Prince George's County
DEPARTMENT OF THE
ENVIRONMENT

November 30, 2024

2024 Sediment Stormwater Wasteload Allocation (SW-WLA) Watershed Implementation Plan (WIP) for the **Piscataway Creek Watershed** in Prince George's County, Maryland

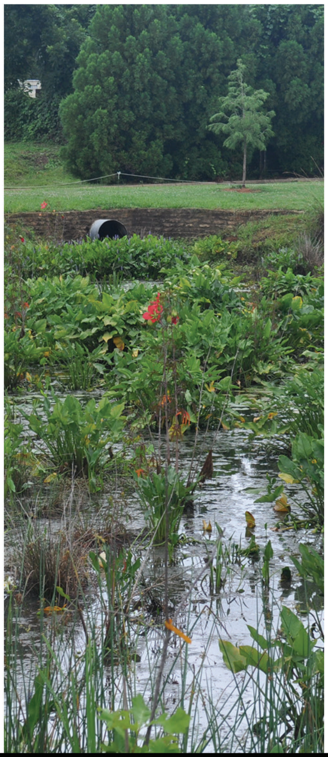
Prepared for: Prince George's County Department of the Environment, 1801 McCormick Drive, Suite 500, Largo, Maryland 20774
Prepared by: Tetra Tech, 10306 Eaton Place, Suite 340, Fairfax, VA 22030









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ABBREVIATIONS AND ACRONYMS

ALT	alternative BMP practice
A-StoRM	Advancing Stormwater Resiliency in Maryland
BIBI	Benthic Index of Biotic Integrity
BMP	best management practice
BSID	Biological Stressor Identification
CFR	Code of Federal Regulations
CIP	Capital Improvement Program
COMAR	Code of Maryland Regulations
CWA	Clean Water Act
CWP	Clean Water Partnership
DO	dissolved oxygen
DoE	[Prince George's County, MD] Department of the Environment
DPIE	[Prince George's County, MD] Department of Permitting, Inspection, and Enforcement
DPW&T	[Prince George's County, MD] Department of Public Works and Transportation
EPA	U.S. Environmental Protection Agency
ESD	environmental site design
°F	degrees Fahrenheit
FAP	Financial Assurance Plan
FIBI	Fish Index Biotic Integrity
FY	fiscal year
GRTS	Generalized Random Tessellation Stratified
HOA	homeowner association
HSG	hydrologic soil group
IBI	Index of Biotic Integrity
IDDE	illicit discharge detection and elimination
IDF	intensity-duration-frequency
JBA	Joint Base Andrews
LA	load allocation
lb	pound
MARISA	Mid-Atlantic Regional Integrated Sciences and Assessments
MBSS	Maryland Biological Stream Survey
MD DNR	Maryland Department of Natural Resources
MDE	Maryland Department of the Environment
MEP	maximum extent practicable
mg/L	milligrams per liter
M-NCPPC	Maryland-National Capital Park and Planning Commission
MOS	margin of safety
MS4	municipal separate storm sewer system

NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
PC	Piscataway Creek
PCB	polychlorinated biphenyl
ROW	right-of-way
RR	runoff reduction
SCA	stream corridor assessment
ST	stormwater treatment
SW-WLA	stormwater wasteload allocation
SWM	stormwater management
SWMM	Stormwater Management Model
TIPP	TMDL Implementation Progress and Planning
TMDL	total maximum daily load
TP40	Technical Paper Number 40
TSS	total suspended solids
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WIP	Watershed Implementation Plan
WLA	wasteload allocation
WSSC	Washington Suburban Sanitary Commission
XSa	cross sectional area
XS	cross-section

EXECUTIVE SUMMARY

On December 2, 2022, the Maryland Department of the Environment (MDE) issued Prince George's County (the County) its fifth-generation permit (Permit Number: 20-DP-3314 MD0068284) for its National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4), which 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., Piscataway Creek). The permit covers the period of December 2, 2022, through December 1, 2027. The MS4 permits are generally issued in 5-year cycles enabling regulators and permit holders to adjust permit objectives and expectations.

The 2022 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 a stormwater wasteload allocation (SW-WLA). 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.

This SW-WLA Watershed Implementation Plan (WIP) covers the SW-WLA assigned to the County's MS4 for sediment impairments in the Piscataway Creek watershed. A WIP is a strategy for managing the natural resources within a geographically defined watershed (Figure ES-1). For the County's Department of the Environment (DoE), this means managing urban stormwater (i.e., runoff originating from rainstorms) 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 streams that convey stormwater runoff downstream to a single point.

Along with the 2022 MS4 permit, MDE released multiple guidance documents on addressing TMDLs. This WIP uses new information, including loading rates derived from the Bay Model 6, provided by MDE to counties in the TMDL Implementation Progress and Planning (TIPP) tool. This WIP follows the following MDE guidance documents:

- *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated: Guidance for National Pollutant Discharge Elimination System Stormwater Permits* (November 2021)
- *General Guidance for Local TMDL (Total Maximum Daily Load) Stormwater Wasteload Allocation (SW-WLA) Watershed Implementation Plans (WIPs)* (February 2022)
- *Guidance for Developing Local Nutrient and Sediment TMDL (Total Maximum Daily Load) Stormwater Wasteload Allocation (SW-WLA) Watershed Implementation Plans (WIPs)* (March 2022)
- *TMDL Implementation Progress and Planning (TIPP) Tool* (Original version: June 2021, Most recent version: April 2022)

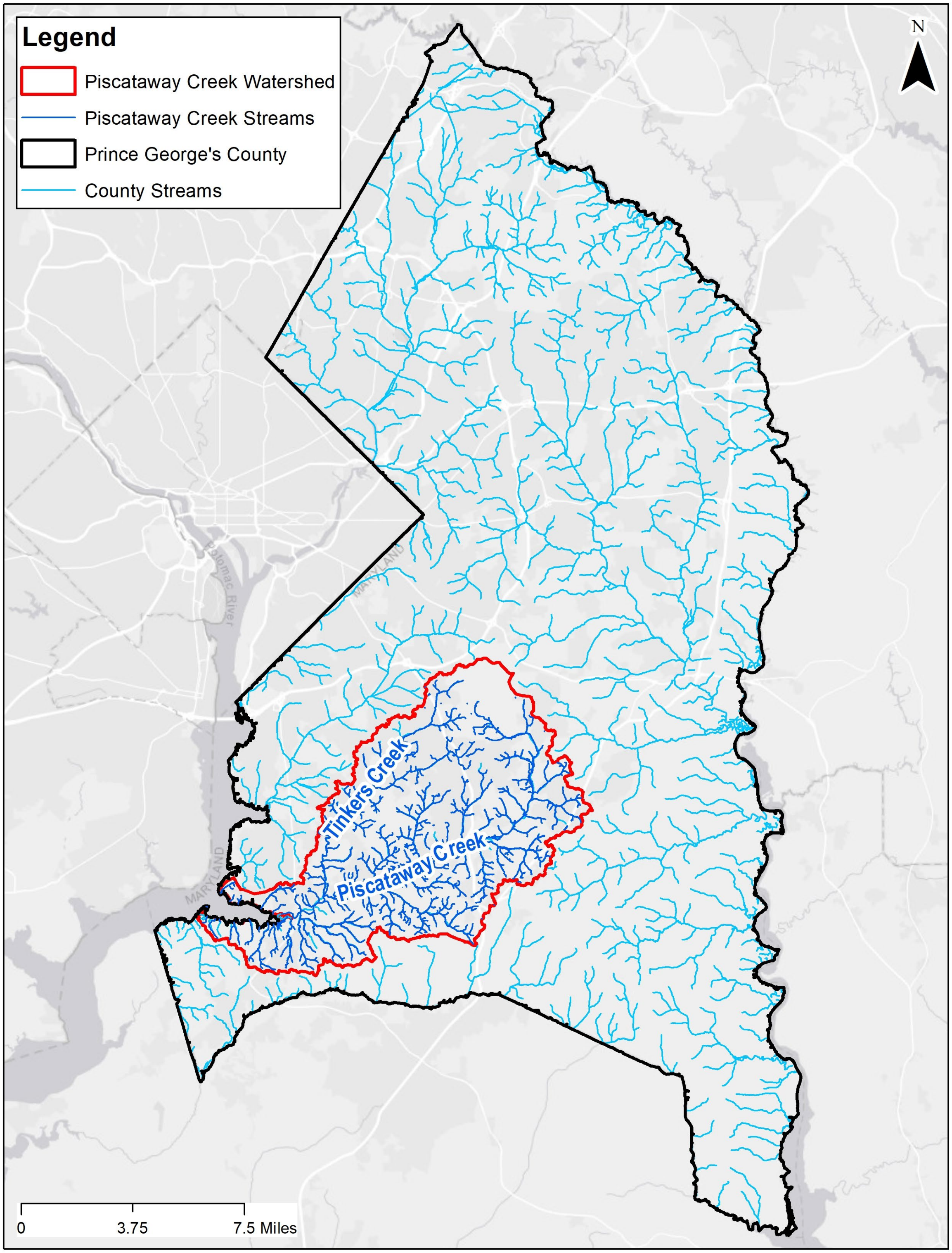
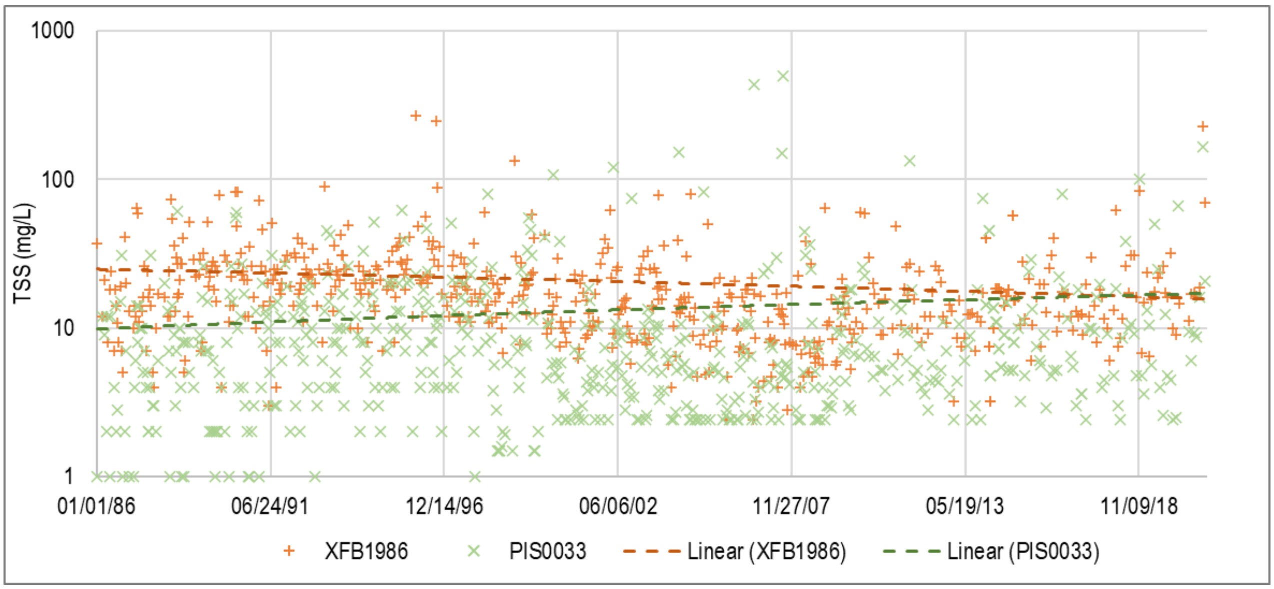


Figure ES-1. Piscataway Creek Watershed.

Long-term Water Quality Data

There is a long history of sediment data (1986–2022) at two locations in the watershed. Figure ES-2 presents an overview of sediment trends from the locations with the most data. (Refer to Section 3.1 for a location map, summary tables, and additional information on these and other locations.) The sediment TMDL was established in 2019. The plots show a downward trend in nutrient concentrations, which might be attributed to various watershed factors (see Section 2 for the watershed characterization) or work by the Washington Suburban Sanitary Commission (WWSC) on repairing leaking sewer lines. The PIS0033 monitoring station shows an increase of sediment concentrations from the watershed, while there is a decrease in concentrations in the mouth of Piscataway Creek. There are other water quality stations in the watershed, but without a long period of record. Data from these stations are further summarized in Section 3.1 of this document.



Source: NWQMC 2023.

Figure ES-2. Plot of TSS concentrations over time at monitoring stations PIS0033 and XFB1986.

TMDL Load Reduction Goals

Table ES-1 summarizes the load reductions. The table presents the baseline load at the time of the TMDL, progress loads as of July 2023, and projected future loads. (For full descriptions of load reduction terminology, please see Section 5.1 of this document.) Figure ES-3 presents the cumulative reductions by restoration activity since the TMDL was developed, which are represented in the table as the difference between the baseline load and the progress load.

MDE has not mandated an end date for the local TMDL WIPs; however, the County understands the public prefers an expedited restoration process and shares that sense of urgency. The County and its watershed partners are committed to finding site opportunities and expediting the planning, design, and construction phases for management activities to the maximum extent practicable (MEP). Implementation milestones in these tables follow a proposed 2 percent restoration rate of untreated impervious surfaces having a 20-year time span to accomplish the reductions needed.

The Piscataway Creek sediment TMDL requires 51 percent or more reductions for sediment. For local TMDL compliance, load reduction estimates are based on MDE's 2021 *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated: Guidance for National Pollutant Discharge Elimination System Stormwater Permits* (MDE 2021a). The guidance lists available best management practices (BMPs) and practices and the associated load reduction efficiencies for WIP load reduction calculations. The current load reduction targets could take $110 million 20 years to meet the target. Current estimates show that most, if not all, land area in the County's MS4 will need to be treated with BMPs, in addition to stream restoration and tree planting to meet TMDL goals.

The County identifies specific BMPs opportunities over a 6-year planning horizon, which becomes part of the approved annual county stormwater capital improvement program (CIP) budget. The milestones in Table ES-1 were developed through the CIP and represent future CIP and programmatic restoration initiatives. These opportunities are included in the County's biannual Financial Assurance Plan (FAP) and summarized in the County's annual MS4 progress report. Planning, design, and construction activities follow a rigorous internal evaluation, including budget, CIP progress tracking, and necessary adjustments to implementation schedules due to unforeseen conditions. The result of this process is adjusted annually. Any BMPs installed by the County to address local TMDLs will also help meet Chesapeake Bay load reduction goals.

Table ES-1 presents the required reductions, current restoration progress (from restoration BMPs installed from the date of the TMDL to June 30, 2023), planned BMP reductions for BMPs in the County's BMP database of upcoming projects, and BMPs identified in this WIP to meet the restoration gap (load reductions from current and planned BMPs from the required reduction).

Table ES-1. Summary of WIP sediment load reductions in the Piscataway Creek watershed.

Measure or Practice	TSS (lbs/yr)	% of Baseline Load
Information from Table 5-3		
Required Reductions	***17,072,807***	***100%***
Current Restoration BMP Reductions (through June 30, 2023)	4,359,140	13%
Planned Restoration BMP Reductions (Identified in County BMP database)	4,844,495	14%
Remaining Restoration Gap to meet TMDL	7,869,171	24%
BMPs identified in this WIP to Meet Restoration Gap		
Stream Restoration / Outfall Stabilization	7,660,624	23%
Tree Planting	124,161	0%
Wet Ponds	0	0%
RR Practices	84,387	0%
Impervious to Turf	0	0%
Total WIP	7,869,172	24%
Total Restoration Activities		
Current BMPs, Planned BMPs, and WIP BMPs	**17,072,807**	51%

Notes:

lbs/yr = pounds per year.
See Section 5.1 for a discussion of the terminology in this table.

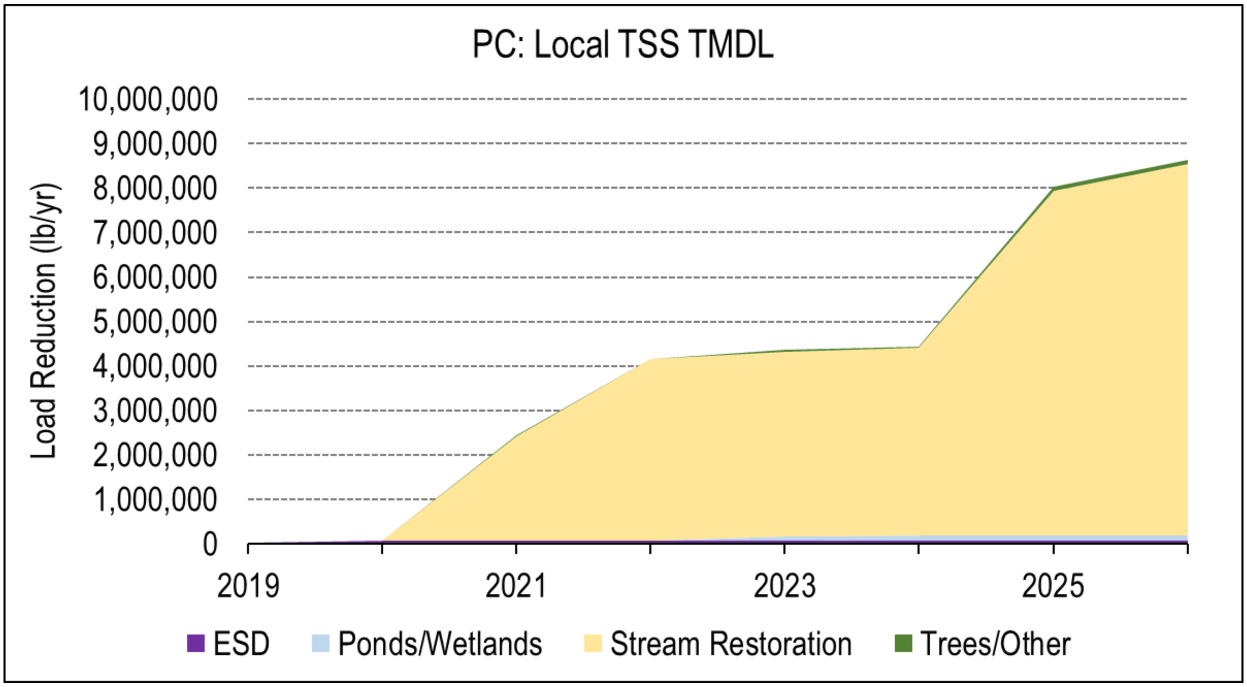


Figure ES-3. Cumulative Load Reductions from Existing and Planned Restoration Activities.

WATERSHED IMPLEMENTATION PLAN DOCUMENT ORGANIZATION

This document is organized into the following sections, which help the reader understand the TMDL, the watershed, and existing or planned restoration activities. Sections 4 through 7 build on information from the prior sections:

- **Section 1 – Introduction:** Contains information for readers new to TMDLs and WIPs and includes information on previous studies, water quality standards, designated uses, and impaired waters.
- **Section 2 – Watershed Characterization:** Contains information on watershed hydrology, climate/precipitation, topography soil, land use, land cover including impervious area, and land ownership. Focuses on watershed information to aid in planning and designing restoration projects.
- **Section 3 – Watershed and Water Quality Conditions:** Contains information on past water quality data, along with biological data, geomorphic data, stream erosion estimates, and potential pollutant sources. Provides Capital Improvement Project (CIP) designers with background to plan restoration projects.
- **Section 4 – Current Stormwater Management Activities:** Provides non-technical readers insight and information on current BMPs in the watershed. Provides the foundation for the discussion of the load reduction targets and current progress in Section 5. Written in a general form for an audience of readers who do not have a background in stormwater management.
- **Section 5 – Load Reduction Targets and Current Progress:** Provides the WIP's overall load calculation methodology and terminology, so that the non-technical readers understand the discussions in Section 6 and Section 7. Contains baseline, progress, and target loads.
- **Section 6 – Load Reduction Strategy:** Provides the overall WIP methodology and restoration scenarios for achieving load reductions. Includes information on BMP identification and selection along with implementation budgeting.
- **Section 7 – WIP Restoration Activities**: Analyzes the future BMPs necessary to meet the TMDL reductions. Includes budget and timeline.
- **Section 8 –Tracking Progress, Monitoring Stream Health, and Conducting Adaptive Management:** Contains information on County restoration progress tracking and reporting, along with information on County monitoring programs. Discusses the County's adaptive management approach to the WIP.
- **Appendix A – Current Stormwater Management Programs:** Overview of existing County stormwater management programs for readers unfamiliar with the programs.
- **Appendix B – BMP Removal Efficiencies:** Contains the BMP efficiencies used in load reduction calculations.
- **Appendix C – BMP Identification and Selection:** Overview of the methodology for identifying and siting BMPs for readers unfamiliar with County protocols.
- **Appendix D – Funding:** Overview of County funding mechanisms for readers unfamiliar with them.

- **Appendix E – Public Outreach and Involvement:** Provides residents and businesses ways that they can stay informed about and aid in the watershed restoration process.

MDE WIP Compliance Checklist

MDE's *General Guidance for Local TMDL (Total Maximum Daily Load) Stormwater Wasteload Allocation (SW-WLA) Watershed Implementation Plans (WIPs)* (MDE 2022a) listed seven items that must be included in SW-WLA WIPs. This table lists these seven primary elements and suggested sub-elements. Each item has a link to the relevant section in this WIP.

Elements and Sub-elements from MDE Guidance		Section/Page
1. What is being adaptively managed, e.g., a resource, a pollutant, a program, and/or individual implementation projects?		1.2.1 / 1-8
2. Why is adaptive management being used?		8.3 / 8-4
	2.1. Is there an aspect of the water resource management process that is specialized?	8.3 / 8-4
	2.2. Does the jurisdiction expect to have to modify the project or program as a result of an issue?	8.3 / 8-4
3a. What are the stepwise goals and objectives that consider both jurisdictional resources and the goals and objectives of the SW-WLA and TMDL?		1.1.2 / 1-2 7 / 7-1
3b. What are the costs associated with proposed management strategies?		6.3 / 6-8 7.3 / 7-5
	3.1. What is the budget?	D-1 / D-1
	3.2. Who has responsibility?	8.1 / 8-2
	3.3. Who is legally liable?	1 / vii
4. Who is the primary audience of the plan, and why?		1.1.3 / 1-4
5. What information is available and how is that information used to inform WIP development?		2 / 2-1 3 / 3-1 4.2 / 4-2
	5.1. Is information from permit required watershed assessments being addressed in detail by section in the TMDL implementation plan?	0 / 2-1 3 / 3-1
	5.2. Have other documents/studies been published that contribute to understanding the watershed as a multi-faceted system and the natural resources it supports?	1.1.4 / 1-5
	5.3. Do other watershed plans exist in the watershed; either generated by a government, utility, or nongovernmental entity? Provide this information and details about other monitoring programs, so data can be shared on a regularly scheduled basis.	1.1.4 / 1-5 3 / 3-1
	5.4. Has the jurisdiction modeled pollutant sources and expected load reductions from potential, planned actions, where applicable?	5 / 5-1 7.2.2 / 7-3
	5.5. Is monitoring data being used to inform actions?	8.2 / 8-2 C.2.3 / C-5
6. How does the watershed function for the public in terms of its beneficial uses?		1.2.1 / 1-8
	6.1. How are stakeholders considered in the planning document	1.1.3 / 1-4 E / E-1
7. What are the proposed planning horizons and how will they be justified?		7.4 / 7-6
	7.1. Identify indicators and determine if they are currently meeting goals.	8 / 8-1
	7.2. Is the proposed planning horizon the point at which improvement is expected? 7.3. Or is the planning horizon simply based on model accounting?	7.4 / 7-6
	7.5. Who does what if milestones for horizons are not met on time?	8.1 / 8-2 8.3 / 8-4

1 INTRODUCTION

On December 2, 2022, the Maryland Department of the Environment (MDE) issued Prince George's County (the County) its fifth-generation permit (Permit Number: 20-DP-3314 MD0068284) for its National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4), which 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., Piscataway Creek). The permit covers the period of December 2, 2022, through December 1, 2027. The MS4 permits are generally issued in 5-year cycles, enabling regulators and permit holders to adjust permit objectives and expectations that could require adjustments to this plan.

The County's 2022 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 a stormwater wasteload allocation (SW-WLA). 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.

This SW-WLA Watershed Implementation Plan (WIP) is the portion of the TMDL that is allocated to permitted dischargers such as wastewater treatment plants or MS4s. This SW-WLA WIP covers the SW-WLA assigned to the County's MS4 for sediment impairments in the Piscataway Creek watershed.

The 2014 and 2022 MS4 permits stipulate that the County must develop additional restoration plans within one (1) year of the EPA approval of a new TMDL. This WIP covers the Piscataway Creek nontidal sediment TMDL, which was approved by EPA in October 2019. This WIP contains updated watershed information from the previous restoration plan for bacteria that was submitted to MDE in 2015 as part of the 2014 MS4 permit compliance (Tetra Tech 2015). This WIP only covers sediment and uses new information, including loading rates derived from the Bay Model 6, provided by MDE to counties in the TMDL Implementation Progress and Planning (TIPP) tool. This plan was developed in a similar way as previous plans, following guidance provided by MDE's *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated: Guidance for National Pollutant Discharge Elimination System Stormwater Permits* (MDE 2021a).

1.1 Purpose of Report and Watershed Restoration

1.1.1 What is a TMDL?

Section 303(d) of the Clean Water Act (CWA) and EPA's Water Quality Planning and Management Regulations (codified in 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 is a *pollution diet* that establishes the amount of a pollutant a water body can assimilate without exceeding its water quality standard for that pollutant and is represented as a mass per unit of time (e.g., pounds per day). The mass per unit of 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 before the stream experiences any detrimental effects. The pollution diet for a given pollutant and water body is composed of the sum of individual waste load allocations (WLAs) for point sources and LAs for nonpoint sources and natural background levels. The WLA is the portion of the TMDL that is allocated to permitted dischargers such as wastewater treatment plants or MS4s. 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 following equation illustrates TMDL components:

$$TMDL = \Sigma\ WLAs + \Sigma\ LAs + MOS$$

The County's MS4 permit requires the County to develop local WIPs to address each EPA-approved TMDL with stormwater WLAs.

