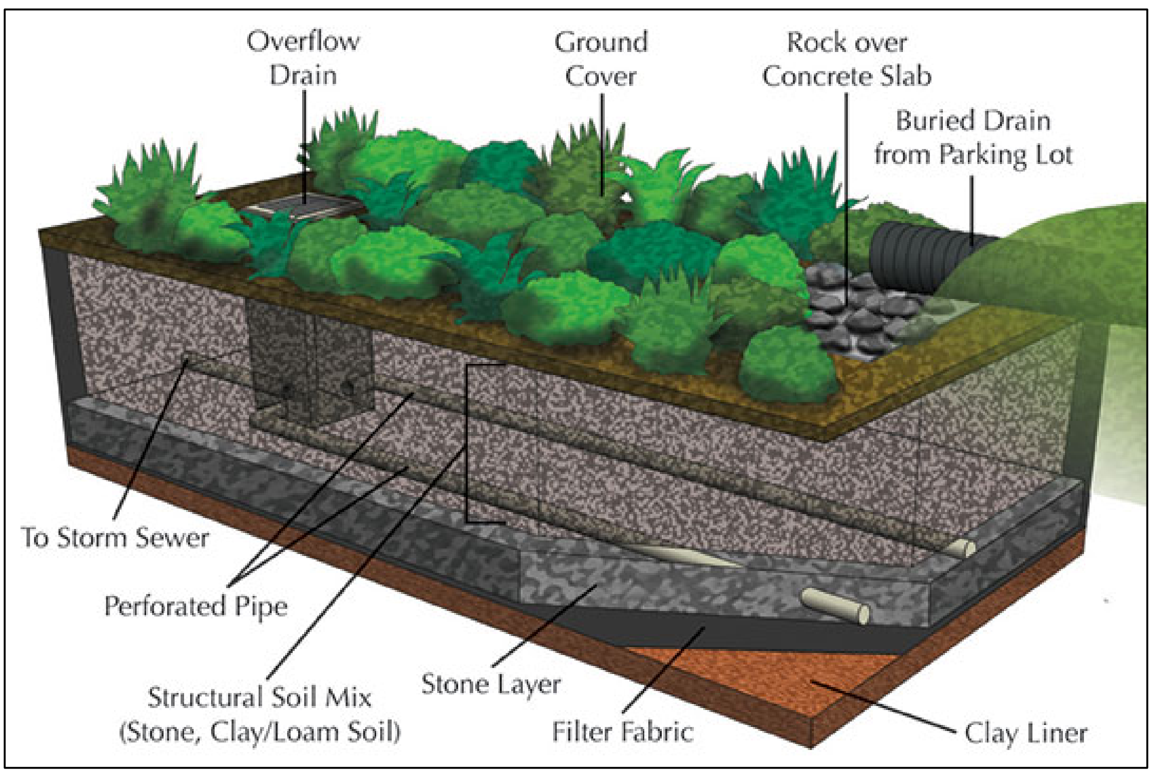


desirable shape for a berm



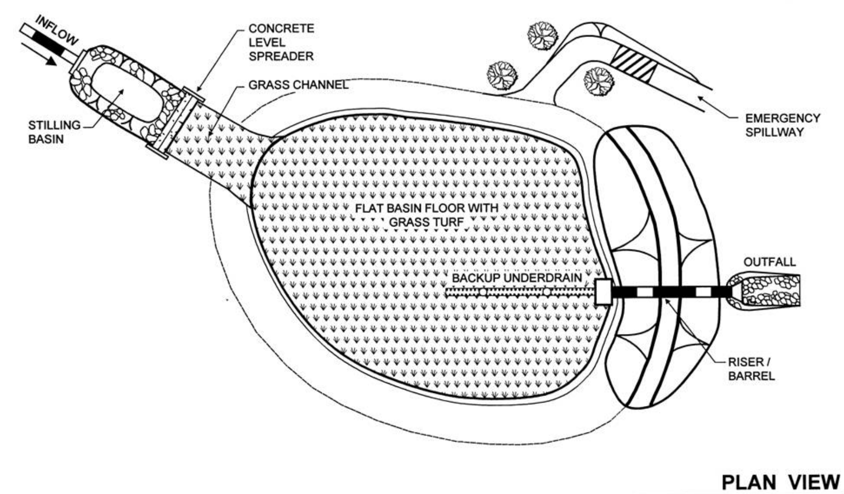
Source: Pennsylvania Department of Environmental Protection, Stormwater Best Management Practices Manual (top and middle); Maryland Department of the Environment (bottom)

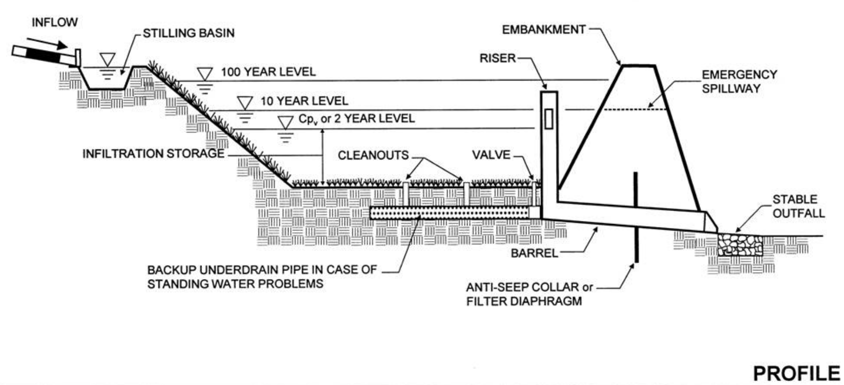
Infiltration practices



Source: University of Maryland Extension, College of Agriculture and Natural Resources (top); Center for TMDL and Watershed Studies, Virginia Tech (bottom)

Infiltration trenches with underdrains





Source: Center for Watershed Protection (top) and Maryland Department of the Environment (bottom)

Landscape infiltration

Source: Tom Liptan, Portland Bureau of Environmental Services(top), Ecosite,Inc. (bottom)

Micro-bioretention

Source: Prince George's County, MD

Permeable pavement shoulder instead of grass shoulder/buffer

Source: U.S. Environmental Protection Agency (top); City of Berkeley, CA Department of Public Works (bottom)

Permeable pavements / sidewalks

Source: Tetra Tech, Inc. (top and middle), U.S. Environmental Protection Agency (bottom)

Rain gardens

Source: U.S. Environmental Protection Agency (top); Montgomery County, MD Department of Environmental Protection (bottom)

Rainwater harvesting

Source: U.S Environmental Protection Agency (top); Tetra Tech, Inc. (middle) Montgomery County, MD Department of Environmental Protection (bottom)

Reinforced turf

Source: PERFO®

Sheet Flow to Conservation Areas

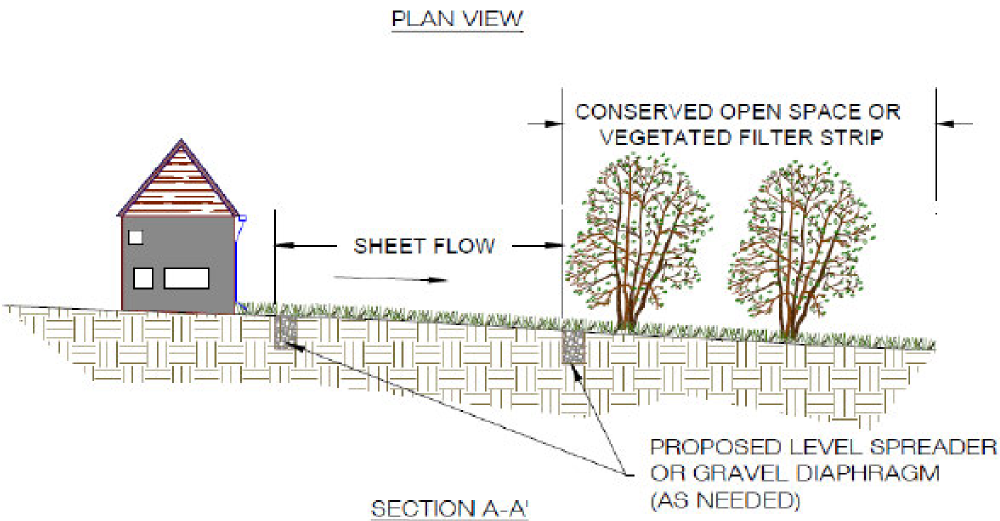
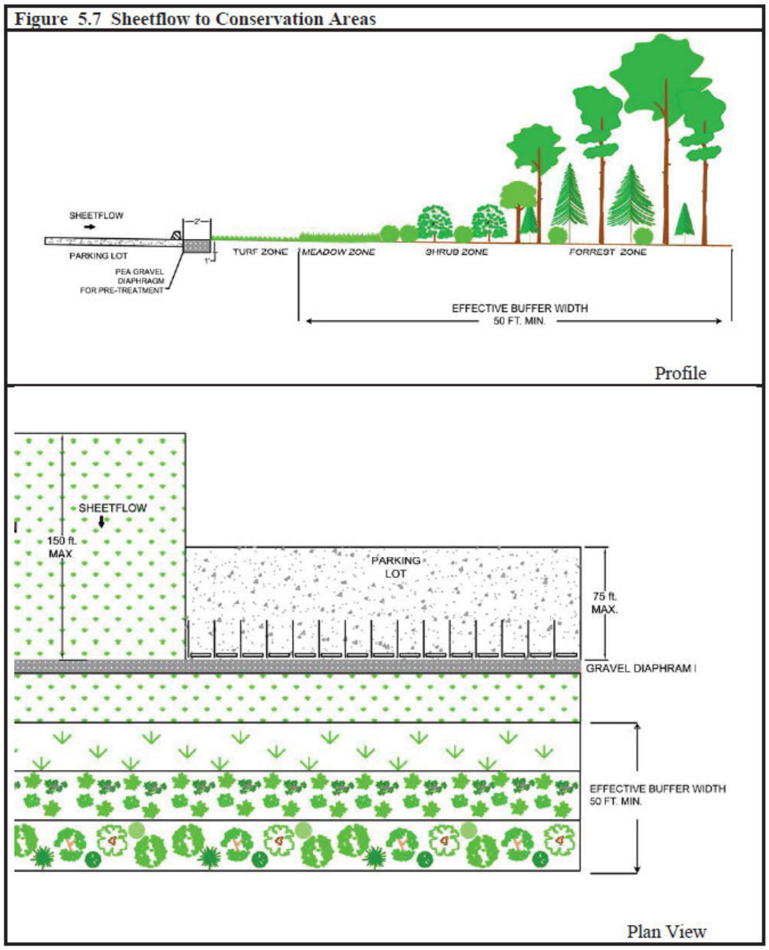
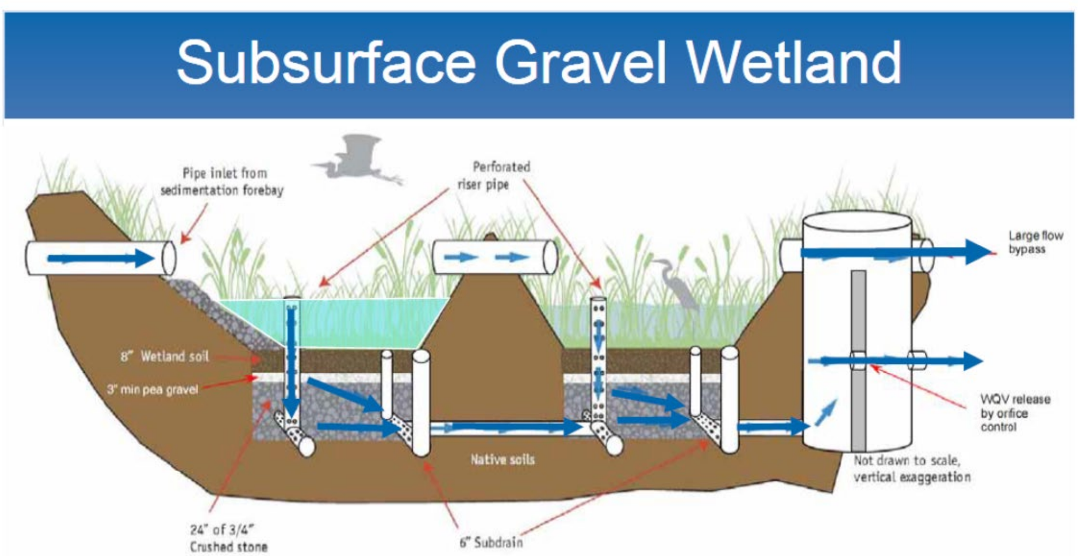