Figure 1-1 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 *baseline* pollutant load that exists in a water body before a TMDL is developed. The elevated load causes the water body to exceed water quality criteria associated with the water body's officially designated uses. The bar on the right represents the amount 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.

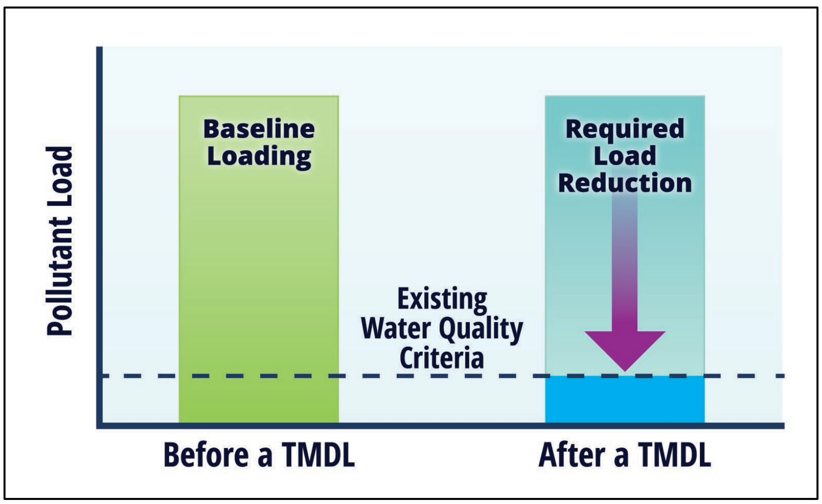


Figure 1-1. Conceptual schematic of a typical pollution diet, or TMDL.

1.1.2 What is a SW-WLA Watershed Implementation Plan?

A WIP is a strategy for managing natural resources in a geographically defined watershed. For the County's Department of the Environment (DoE), this means managing urban stormwater (i.e., runoff originating from rainstorms) 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 streams that convey stormwater runoff to a common body of water. Successful stormwater management consists of structural practices (e.g., vegetated roadway swales) and public outreach (e.g., pet waste campaigns and education) at both the public and private levels. Stormwater management must be implemented per the County's State-approved stormwater regulations and ordinances. These guidelines use changes and their stormwater runoff management requirements. The State provides the County with prescribed methods for restoration for addressing various types of impairments through its accounting for SW-WLA guidance (MDE 2021a), which contains recommended BMP practices and their associated pollutant load removal efficiencies. In preparation for this WIP, the County must follow MDE recommendations as prescribed in the guidance. The WIP 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.
- Support environmental justice initiatives to help underserved and overburdened communities.
- Provide the understanding that these implementation plans will carry over several years and be based on adaptive management.

This document represents the first stage in achieving these goals. This plan focuses on watershed-based planning, not site-level planning. The restoration planning process seeks to:

- Identify the causes and sources of pollution.
- Estimate pollutant load reductions.
- Describe management options and identify critical areas.
- Estimate the 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.

WIP progress is tracked and reported to MDE via annual NPDES reports, which include a geodatabase with updated restoration information and geographic features representing BMP locations. The County prepares a financial assurance plan that provides information on the County's financial capacity to fund projects two years in advance. That plan also includes lists of completed projects and future planned projects. This is discussed in Section 8.

1.1.3 Stakeholders

Overall success of the WIP will depend on the concerted effort of the County and many regional agencies, municipalities, community leaders, and local landowners. Each watershed partner has an important role to play in the restoration process. The proposed management actions will require significant time and resources from all those entities. Technical assistance and other in-kind support from the watershed partners and the public will be important in implementing the plan, especially when addressing obstacles, including permitting challenges, technological limitations, and a lack of available sites where best management practices (BMPs) sites can be implemented.

The intended audience of the WIP includes a wide range of interest groups including local watershed groups, individual citizens (landowners), developers (new and re-development), DoE restoration program planning staff (e.g., DoE Capital Improvement Project [CIP] Section, Clean Water Partnership), DPW&T CIP planning staff, and nongovernment organizations (e.g., Low Impact Development Center, Chesapeake Bay Trust).

This WIP was developed to aid County decision makers and watershed planners in the watershed restoration process. DoE staff use the WIP for BMP project planning and design. It also serves to inform the public and stakeholders on the restoration strategies that the County is taking for impaired waterbodies. The County routinely engages watershed groups countywide. There are watershed groups already formed that can participate as stakeholders during the development of these plans, which are available online for comments and collaboration. Information on how the public and stakeholders can contribute to the restoration process is provided in Appendix E. For instance, watershed groups can search various County sources for information using the County websites, focusing on issues affecting the watershed (e.g., littering, illegal dumping, illicit discharges, erosion control). They can participate in volunteer clean ups or address community stormwater BMPs needs that also treat water quality.

Developers also are stakeholders in watershed health. They are required to treat stormwater from their properties during construction using erosion and sediment control practices to prevent sediment from entering the MS4 and waterways. Developers are also required to implement post-construction BMPs to offset increased impervious areas, and they are responsible for operation and maintenance (O&M) activities to keep the practices functioning properly. This and other WIPs are available to the County Department of Permitting, Inspections, and Enforcement (DPIE) to ensure developers follow BMP recommendations and practices.

When approved, all County restoration plans and WIPs are made available via a County website, along with the materials from public meetings, for anyone who wishes to participate in making improvements to the watershed.[1] The County's annual MS4 reports are also posted on the County website for stakeholders to review.[2]

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[1] https://www.pgcdoe.net/pgc_watershedassesments. Accessed December 2023.
[2] https://www.princegeorgescountymd.gov/departments-offices/environment/stormwater-management/clean-water-program/npdes-ms4-permit. Accessed December 2023.

1.1.4 Previous Studies

Over the years, the County and other agencies have conducted studies and developed plans in the County, including for the Piscataway Creek watershed. This section details the more recent studies.

In 2008, the County commissioned a watershed analysis of Piscataway Creek titled *Piscataway Watershed Assessment 2008/2009*. This analysis included several reports relevant to the current study. The findings of these reports were summarized in the Piscataway Creek Watershed Characterization 2011, prepared by the County, and include:

- TASK 2.A. Land Use Analysis Final Report. A thorough land use/land cover analysis. It characterized the impervious and pervious land covers and determined how much of that impervious area was connected to stormwater outfalls through a stormwater network and how much was disconnected impervious that flowed over the adjacent turf or field areas. A notable example of this is the Joint Base Andrews (JBA) runways, which flows to adjacent grassy areas for infiltration.
- TASK 2.B. Flow Duration Analysis Final Report. Presents the results of a detailed Stormwater Management Model (SWMM) study that used aquifers to partition runoff into overland and subsurface flow regimes. This model was calibrated to the U.S. Geological Survey (USGS) gauge 01653600 for the 2000 water year, which included Hurricane Floyd.
- TASK 2.G. Pollutant Loading Analysis Final Report. Uses the SWMM partitioning of overland runoff as opposed to subsurface flows to project cumulative pollutant loads. Because many particulate pollutants, such as total suspended solids (TSS), particulate phosphorus, particulate nitrogen, and fecal coliform, are filtered by the soil profile, the runoff volumes conveyed by disconnected pathways are substantially attenuated. By accounting for these variables, the final pollutant loading analysis highlighted major differences in the type and volume of pollutant loads.

In 2010, the Maryland-National Capital Park and Planning Commission (M-NCPPC) developed its Water Resources Functional Master Plan (M-NCPPC 2010). The document amended the County's 2002 General Plan. The update summarized estimated existing and future nutrient loadings and looked at the County's water and sewer services capacity relative to planned growth through 2030.

The state of Maryland published its Chesapeake Bay Phase I WIP in December 2010 for major basins, including the Piscataway Creek. A primary goal was to identify target pollutant load reductions that need to be achieved by various sources and geographic areas within the state. In 2011, the County developed a countywide Chesapeake Bay WIP in response to the 2010 Chesapeake Bay Nutrient and Sediment TMDL (PGC DER 2012). The Chesapeake Bay WIP was finalized in 2012 and laid out a plan for BMP implementation and other restoration activities through two target years: 2017 and 2025. In addition to urban stormwater runoff, the Chesapeake Bay WIP covered agricultural practices and upgrades to wastewater systems (i.e., municipal wastewater treatment plants and on-site wastewater systems). MDE also published a Phase II WIP in October 2012, which contained detailed plans for meeting the TMDL at a local level. The plans identified the target loads for each individual jurisdiction (i.e., counties and the city of

Baltimore) within the area. The MDE Phase II WIP included the Prince George's County Phase II WIP.

In 2014, the County developed restoration plans to serve as blueprints for improving water quality and meeting pollutant reduction goals called for in approved local TMDLs. One of these plans was for bacteria in the Piscataway Creek watershed (Tetra Tech 2015). That plan describes the pollutants and sources of those pollutants specific to each body of water, the land uses and natural features in the watershed, a method for determining the amount of pollutant reductions that need to be achieved, and targeted pollutant reduction strategies for each watershed. The strategies include programmatic initiatives (e.g., tree planting, street sweeping) and on-the-ground, pollution-reducing BMPs. The County continues to perform restoration planning throughout the watershed, such as the recently completed watershed plan for Tinkers Creek, as part of grant funding (Tetra Tech 2021). Tinkers Creek is a subwatershed of the Piscataway Creek watershed. This plan covered nutrients and sediment and suggested potential BMP locations.

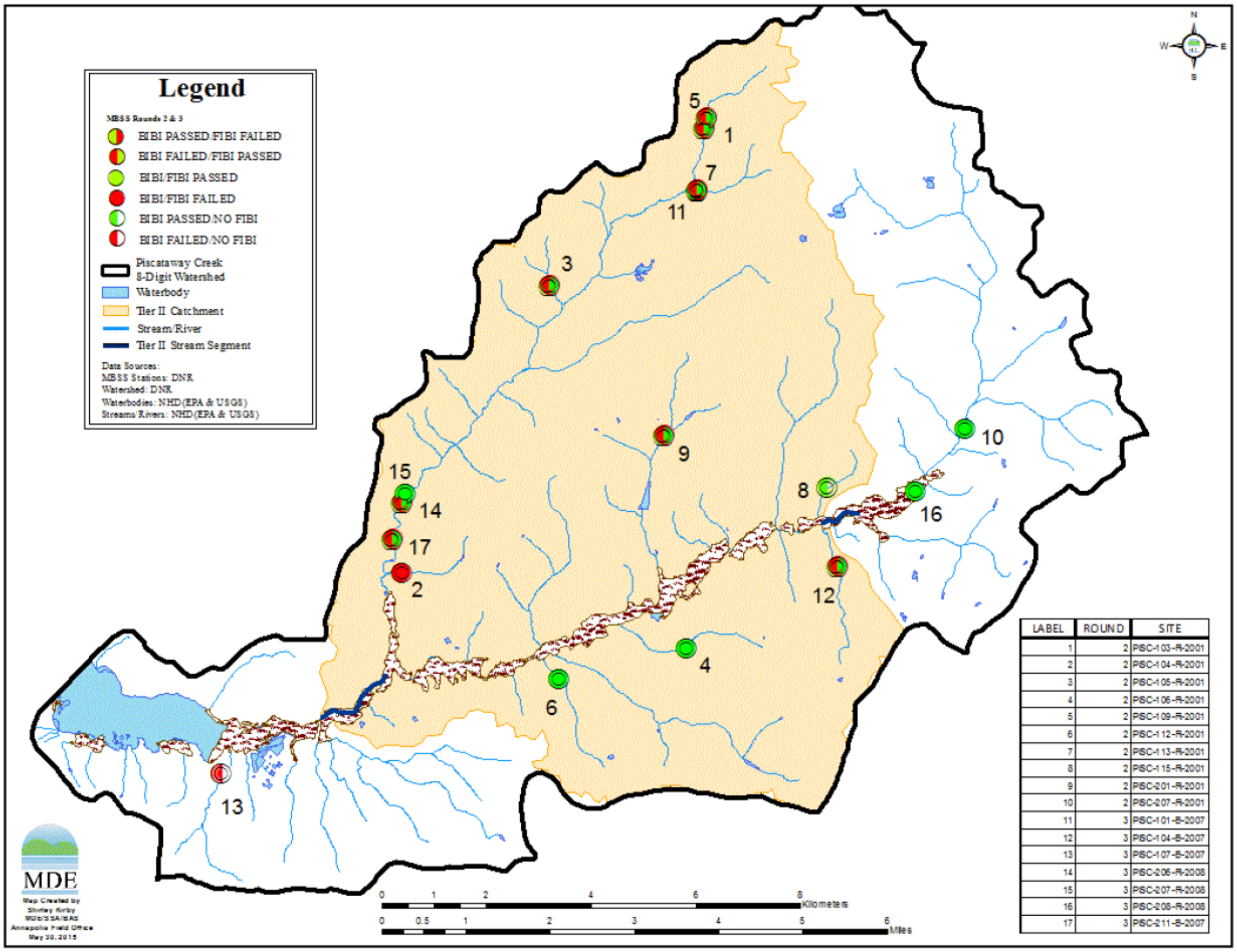
This WIP updates watershed information from the 2015 bacteria restoration plan with new information, such as land use. The 2015 plan used Maryland Department of Planning 2010 land use. This updated plan uses land cover data provided by MDE representing 2015. This new land cover data is the same as used in the recent Chesapeake Bay model and the land cover categories match the updated land-cover loading rates and BMP efficiencies from MDE's 2021 wasteload allocation guidance (MDE 2021a). In early 2022, MDE released its *General Guidance for Local TMDL (Total Maximum Daily Load) Stormwater Wasteload Allocation (SW-WLA) Watershed Implementation Plans (WIPs)* (MDE 2022a). This document lays out the required elements of a WIP, along with additional data. This plan follows MDE guidance.

In 2024, the County finalized its countywide plans for addressing bacteria and polychlorinated biphenyls (PCBs). Both plans follow recent MDE guidance. The bacteria strategy covers the bacteria TMDLs in Anacostia River, Piscataway Creek, and a portion of the Upper Patuxent River watersheds (Tetra Tech 2024a). The PCB strategy covers the bacteria TMDLs in Anacostia River, Mattawoman Creek, Piscataway Creek, Patuxent River, and the Potomac River watersheds (Tetra Tech 2024b). Also, in 2024, the County reviewed and analyzed data on chlorides in the County (Tetra Tech 2024c). This analysis was in response to new MDE permit requirements in the County's 2022 MS4 permit. The County has five watersheds (Anacostia, Mattawoman, Piscataway, Upper Potomac Tidal, and Upper Patuxent) on Maryland's list of impaired waters due to chloride, however, not all have established TMDLs. The County Department of Public Works and Transportation (DPW&T) will be developing the overall salt/de-icer management plan for the County to meet the permit requirement by December 2025.

1.2 Piscataway Creek Water Quality Impairments

This section summarizes the various water quality problems identified in the Piscataway Creek watershed. MDE used its Biological Stressor Identification (BSID) data to support its impairment decisions (MDE 2015). The Watershed Report for Biological Impairment (MDE 2015) indicated that long-term monitoring data collected in the watershed showed significant negative deviations from reference biological conditions, indicating impacts to biological communities that impair the watershed's ability to support aquatic life and wildlife (support of aquatic life and wildlife must be achieved to meet water quality standards). These 303(d) listings for impairment use a biological assessment methodology, the BSID method, which examines the Benthic Index of Biotic Integrity (BIBI) and the Fish Index of Biotic Integrity (FIBI). In addition to the Index of Biotic Integrity (IBI) data, the TMDL development process also examined physical habitat assessments in the context of epifaunal substrate (surfaces on which aquatic organisms may live), and other in-stream habitat considerations, finding correlated results of these measures with sediment influence in the watershed. The BSID identified that the biological communities were likely degraded due to sediment-related stressors.

MDE (MDE 2015) estimates that 36 percent of the Piscataway Creek watershed is in nonattainment of biological water quality standards, demonstrated by 8 out of 22 monitoring stations having benthic and/or fish IBIs significantly lower than 3.0 (on a scale of 1–5). These data were collected during Maryland Biological Stream Survey (MBSS) round 1 (1995–1997), round 2 (2000–2004), and round 3 (2007–2009) monitoring activities. Monitoring rounds 2 and 3 (2000–2009) included the 17 monitoring stations that comprise the principal dataset used for this TMDL; 11 of those stations exhibited benthic and/or fish IBIs significantly lower than 3.0 (on a scale of 1–5). The results from these datasets are presented in Figure 1-2. The low scoring IBIs can be attributed to the watershed having undergone full development with no stormwater management controls, predating the first stormwater management (SWM) ordinance in 1985. The hydrologic watershed balance was disrupted and created a domino effect to the biology and fish.



Source: MDE 2015.

Figure 1-2. MBSS results from MDE 2015 for Piscataway Creek watershed.

1.2.1 Designated Uses

MDE has classified waterbodies in the state based on the waterbody's existing conditions and the potential uses for the waterbody. Additional information on designated uses is found in the *Code of Maryland Regulations* (COMAR) Sections 26.08.02.02[3] and 26.08.02.02-1.[4]

Figure 1-3 presents the designated uses in the watershed, which are also listed below:

- Majority of Piscataway Creek watershed streams
  - Use Class I: Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life
- Small tributary at the mouth of Piscataway Creek to Piscataway Creek the Potomac River in Fort Washington Park
  - Use Class II: Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting

[3] http://mdrules.elaws.us/comar/26.08.02.02

[4] http://mdrules.elaws.us/comar/26.08.02.02-1

- Tidal areas of the Piscataway Creek
  - Use Class II: Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting
    - Seasonal Migratory Fish Spawning and Nursery Subcategory.
    - Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory.
    - Open-Water Fish and Shellfish Subcategory.
- Cosca Lake
  - Use Class I: Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life

The Class I designation includes waters that are suitable for:

a) water contact sports;
b) play and leisure time activities where individuals may come in direct contact with the surface water;
c) fishing;
d) the growth and propagation of fish (other than trout), other aquatic life, and wildlife;
e) agricultural water supply; and
f) industrial water supply.

Maryland has also designated Tier II high-quality waters, which are waterbodies with existing water quality that is significantly better than water quality standards. Per federal regulations (Title 40 of the *Code of Federal Regulations* Section 131.12 [40 CFR 131.12]), these waters must be maintained at their high-quality level.

The Piscataway Creek has two stream segments that have been designated as Tier II waters (Figure 1-3). The downstream segment is 1.01 miles (drainage area of 13.4 square miles) and the upstream is 0.55 miles (drainage area of 57.2 square miles). Both streams are listed as not having remaining assimilative capacity. MDE's assimilative capacity analysis is a measure of how much Tier II stream water quality can decline before it is considered degraded. For additional information on Maryland's Tier II waters and assimilative capacity, please see MDE's webpage on anti-degradation.[5]

[5] https://mde.maryland.gov/programs/Water/TMDL/WaterQualityStandards/Pages/Antidegradation_Policy.aspx

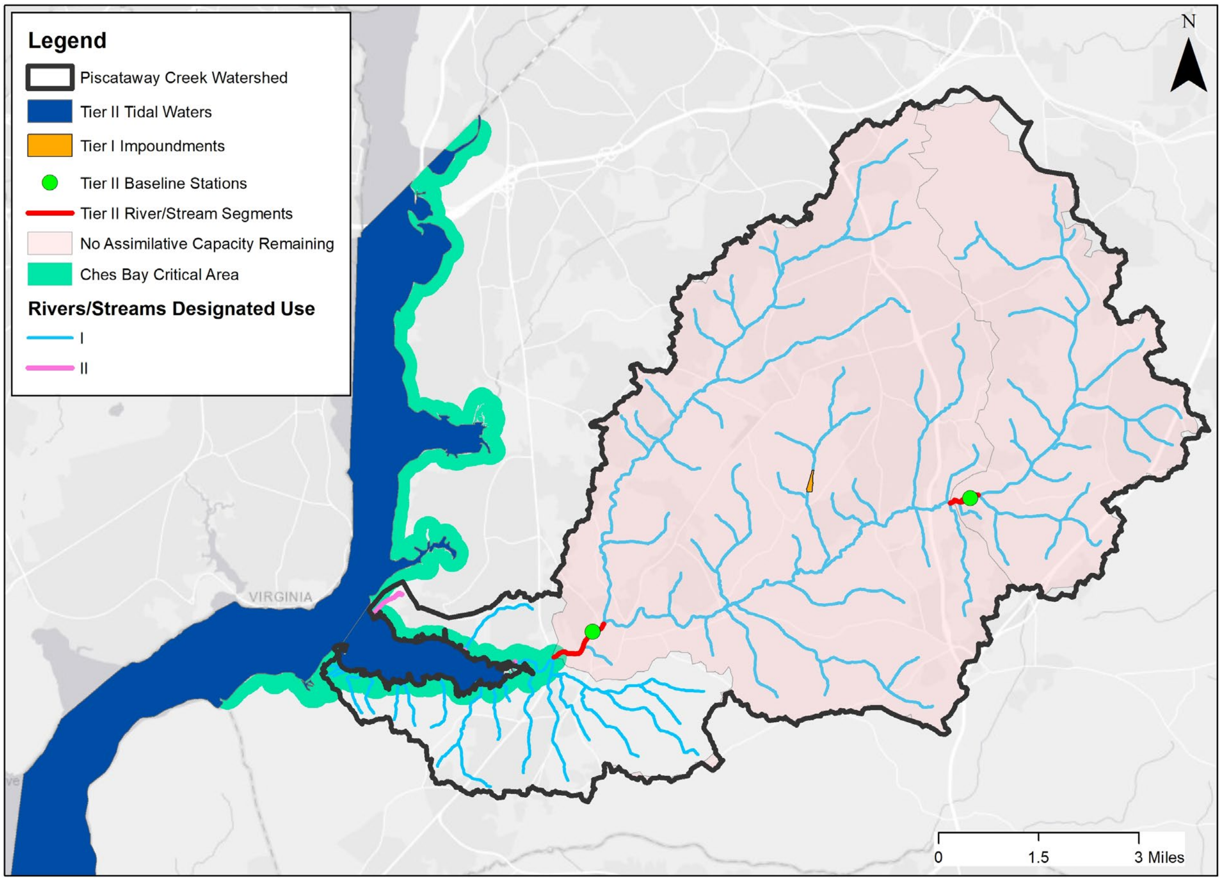


Figure 1-3. Designated uses and Tier II waters in the Piscataway Creek watershed.

1.2.2 *Impairment Listings*

Piscataway Creek and its tributaries are included on the MDE 303(d) list of impaired waters for several pollutants. Table 1-1 lists these pollutants, their listing year, if a TMDL was developed, and the resulting percent reductions. This WIP addresses the TMDL for nontidal sediment pertaining to Prince George's County.

Table 1-1. List of impaired waters in the Piscataway Creek watershed in Prince George's County.

Pollutant	Year	Finalized TMDL? (Year)	TMDL Percent Reduction for MS4	Included in this WIP?
Sediment, total suspended solids	2016	Yes (2019)	51%	Yes
Nutrients (nitrogen, phosphorus) and Sediment, as part of Chesapeake Bay TMDL	2012	Yes (2010)	TN: 22.2% TP: 41.0%	No. See PGC DER 2012.
Fecal coliform bacteria (enterococci)	nontidal waters (2002); tidal waters (2004)	Yes (2006)	NEB / NWB: 80.3% Tidal: 99.3%	No. See Tetra Tech 2024a.
Polychlorinated biphenyls (PCBs)	2014	Yes (2019)	5%	No. See Tetra Tech 2024b.
Perfluorooctane sulfonate (PFOS) In Fish Tissue	2024	No. Required (high priority).	n/a	n/a

Pollutant	Year	Finalized TMDL? (Year)	TMDL Percent Reduction for MS4	Included in this WIP?
Salt (chlorides)[a]	2016	No[b]	n/a	n/a

Source: MDE 2024.
Notes:
n/a = not applicable.
[a] Replaces biological integrity biological listing.
[b] High priority to be addressed through pollution control requirements. Low priority for TMDL development.

MDE developed TMDLs to address impairments caused by the exceedance of water quality standards for fecal coliform bacteria, polychlorinated biphenyls (PCBs), and nontidal sediment. This WIP addresses the sediment impairments. Other documents address the bacteria and PCB impairments (Tetra Tech 2024a, Tetra Tech 2024b). In addition, EPA developed an overall TMDL for the Chesapeake Bay watershed for nitrogen, phosphorus, and sediment (USEPA 2010). MDE suggests that the Chesapeake Bay TMDL sediment reductions will be met by achieving nutrient reductions, therefore, does not provide a percent load reduction needed for sediment. The County has developed restoration plans for fecal bacteria to address those TMDLs (Tetra Tech 2015) and developed a WIP in response to the Chesapeake Bay TMDL (PGC DER 2012).

1.2.3 Water Quality Standards

The Maryland water quality standards Surface Water Use Designation Code of Maryland Regulations for the non-tidal portion of Piscataway Creek is Use I - Water Contact Recreation, Fishing, And Protection of Aquatic Life and Wildlife [COMAR) 26.08.02.08M]. The tidal Patuxent River Lower mainstem and tidal tributaries are designated Use Class II - support of estuarine and marine aquatic life and shellfish harvesting.

Maryland's Biological Stressor Identification (BSID) analysis determined the Piscataway Creek watershed was impaired by total suspended solids (TSS). To address this impairment, a TMDL for sediment/TSS was developed for the non-tidal portion of the Piscataway Creek watershed. For the purposes of the TMDL, the terms TSS and sediment are used interchangeably. In Maryland, there are no specific numeric criteria that quantify the impact of sediment on the aquatic life of nontidal stream systems.