Figure 5.7 Sheetflow to Conservation Areas



Source: Virginia Department of Conservation and Recreation, BMP Standards and Specifications (top); Maryland Department of the Environment (bottom)

Submerged gravel wetlands



Source: Maryland Department of the Environment (top); University of New Hampshire Stormwater Center (middle, bottom)

Swales

Source: Fairfax County, VA (top); California Department of Transportation (bottom)

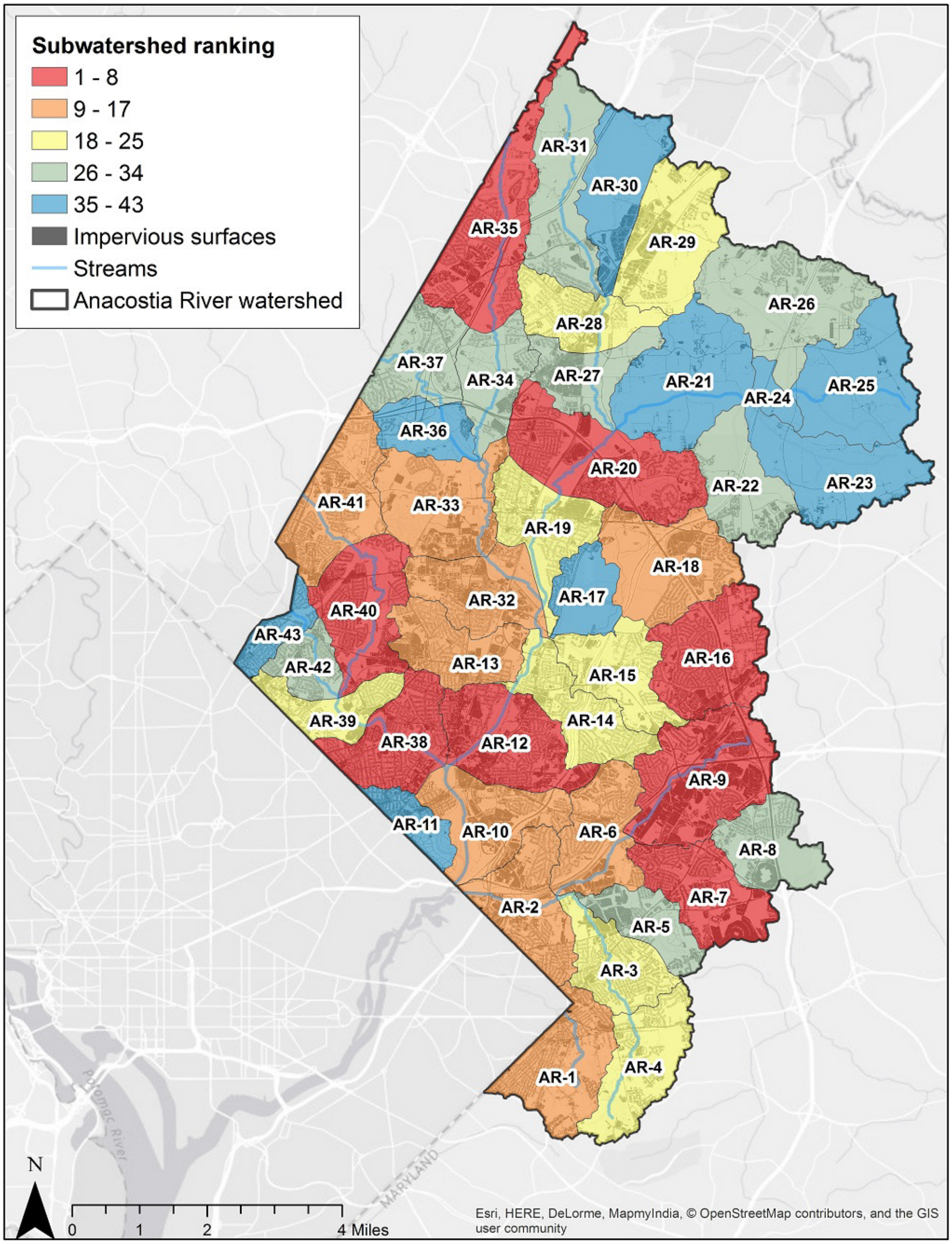
Tree planter / Planting trees on impervious urban

Source: U.S. Environmental Protection Agency

Wet ponds/wetlands

Source: Montgomery County, MD Department of Environmental Protection (top); U.S. Environmental Protection Agency (bottom)

APPENDIX B: IMPERVIOUS AREA TO BE TREATED AND LOAD REDUCTIONS BY LAND USE AND SUBWATERSHED



Note:
Subwatersheds are ranked 1 through 43, with 1 being the highest priority subwatershed.

Figure B-1. Subwatershed prioritization in the Anacostia River watershed in Prince George's County.

Table B-1. Amount of impervious area by land use per subwatershed

Subwatershed	Area (acres)	Impervious Area Treated			
		ROW (acres)	Institutional (acres)	Commercial/ Industrial (acres)	Residential (acres)
AR-1	1,047.8	93.4	18.2	39.4	184.3
AR-10	792.8	26.4	6.5	85.7	30.2
AR-11	360.9	25.1	2.8	29.9	41.5
AR-12	1,417.4	144.3	39.0	233.2	219.9
AR-13	876.4	86.4	24.4	108.2	112.7
AR-14	892.1	108.3	21.2	42.7	151.9
AR-15	755.8	60.9	25.2	29.2	117.1
AR-16	1,450.5	97.1	25.2	53.3	130.0
AR-17	126.9	14.0	0.0	0.0	27.2
AR-18	749.6	41.1	9.6	56.5	93.8
AR-19	859.9	87.9	22.0	127.7	109.4
AR-2	995.4	125.6	28.2	150.6	117.3
AR-20	1,189.7	117.9	28.3	63.0	227.1
AR-21	57.0	4.4	1.1	0.0	6.7
AR-22	213.1	3.6	3.6	0.1	18.2
AR-23	113.9	3.3	0.4	0.0	3.8
AR-24	0.9	0.0	0.0	0.0	0.3
AR-25	7.6	0.5	0.0	0.0	0.6
AR-26	508.1	26.9	7.7	0.2	55.2
AR-27	328.3	29.7	6.3	163.1	14.6
AR-28	762.1	70.8	8.9	114.0	94.3
AR-29	834.4	47.6	1.6	200.5	46.7
AR-3	897.1	103.8	15.2	75.3	137.2
AR-30	286.2	21.5	1.2	131.9	7.0
AR-31	431.3	26.4	9.7	32.7	27.7
AR-32	667.3	79.1	44.5	28.4	86.5
AR-33	520.3	38.0	11.5	51.5	58.8
AR-34	301.9	14.2	0.0	26.3	32.4
AR-35	1,246.2	60.4	21.1	73.7	160.3
AR-36	146.4	9.8	0.0	0.0	25.5
AR-37	540.1	34.7	10.9	2.7	89.6
AR-38	1,135.2	145.4	10.2	61.8	237.5
AR-39	564.8	59.2	15.7	50.8	99.3
AR-4	758.2	57.3	18.1	40.0	88.1
AR-40	963.5	97.9	11.0	56.9	176.6