To quantify the impact of sediment on aquatic life, a reference watershed TMDL approach was used. A sediment loading threshold was established by performing a detailed analysis of sediment loads from other Maryland watersheds that were identified as supporting aquatic life based on Maryland's biocriteria (reference watersheds). The Chesapeake Bay Program Phase 5.3.2 (CBP P5.3.2) watershed model was chosen to calculate reference watershed sediment loading thresholds. The median (50th percentile) sediment loading rate from reference watersheds was applied to the non-tidal Piscataway Creek watershed to quantify a reduction in sediment needed to protect aquatic life. This assumes that aquatic life in the Upper Patuxent would be protected if sedimentation rates were reduced to levels observed in streams with good biotic integrity.

A sediment TMDL for the tidal portion of Piscataway Creek was established under the Chesapeake Bay TMDL in 2010. Suspended sediment in the water column reduces the amount of sunlight reaching the leaves of submerged aquatic vegetation (SAV). The Chesapeake Bay

TMDL prescribes reductions to sediment necessary to meet water clarity and SAV restoration goals in concert with projected water quality improvement from concurrent nutrient reductions.

1.2.4 TMDL Pollutants

TMDLs for sediment were developed by MDE to address water quality impairments. Below are brief descriptions of the TMDL pollutants.

Total Suspended Solids

TSS are small soil particles, including particles that make up sediment, that are carried in water and capable of being captured by a filter. Stream channel erosion is a major source of TSS and tends to worsen because of land development if stormwater runoff is not effectively controlled.

TSS concentrations in streams tend to increase with the amount of impervious surface in a watershed. As the impervious surfaces send runoff more quickly to local streams, the higher velocities and volumes of water in typically incised stream channels tend to increase rates of erosion. Channel erosion moves soil particles into the water from both the stream banks and the stream bed. Much of the resulting suspended sediment that is generated during a stormwater runoff event could settle out in deposits as the water slows between events. But those sediments can be resuspended and transported downstream with increased stream flow velocity.

In addition to the erosive effects, excessive settling of sediment on the stream bed and into the gravel blocks the flow of fresh, oxygenated water into the substrate. This situation leads to the destruction of fish spawning beds, a loss of aquatic habitat, and an increase in the mortality rate of macroinvertebrates from damaged or clogged gills and loss of food sources. Suspended sediment blocks light transmission, which limits the growth and survival of submerged aquatic vegetation (SAV). Sediment and sediment deposits in tidal reaches can also contribute to the demise of aquatic life there.

2 WATERSHED CHARACTERIZATION

The Piscataway Creek watershed is completely within Prince George's County, with a very small part of the watershed overlapping with the municipality of Morningside along Allentown Road in the northern portions of subwatershed PC-11 (Figure 2-1). The watershed also contains portions of JBA. Piscataway Creek discharges into the Potomac River near Fort Washington and Accokeek, Maryland. The Piscataway Creek watershed has a drainage area of about 43,250 acres or 67.6 square miles.

2.1 Physical and Natural Features

2.1.1 Hydrology

The Piscataway Creek watershed comprises two major subwatersheds (Figure 2-1). The mainstem of the Piscataway Creek is 18.2 miles long, beginning at JBA and ending at the Potomac River below Washington, D.C. It also includes Tinkers Creek, which is 9.1 miles long, and originates at JBA. There are also several named tributaries to these mainstem creeks. In the Piscataway Creek watershed, these are Burch Branch, Butler Branch, Dower House Branch, and many other unnamed tributaries. In Tinkers Creek, these are Meetinghouse Branch, Pea Hill Branch, and Haynes Branch. Below the confluence with Tinkers Creek, the Piscataway becomes tidal for 2.8 miles.

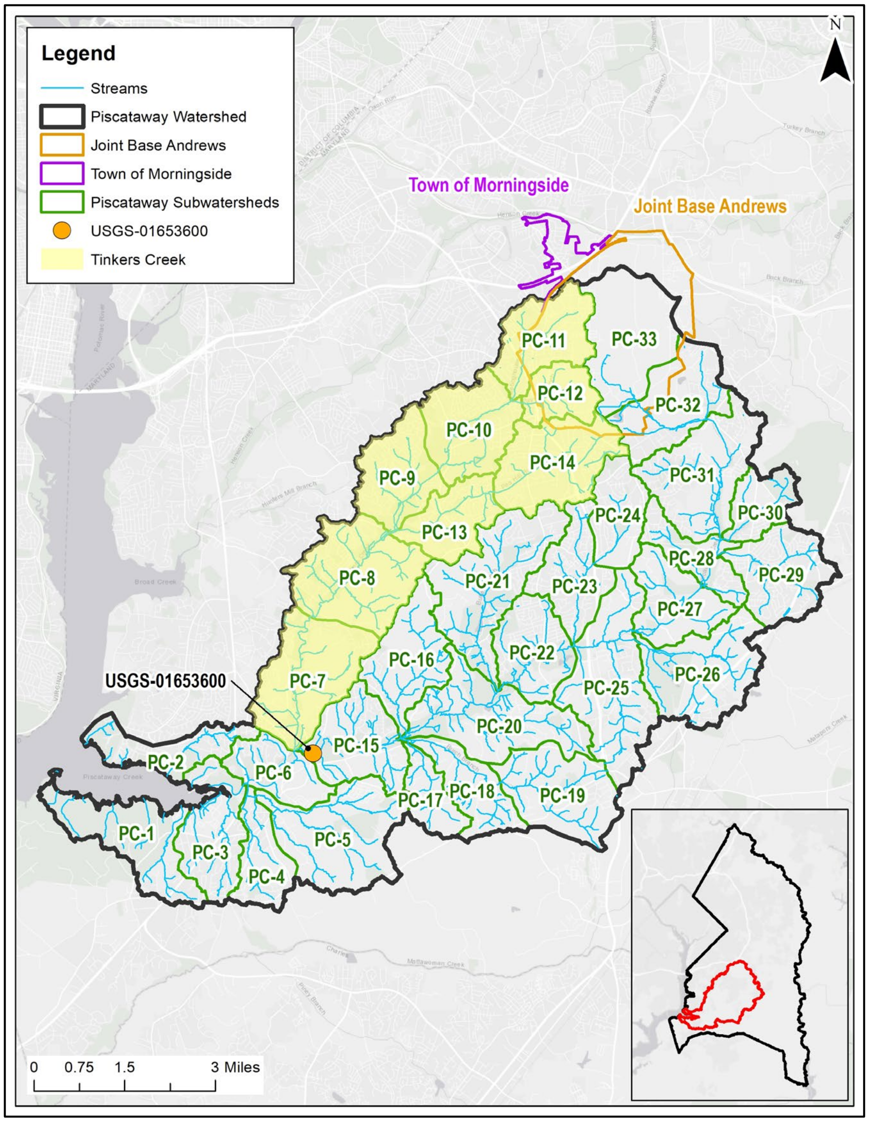


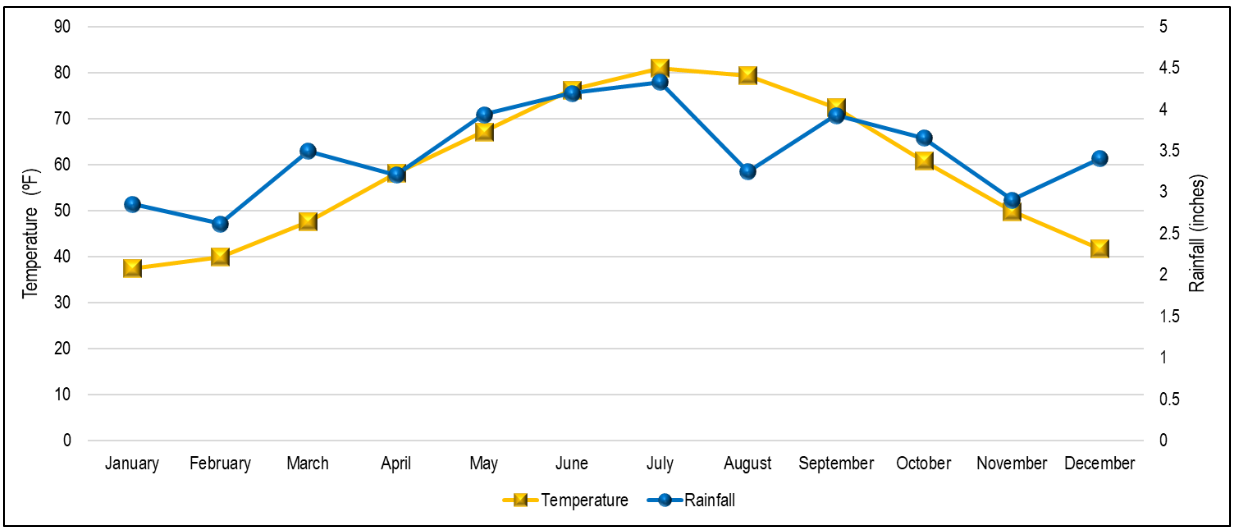
Figure 2-1. Location of the Piscataway Creek watershed.

The County has broken down the main watershed into small subwatersheds (e.g., 500–1,000 acres) to help address restoration at a smaller scale. These smaller subwatersheds are identified as PC-1 through PC-33 in Figure 2-1. The smaller watersheds are not considered watershed management areas. Implementation strategies are presented in later sections for the entire watershed, as individual project opportunities are unknown at the time of WIP development.

There is only one USGS stream gage in the watershed with flow data (see Section 3.1). It is on the downstream side of Maryland Route 223 (Piscataway Road). This gage is upstream of the confluence with Tinkers Creek, leaving a large segment of the Piscataway Creek watershed unaccounted for by this gage. Flow data provides general historical trends that can help the County understand hydrologic response in the watershed. The station is not collecting data specific to the impairments; however, they are helpful as a big picture of watershed conditions. USGS 01653600 currently provides gage height and discharge data, but has served as a sampling point for USGS to evaluate the presence of nutrients and sediments (see Section 3.1).

2.1.2 Climate/Precipitation

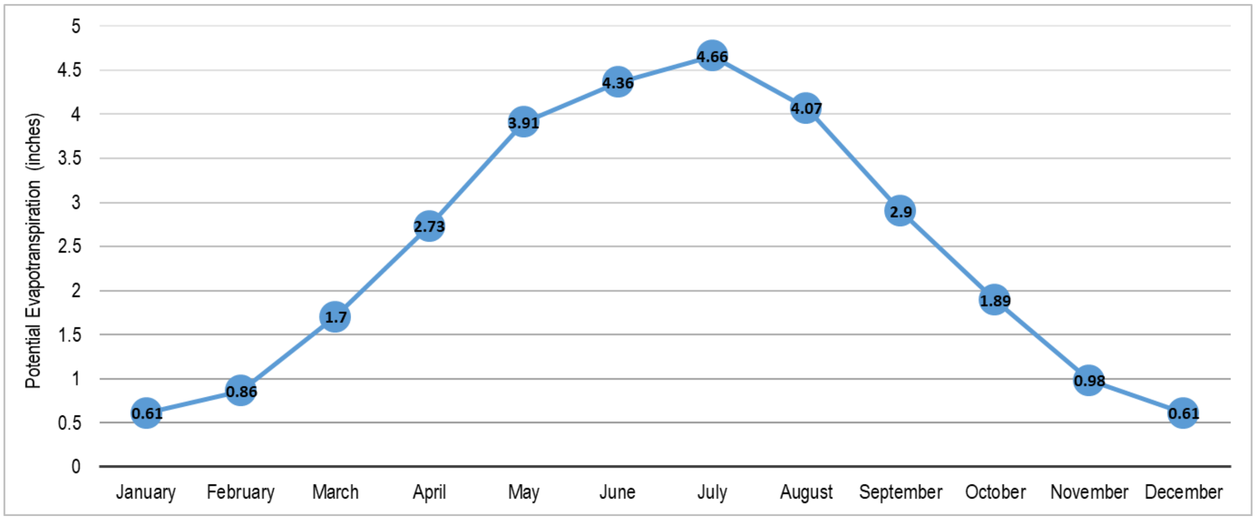
The climate of the Piscataway Creek watershed is characterized as temperate. The National Weather Service Forecast Office reports a 30-year average annual precipitation of 39.74 inches (NWS 2023). On average, winter is the driest season, with 8.48 inches of precipitation, and summer is the wettest season, with 10.44 inches (NWS 2023). Precipitation is highest in late spring to late summer. The average annual temperature is 58.2 degrees Fahrenheit (°F), with the January normal low at 28.6 °F and the July normal high at 88.4 °F (NWS 2022). The normal monthly precipitation and temperature for Upper Marlboro are presented in Figure 2-2. Average monthly temperatures range from approximately 33 °F in January to a peak of almost 80 °F in July.



Sources: NWS 2022, 2023.

Figure 2-2. Average monthly temperature and precipitation.

Evapotranspiration accounts for water that evaporates from the land surface (including water bodies) and is lost through plant transpiration. Evapotranspiration varies throughout the year because of climate but is greatest in the summer. Figure 2-3 presents the potential evapotranspiration, which is described by the National Oceanic and Atmospheric Administration (NOAA) as "the maximum amount of water that would be evapotranspired if enough water were available (from precipitation and soil moisture)" (NOAA n.d.). That amount is affected by solar radiation, air temperature, vapor pressure, and wind speed. Expected rates of evapotranspiration constitute a design consideration for certain BMPs, particularly those that have permanent water (e.g., wet ponds) or rely on moisture-rich soils (e.g., wetlands).



Source: NRCC 2014.

Figure 2-3. Average monthly potential evapotranspiration in inches (1981–2010).

The County is reviewing the potential effects of climate change on watershed implementation.[6] Climate change is the result of rising temperatures due to elevated levels of heat-trapping greenhouse gases such as carbon dioxide in the atmosphere. Rising temperatures are expected to increase and shift energy distribution in the atmosphere, which could lead to increased evaporation, increased humidity, higher average rainfall, and greater occurrences of heavy rainstorms in some regions and droughts in others (USEPA 2016). Though average annual precipitation in Maryland has increased by approximately 5 percent in the past century, precipitation from extremely heavy events has increased in the eastern United States by more than 25 percent since 1958 (USEPA 2016). Average precipitation is expected to increase during winter and spring, which will cause snow to melt earlier and intensify flooding during these seasons. The higher rates of evaporation will also likely result in drier soil during the summer and fall.

The Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA) program maintains a website that helps illustrate the impact of climate change on precipitation under future climate conditions (MARISA 2022). The website provides updated intensity-duration-frequency (IDF) curves by county. These curves describe the relationship between rainfall intensity, rainfall duration, and frequency of the interval (e.g., 5-year rainfall). IDF curves are used for forecasting floods and designing stormwater conveyance and treatment practices. Precipitation frequency is the amount of rainfall at a location for a specified duration that has the probability of occurring. For instance, if a location has an 8.5-inch precipitation frequency for a 100-year, 24-hour storm, it means that for a rainfall event that lasts 24 hours, there would be a one in a hundred (1 percent) chance that 8.5 inches would be exceed in a 24-hour period.

[6] Prince George's County has created an overall County *Climate Actin Plan*. For additional information, please see https://www.princegeorgescountymd.gov/departments-offices/environment/sustainability/climate-change.

Initial precipitation frequency estimates were developed in 1961 by the U.S. Weather Bureau in Technical Paper Number 40 (TP40). These numbers were revised in 2006 by NOAA and are referred to as Atlas 14. Recently, the MARISA team and the Chesapeake Bay Program looked at future predictions for precipitation frequencies. Table 2-1 presents the precipitation frequencies for Beltsville, MD from TP40, Atlas 14, and MARISA.

Table 2-1. Precipitation (inches) frequency 24-hour estimates for Beltsville, MD.

24 Hour Duration	TP 40	Atlas 14	MARISA Atlas 14 Projected 2020–2070	MARISA Atlas 14 Projected 2050–2100
2-Year	3.3	3.2	3.46	3.68
10-Year	5.3	4.92	5.31	5.71
100-Year	7.4	8.49	9.42	10.1

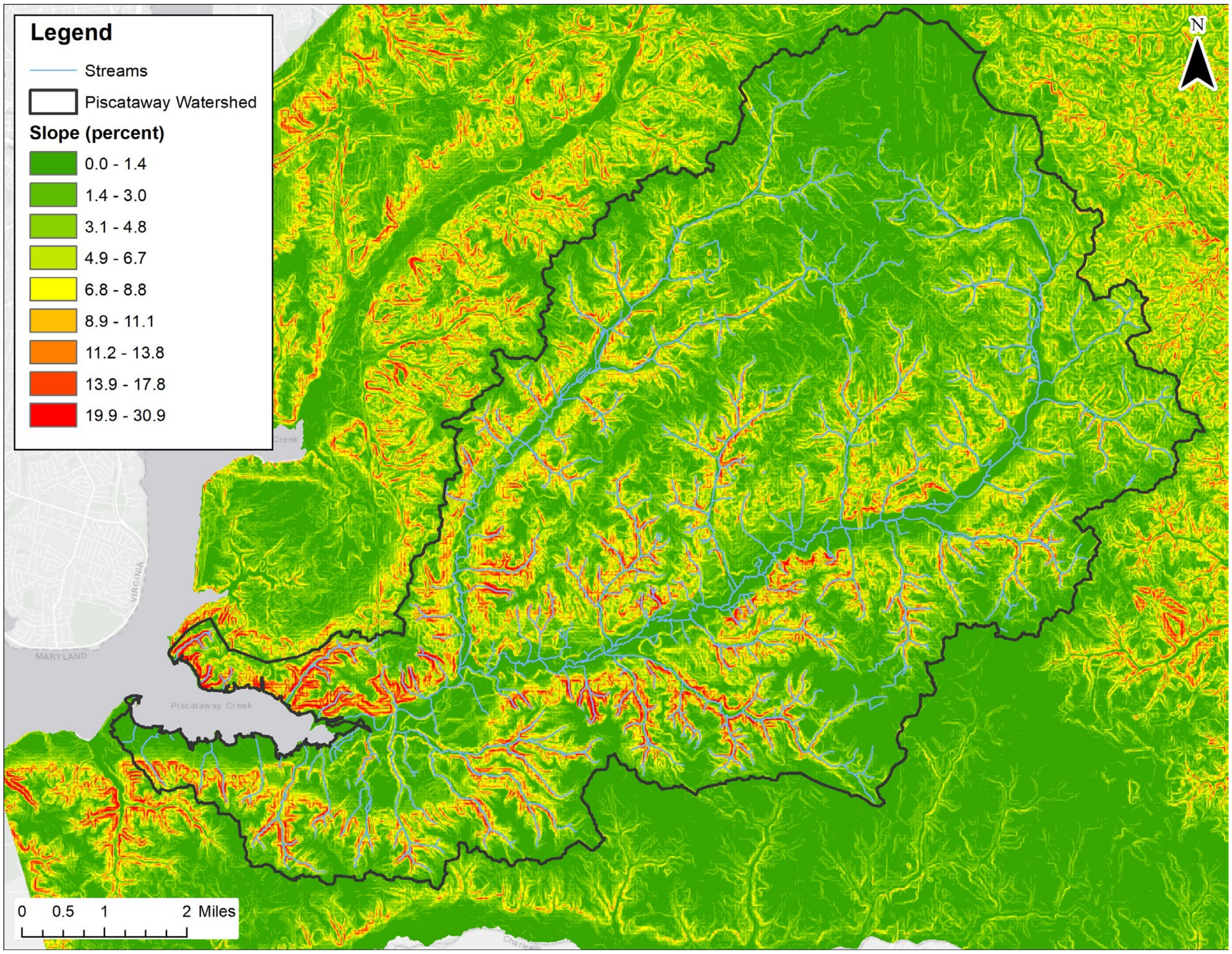
Sources: NOAA 2006, Miro et. al. 2021.

2.1.3 Topography/Elevation

According to the Maryland Geological Survey, the Piscataway Creek watershed lies in the Coastal Plain geologic province, which is characterized by gentle slopes, good drainage, and deep sedimentary soil complexes (MGS 2014).

Figure 2-4 displays land surface slopes across the Piscataway Creek watershed. This method of mapping identifies the steepest areas of the watershed, which could indicate the variability of speed in overland runoff and suggest places that are more susceptible to higher rates of erosion and increased sediment in the stream. This can help to characterize some of the sediment-influencing capacity of that flow, especially when combined with other relevant information, such as soils data.

The watershed is relatively low-lying along the mainstem stream valleys, but it reaches elevations of 250–300 feet in the most northern headwaters portions of the watershed. The greatest slopes encountered in the Piscataway Creek watershed are found near the transition from the primary mainstem floodplains in the initial stream valley wall; therefore, stream flows will experience greater velocities in these areas (Figure 2-4).



Source: M-NCPPC 2014,

Figure 2-4. Land slopes across the Piscataway Creek watershed.

2.1.4 Soils

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service has defined four major hydrologic soil groups (HSGs) for categorizing soils by similar infiltration and runoff characteristics (SCS 1974). HSGs are generally categorized into one of four groups: A, B, C, or D. 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; group B and group C soils, in between groups A and D, have respectively moderate levels of infiltration and runoff. Soils in the watershed are frequently also 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.

Table 2-2 summarizes soil make-up in the watershed by HSG.

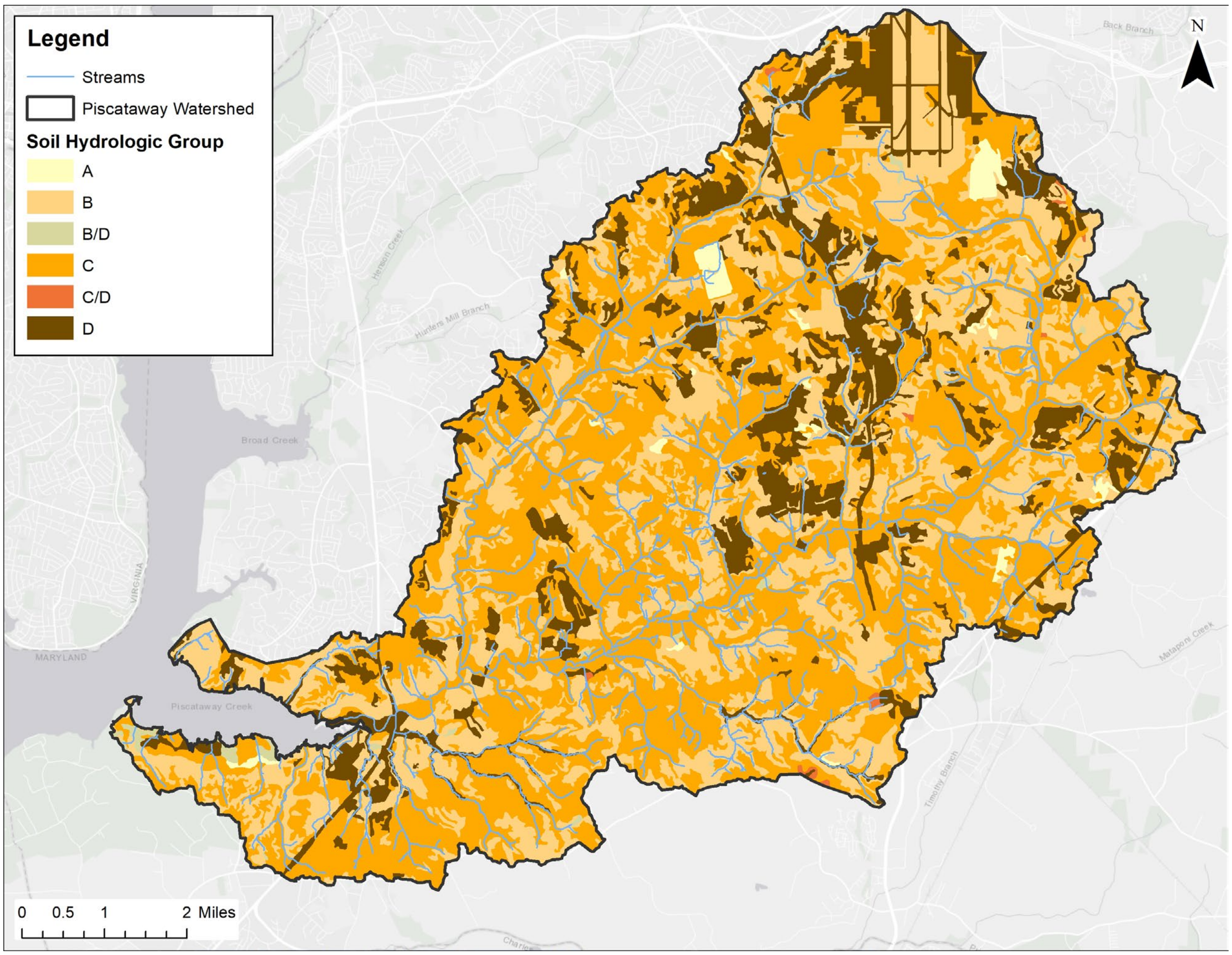
Figure 2-5 shows the locations of the different USDA HSGs across the Piscataway Creek watershed (USDA 2003). Soils in group C are the predominant soils in the watershed, while soils in group D are the least common.

Soils in the watershed are frequently also 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.

Table 2-2. Summary of soils in the Piscataway Creek watershed.

Soil Type	A	A/D	B	B/D	C	C/D	D
Acres	6,995	48	3,792	1,210	25,183	3,356	2,236
% Total	16.3%	0.1%	8.9%	2.8%	58.8%	7.8%	5.2%

Note: Soil types A/D, B/D, and C/D behave as A, B, or C soils, respectively, during dry weather and soil type D during wet weather.



Source: USDA 2003.

Figure 2-5. Hydrologic soil groups in the Piscataway Creek watershed.

2.2 Land Use and Land Cover

Land use and land cover are key watershed characteristics that influence the type and amount of pollution entering the County's water bodies. Land use is how the land is being used (e.g., residential neighborhood). Land cover is what is covering the land (e.g., turf, impervious surface).