Subwatershed	Area (acres)	Impervious Area Treated			
		ROW (acres)	Institutional (acres)	Commercial/ Industrial (acres)	Residential (acres)
AR-41	1,197.4	101.2	26.4	40.9	216.4
AR-42	473.6	57.8	14.7	21.0	83.7
AR-43	319.5	37.8	1.1	19.1	63.9
AR-5	607.0	23.7	13.5	111.4	33.0
AR-6	1,003.9	100.0	8.7	94.4	124.9
AR-7	1,025.9	99.6	47.7	115.3	141.6
AR-8	567.6	51.8	12.6	56.8	91.3
AR-9	1,310.1	113.8	25.0	337.1	105.8
Total	**29,304.0**	**2,548.3**	**599.0**	**2,925.1**	**3,889.8**

Table B-2. Load reductions from ESD practices in ROWs per subwatershed

Subwatershed	Total Nitrogen (lb/year)	Total Phosphorus[a] (lb/year)	TSS[a] (ton/year)	BOD (lb/year)	Fecal Coliform Bacteria (MPN B/year)
AR-1	1,046	213	81	8,718	20,439
AR-10	297	61	23	2,487	6,131
AR-11	315	64	23	2,382	8,201
AR-12	1,700	347	127	13,671	38,548
AR-13	1,063	217	77	8,227	26,250
AR-14	1,267	258	95	10,158	28,330
AR-15	704	144	53	5,706	15,084
AR-16	1,124	230	85	9,100	24,287
AR-17	145	30	12	1,295	2,229
AR-18	534	109	38	3,991	14,620
AR-19	950	194	74	8,171	16,750
AR-2	1,467	295	119	11,375	32,885
AR-20	1,384	284	103	11,232	31,203
AR-21	51	10	4	414	1,018
AR-22	46	9	3	353	1,240
AR-23	49	10	4	326	1,343
AR-24	0	0	0	0	0
AR-25	7	1	1	44	157
AR-26	329	67	25	2,561	7,450
AR-27	334	67	26	2,708	7,138
AR-28	759	154	64	6,480	12,046
AR-29	546	111	42	4,443	11,258

Subwatershed	Total Nitrogen (lb/year)	Total Phosphorus[a] (lb/year)	TSS[a] (ton/year)	BOD (lb/year)	Fecal Coliform Bacteria (MPN B/year)
AR-3	1,278	261	93	9,913	31,514
AR-30	244	48	21	1,929	4,579
AR-31	285	58	23	2,446	4,852
AR-32	1,058	208	76	7,956	24,271
AR-33	410	84	32	3,536	7,204
AR-34	172	35	13	1,350	4,008
AR-35	666	136	52	5,643	12,133
AR-36	113	23	8	921	2,393
AR-37	406	83	31	3,280	8,820
AR-38	1,805	371	131	14,078	45,896
AR-39	714	147	53	5,701	17,399
AR-4	682	139	51	5,424	15,581
AR-40	1,185	243	87	9,336	28,344
AR-41	1,191	243	89	9,573	26,725
AR-42	679	140	51	5,488	15,448
AR-43	434	89	33	3,563	9,245
AR-5	259	52	20	2,178	4,959
AR-6	1,119	223	97	8,773	22,697
AR-7	1,202	246	88	9,518	28,868
AR-8	580	118	44	4,835	11,395
AR-9	1,283	256	108	10,113	26,283
Total	**29,884**	**6,079**	**2,276**	**239,395**	**659,220**

Notes:
[a] Includes loadings due to streambank erosion.
These loadings are planning-level estimates. Actual reductions will differ based on site suitability and implementation costs.

Table B-3. Load reductions from ESD practices on institutional land per subwatershed

Subwatershed	Total Nitrogen (lb/year)	Total Phosphorus[a] (lb/year)	TSS[a] (ton/year)	BOD (lb/year)	Fecal Coliform Bacteria (MPN B/year)
AR-1	252	49	17	1,574	5,991
AR-10	85	17	6	587	1,796
AR-11	36	7	2	214	785
AR-12	571	110	35	3,442	15,117
AR-13	353	69	24	2,143	9,176
AR-14	299	60	19	1,946	7,379
AR-15	338	66	21	2,191	7,984
AR-16	331	64	22	2,161	7,178
AR-17	0	0	0	0	0

Subwatershed	Total Nitrogen (lb/year)	Total Phosphorus[a] (lb/year)	TSS[a] (ton/year)	BOD (lb/year)	Fecal Coliform Bacteria (MPN B/year)
AR-18	132	25	9	795	3,020
AR-19	302	63	21	2,094	6,932
AR-2	357	70	25	2,425	7,033
AR-20	394	76	26	2,438	9,652
AR-21	15	2	1	73	389
AR-22	55	12	4	370	1,433
AR-23	5	1	0	33	85
AR-24	0	0	0	0	0
AR-25	0	0	0	0	0
AR-26	103	21	7	698	2,433
AR-27	84	16	7	525	1,724
AR-28	114	22	7	764	2,363
AR-29	22	4	1	129	363
AR-3	208	40	14	1,277	5,041
AR-30	15	3	1	103	288
AR-31	121	24	8	848	2,295
AR-32	604	108	40	3,355	12,291
AR-33	162	30	9	957	4,045
AR-34	0	0	0	2	12
AR-35	293	58	19	1,875	6,927
AR-36	1	0	0	4	27
AR-37	153	29	10	948	3,697
AR-38	143	27	9	890	3,245
AR-39	217	44	15	1,423	5,306
AR-4	243	46	16	1,557	5,271
AR-40	145	28	9	955	3,212
AR-41	364	70	24	2,264	8,968
AR-42	192	38	12	1,324	4,076
AR-43	15	3	1	89	317
AR-5	171	33	12	1,111	3,764
AR-6	124	24	8	758	3,154
AR-7	644	131	43	4,359	15,505
AR-8	158	31	10	1,104	3,253
AR-9	320	62	22	2,133	6,784
Total	**8,142**	**1,582**	**535**	**51,937**	**188,311**