Over time, land use and land cover changes have caused stream health to be degraded and certain streams to be classified as impaired. Some natural changes have occurred over centuries, others were the result of farming, new development, and construction of roads. The County has many older neighborhoods inside the Beltway, close to the border with Washington DC, which were developed without stormwater quality controls. The areas outside the Beltway, such as the Piscataway Creek watershed, continue to be developed and are moving from agricultural land and forests to developed land, which is the leading cause of impairments. In 2014, the County Planning Department created *Plan 2035*, which contains the County's future development plans.[7] One of the policy goals of Plan 2035 is to reduce stormwater runoff.

2.2.1 Land Use Distribution

Land-use information for the Piscataway Creek watershed was obtained from the Maryland Department of Planning 2010 land use update (MDP 2010). Different land use categories (e.g., agriculture, residential) have different types of land cover, such as roads, roofs, turf, and tree canopy. Consequently, land use affects how readily stormwater drains from the land and how much pollution it carries. Table 2-3 summarizes the land use distribution in the Piscataway Creek watershed. Figure 2-6 shows the land uses in the watershed.

Overall, a little less than half (45 percent) of the land use in the watershed is urban land and slightly less than that (43 percent) is forested. The largest areas of urban land are medium-density residential (18.9 percent), followed by low-density residential (11.2 percent). There are also significant areas of agricultural land (10 percent). Most of the institutional and open space land use area is part of JBA.

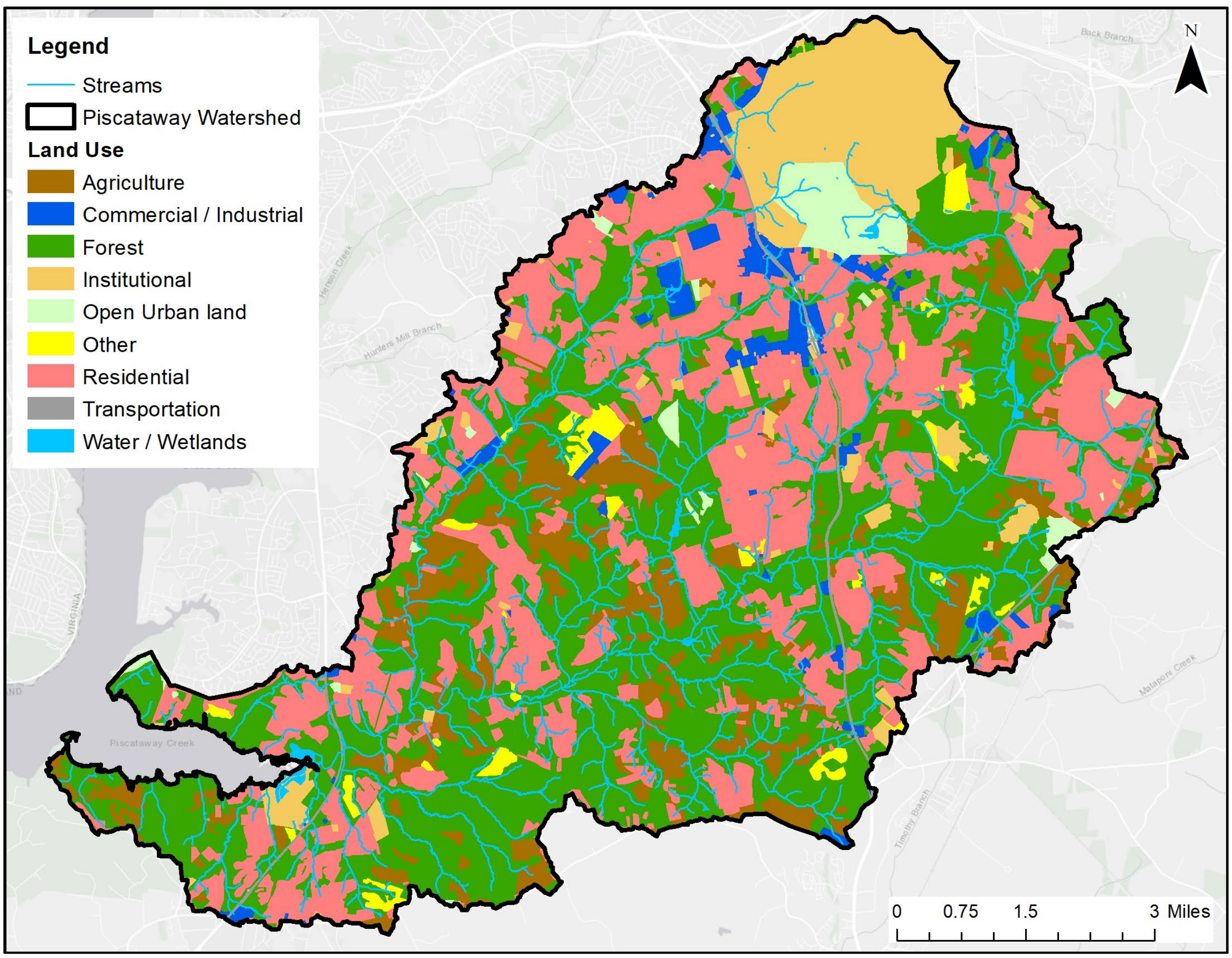
Table 2-3. Piscataway Creek watershed land use.

Land Use Category	Area (acres)	% Total
Agriculture	**4,356.6**	**10.07%**
Agricultural building	58.3	0.13%
Cropland	3,065.5	7.09%
Large lot subdivision (agriculture)	95.8	0.22%
Pasture	1,118.6	2.59%
Row and garden crops	18.3	0.04%
Forest	**18,472.4**	**42.71%**
Brush	439.6	1.02%
Deciduous forest	12,850.2	29.71%
Evergreen forest	536.9	1.24%
Large lot subdivision (forest)	1,070.3	2.47%
Mixed forest	3,575.4	8.27%
Other	**728.9**	**1.69%**
Bare ground	728.9	1.69%
Urban	**19,491.9**	**45.07%**
Commercial	847.2	1.96%

[7] https://www.mncppcapps.org/planning/publications/BookDetail.cfm?item_id=279&Category_id=1

Land Use Category	Area (acres)	% Total
Extractive	153.7	0.36%
High-density residential	335.9	0.78%
Industrial	193.9	0.45%
Institutional	3,605.4	8.34%
Low-density residential	4,848.7	11.21%
Medium-density residential	8,165.1	18.88%
Open urban land	1,016.2	2.35%
Transportation	325.8	0.75%
Water and wetlands	**197.5**	**0.46%**
Water	125.9	0.29%
Wetlands	71.6	0.17%
Total	**43,247.3**	**100%**

Source: MDP 2010.



Source: MDP 2010.

Figure 2-6. Land use in the Piscataway Creek watershed.

2.2.2 Land Cover Distribution

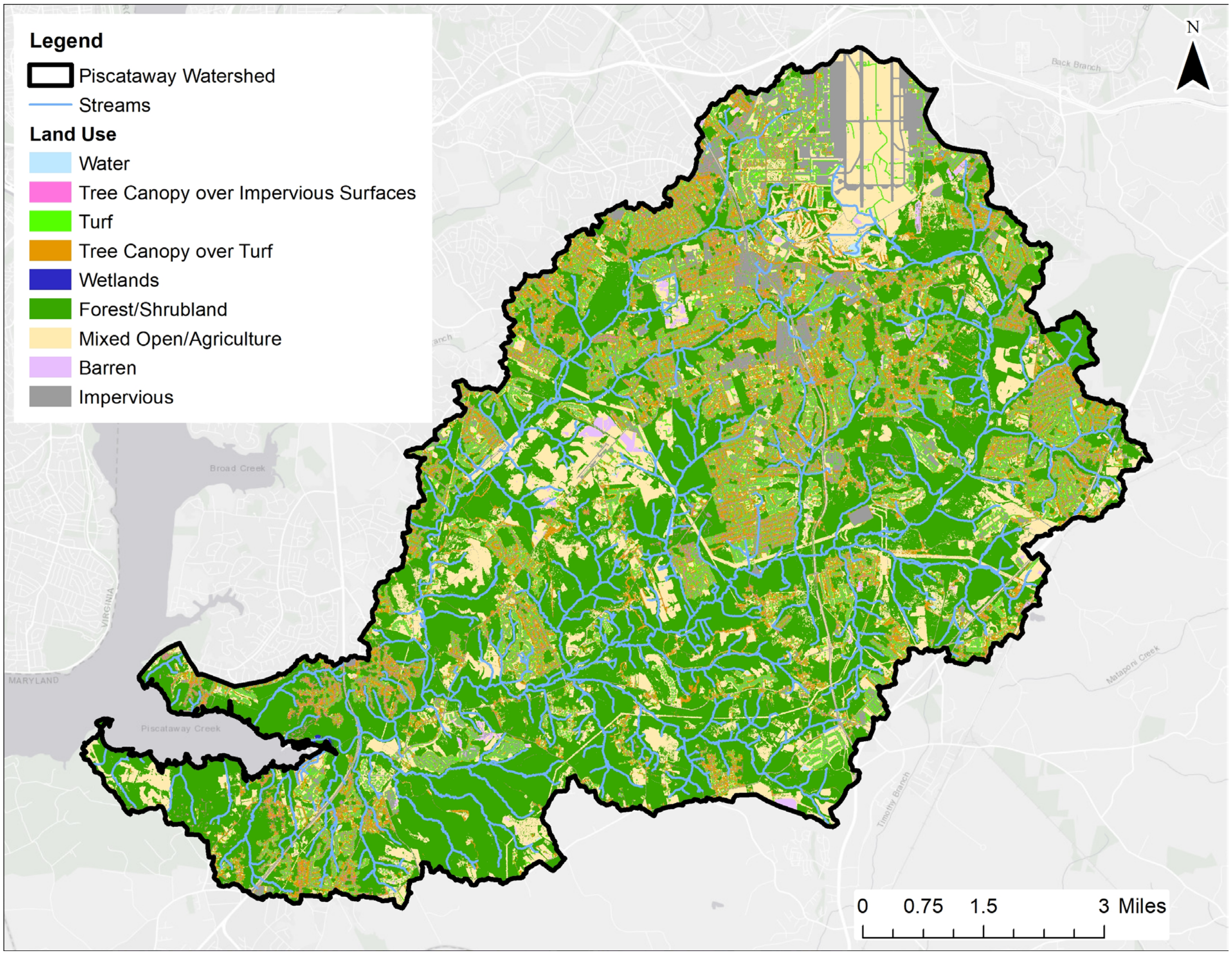
Land cover differs from land use in that it describes what covers the land instead of how it is used. Land cover information was obtained from MDE (2021b) and matches the land cover data in the Chesapeake Bay model. Table 2-4 summarizes the land cover distribution in the Piscataway Creek watershed. Figure 2-7 shows a map of land cover in the watershed.

Overall, half the land cover in the watershed is forest and 32 percent is urban. The largest areas of urban land cover are tree canopy over turf (9.8 percent) followed by turf (8.4 percent). There are also significant areas of mixed open/agriculture land cover (17 percent), which is considered outside the MS4 area.

Table 2-4. Piscataway Creek watershed land cover.

Land Cover Category	Area (acres)	% Total
Turf	3,646.80	8.43%
Tree canopy over turf	4,229.40	9.78%
Impervious roads	1,346.50	3.11%
Structures	1,376.20	3.18%
Impervious surfaces	2,160.70	5.00%
Tree canopy over impervious roads	288.3	0.67%
Tree canopy over structures	170.7	0.39%
Tree canopy over impervious surfaces	422	0.98%
Forest	21,481.40	49.67%
Shrubland	409.2	0.95%
Mixed open/agriculture	7,345.70	16.99%
Barren	255.3	0.59%
Wetlands	19.7	0.05%
Water	95.2	0.22%
Total	**43,247.30**	**100.00%**

Source: MDE 2021b.



Source: MDE 2021b.

Figure 2-7. Land cover in the Piscataway Creek watershed.

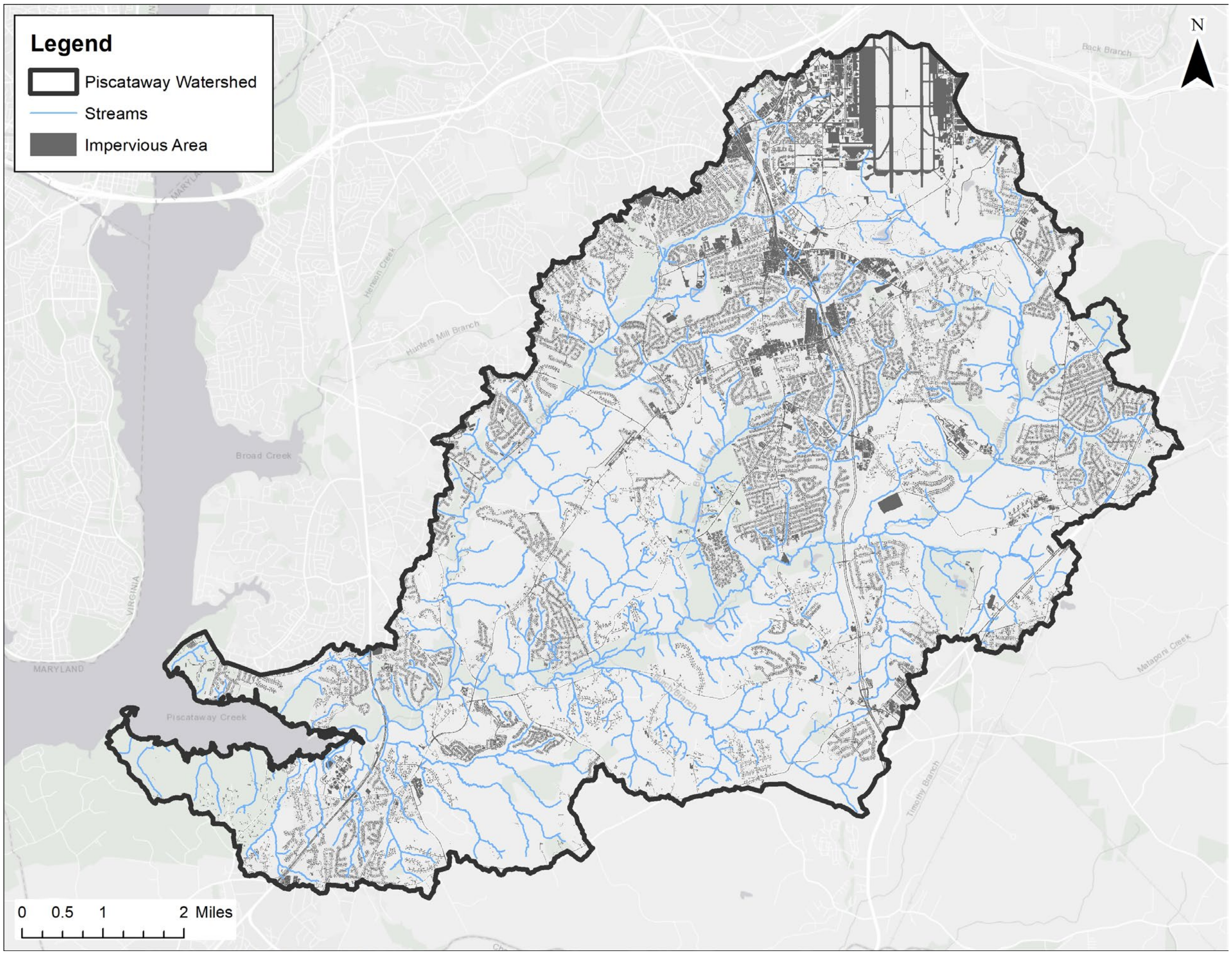
2.2.3 Impervious Area

Impervious area is the land surface covered with a solid material or compacted to the point at which water cannot infiltrate into underlying soils (e.g., parking lots, roads, houses, patios, swimming pools, compacted gravel areas). Consequently, impervious areas resulting from land development affect both the amount and the quality of runoff.

Compared to naturally vegetated areas, impervious areas generally decrease the amount of water infiltrating into groundwater and increase the amount of water flowing to the stream channels in the watershed. This increased surface flow not only carries greater amounts of sediment and other pollutants but also increases the velocity of the streams, which worsens erosion. More erosion increases the amount of sediment carried by the water, which can be detrimental to the appearance of a stream and its ecological health.

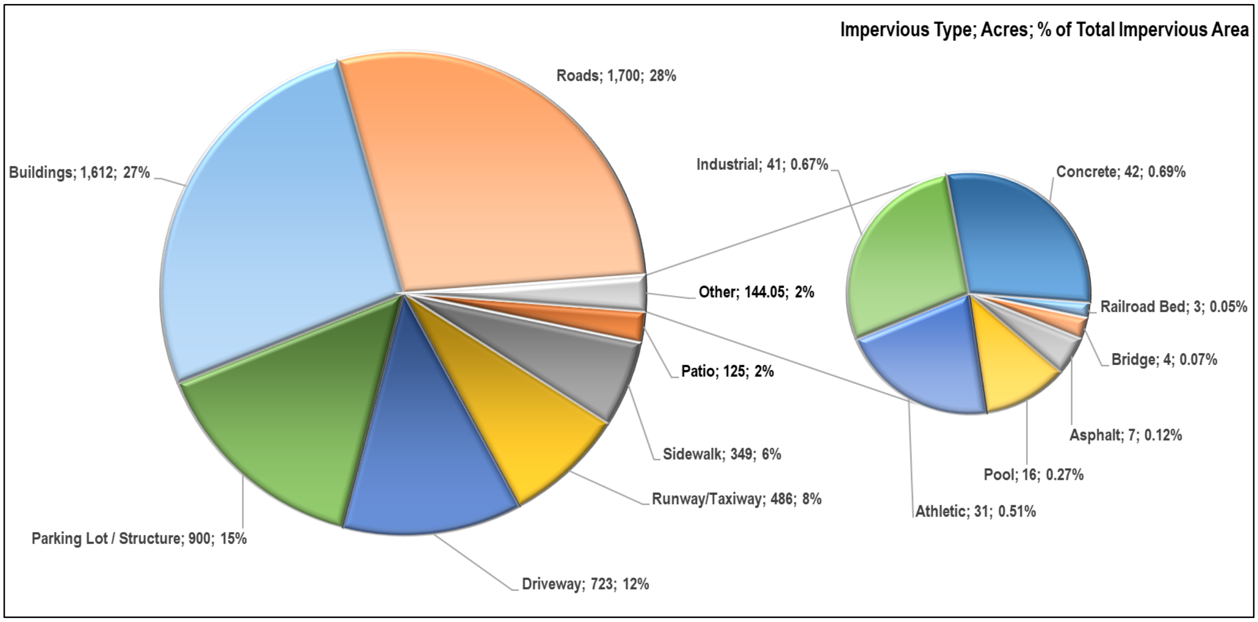
Figure 2-8 shows the impervious land cover, which is available from the Prince George's County GIS Open Data Portal (M-NCPPC 2022). Greater proportions of impervious land cover may be seen in more developed areas on smaller scales, especially in the form of roadways, parking facilities, and buildings.

Figure 2-9 shows the percent of each type of impervious area (e.g., roads) in the watershed. Roads accounted for 28 percent of the impervious surfaces in the watershed, followed by buildings accounting for 27 percent of the watershed. Parking lots also accounted for 15 percent of the watershed. In the watershed, there is the additional influence of JBA, which features large concentrations of impervious surface to service the airfield at the base (8 percent airfields).



Source: M-NCPPC 2022.

Figure 2-8. Impervious cover in Piscataway Creek watershed.

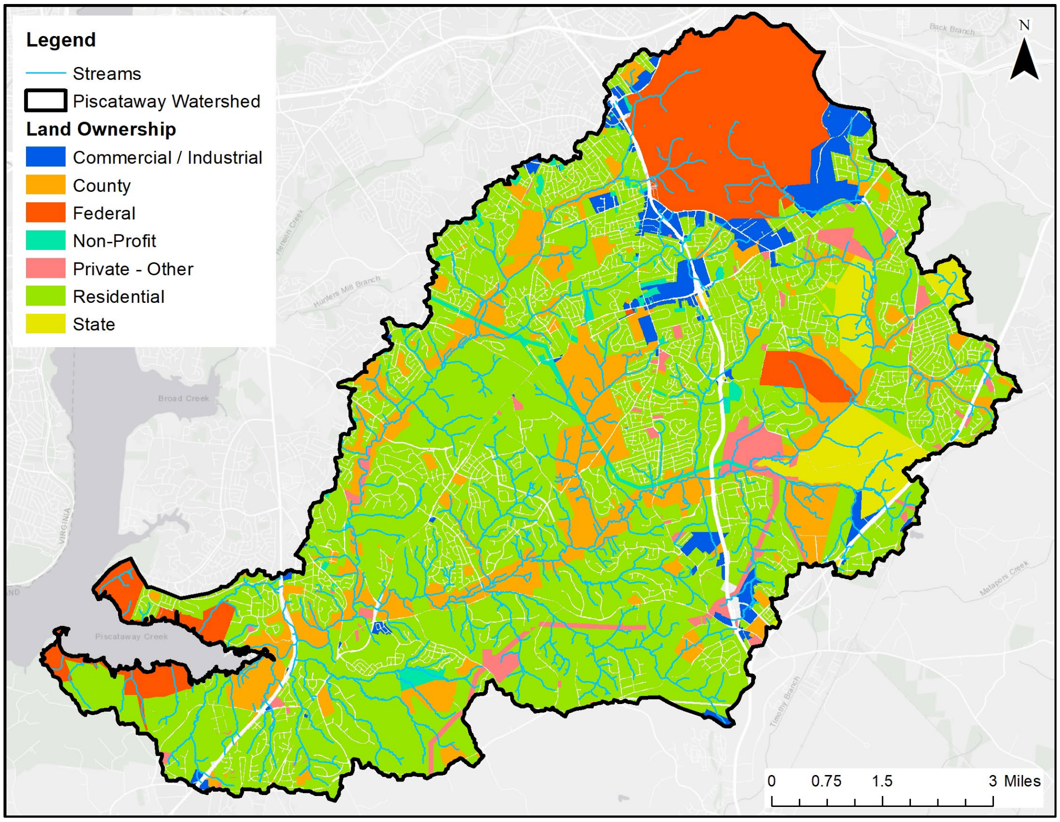


Source: M-NCPPC 2022.

Figure 2-9. Piscataway Creek watershed percent of impervious area by source.

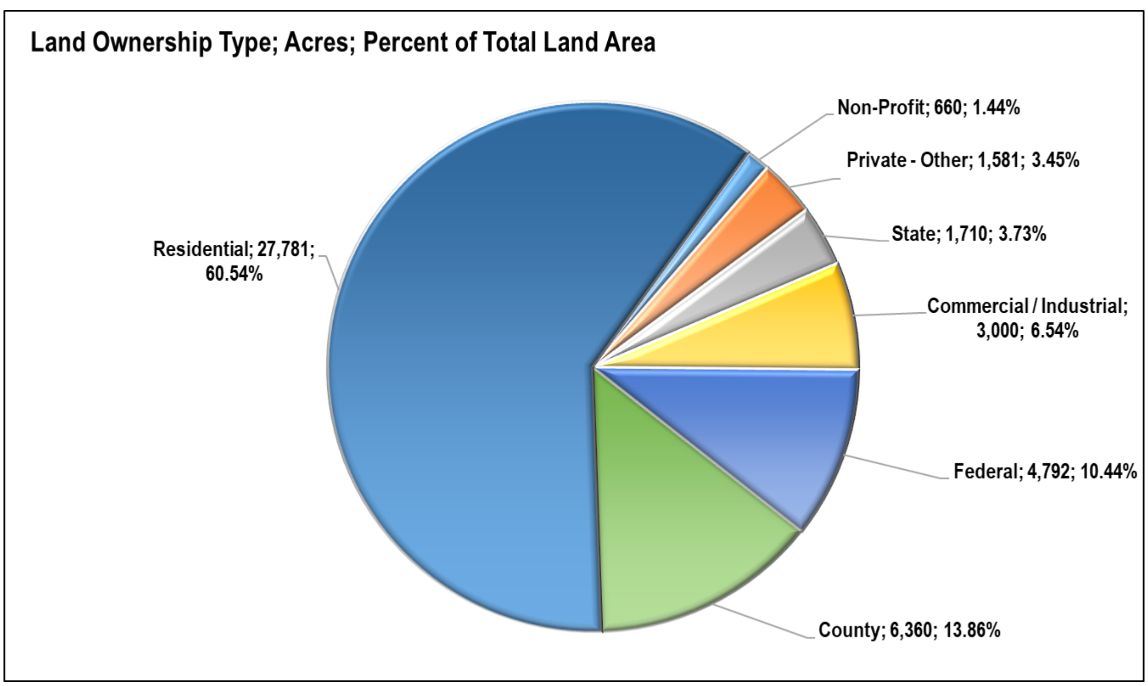
2.3 Land Ownership

Overall, the watershed is primarily privately owned residential land (Figure 2-10, Figure 2-11). The majority (60 percent) of land is owned by residents, with 14 percent being County-owned (including by M-NCPPC), and 10 percent owned by federal entities. A closer examination of land ownership will come into play during specific restoration planning, as it can sometimes be a simpler solution to implement BMPs on County, or otherwise publicly-owned, lands. While roadways are usually considered public right-of-way, Figure 2-10 was created using only parcel information available from the Prince George's County GIS Open Data Portal (M-NCPPC 2022), which does not include roadway information, so roadways show on the map as white lines.



Source: M-NCPPC 2022.

Figure 2-10. Land ownership in the Piscataway Creek watershed.



Source: M-NCPPC 2022.

Figure 2-11. Land ownership percent by source.

2.4 Population and Growth

Table 2-5 presents the recent U.S. Census population estimates for Prince George's County. These numbers are not available by watershed level but there is a continuing upward trend in population. Figure 2-12 presents the population density of the watershed, by U.S. census block. There are higher density populations at the headwaters to Tinkers Creek and in the upper reaches of the mainstem of Piscataway Creek.

Table 2-5. Prince George's County population (1980–2020).