Notes:
[a] Includes loadings due to streambank erosion.
These loadings are planning-level estimates. Actual reductions will differ based on site suitability and implementation costs.

Table B-4. Load reductions from ESD practices on commercial/industrial land per subwatershed

Subwatershed	Total Nitrogen (lb/year)	Total Phosphorus[a] (lb/year)	TSS[a] (ton/year)	BOD (lb/year)	Fecal Coliform Bacteria (MPN B/year)
AR-1	515	100	40	3,402	9,264
AR-10	1,002	193	73	7,147	15,835
AR-11	361	65	23	2,403	5,684
AR-12	2,877	552	226	19,576	47,409
AR-13	1,424	287	93	9,895	31,128
AR-14	548	114	37	4,029	10,985
AR-15	360	75	27	2,716	6,762
AR-16	652	136	49	4,917	11,898
AR-17	0	0	0	0	0
AR-18	775	165	53	5,548	18,751
AR-19	1,588	306	118	10,751	28,387
AR-2	1,720	314	135	11,630	24,446
AR-20	879	185	60	6,125	21,570
AR-21	0	0	0	0	0
AR-22	1	0	0	11	39
AR-23	0	0	0	0	0
AR-24	0	0	0	0	0
AR-25	0	0	0	0	0
AR-26	4	1	0	16	87
AR-27	1,839	339	123	13,001	27,576
AR-28	1,361	256	110	9,309	19,776
AR-29	2,338	452	183	16,623	37,102
AR-3	869	162	73	5,943	12,168
AR-30	1,592	308	112	11,149	28,763
AR-31	376	72	30	2,624	6,095
AR-32	374	74	24	2,550	8,226
AR-33	646	129	48	4,513	12,199
AR-34	357	70	23	2,339	8,278
AR-35	969	200	73	6,804	20,926
AR-36	0	0	0	0	0
AR-37	34	7	2	228	681
AR-38	756	138	61	4,806	12,512
AR-39	636	132	45	4,767	12,019
AR-4	465	86	53	2,957	5,472
AR-40	707	145	47	5,222	13,801
AR-41	511	104	33	3,717	10,133

Subwatershed	Total Nitrogen (lb/year)	Total Phosphorus[a] (lb/year)	TSS[a] (ton/year)	BOD (lb/year)	Fecal Coliform Bacteria (MPN B/year)
AR-42	271	55	18	1,936	5,363
AR-43	230	46	16	1,649	4,228
AR-5	1,248	234	82	8,953	19,426
AR-6	1,086	205	76	7,668	17,300
AR-7	1,532	324	111	10,856	35,877
AR-8	718	162	57	5,713	14,257
AR-9	3,915	754	262	28,268	65,388
Total	**35,539**	**6,948**	**2,598**	**249,764**	**629,812**

Notes:
[a] Includes loadings due to streambank erosion.
These loadings are planning-level estimates. Actual reductions will differ based on site suitability and implementation costs.

Table B-5. Load reductions from ESD practices on residential land per subwatershed

Subwatershed	Total Nitrogen (lb/year)	Total Phosphorus[a] (lb/year)	TSS[a] (ton/year)	BOD (lb/year)	Fecal Coliform Bacteria (MPN B/year)
AR-1	3,559	557	182	15,107	72,261
AR-10	570	91	29	2,566	11,396
AR-11	803	119	38	3,229	15,261
AR-12	4,157	665	216	18,477	88,091
AR-13	2,347	352	111	9,134	47,693
AR-14	3,249	476	150	12,070	66,761
AR-15	2,165	342	112	9,448	44,531
AR-16	2,463	380	124	10,394	48,437
AR-17	556	82	26	2,167	11,303
AR-18	1,837	293	90	7,828	43,691
AR-19	2,322	339	108	8,834	44,755
AR-2	2,429	362	120	9,414	48,212
AR-20	4,019	651	203	18,545	89,884
AR-21	124	19	7	524	2,282
AR-22	302	55	17	1,608	8,342
AR-23	84	13	4	294	1,989
AR-24	0	0	0	0	0
AR-25	0	0	0	0	0
AR-26	1,014	168	55	4,578	22,093
AR-27	300	45	15	1,200	5,575
AR-28	2,022	297	95	7,637	38,352
AR-29	802	132	43	3,761	17,276
AR-3	2,799	423	135	11,102	56,541

Subwatershed	Total Nitrogen (lb/year)	Total Phosphorus[a] (lb/year)	TSS[a] (ton/year)	BOD (lb/year)	Fecal Coliform Bacteria (MPN B/year)
AR-30	118	21	9	538	2,482
AR-31	579	89	31	2,234	10,916
AR-32	1,653	264	88	7,327	33,145
AR-33	1,272	188	61	4,826	25,728
AR-34	722	103	34	2,570	14,163
AR-35	3,053	472	150	13,128	61,068
AR-36	458	77	25	2,237	9,898
AR-37	1,705	268	94	7,289	34,369
AR-38	4,655	711	225	19,107	96,499
AR-39	1,905	305	96	8,346	42,280
AR-4	1,602	258	83	7,317	33,855
AR-40	3,580	547	169	14,309	79,157
AR-41	3,869	627	200	17,754	83,540
AR-42	1,678	254	79	6,732	34,782
AR-43	1,214	192	63	5,172	27,225
AR-5	506	91	29	2,846	10,679
AR-6	2,400	371	117	10,049	50,554
AR-7	2,616	419	133	11,565	59,623
AR-8	1,697	268	86	7,411	35,831
AR-9	1,911	306	100	8,634	40,177
Total	**75,117**	**11,693**	**3,752**	**317,308**	**1,570,699**

Notes:
[a] Includes loadings due to streambank erosion.
These loadings are planning-level estimates. Actual reductions will differ based on site suitability and implementation costs.

APPENDIX C: COMPARISONS OF LOAD REDUCTIONS TO CHESAPEAKE BAY TMDL

The Chesapeake Bay and local TMDLs each establish target load reductions for nitrogen, phosphorus, and TSS; the County is required to meet the most stringent of each of the reductions. In 2011, the County received a Chesapeake Bay WLA and percent reduction for the entire County, which MDE disaggregated into watersheds in the MDE *TMDL Data Center*.

The total nitrogen, total phosphorus, and TSS loads for the County's main watersheds were determined using the calibrated implementation model (WTM) that was developed as part of this restoration plan. The purpose of the implementation model was not to recalculate the WLA as defined in the TMDL documents and by the MDE *TMDL Data Center*, but to convert the TMDL load reduction from the original TMDL model to an implementation model that can be effectively used in planning restoration activities. The level of effort (load reduction percentage) to meet water quality standards is kept the same between the two models.

Table C-1 shows the load reduction needed to reach the County's WLA for both the local TMDLs and the Chesapeake Bay TMDL as calculated by WTM. Both sets of required reductions used the same baseline loadings from WTM; then the percent of necessary reduction from the MDE *TMDL Data Center* and the respective local TMDLs were applied to that baseline loading.

The comparison found that the required load reductions established by the local TMDLs for the Anacostia River and Mattawoman Creek watersheds are more stringent than the required overall total nitrogen and TSS load reductions for the County's portion of the Chesapeake Bay WLA. Required load reductions from the local TMDLs would not be sufficient for the County's portion of the total phosphorus Chesapeake Bay WLAs. Therefore, the County will need to implement additional restoration activities elsewhere in the County to meet phosphorus WLAs for the Chesapeake Bay TMDL.

Table C-1. Comparison of required load reductions Using WTM: Chesapeake Bay TMDL and local TMDLs

Watershed	Chesapeake TMDL-Required Load Reductions Calculated Using WTM (lb/yr)			Local TMDL-Required Load Reductions Calculated Using WTM (lb/yr)		
	Nitrogen	Phosphorus	TSS	Nitrogen	Phosphorus	TSS
Anacostia River	56,693	13,932	1,876,139	227,917	28,573	5,200,998
Mattawoman Creek	1,779	754	134,487	9,329	1,083	n/a
Lower Patuxent River	5,127	1,224	177,401	n/a	n/a	n/a
Middle Patuxent River	3,527	814	105,450	n/a	n/a	n/a
Upper Patuxent River	11,771	2,785	503,515	n/a	18	188,692
Piscataway	25,336	6,022	758,703	n/a	n/a	n/a

Watershed	Chesapeake TMDL-Required Load Reductions Calculated Using WTM (lb/yr)			Local TMDL-Required Load Reductions Calculated Using WTM (lb/yr)		
	Nitrogen	Phosphorus	TSS	Nitrogen	Phosphorus	TSS
Creek						
Potomac River	43,576	8,912	784,156	n/a	n/a	n/a
Western Branch	30,612	6,922	706,167	n/a	n/a	n/a
Total	178,422	41,365	5,046,018	237,246	29,674	5,389,690

Notes:
n/a: This watershed did not have a local TMDL for the listed parameter; therefore, there is no required load reduction.
The phosphorus and TSS calculations in this table are not adjusted for streambank erosion, as was done in the local TMDL plans. The conversions factors, which vary by watershed, are unknown for most watersheds.

The impervious area treated by BMPs identified in the WIP were compared with the impervious area treated by the local TMDL restoration plans, as presented in Table C-2. The impervious areas treated were pulled directly from the WIP and local TMDL restoration plans. It can be seen from this comparison that overall, the impervious area treated in the restoration plans is greater than the impervious area treated as determined in the WIP. This is true especially for the ESD practices.