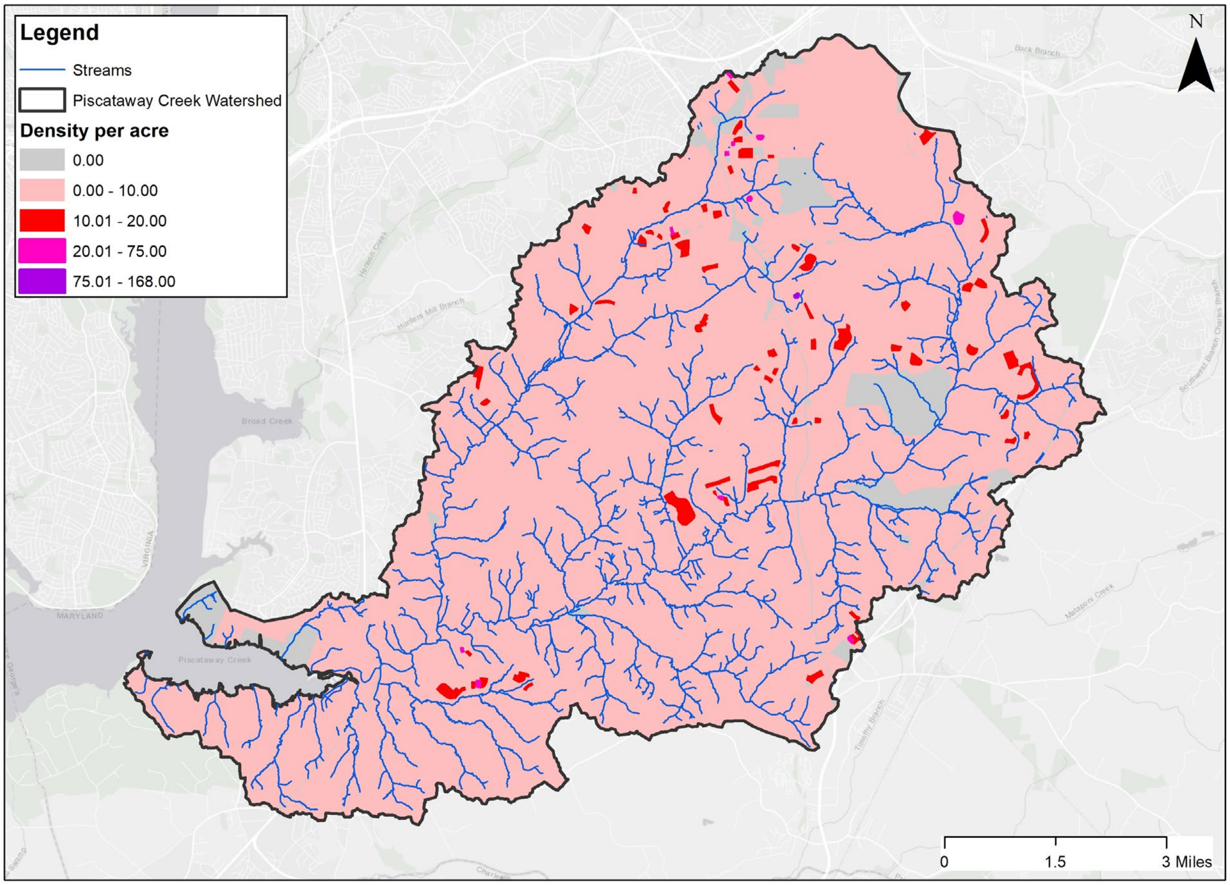
1980	1990	2000	2010	2020
665,071	729,268	801,515	863,420	967,201

Source: Wikipedia 2023.

In 2010, the Prince George's County Planning Department developed the County's *Water Resources Functional Master Plan*, which amended the 2002 *General Plan* (M-NCPPC 2010). The plan contains information on the County's water and sewer service capacity for planned growth through 2030. It included a methodology to calculate nutrient loadings from existing and future conditions. The plan discusses County agency responsibilities regarding stormwater, key issues, and overarching policies and strategies.

MDE maintains an *Environmental Justice Screening Tool*.[8] The tool contains demographic and socioeconomic data by U.S. Census tracks, which can cross watershed boundaries. The tool also identifies underserved communities (based on income level, ethnicity, and English proficiency) and overburdened communities (based on factors such as air quality, cancer risk, certain health statistics, and proximity to hazardous or toxic waste, landfills, and power plants). The final environmental justice score is a combination of pollution burden exposure, pollution burden environmental effects, sensitive populations, and socioeconomic/demographic indicators.

[8] https://mde.maryland.gov/Environmental_Justice/Pages/EJ-Screening-Tool.aspx



Source: U.S. Census 2023.

Figure 2-12. Population density by census block in the Piscataway Creek watershed.

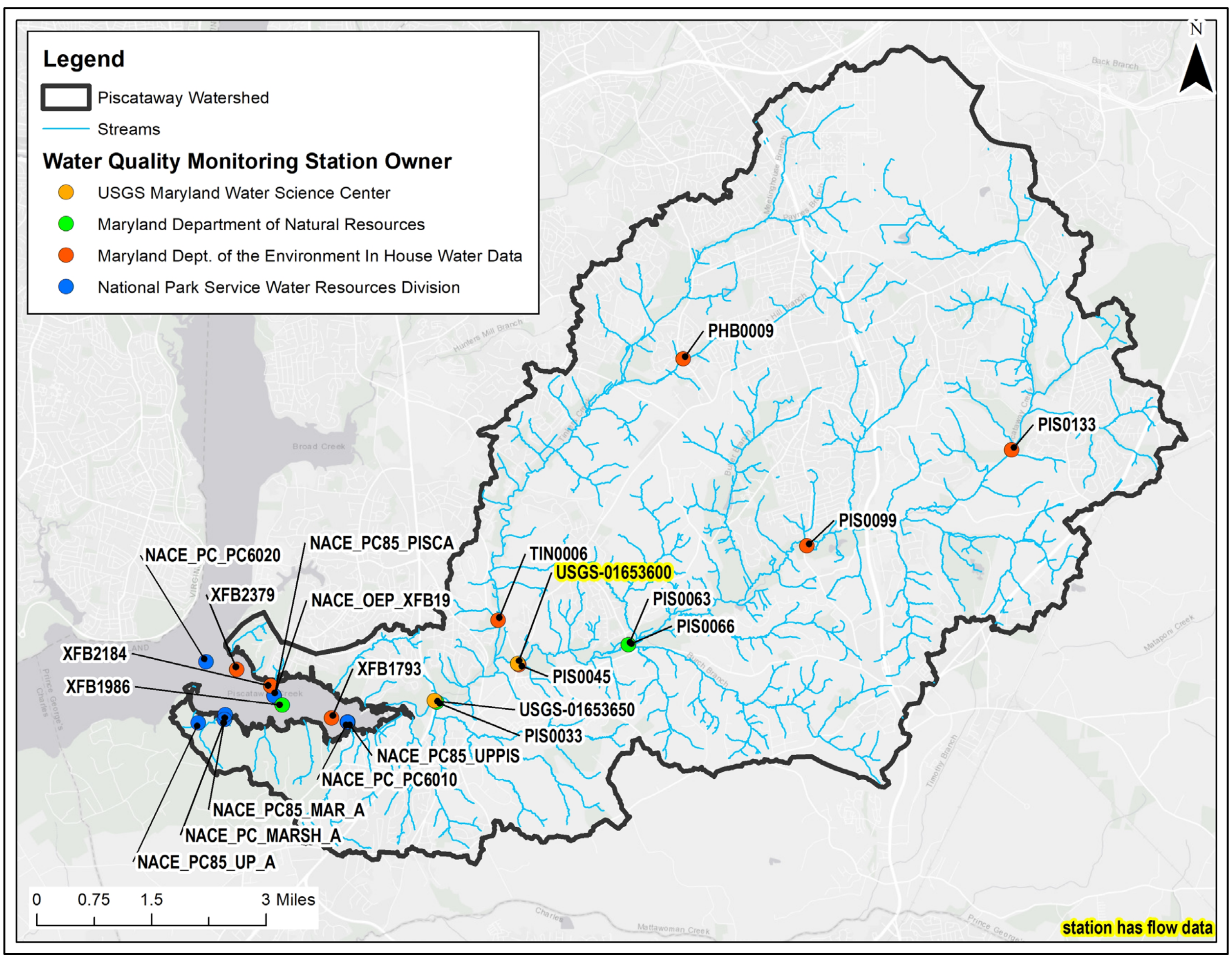
3 WATERSHED AND WATER QUALITY CONDITIONS

3.1 Water Quality Data

Water quality data were analyzed to assess the degree to which water quality might be getting better or worse. Graphs later in this section present a record of TSS concentrations over different periods of record. Figure 3-1 presents the locations of the water quality monitoring stations in the Piscataway Creek watershed. The County is unaware of any ongoing monitoring programs. USGS maintains a flow gage but does not currently collect water quality data. MDE has multiple stations for watershed assessment but has not collected data since 2008.

Water quality data were obtained from the following sources:

- EPA's STORET (STOrage and RETrieval) Data Warehouse.
- Federal Water Quality Portal (www.waterqualitydata.us/). (This service, which is sponsored by EPA, USGS, and the National Water Quality Monitoring Council, collects data from more than 400 federal, state, local, and tribal agencies.)



Source: NWQMC 2023.

Figure 3-1. Locations of water quality monitoring stations in the Piscataway Creek watershed.

Time series of water quality data from these monitoring stations for the periods in Table 3-1 are shown in Figure 3-2 and Figure 3-3 for the Piscataway Creek watershed. This section only discusses stations with recent water quality data after 2000 and stations with at least 25 data points. Of the sample locations, only USGS 01653600 contains flow data. This station is on the mainstem of Piscataway Creek, just upstream of its convergence with Tinkers Creek.

Fourteen monitoring stations with recent (since 2000) data are in the Piscataway Creek watershed and two of those monitoring stations have significantly comprehensive datasets ranging from 1986 into 2020 (Table 3-1). Monitoring stations PIS0033 (the tidal portion of the mainstem at Indian Head Highway) and XFB1986 (tidal embayment influenced by the tidal Potomac River) represent the most complete datasets in the watershed, with a respective 606 and 604 records (Table 3-1). Both are in the watershed's lower portion and in the tidal zone. PIS0033 is located where USGS 01653650 was in 1973.

Figure 3-2 and Figure 3-3 are scatter plots that show total suspended sediment trends over time. Past water quality data can be compared to future water quality data to show improvements from restoration activities. TSS concentrations at PIS0033 have a slightly positive slope (+0.0006), and the concentrations at XFB1986 have a slightly negative slope (-0.0007). The trend line slopes of these more comprehensive datasets are so small it would be difficult to categorize any of the observed changes in TSS concentrations over the full timescale of this dataset as significant. The coefficient of determination (R^2 value) for both are under 0.02, indicating no significant trend of concentration versus time.

The other monitoring stations in the Piscataway Creek watershed have significantly fewer data records (between 1 and 192) for analysis (Table 3-1). The limited sample sizes of those stations and shorter periods of record contribute to uncertainty within those datasets because the extreme values may more strongly influence the slopes of the trendlines for those data. Stations with more than 25 data points since 2000 are plotted in Figure 3-3. Station USGS-01653600 reported loads for two years from October 2000 till October 2002. These are presented in Figure 3-4.

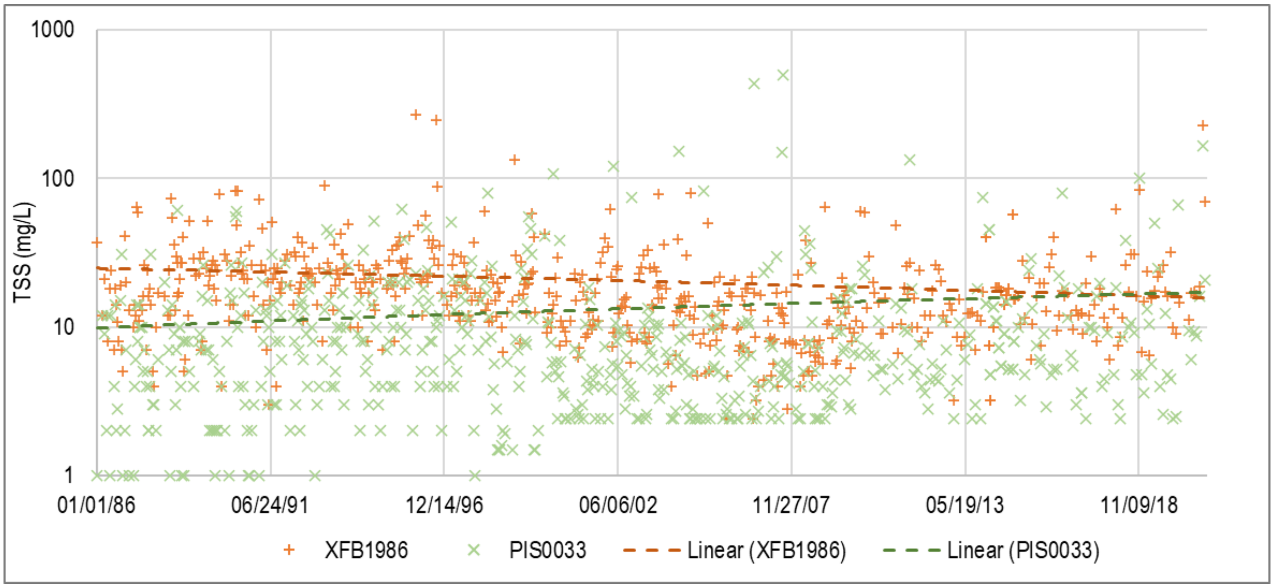
Sediment transport could explain the slight positive trend measured at station PIS0033, from activities in the urbanized zones throughout the watershed (Figure 3-2). Station XFB1986 shows a slight decrease potentially from dilution with the tidal action from the Potomac River. The rate, volume, and quality of runoff also vary with land use and land cover—impervious surface runoff increases water volume and velocities and alters the concentration levels of water quality parameters. Over a period of several years, land cover changes that might help degrade water quality in one location can be offset by restoration practices. All the interactions between the waterway, terrain, and climate contribute to the scatter of the data points.

Table 3-1. Summary of TSS data in the Piscataway Creek watershed.

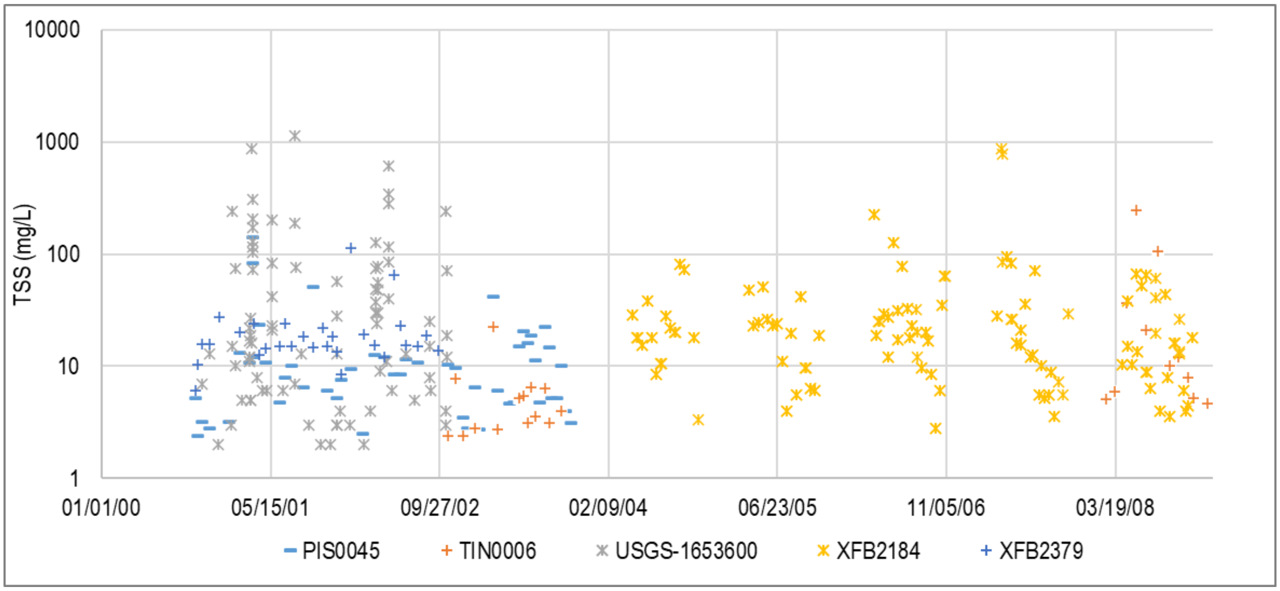
Station ID	Station Name	Owner	Start Date	End Date	Number of Records	Min. Value (mg/L)	Mean Value (mg/L)	Max. Value (mg/L)
NACE_OEP_XFB 19	Center of Piscataway Creek embayment	National Park Service, Water Resources Division (NPS-WRD)	01/06/86	12/08/86	17	5	17	41
NACE_PC_MAR SH_A	Marsh 1/2 Mile Southeast of Mockley Point	NPS-WRD	10/26/76	08/16/77	45	1	25	140
NACE_PC_PC60 10	Piscataway Creek 1/4 mile west of Calvert Manor	NPS-WRD	11/03/76	08/16/77	7	4	30	48
NACE_PC_PC60 20	Piscataway Creek at Potomac River confluence	NPS-WRD	11/03/76	08/16/77	8	1	17	23
NACE_PC85_MA R_A	Marsh 1/2 mile southeast of Mockley Point	NPS-WRD	10/02/79	09/17/84	56	5	30	128
NACE_PC85_PIS CA	Center of Piscataway Creek embayment	NPS-WRD	10/02/79	09/17/84	7	8	31	57
NACE_PC85_UP _A	Upland Creek where drains into Marsh_A	NPS-WRD	10/02/79	09/17/84	6	17	41	59
NACE_PC85_UP PIS	Piscataway Creek 1/4 Mile west of Calvert Manor	NPS-WRD	06/19/84	06/19/84	1	11	11	11
PG001	PGTC01	PGC DoE	05/12/20	04/13/22	29	1	13	200
PG002	PGTC02	PGC DoE	04/10/19	04/13/22	32	1	16	93
PG003	PGTC03	PGC DoE	04/10/19	04/13/22	34	1	17	170
PHB0009	Pea Hill Branch	MDE	02/20/08	12/16/08	11	2	13	84
PIS0033	PIS0033	MD DNR	01/06/86	12/07/20	606	0	13	497
PIS0045	Piscataway Creek	MDE	10/03/00	10/20/03	61	2	12	140
PIS0063	Piscataway Creek	MDE	01/29/08	12/16/08	12	2	14	57
PIS0066	Piscataway Creek	MDE	01/29/08	12/16/08	10	2	16	57
PIS0099	Piscataway Creek	MDE	01/29/08	12/16/08	9	2	15	71
PIS0133	Piscataway Creek	MDE	01/29/08	12/16/08	12	2	15	103
TIN0006	Tinkers Creek	MDE	10/23/02	12/16/08	25	2	22	248
USGS-01653600[a]	Piscataway Creek at Piscataway, MD	USGS	10/24/00	10/18/02	84	2	83	1,150
USGS-01653650	Piscataway Creek near S Piscataway, MD	USGS	12/13/72	12/06/73	6	11	125	580
XFB1793	Piscataway Creek	MDE	03/27/01	08/20/02	8	2.9	38	140

Station ID	Station Name	Owner	Start Date	End Date	Number of Records	Min. Value (mg/L)	Mean Value (mg/L)	Max. Value (mg/L)
XFB1986	XFB1986	MD DNR	01/06/86	12/07/20	604	2.4	21	270
XFB2184	XFB2184	MDE	04/21/04	11/03/08	188	2.8	34	784
XFB2379	Piscataway Creek	MDE	10/03/00	09/24/02	29	6	21	113

Source: NWQMC 2023.
Notes:
mg/L = milligrams per liter.
[a] Has flow data.

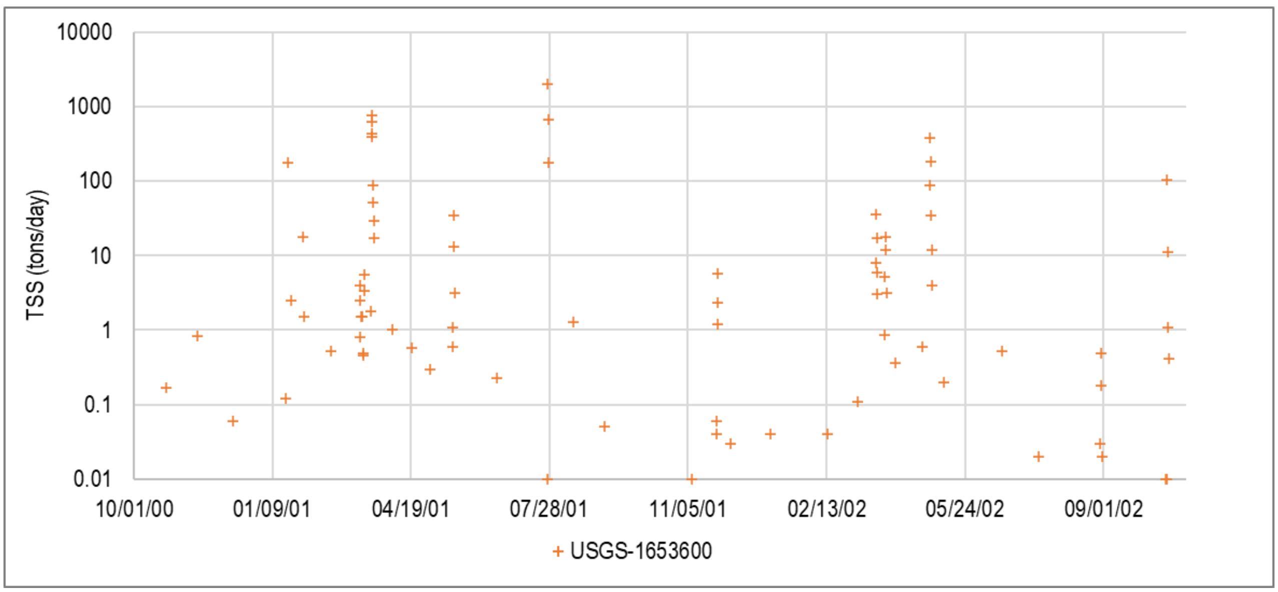


Source: NWQMC 2023.
Figure 3-2. Plot of TSS concentrations over time at monitoring stations PIS0033 and XFB1986.



Source: NWQMC 2023.

Figure 3-3. Plot of TSS concentrations over time at other Piscataway Creek monitoring stations.



Source: NWQMC 2023.

Figure 3-4. Plot of TSS loads over time at USGS 01653600 monitoring station.

3.2 Biological Assessment

Analyses of biological monitoring program data provide insights into the status and trends of ecological conditions in a stream and watershed. Watershed planners can use the biological monitoring data to identify problems; document relationships among stressor sources, stressors, and response indicators; and evaluate environmental management activities, including restoration. Especially with a TMDL for sediment specific to first- through fourth-order streams, biological monitoring data is central to targeting potential restoration to the areas of the watershed with the greatest need because biological responses are closely related to upland land use changes. Lack of or insufficient stormwater management controls will cause stream scour, incision, sediments, and other geomorphic changes affecting the benthic macroinvertebrate communities. The County's biological monitoring collects annual stream samples of those communities, and a report is submitted to MDE. Past bioassessment data can be compared to future bioassessment data to determine trends.

3.2.1 Assessment Methodology

DoE began implementing its countywide, watershed-scale biological monitoring and assessment program in 1996. To date, the department has collected 179 stream samples in the Piscataway Creek watershed, including 38 in the Tinkers Creek tributary, through three rounds of data gathering. The primary measure of stream health is the BIBI (Southerland et al. 2007). Because different stream conditions support different types of "benthic"—or bottom-dwelling—organisms, analyzing the benthic organisms collected along a stream reach can provide a good indication of the health of that reach.

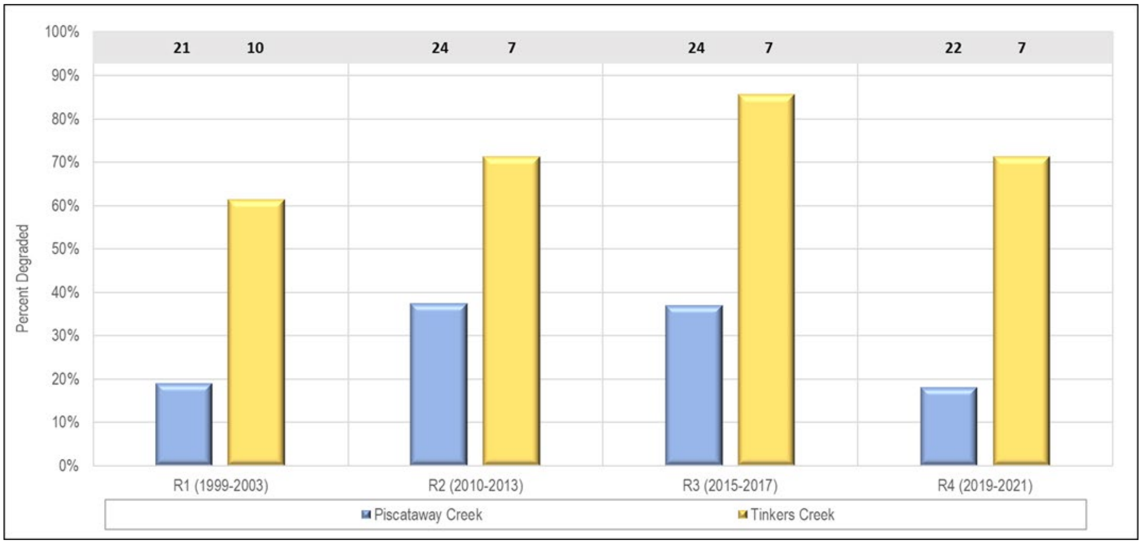
Field sampling and data analysis protocols employed by the County for the program are comparable to those used in the Maryland Department of Natural Resources' (MD DNR's) MBSS. Streams assessed are wadeable and generally first- through third-order according to the Strahler Stream Order system (Strahler 1957). Stream order designation is based on the National Hydrography Dataset map scale of 1:100,000. The numbers of streams sampled in each watershed are proportional to the size of the watershed and are allocated among first- to third-order streams, with a larger number of sites on smaller first-order streams. Samples and data collected at each location include benthic macroinvertebrates, visual-based physical habitat quality, substrate particle size distribution, and field chemistry (dissolved oxygen [DO], conductivity, pH, and water temperature).