Table C-2. Comparison of impervious area treated for the Chesapeake Bay WIP and local TMDL restoration plans

Watershed	Impervious Area Treated from Chesapeake WIP (acres)			Impervious Area Treated from Local TMDL Restoration Plans (acres)		
	ESD	Non-ESD	Stream Restoration[a]	ESD	Non-ESD	Stream Restoration[a]
Anacostia River	1,333	3,050	1,123	9,962	167	750
Mattawoman Creek	25	58	21	383	5	0
Lower/Middle Patuxent River	38	86	32	n/a	n/a	n/a
Upper Patuxent River	192	440	162	102	42	0
Piscataway Creek	265	607	224	927	73	0
Potomac River	408	935	344	1,926	102	0
Western Branch	418	956	352	n/a	n/a	n/a
Total	2,679	6,131	2,258	13,300	388	750

Notes:
n/a: This watershed did not have a local TMDL; therefore, no BMPs have been identified.
[a] 1 linear foot of stream restoration is considered as 0.01 impervious acre equivalent (MDE 2014a).

Table C-3 presents the required load reductions for the WIP (using WTM) compared to the local TMDL restoration plan load reductions for BMPs and other restoration practices (e.g., street sweeping, nutrient management). Table C-3 has load reductions identified for the watersheds that had a local TMDL, even if it did not have required load reductions for a parameter. For instance, Piscataway Creek has a local TMDL for bacteria, but load reductions for nitrogen, phosphorus, and TSS are listed because the BMPs required to reduce bacteria loads also will reduce nitrogen, phosphorus, and TSS loads.

As shown, the load reductions from the BMPs and other restoration practices in TMDL restoration plans are greater than the required load reductions from the Chesapeake Bay TMDL to total nitrogen and TSS, however additional total phosphorus reductions are necessary.

Table C-3. Comparison of Chesapeake Bay TMDL required load reductions using WTM and load reductions from BMPs from Local TMDL restoration plans

Watershed	Chesapeake TMDL-Required Load Reductions Calculated Using WTM (lb/year)			Load Reductions from BMPs and Other Restoration Practices Identified in Local TMDL Restoration Plans Calculated Using WTM (lb/yr)		
	Nitrogen	Phosphorus	TSS	Nitrogen	Phosphorus	TSS
Anacostia River	56,693	13,932	1,876,139	199,915	32,195	25,609,036
Mattawoman Creek	1,779	754	134,487	7,068	1,202	215,470
Lower Patuxent River	5,127	1,224	177,401	n/a	n/a	n/a
Middle Patuxent River	3,527	814	105,450	n/a	n/a	n/a
Upper Patuxent River	11,771	2,785	503,515	6,817	1,055	197,547
Piscataway Creek	25,336	6,022	758,703	17,075	1,983	365,044
Potomac River	43,576	8,912	784,156	25,283	3,587	666,370
Western Branch	30,612	6,922	706,167	n/a	n/a	n/a
Total	178,422	41,365	5,046,018	256,158	40,022	27,053,467

Notes:
n/a: This watershed did not have a local TMDL; therefore, no BMPs were identified.
The phosphorus and TSS in this table are not adjusted for streambank erosion, as was done in the local TMDL plans. The conversions factors, which vary by watershed, are unknown for most watersheds.

APPENDIX D: FUNDING OPPORTUNITIES

- Chesapeake Bay Trust
  - Demonstration scale, community-based, on-the-ground restoration projects: Stream bank stabilization; BMPs (LID), wetland creation and enhancement
  - Watershed Assistance Grant Program: Technical planning and design assistance
  - Outreach and Community Engagement Grant Program: Implements community-led stewardship efforts
- National Fish and Wildlife Foundation Chesapeake Bay Stewardship Fund
  - Competitive grant programs: *Innovative Nutrient and Sediment Reduction* and *Small Watersheds*
- National Fish and Wildlife Federation Five Star and Urban Waters Restoration Grant Program
  - Coastal, wetland, and riparian restoration
  - Focus on education and training encouraging a diverse group of community partners
- Chesapeake Wildlife Heritage
  - Provides technical assistance and project labor for wetland, riparian buffer, and other related creation and restoration projects.
- Maryland Landowner Incentive Program
  - Competitive grants for private land owners
  - Funds reforestation, grassland and forest buffers
- Urban Waters Small Grants
  - Engages communities with environmental justice concerns
  - Provides education and resources through $40,000–$60,000 grants
- American Forests Global ReLeaf
  - Reforestation on public lands (>20 acre plantable areas)
  - Provides funding, cost-sharing, technical assistance, site prep, seedling purchase
- EPA Environmental Education Model Grant
  - The Environmental Education Regional Grant Program aims to increase public awareness and knowledge about environmental issues. The program provides skills for participants to make informed environmental decisions and perform actions to help the environment.
- EPA Clean Water State Revolving Fund
  - Provides low-interest and flexible-term loans to help communities meet the goals of the Clean Water Act.