For the County's biological monitoring assessment, a 100-meter reach was sampled at each selected site. At a laboratory, technicians identified these biological samples, each to a target taxonomic level, usually genus. The numbers of the different kinds of organisms found were used to calculate the BIBI numeric value or score. Based on that score, the biological integrity was rated as Good, Fair, Poor, or Very Poor. Stream reaches rated as Poor or Very Poor are considered degraded. All biological data is supplied to MDE and MD DNR annually for tracking progress and inclusion on MDE's Integrated report.

3.2.2 Biological Assessment Results

This section evaluates the results in three ways: (1) plot of percent degradation by assessment round and major basin, (2) plot of number of sites per basin and round per narrative rating, and (3) a map of monitoring locations and their narrative ratings.

The biological data reveal that the Piscataway Creek watershed consistently had low-to-moderate levels of degradation through the three assessment rounds, while Tinkers Creek had significantly elevated levels of degradation across the same period (Figure 3-5). The specific stream reaches (sites) sampled in a basin are different each year. They are randomly selected to be more representative of stream and basinwide conditions. This is why there are differences from one round to the next, reflecting expected environmental variability. The biological assessment narrative ratings by monitoring location for rounds 1–3 in Piscataway Creek and Tinkers Creek are depicted in Figure 3-6. A significant number of sites in the Piscataway Creek watershed were rated as Good or Fair, with only a few being rated as degraded (Poor or Very Poor) in round 1. Later sampling rounds revealed an increased frequency of sites that may be described as degraded. The data suggest that even with multiple sites demonstrating Fair or Good narrative ratings, there are still strong impacts to water quality on localized scales. The data in Tinkers Creek were more frequently degraded, with most sites being rated as Poor and none being rated as Good. The results in Tinkers Creek could be reflective of the higher amounts of impervious cover in the watershed, especially throughout the headwaters of the stream network that exhibit greater amounts of urban land use. The narrative results of the biological assessments can be seen in Figure 3-7, where the Piscataway Creek watershed (southern portion of the watershed) has more areas rated as Good to Very Good while Tinkers Creek (northern portion of the watershed) has more areas rated as Poor.



Note: The gray bar across the top shows the number of site locations sampled in each basin for the assessment round.

Figure 3-5. Piscataway Creek and Tinkers Creek percent degraded by assessment round.

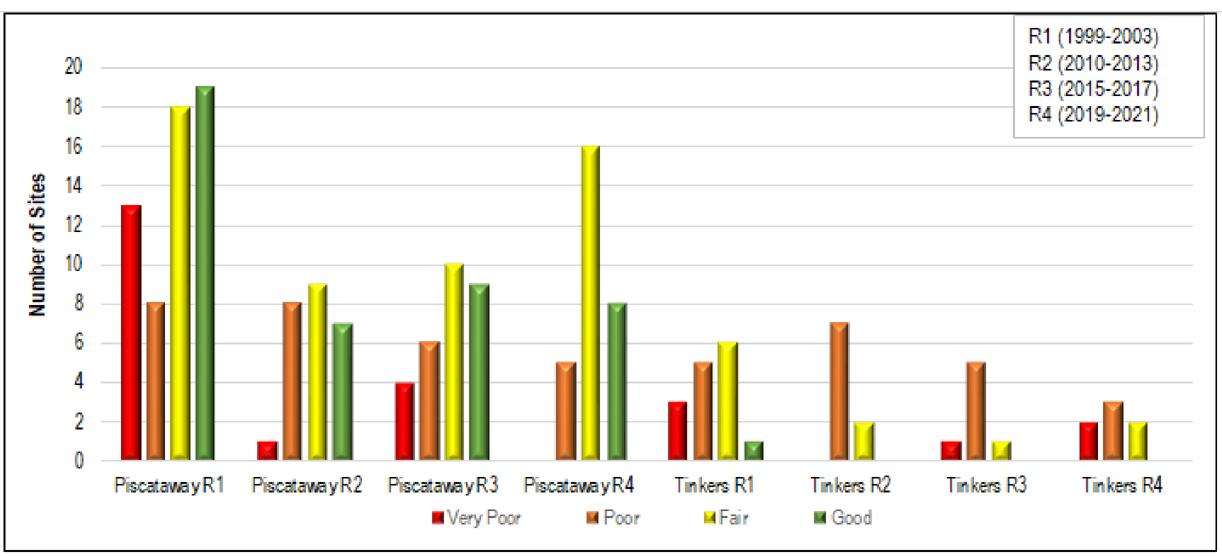


Figure 3-6. Piscataway Creek and Tinkers Creek IBI narrative results by assessment round.

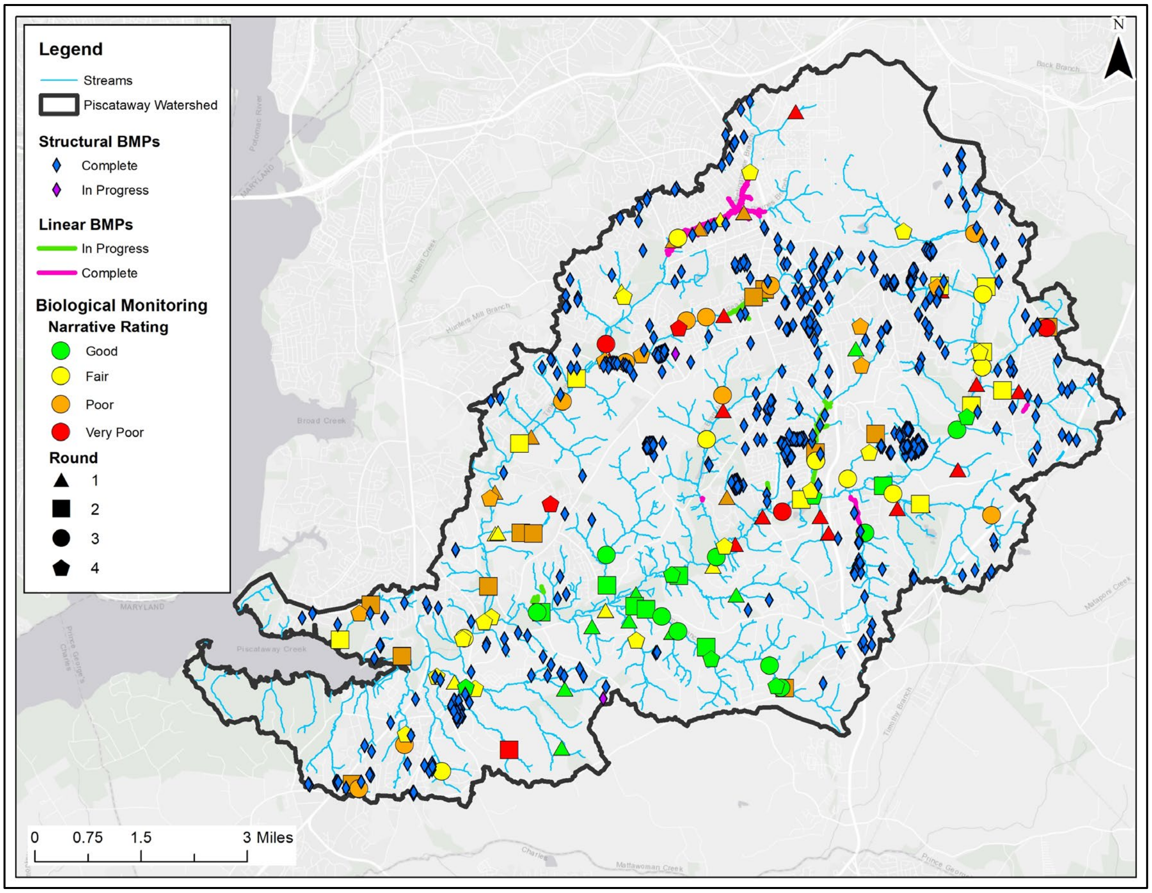


Figure 3-7. Biological assessment narrative ratings by monitoring location.

3.3 Geomorphic Cross Section Assessment

During round 1 and part of round 2 of the countywide biological assessments, DoE assessed fluvial geomorphic conditions (primarily Rosgen Level II classification) to document and characterize channel stability. Rosgen Level II is a quantitative morphological assessment of the stream reach, which provides greater detail from data collected in the field for the implementation into land management/design decisions as part of the analysis for alternatives of proposed repairs. Rosgen Level II will help determine if the stream channel is stable and describes channel aggradation/degradation. These are directly related to the MBSS physical habitat determination as required by DNR. Restoration opportunities can be derived from the collected field data, including assessments of the channel cross-section, longitudinal profile, and plan-form pattern. Often, restoration engineers use geomorphic assessment entrenchment ratios as indicators for excess discharges from upland sources, requiring further evaluation of effective stormwater management controls. If a stream segment needs repair or stabilization due to damage or infringement (soil loss), the geomorphic assessments contain cross-section measurements, entrenchment ratio, width:depth ratio, dominant substrate, slope, stream bed features, sinuosity, and meander, which will aid in restoration design.

Physical habitat is widely understood to be the principal environmental factor controlling stream biological condition, as well as a reflection of the complex interplay among surface water flows, topography/gradient, soils, vegetation, and surrounding land cover characteristics. Thus, when a stream is exposed to altered patterns of flow and the resulting accelerated erosion, the relative stability of stream channel morphology is compromised and is (A) directly related to the quality of the habitat supporting the survival and reproduction of aquatic life, such as benthic macroinvertebrates and fish, and (B) an indicator of sources of unmanaged storm flow that cause the instability, thus supplying information for siting and potentially designing control measures. The County reassessed 80 cross-section sites with historic monumented cross section data randomly selected throughout the County for the 2020 re-surveying effort (Tetra Tech 2022). The historic cross-section locations were co-located with stations monitored over the first several years of countywide biological monitoring. The original, and subsequent, biological stations are chosen at random sampling sites with GRTS (Generalized Random Tessellation Stratified), adopting a sampling approach stratifying by at least the Maryland 8-digit watershed and adopting a 1:24,000 scale map, enhancing the temporal and spatial resolution of the data and its usefulness in data analysis. Of the 78 re-assessed sites, there were four sites assessed in this manner in the Piscataway Creek watershed (Figure 3-8).

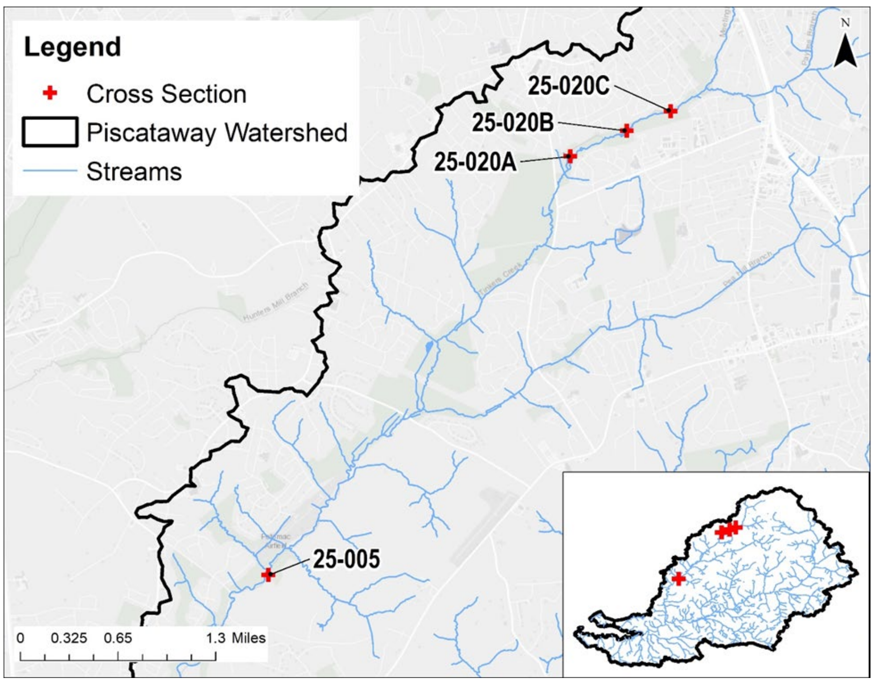


Figure 3-8. Cross-section measurement locations.

3.3.1 Assessment Methodology

Permanent monuments were established as the point of reference for taking channel cross-sectional (XS) measurements, which also allowed several other components of channel form to be measured and documented. Following a time interval ranging from approximately 12–20 years, 78 reaches were visited to re-survey; comparisons of results allowed calculation of changes in XS area (square meters) and the amounts of sediment lost (erosion) or gained (sedimentation). In addition to XS, we also collected modified Wolman 100-particle pebble counts and other data needed for the Rosgen Level II classification of each reach. Data were downloaded, organized, and processed to characterize changes in land use and land cover contributing to conditions potentially affecting rates and magnitudes of erosion. The County calculated changes in XS area over the 15- to 21-year intervals and used a conversion factor developed by a mid-Atlantic expert panel for the two nontidal physiographic provinces in which the County lies: the Coastal Plain Lowland Non-Tidal and the Coastal Plain Dissected Uplands Non-Tidal. The conversion factor was used to calculate annual sediment yield (tons) from changes in XS area due to erosion and deposition. Additional analyses of the results include site-specific bulk density values, which provide a more accurate estimate of sediment yield. Sites were ranked to isolate those with the greatest geomorphic activity, specifically each of the 10 undergoing the most erosion (sediment loss) and deposition (sediment gain).

3.3.2 Geomorphic Assessment Results

Table 3-2 presents geomorphic assessment results for four locations from the 2001 and 2020 assessment years. The data presented is from the field geomorphic field observations and measurements, and the subsequent geomorphic calculations. Sediment yield is calculated using changes in full stream channel cross-sectional area (XSa) and by converting the volume (freight tons) of sediment lost (degradation) or gained (aggradation) into annual changes. The magnitude of changes in full XSa ranges from -131.2 square feet to -4.4 square feet; negative values indicate aggradation (deposition) and positive values indicate degradation (erosion) (Table 3-2). This suggests there is erosion upstream, and the resulting sediment is being deposited in the study reaches.

Table 3-2. Results of geomorphic assessments.

Site ID	25-005		25-020A		25-020B		25-020C	
Year	2001	2020	2001	2020	2001	2020	2001	2020
Entrenchment ratio	1.2	3.4	3.1	2.9	3.9	2.9	5.1	2.5
Width:depth ratio	21.4	21.6	22	36.6	16.9	24.4	18.8	20.9
Sinuosity	1.25	1.25	1.11	1.11	1.14	1.14	1.17	1.17
Slope	0.28	0.28	1.5	1.5	0.42	0.42	0.29	0.29
Median substrate particle size (D50)	21.2	32	6.3	20.6	3.3	23.7	7.5	22.5
Rosgen classification	F1	C4	C4	C4	C4	C4	C4	C4
Bankfull XSa (ft^2)	143	162.9	47.5	31.8	52.5	48.1	81	76.9
Bankfull XSa difference (ft^2)	19.9		15.7		-4.4		-4.1	
Full XSa (ft^2)	317	185.8	47.8	31.8	52.5	48.1	101.7	76.9
Full XSa difference (ft^2)	-131.2		-16		-4.4		-24.8	
Sed. yield (tons/year)	-0.43		-0.05		-0.01		-0.08	

Notes:
ft^2 = square feet; XSa = Stream channel cross-sectional area.

Comparison of fluvial geomorphic conditions using the Rosgen classification system organizes several pieces of data and information to help interpret relative stream channel stability, including entrenchment, width:depth ratio, sinuosity, slope, and substrate characteristics. The County compared stream classification from the original field geomorphic characterization to those taken in 2020 (Table 3-2). Elevated channel instability is generally associated with F- and G-type channels, and relative geomorphic stability is generally associated with E-, C-, and B-type channels. Results from current and historical data showed that three reaches were classified as having experienced little to no change in relative stability, with the final station going from an unstable channel to a stable channel.

Figure 3-9 through Figure 3-12 present the changes in stream cross sections at the four stations. The plots show how the stream channel cross-sections have changed at 16- to 20-year intervals due to erosion and deposition. While 25-005 and 25-020B were relatively stable, 25-020A and 25-020C significantly changed through channel migration and incision.

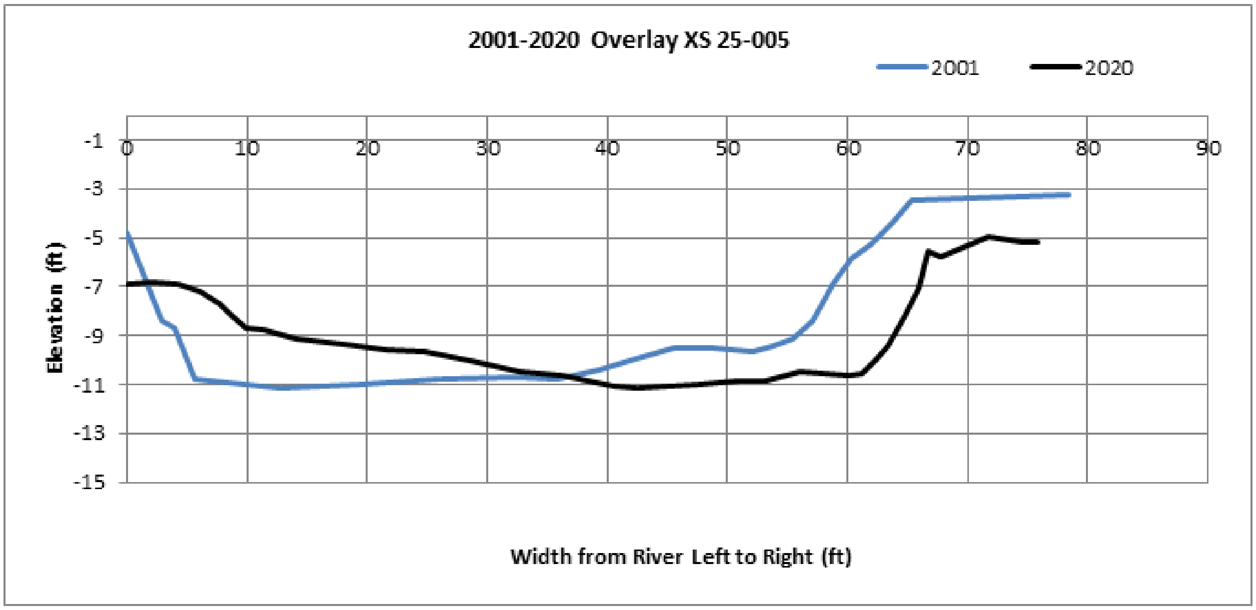


Figure 3-9. Change in cross-sections for 25-005 between 2001 and 2020.

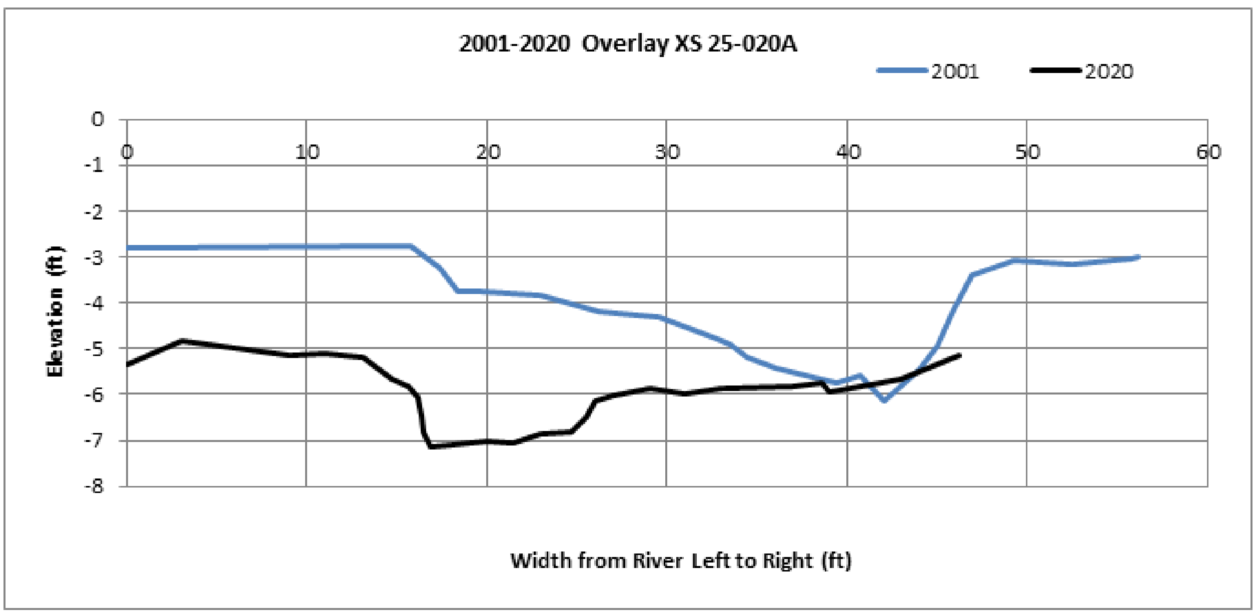


Figure 3-10. Change in cross-sections for 25-020A between 2001 and 2020.

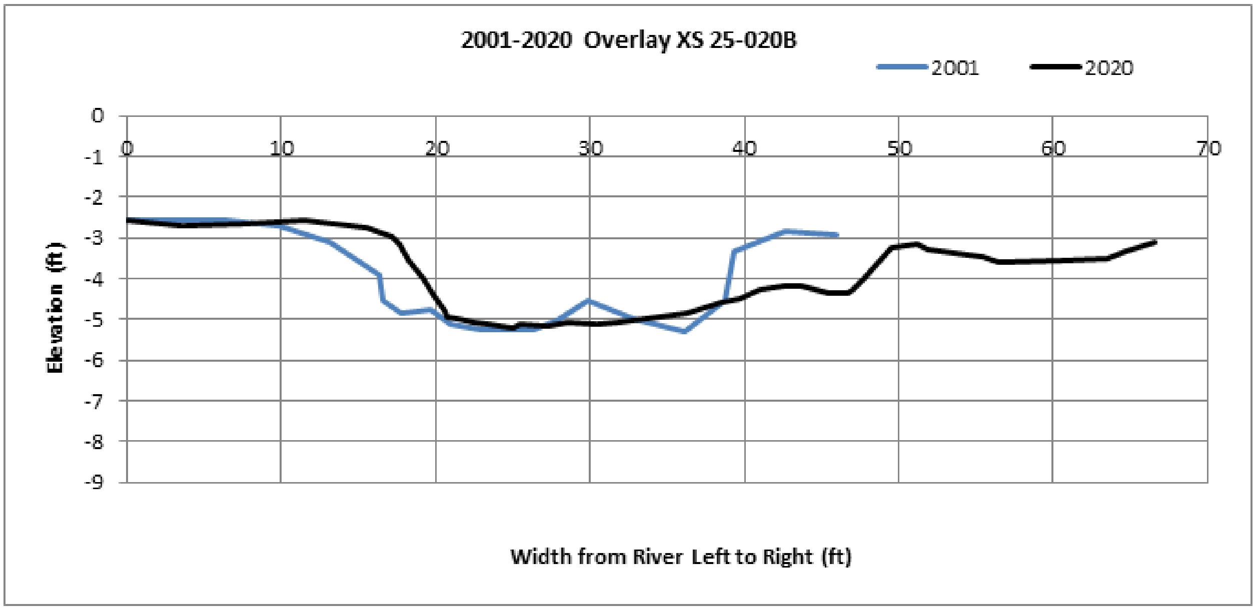


Figure 3-11. Change in cross-sections for 25-020B between 2001 and 2020.

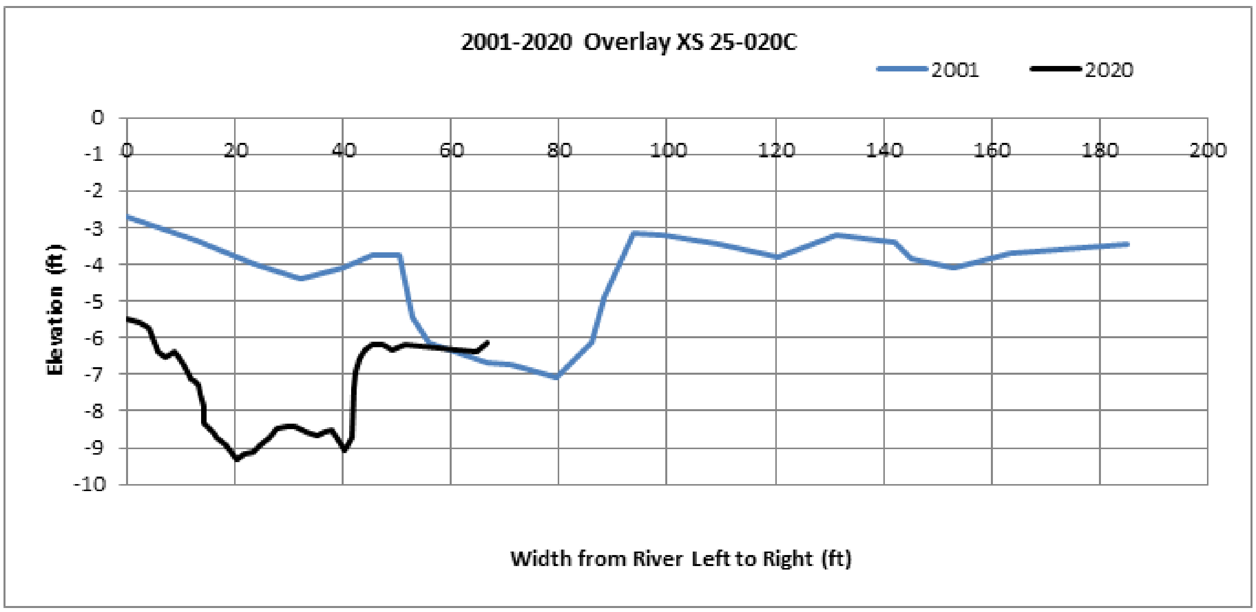


Figure 3-12. Change in cross-sections for 25-020C between 2001 and 2020.

3.4 Known Stream Erosion Issues

The MD DNR conducted stream corridor assessments (SCAs) of all County watersheds in the 2000s. These assessments included field site visits and stream walks to determine the conditions of the streams. Each site was given an identification number and photographed. Stream bank erosion and head cutting were investigated during the analysis. Stream reaches were rated on the severity of erosion, correctability, and access to the stream. This WIP assumes that if a stream had erosion issues in the 2000s, it is likely to have them still today if no corrective actions have been taken.

Only a few SCAs showed severe or very severe in-stream erosion concerns (Figure 3-13). The greatest concentration of stream reaches identified as being of at least moderate concern was in the northern half of the Piscataway Creek watershed, perhaps from being closer to regional urban centers to the north of the watershed. These SCAs identified 20,203 linear feet of stream—rated as severe or very severe—for potential restoration. These will be part of the restoration strategy presented in Section 7 of this WIP.

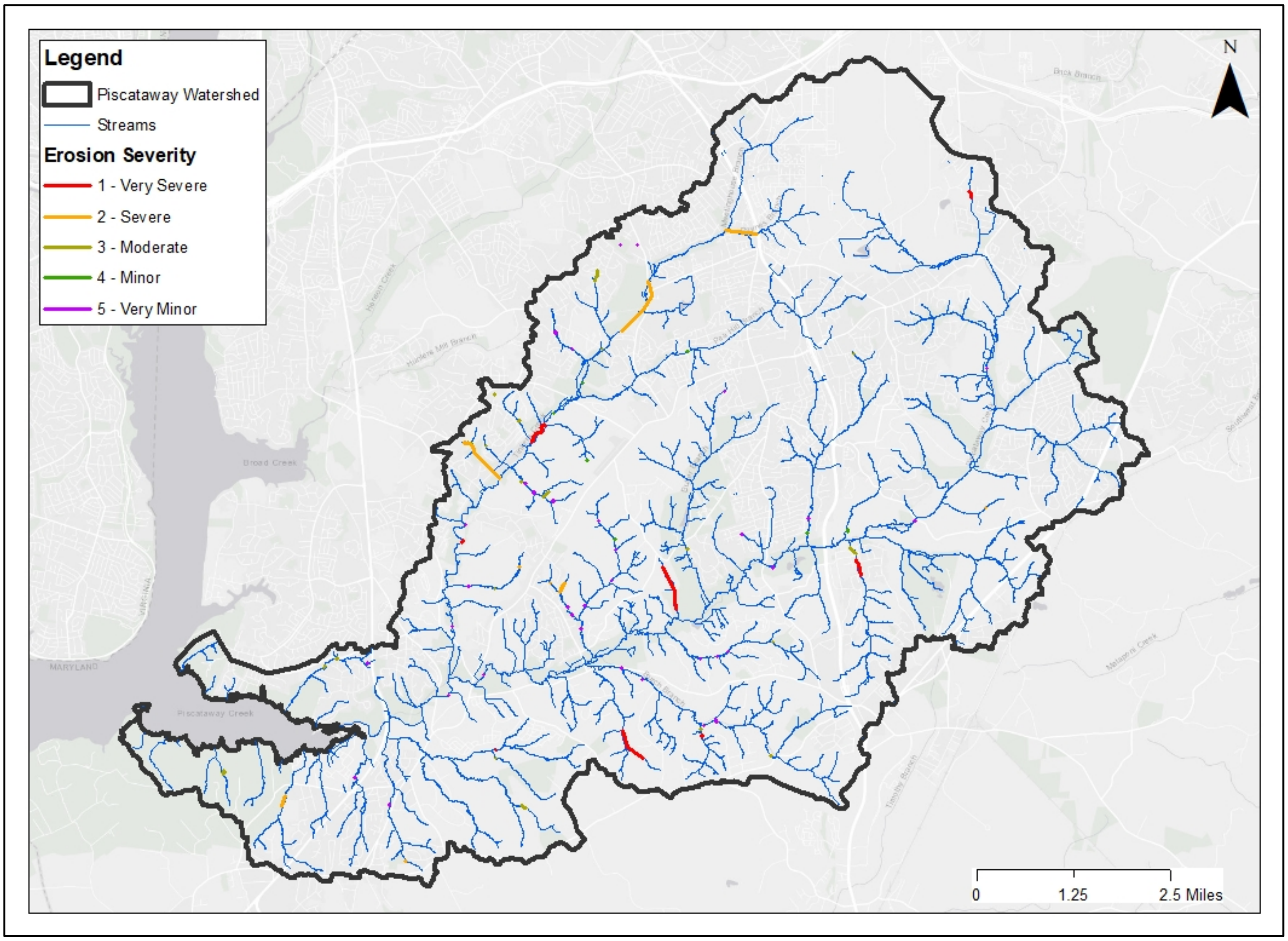


Figure 3-13. Locations of SCA-identified erosion (with severity) in the Piscataway Creek watershed.

3.5 Other Potential Pollutant Sources

Identifying the sources of pollutants of concern is valuable in developing appropriate strategies to reduce the amount of those pollutants entering the environment. This section provides an assessment of the potential point and nonpoint pollutant sources in the watershed. Point sources discharge effluent through distinct points that are regulated through permits from the NPDES program. Nonpoint sources are not covered by this permitting program. They 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 pollutants to surface water from rainfall runoff. Types of nonpoint source pollution include wildlife, atmospheric deposition, onsite wastewater disposal systems (septic tanks), and agricultural practices.

3.5.1 NPDES-Permitted Point Sources

Under 40 CFR 122.2, a point source is described as a discernible, confined, and discrete conveyance from which pollutants may be discharged to surface waters. The NPDES program, established under CWA Sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources, including urban stormwater systems known as MS4s. The County is an MS4-permitted discharger.

Stormwater discharges are generated by runoff during precipitation events from urban land and impervious areas, such as paved streets, parking lots, and rooftops. These discharges often contain high concentrations of pollutants that can eventually enter nearby water bodies.

Under the NPDES stormwater program, operators of large, medium, and regulated small MS4s must obtain authorization from MDE to discharge pollutants. The Stormwater Phase I Rule requires all medium and large MS4s operators to obtain NPDES permits and develop stormwater management programs (55 Federal Register [FR] 47990, November 16, 1990). Medium and large MS4s are defined by the size of the population in the MS4 service area, not including the population served by combined sewer systems. A medium MS4 serves a population of between 100,000 and 249,999. A large MS4 serves a population of 250,000 or more. The Stormwater Phase II Rule applies to operators of regulated small MS4s serving a population of less than 100,000 not already covered by Phase I; however, the Phase II Rule is more flexible and allows greater variability of regulated entities than does the Phase I Rule (64 FR 68722, December 8, 1999).

Regulated small MS4s include those lying within the boundaries of urbanized areas, as defined by the U.S. Census Bureau, and those designated by the NPDES permitting authority. The NPDES permitting authority can designate a small MS4 as requiring regulation under any of the following circumstances: the MS4's discharges do or can negatively affect water quality, the population served exceeds 10,000, the population density is at least 1,000 people per square mile, or the contribution of pollutant loadings to a physically interconnected MS4 is evident. The Phase II MS4 in the Piscataway Creek watershed is mostly present in the western half of the watershed.

Table 3-3 lists the federal, state, and other entities in the Piscataway Creek watershed that possess an MS4 permit. These entities should have their own stormwater or sediment load goals and are not included in Prince George's County restoration calculations. Figure 3-14 shows the locations of other regulatory MS4s in the watershed. Figure 3-14 shows where there are federal and state lands in which the County is not responsible for stormwater. Other MS4 entities cover 14 percent of the watershed.

Table 3-3. MS4 permitted federal, state, and other entities in the Piscataway Creek watershed.

Agency/Operator	Installation/Facility/Notes	Acres[a]
ABC Distribution LLC	Other NPDES regulated stormwater	n/a[b]
Cheltanham Boy's Village	Cheltanham Boy's Village wastewater treatment plant	133.9[c]
Maryland Department of Transportation Motor Vehicle Administration	Multiple properties	648.1[d]
Maryland State Highway Administration	Multiple properties	

Agency/Operator	Installation/Facility/Notes	Acres[a]
Maryland Transportation Authority	Multiple properties	
O & A Used Auto Parts	Other NPDES regulated stormwater	5.2
Potomac Airfield	Other NPDES regulated stormwater	68.2
United States Federal Government; Department of Homeland Security	Federal Law Enforcement Training Center, Cheltenham	357.2
United States Federal Government; National Park Service	Fort Washington Park	410.8
United States Federal Government; National Park Service	Piscataway Creek Park	328.8[c]
United States Federal Government; United States Air Force	Joint Base Andrews	3,659.6
United States Federal Government; United States Postal Service	United States Post Office, Clinton	6.2
Washington Executive Airpark	Hyde Field	283.9
Washington Suburban Sanitary Commission	Multiple properties	129.8

Notes:
[a] Acres were determined using the County's property parcel boundaries.
[b] Property information for this permittee was not found.
[c] Cheltanham Boy's Village and Piscataway Creek Park are on the same property parcel. Aerial photography was used to determine the area.
[d] All state transportation and highway acres were combined.

Information on other permitted facilities was available from MDE's website and EPA's Integrated Compliance Information System. There are 32 privately owned permitted facilities in the watershed. Of these, 10 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 publicly owned treatment works providing wastewater treatment and disinfection for sanitary sewer systems or industrial facilities providing treatment of process waters. In the Piscataway Creek watershed, one federal and one state facility are permitted to discharge treated sanitary wastewater into the watershed. The Washington Suburban Sanitary Commission (WSSC) recently addressed problems that cause sanitary sewer overflows and leaks through their Sewer Repair, Replacement and Rehabilitation Program.

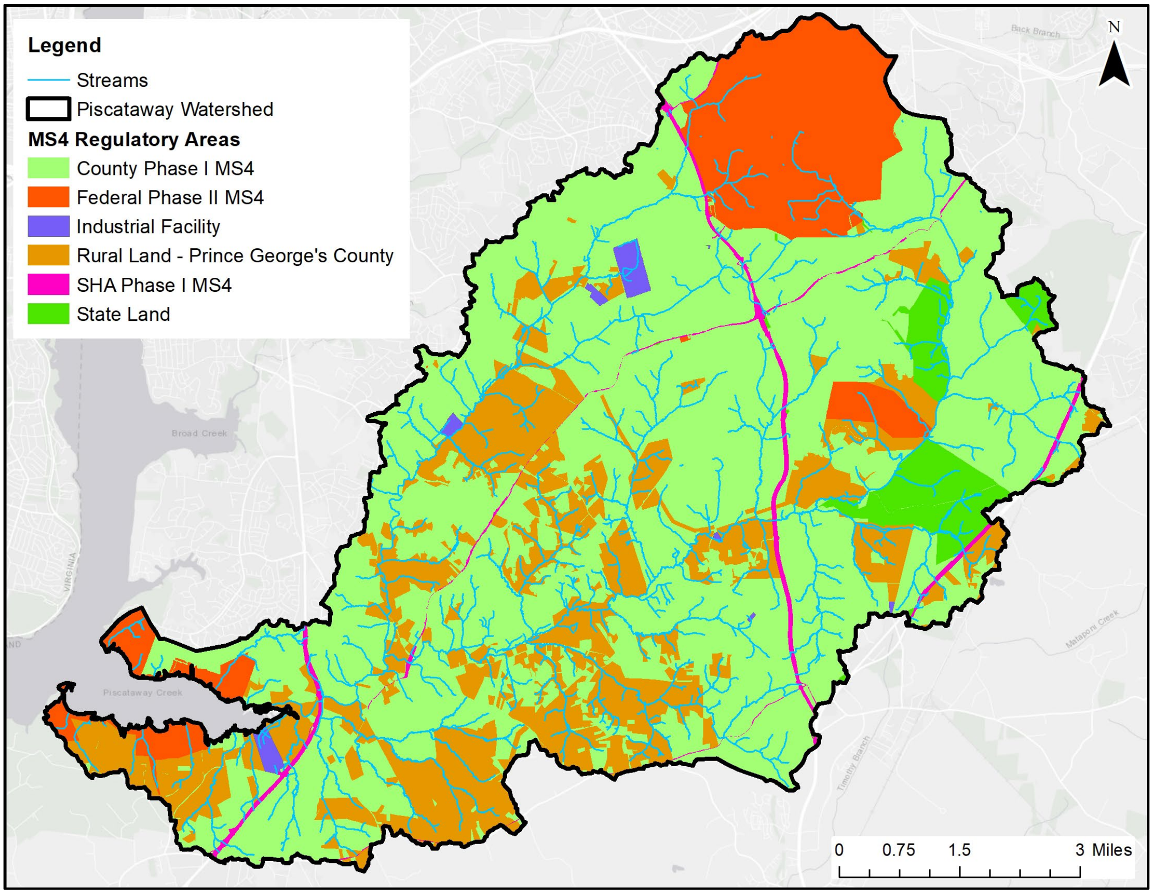


Figure 3-14. MS4-regulated areas in the Piscataway Creek watershed.

3.5.2 Nonpoint and Other Sources

Potential nonpoint sources vary greatly, including agriculture-related activities, atmospheric deposition, on-site treatment systems, and wildlife.

Nonpoint sources of pollution from agricultural activities include the runoff of fertilizers and exposed soils from crop fields, and waste from animal operations. The Maryland Department of Agriculture regulates agricultural activities, which are outside of the jurisdiction of DoE. Consequently, the Piscataway Creek watershed WIP does not include restoration activities for agricultural practices.

Streams and rivers can be vulnerable to wildlife impacts. Wild animals with direct access to streams, such as deer, raccoons, other small mammals, and avian species, can potentially increase erosion. For example, deer populations can clear low vegetation, including regenerative forest growth, which poses potential vulnerabilities to sediment load reduction efforts. Deer and other animals also create paths to the stream's edge, exposing base sediment and potentially causing stream bank erosion at the site of their access to the stream.

4 CURRENT STORMWATER MANAGEMENT ACTIVITIES

When precipitation falls in the County, the resulting runoff flows off roofs, lawns, driveways, and roads into a network of stormwater sewers that discharge directly to area streams. The stormwater flow picks up pollutants such as sediments and transports them into the waterways of the County. High volumes of water flowing to the stream channel during storm events cause erosion of the land and the channel itself. Many areas of the County were developed before stormwater regulations and practices were adopted in the 1970s and early 1980s. Many of these older developments did not have adequate stormwater controls for water quality at the time of their construction; since then, the County has accelerated a restoration program to address stormwater and water quality restoration.

The State adopted a statewide stormwater law and new regulations in 1983, and the County enacted a SWM ordinance in 1985. Since 2000, following new state regulations, developers of new and redevelopment projects in the County are required to provide water quality treatment for this urban runoff using a wide range of stormwater practices. During the initial years of stormwater regulation, those practices were somewhat crude and straightforward, but they have been continuously improved. Today, *environmental site design* (ESD)—the approach to SWM 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 SWM. The County is currently installing those types of BMPs. This section describes current SWM programs and the BMPs installed in the County.

The County has implemented a wide range of programmatic SWM initiatives over the years to address existing water quality concerns. They are grouped into three categories: stormwater-specific programs, tree planting and landscape revitalization programs, and public education programs. This section describes each grouping (and its respective individual initiatives), including the contributions the programs make to water quality protection and improvement.

4.1 Stormwater Programs

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

- Stormwater-specific programs
  - Stormwater Management Program
  - Clean Water Partnership (CWP)
  - Alternative Compliance Program
  - Rain Check Rebate and Grant Program
  - Stormwater Stewardship Grant Program
  - Countywide Green/Complete Streets Program

  - Erosion and sediment control
  - Street sweeping
  - Storm drain maintenance: inlet, storm drain, and channel cleaning
  - Storm drain stenciling
  - Illicit Connection and Enforcement Program
- Tree planting and landscape revitalization programs
  - Volunteer Tree Planting
  - Tree ReLeaf Grant Program
  - Neighborhood Design Center
  - Arbor Day Every Day
  - Tree planting demonstrations
- Public education programs
  - Interactive displays and speakers for community meetings
  - Stormwater Audit Program
  - Master Gardeners
  - Flood Awareness Month

4.2 Existing Stormwater BMPs

The County has been installing BMPs since 1985, with the inception of the first SWM ordinance. BMPs were applied to control peak discharges and infiltration where possible. In 2000, the County's new SWM ordinance instituted the requirement for improving water quality from runoff. This later requirement introduced the new ESD concept, by combining BMP strategies to treat runoff at the source.

Since the Chesapeake Bay TMDL was developed in 2010, the County has implemented SWM BMPs to control and reduce the pollutant load. This section describes the type and distribution of BMPs the County has installed in the watershed and evaluates the load reductions from the BMPs.

BMPs are measures used to control and reduce sources of pollution. They can be structural or nonstructural and are used to address both urban and agricultural sources of pollution. Structural practices include the placement of retention ponds, porous pavement, tree planting, stream restoration, and bioretention systems. Nonstructural BMPs include institutional, educational, or pollution prevention activities that, when implemented, work to reduce pollutant loadings. Examples of nonstructural BMPs include implementing strategic disconnection of impervious areas in a municipality, street sweeping, homeowner and landowner education campaigns, and nutrient management. Different BMP types remove pollutants at varying levels of efficiency. Ponds tend to have lower efficiencies but can treat large areas, while bioretention systems and infiltration practices tend to have higher efficiencies but can treat only smaller areas.

The two main reasons for installing BMPs are: (1) new development and (2) watershed restoration. Developer BMPs are installed as new development is constructed to negate the effects of excess runoff and pollution. As part of their construction permit, developers are required to install these BMPs. These do not get credited toward the TMDL load reduction targets. Even with developer BMPs installed, a waterbody might not meet water quality criteria due to development prior to stormwater regulations. In these circumstances, additional water quality treatment is needed. BMPs for watershed restoration are installed to improve the water quality of streams and, if installed after the date of the TMDL, can be credited towards meeting the TMDL.

The Piscataway Creek watershed has limited BMP coverage. The County actively updates a BMP geodatabase with new information as it becomes available. The BMPs were installed to support restoration activities or as offsets for new development. Table 4-1 lists the number of each type of restoration BMPs per watershed and categorizes them as a part of the baseline period (prior to 2015), progress, and planned BMPs. Table 4-2 shows similar information for developer BMPs. In Table 4-2, the baseline BMPs are considered part of the baseline calculations (prior to 2015), and the other column lists developer BMPs after the baseline period. These developer BMPs do not count towards TMDL restoration progress. Figure 4-1 shows the locations of the developer and restoration BMPs as of August 2022. While bioretention systems, infiltration trenches, and dry wells make up the majority of BMPs, wet ponds treat more watershed area. The County recently constructed a large stream restoration project along Tinkers Creek, which is reflected in the progress BMP column.

Table 4-1. Restoration BMPs in the Piscataway Creek watershed as of August 2023.

BMP Type	Baseline		Progress		Planned		Total	
	#	Acres Treated[a]	#	Acres Treated[a]	#	Acres Treated[a]	#	Acres Treated[a]
Bioretention	1	1.44	0	0.00	0	0.00	1	1.44
Disconnection of Rooftop Runoff	1	0.01	0	0.00	0	0.00	1	0.01
Dry Swale	1	0.76	0	0.00	0	0.00	1	0.76
Forest Conservation	0	0.00	0	0.00	1	27.79	1	27.79
Impervious Surface Elimination (to pervious)	3	0.32	0	0.00	0	0.00	3	0.32
Micro-Bioretention	1	0.13	3	0.77	0	0.00	4	0.91
Outfall Stabilization	0	0.00	2	615.00	0	0.00	2	615.00
Permeable Pavements	1	0.20	0	0.00	0	0.00	1	0.20
Planting Trees or Forestation on Previous Urban	0	0.00	0	0.00	1	12.24	1	12.24
Rain Gardens	1	0.71	0	0.00	0	0.00	1	0.71
Rainwater Harvesting	7	0.14	0	0.00	0	0.00	7	0.14
Retention Pond (Wet Pond)	9	184.24	1	14.77	0	0.00	10	199.01
Sand Filter	4	8.91	1	0.66	0	0.00	5	9.58
Step Pool Storm Conveyance	0	0.00	1	9.51	0	0.00	1	9.51
Stream Restoration	2	2,677.34	17	64,719.62	6	13,510.37	25	80,907.33
Street Trees	5,738	57.38	5,367	53.67	0	0.00	11,105	111.05
Submerged Gravel Wetlands	0	0.00	2	15.86	0	0.00	2	15.86

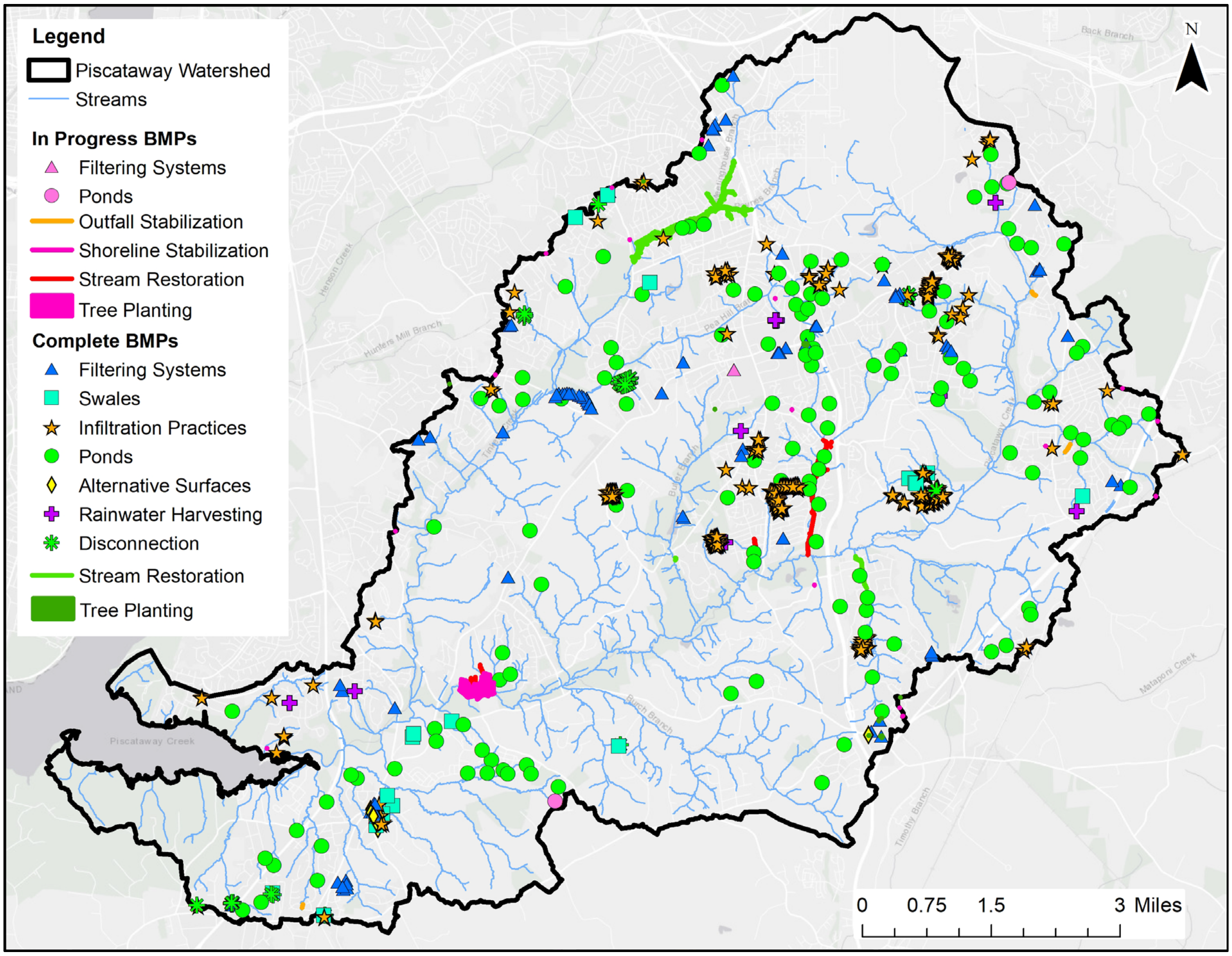
BMP Type	Baseline		Progress		Planned		Total	
	#	Acres Treated[a]	#	Acres Treated[a]	#	Acres Treated[a]	#	Acres Treated[a]
Total	5,769	2,931.58	53,94	65,429.86	8	13,550.4	11,171	81,911.86

Source: DoE 2023.
Note:
[a] Stream restoration and outfall stabilization totals are provided in linear feet.

Table 4-2. Developer BMPs in the Piscataway Creek watershed as of August 2023.

BMP Type	Developer Baseline		Developer	
	#	Acres Treated	#	Acres Treated
Bioretention	43	10.71	3	1.77
Bio-Swale	0	0.00	7	2.00
Detention Structure (Dry Pond)	4	25.45	0	0.00
Disconnection of Non-Rooftop Runoff	2	0.09	1	0.00
Disconnection of Rooftop Runoff	33	0.43	19	0.02
Dry Swale	0	0.00	1	0.02
Dry Well	109	2.78	211	2.22
Extended Detention Structure, Dry	8	38.63	1	0.01
Extended Detention Structure, Wet	25	238.18	6	22.98
Flood Management Area	3	4.16	2	3.95
Grass Swale	5	3.37	5	0.44
Green Roof - Extensive	0	0.00	1	0.19
Infiltration Basin	2	2.90	1	0.26
Infiltration Trench	41	50.07	5	0.01
Micro-Bioretention	0	0.00	22	2.93
Oil Grit Separator	8	9.60	1	0.57
Other	0	0.00	2	1.19
Permeable Pavements	0	0.00	5	3.59
Pocket Pond	2	5.62	0	0.00
Rain Gardens	0	0.00	3	0.05
Rainwater Harvesting	0	0.00	4	0.05
Retention Pond (Wet Pond)	50	406.62	16	44.10
Sand Filter	2	0.75	0	0.00
Shallow Marsh	1	1.71	0	0.00
Submerged Gravel Wetlands	0	0.00	5	5.34
Underground Filter	1	1.32	1	0.56
Wet Pond - Wetland	0	0.00	1	0.39
Total	339	802.39	323	92.64

Source: DoE 2023.



Source: DoE 2023.

Figure 4-1. Developer and restoration BMPs in the Piscataway Creek watershed.

5 LOAD REDUCTION TARGETS AND CURRENT PROGRESS

This section discusses the calculation of load reduction targets for the watershed, reductions that have resulted from current BMPs, and reductions remaining to be met through this WIP. The calculations rely on TMDL, land cover, and existing BMP information. This WIP examines local sediment TMDL reductions for the Piscataway Creek watershed.

5.1 Load Reduction Terminology

The amount of sediment load still required to be reduced after accounting for load reductions from current practices is called the *load reduction gap*. Figure 5-1 illustrates that concept.

The following load reduction terms are used in text, tables, and plots in the Executive Summary and throughout the remainder of this document:

- **No-action load:** This load is the pollutant load directly from the land surface without the influence of any BMPs.
- **Baseline load:** This load is the pollutant load from the land surface at the time the TMDL was developed. It includes reductions from restoration BMPs installed prior to the TMDL and developer BMPs installed prior to the date of the land use.
- **Target load:** This is the load that is met once load reductions specified in the Chesapeake Bay TMDL are met. This is determined using the baseline load and required percent reduction from the TMDL Data Center (MDE 2019c).
- **Required load reduction:** This is the load that will need to be reduced through restoration BMPs. This load is the difference between the baseline load and the target load.
- **Permit load:** The load at the beginning of the 2014 MS4 permit term (December 2014).
- **Progress load:** The County has already installed BMPs in the watersheds. This is the current load accounting for these BMPs and is the difference between baseline loads and the loads treated by restoration BMPs after the date of the TMDL.
- **Milestone load:** The load is based on all BMPs planned to be installed by the end of fiscal year (FY) 2025 (Milestone 1) and FY 2027 (Milestone 2).
- **Planned load:** The load reduction is based on BMPs identified during the development of this WIP.
- **Load reduction to date:** This is the load reduced by currently installed BMPs or the difference between the baseline and current loads.
- **% of target:** This is the percent of the required load reduction removed by installed BMPs.
- **Progress load reduction gap:** This is the required load reduction remaining (i.e., gap) once the load reduction to date is subtracted from the required load reduction.
- **Load removed from BMPs in planning/design:** This value is the load reduction from the implementation of BMPs for watershed restoration not yet constructed but already being planned and designed.
- **Final load gap:** This is the required load reduction that remains (i.e., gap) once the load reductions from current BMPs and restoration BMPs in design and planning are subtracted. This is the load reduction this plan addresses.

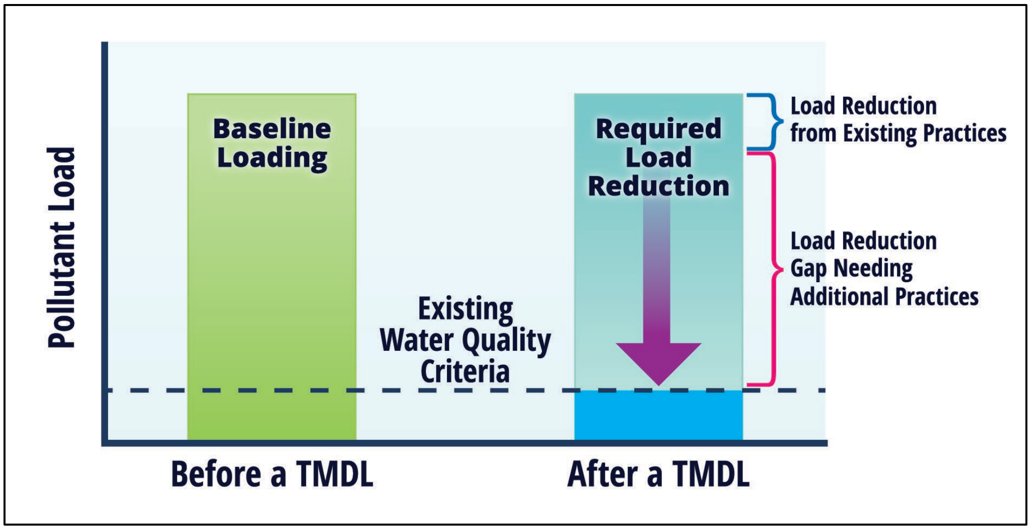


Figure 5-1. Schematic for typical pollution diet (TMDL) showing existing load reduction credits.

5.2 Load Calculation Methodology

Prior to the development of this WIP, the County had consulted and collaborated with MDE on the load calculation approach and methodology. The County used the load calculation methodology from MDE's *TMDL Implementation Progress and Planning (TIPP) Tool* (MDE 2022c). "MDE requires the use of TIPP to ensure consistency among load reduction calculation methods" for "meeting Phase I MS4 permit implementation planning and reporting requirements" for applicable TMDLs (MDE 2022b). The loads calculated in this WIP incorporate recent land use data, land use loading rates, and restoration data for the portions of the Piscataway Creek watershed in the County's MS4 area. The loadings will not match the loads in the local Piscataway Creek watershed TMDL because of the different data used in the TMDL.

The County uses a Microsoft Access database in its load calculation process that uses the data and methodology of MDE's April 2022 TIPP Tool (MDE 2022c). Still, the County's process breaks down the loadings into smaller subwatersheds for planning purposes. For example, the County's tool follows the MDE spreadsheet tool in only including impervious areas and turf in its baseline load calculations. Like the MDE tool, the County's load calculations did not include loads generated from agriculture, wetlands, forested areas, or mixed open land areas, which are considered outside the County's MS4 area. Similarly, TSS loads from state and federal lands were not used in this WIP. In developing its loads, the County used the land cover-specific loading rates for TSS provided by MDE in its TIPP Tool (MDE 2022c), which is in Microsoft Excel (Table 5-1). The MDE rates were derived from the latest Chesapeake Bay model data, which include loading contributions from stream bed and bank erosion. After developing the Access tool, the County compared the results from the Mattawoman Creek, Piscataway Creek, and Anacostia River watersheds. The largest percent difference for any watershed/analyte pair is 0.12 percent difference. Differences are attributed to slight rounding differences and that the TIPP Tool uses the BMP rating curves for rainfall treated values greater than 2.6, as opposed to using the numeric tables. Based on these results, the County is confident that the Access Tool can replicate the TIPP Tool results.

Table 5-1. TIPP land cover/use loading rates for the Piscataway Creek watershed.

TIPP Land Cover/Use	MS4 Land	TSS (lb/ac/yr)	Comment
Aggregate impervious	yes	7,553.8	
Impervious road	yes	9,253.8	
Impervious nonroad	yes	5,324.8	Includes *Impervious Surfaces* and *Structures* land cover classifications.
Tree canopy over aggregate impervious	yes	7,025.1	
Tree canopy over impervious road	yes	8,606.1	
Tree canopy over impervious nonroad	yes	4,952.1	Includes *Tree Canopy over Impervious Surfaces* and *Tree Canopy over Structures* land cover classifications.
Tree canopy over turf	yes	1,634.2	
Turf	yes	1,734.8	
Forest	no	325.8	Includes *Shrubland* land cover classification.
Mixed open/agriculture	no	1,734.8	
Water	no	0.0	

Source: MDE 2022c.

5.3 BMP Pollutant Load Reduction Calculation

The primary purpose of implementing BMPs is to remove stormwater pollutants (e.g., sediment) near their source and prevent pollutant loads from entering and degrading water bodies. Different types of BMPs remove pollutants with differing degrees of effectiveness or pollutant removal efficiency. Estimating pollutant reductions achieved through implementing BMPs is a two-step process: (1) determine the varying removal efficiencies of the BMPs being considered and (2) calculate the load reduction.

The information available for most BMPs included drainage area (i.e., total land area flowing to a specific BMP [e.g., a bioretention system]). Load reductions for the existing BMPs were calculated using the documented pollutant removal rates (Appendix B) in conjunction with BMP drainage area land cover and the land-cover-specific pollutant loading rate. MDE's *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (MDE 2021a) incorporates recent Chesapeake Bay Program recommendations for sediment load reduction removal efficiencies associated with BMP implementation. This information is incorporated into their TIPP Tool (MDE 2022c). By using those removal efficiencies in its reduction calculations, the County is consistent with regional efforts to meet the Chesapeake Bay TMDL. See Appendix B for additional information on BMP effectiveness. That calculation provided the loading attributed to the BMP drainage area, which was then multiplied by the BMP pollutant removal efficiency to determine the amount of load reduction attributed to a specific BMP.

The County implemented restoration BMPs prior to the TMDL. The load reductions from these BMPs are reflected in the baseline loadings. Besides restoration BMPs, developers also install BMPs to offset the increased pollutant loads from new developments. Because those BMPs are installed to offset new loadings and not to remove existing loadings, they are not counted towards watershed restoration. Partial credits can be counted towards restoration from redevelopment BMPs if the BMPs meet specific requirements.

All BMPs (restoration, retrofit, and developer) installed up to and including 2014 (date of land use) were used to calculate the baseline loads along with restoration BMPs installed up to 2019 (date of TMDL). Load reductions from completed restoration BMPs since 2019 are considered as progress load reductions.

Table 5-2 lists load reductions by BMP type for the baseline period and for those counted towards TMDL progress. It also includes load reductions from specific BMPs that are already in the planning, design, or construction phase. This table includes restoration BMPs that were implemented under one of the programs discussed in Appendix A.

Table 5-2. Baseline, progress, and planned load reductions by BMP types.

BMP Type	Baseline TSS Reduction (lbs/yr)	Progress TSS Reduction (lbs/yr)	Planned TSS Reduction (lbs/yr)	Total TSS Reduction (lbs/yr)
Bioretention	5,258	0	0	5,258
Disconnection of Rooftop Runoff	0	0	0	0
Dry Swale	5,061	0	0	5,061
Forest Conservation	0	0	42,819	42,819
Impervious Surface Elimination (to pervious)	1,153	0	0	1,153
Micro-Bioretention	535	4,239	0	4,774
Outfall Stabilization	0	72,623	0	72,623
Permeable Pavements	983	0	0	983
Planting Trees or Forestation on Previous Urban	0	0	17,251	17,251
Rain Gardens	3,892	0	0	3,892
Rainwater Harvesting	262	0	0	262
Retention Pond (Wet Pond)	1,144,850	102,970	0	1,247,820
Sand Filter	43,684	3,251	0	46,935
Step Pool Storm Conveyance	0	0	0	0
Stream Restoration	663,981	4,077,767	4,784,426	9,526,174
Street Trees	30,341	28,379	0	58,720
Submerged Gravel Wetlands	0	69,912	0	69,912
Total	**1,900,001**	**4,359,140**	**4,844,495**	**11,103,637**

Source: DoE 2023.
Note:
lbs/yr = pounds per year.

5.4 Baseline, Progress, and Target Load Calculation

Table 5-3 presents County MS4 baseline loads for the Piscataway Creek watershed. Those baseline loads do not include loads attributed to the town of Bowie or federal or state land because the County MS4 permit does not cover these areas. The loads in Table 5-3 account for all BMPs installed through 2022. The methodology for calculating the baseline loads followed MDE's TIPP Tool (MDE 2022c). Table 5-3 also presents the percent reduction reported in the TMDL, which was applied to the calculated baseline load to determine the implementation load reduction target. The TMDL percent reduction values were obtained directly from the MDE

TMDL Data Center (MDE 2019c). That target, and the amount by which the loads need to be reduced, are also presented. Table 5-3 presents the sediment loads for different scenarios (e.g., progress, milestones).

As shown in Table 5-3, the load reductions from existing restoration activities are insufficient to meet the targeted reductions. With the BMPs either previously implemented or planned, a reduction gap still exists in the Piscataway Creek watershed. Additional practices will need to be planned to close the gap in its pollutant reduction requirements to meet the TMDL. These are discussed in Section 7.

Table 5-3. Sediment load and targets for the Piscataway Creek watershed.

Measure	TSS (lbs/yr)	TSS (tons/yr)
No-action load	39,402,594	19,701
Baseline reductions	5,926,502	2,963
Baseline load	33,476,091	16,738
Reduction required %	51%	51%
Target load	16,403,285	8,202
Required reduction	17,072,807	8,536
Progress reductions	4,359,140	2,180
Progress load	29,116,951	14,558
Current load reduction gap	12,713,666	6,357
Planned reductions	4,844,495	2,422
Planned load	24,272,455	12,136
Restoration gap (Remaining load reduction to meet target. See Section 7.2.)	**7,869,171**	**3,935**

Notes:
lbs/yr = pounds per year; ton/yr = tons per year.
See Section 5.1 for a discussion of the terminology in this table.

6 LOAD REDUCTION STRATEGY

The County has constructed BMPs countywide, including in the Piscataway Creek watershed. The restoration activities in the Piscataway Creek watershed will require a sustained level of effort annually to reach the reduction targets outlined in the TMDL. Consequently, the County has developed a strategy with five components to achieve the goals of the plan:

- Use MDE-developed land use loading rates and accepted BMP pollutant load reduction efficiencies to evaluate the ability of existing practices and programmatic initiatives to meet the local TMDL SW-WLAs.
- Quantify future BMPs necessary to meet the SW-WLAs.
- Develop cost estimates associated with implementing the BMPs and initiatives.
- Develop timelines associated with the deployment of BMP practices and initiatives to determine if the timelines required by the TMDL program can be achieved.
- Identify the financial and technical resources required to implement the BMPs and initiatives and develop achievable timelines that can meet TMDL program requirements with the greatest efficiency.

The County's strategy for developing a WIP includes evaluating the capacity of existing BMPs and restoration activities and identifying future activities necessary to meet the SW-WLAs. The methodology emphasizes the use of adaptive management as outlined in Section 8.3 and a simplified project identification and implementation framework to achieve greater cost efficiency while not sacrificing the resiliency of the WIP.

In a simplified framework, once the existing BMPs have been accounted for and the load reduction gap has been calculated, the County will attempt to identify potential future BMPs that could be implemented to close the remaining gap. Generally, the County's implementation of those BMPs would be prioritized by the cost-effectiveness for meeting water quality goals. Seeking out cost-effective opportunities that deliver the greatest pollutant load reduction will ensure that the most beneficial practices that are easiest to accomplish are not overlooked during the implementation process.

The overall load calculation process will follow these general steps:

1) Calculate the *no action* load using the MDE land use and land use loading rates.
2) Determine baseline load, which accounts for existing BMPs.
    a) Calculate the load reductions from developer BMPs implemented prior to the date of the land cover data (2014).
    b) Calculate the load reduction from restoration BMPs implemented prior to the date of the TMDL (2019).
    c) Subtract these amounts from the no action load to obtain the baseline load.
3) Apply the TMDL percent reduction to the baseline load to obtain the target load.
4) Calculate the total reduction required.
5) Calculate the load reductions from restoration BMPs installed since the date of TMDL (2019) to determine the current restoration progress.

6) Determine the remaining load reduction gap.
7) Calculate the load reductions from BMPs that are currently in the planning, design, or construction phase.
8) Determine the remaining load reduction gap.
9) Determine the amount of BMPs needed to fill in the load restoration gap.

6.1 Programmatic Initiatives

The County analyzed current stormwater programs (discussed in Section 4 and Appendix A). The existing programmatic activities are expected to continue and will be supplemented with additional practices, to support the programmatic strategies for this WIP as they are identified and/or developed.

6.2 BMP Identification and Selection

The MDE 2000 *Stormwater Design Manual* provides guidance for designing several types of structural BMPs, including wet ponds, wetlands, filtering practices, infiltration practices, and swales (MDE 2009). MDE also describes nonstructural BMPs that include programmatic, educational, and pollution prevention practices that work to reduce pollutant loadings. Examples of nonstructural BMPs include diverting stormwater from impervious to pervious areas, street sweeping, and public education campaigns (MDE 2009). Additionally, the County will use MDE's *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated: Guidance for National Pollutant Discharge Elimination System Stormwater Permits* in planning future BMPs (MDE 2021a).

The County has implemented and will continue to implement runoff reduction (RR) practices, stormwater treatment (ST) practices, nonstructural stormwater treatment practices, and MDE-approved alternative BMP practices to meet its programmatic goals and responsibilities, including MS4 permit compliance, TMDL WLAs, and flood mitigation. Appendix A has additional information on specific practices.

The County does not own many sites that are suitable for BMP implementation. The County could seek partnerships with other organizations (e.g., nonprofit organizations, businesses) to gain access to private lands and conduct restoration activities on them. For example, a shopping center owner could partner with the County to gain assistance with installing BMPs. (For more information, please see Appendix section *E.2. Public Involvement to Support Implementation Activities*.) This assistance may range from technical assistance to partnering to install a BMP that treats the shopping center parking area and the County right-of-way (ROW). Nonprofit organizations can participate with the County through the raincheck rebate and stewardship grant programs (see Appendix A.1). These programs are in place to help property owners work with the County in restoring their own properties. Examples of projects include tree planting, reforestation, impervious surface removal, and nonstructural BMPs. Without forming partnerships and being granted access to private land, the County will be limited to installing BMPs only on properties to which it has direct access, such as ROWs or County government-owned land. Appendix C has additional information on BMP site selection.

BMP types and locations are not explicitly specified in this WIP, giving the County flexibility to identify specific locations for BMPs and to work with partners on implementing them (e.g., installing BMPs on institutional land). The County also will have the flexibility to select suitable BMPs based on costs, land availability, feasibility, pollutant removal efficiencies, and other factors.

6.3 Implementation Budgeting

This section provides projected estimated budgets for the probable expenditures and staff resources that might be anticipated over the implementation period. Given the iterative and adaptive nature of the WIP and the potential for modified proposed activities, the estimated budget in this plan should be considered preliminary for the year estimated; in later years, it should be revisited as the implementation period moves forward and new data becomes available.

6.3.1 Programmatic Initiatives Estimating

Generally, the costs of programmatic initiatives for nonstructural BMPs (e.g., public education, tree planting, downspout disconnection) are more challenging to determine than costs for structural BMPs (e.g., ponds, stream restoration, RR/ST practices). Some programmatic initiatives are included in current County practices; thus, the County has already accounted for those costs. For instance, the ReLeaf Grant Program is one of the County's active tree planting programs with an existing budget. Costs for programs that result in structural BMP implementation, such as the Clean Water Partnership (CWP), are included in the BMP analysis; the only additional cost to the County is staff time for administering and coordinating the program as part of regular duties. Nonstructural BMPs are funded through DoE's operating budget, whereas structural BMPs are funded through the CIP budget. Appendix D has information on the County's funding sources.

6.3.2 BMP Implementation Estimating

Table 6-1 presents data on BMP unit cost per impervious acre treated, including costs for operation and maintenance (O&M). These unit costs were developed in *Cost Analysis of Stormwater and Agricultural Practices for Reducing Nitrogen and Phosphorus Runoff in Maryland* (UMCES 2019). The costs in Table 6-1 were converted to January 2020 dollars using the RSMeans historical cost indexes (Gordian 2020). Table 6-1 shows simple annual unit costs and annualized costs with and without land purchase costs. Simple costs were determined using the median implementation cost divided by the BMP lifespan and adding annual O&M costs. The annualized costs assumed a 5 percent annualization rate applied to the median implementation cost. Then, annual O&M costs were added. Simple annual costs without land costs were used in this plan and do not account for inflation over the course of this plan.

Table 6-1. Typical BMP unit costs by stormwater BMP by impervious acre treated.

Stormwater Practices	Type of Practice	Life-span	Median Implement-ation Cost ($/imp acre per year)[a]	Annual O&M ($/imp acre per year)[a]	Simple Annual ($/imp acre per year)[a]		Annualized ($/imp acre per year)[a]	
					No Land Costs	With Land Costs	No Land Costs	With Land Costs
Bioretention	RR	20	$211,110	$24,278	$34,833	$35,018	$41,217	$41,402
Micro-bioretention	RR	20	$311,121	$35,779	$51,334	$51,519	$60,744	$60,867
Rain gardens	RR	20	$147,635	$16,978	$24,360	$24,544	$28,825	$29,010
Bio-swale	RR	20	$59,994	$6,899	$9,899	$10,022	$11,714	$11,837
Grass swale	RR	20	$250,054	$28,756	$41,259	$41,382	$48,821	$48,944
Dry swale	RR	20	$203,772	$23,434	$33,623	$33,746	$39,785	$39,908
Micro-pool extended detention pond	pond	30	$75,894	$8,727	$11,257	$11,340	$13,665	$13,788
Multiple pond system	pond	30	$163,087	$18,755	$24,191	$24,274	$29,364	$29,487
Extended detention structure, wet	pond	30	$28,816	$3,314	$4,274	$4,357	$5,189	$5,312
Retention pond (wet pond)	pond	30	$53,782	$6,185	$7,977	$8,060	$9,683	$9,806
Extended detent–on - wetland	stormwater	30	$78,413	$9,018	$11,631	$11,714	$14,118	$14,241
Wet pond - wetland	stormwater	30	$58,082	$6,679	$8,616	$8,697	$10,458	$10,581
Shallow marsh	stormwater	30	$36,842	$4,237	$5,465	$5,547	$6,633	$6,756
Impervious surface elimination (to pervious)	alternative	20	$911,948	$0	$45,598	$48,672	$73,177	$76,252
Infiltration basin	stormwater	20	$68,653	$9,199	$12,633	$12,940	$14,709	$15,016
Infiltration trench	stormwater	20	$121,571	$16,291	$22,370	$22,677	$26,046	$26,353
Permeable pavements	RR	20	$389,890	$52,246	$71,740	$71,740	$83,531	$83,531
Organic filter (peat filter)	stormwater	20	$219,834	$25,281	$36,272	$36,580	$42,921	$43,229
Submerged gravel wetlands	RR	30	$161,582	$18,582	$23,968	$24,050	$29,093	$29,216
Sand filter	stormwater	20	$18,759	$2,158	$3,096	$3,403	$3,663	$3,970
Underground filter	stormwater	20	$112,979	$12,993	$18,642	$18,950	$22,059	$22,366
Regenerative step pool conveyance	RR	20	$75,236	$6,169	$9,931	$9,931	$12,207	$12,207
Outfall stabilization	alternative	20	$207,941	$17,051	$27,449	$27,449	$33,737	$33,737
Stream restoration	alternative	20	$61,047	$5,005	$8,059	$8,059	$9,905	$9,905
Planting trees or forestation or pervious urban	alternative	20	$35,385	$0	$1,769	$9,860	$2,840	$10,930
Wet pond average	**pond**	**30**	**--**	**--**	**$11,925**	**$12,008**	**$14,475**	**$14,598**
Runoff reduction average	**RR**	**20**	**--**	**--**	**$33,439**	**$33,550**	**$39,549**	**$39,658**

Source: UMCES 2019.
Notes: $/imp acre = dollars per impervious acre, RR = runoff reduction.
[a] Costs inflated to January 2020 dollars.

7 WIP RESTORATION ACTIVITIES

The County is in its 5th generation NPDES permit and has been constructing BMPs as part of SWM controls and restoration requirement countywide, including in the Piscataway Creek watershed. Existing and planned BMPs meet 51 percent of the TSS target goal in the Piscataway Creek watershed. This section describes the County's proposed changes intended to strengthen the implementation process it uses to improve water quality and, thereby, meet the goals and objectives of this WIP. It includes specific planned actions, cost estimates, and a proposed schedule, as well as describes the financial and technical resources available to support and implement the plan. This section also describes how the County will involve the public throughout the plan's implementation, including keeping residents informed and encouraging them to participate directly in the implementation actions. The WIP creates the overall blueprint and timeline for restoration activities in the Piscataway Creek watershed.

7.1 Programmatic Initiatives

The County's existing programmatic practices (Section 4 and Appendix A) are expected to remain in place. They will be supplemented with additional practices discussed in this section to make up the programmatic strategies for this WIP.

Estimating potential load reductions resulting from programmatic initiatives is challenging because some of the initiatives require public participation and changes in long-standing behaviors. Some of the programmatic initiatives will result in BMPs being installed. The acreage that will be treated through those programs has yet to be estimated. The BMPs that are installed as those programs are implemented will be credited towards the identified load reduction targets and load reduction gap discussed in Section 5.3.

Programmatic activities are generally not measured for load reductions unless they were designed specifically for a surrogate benefit. One of the County's measurable programmatic activities includes inlet cleaning. (See Appendix A for a list of County programs.) Although the cumulative effects of programmatic activities will help reduce loads entering local water bodies in different ways, thus improving their health, their impacts cannot be calculated and are not included as part of this WIP. Those activities do, however, 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 resulting from the activities will be reflected through adaptive management, through which the County will assess cumulative improvements in the water quality and health of water bodies under the WIP.

7.2 Structural BMPs

This section assesses different treatment options, including stream restoration. It also explores outfall stabilization, tree planting, new wet ponds, and RR practices (e.g., grass swales, bioretention systems) that treat stormwater runoff from both pervious and impervious land. The combination of pervious and impervious land is used in calculating the load reduction potential of new wet ponds and RR practices. RR practices are typically smaller and treat smaller areas than wet ponds. (Based on the County's BMP database, RR practices treat an average of 0.5 acres and wet ponds an average of 40 acres.) Wet ponds are typically regional facilities that remove sediments and other pollutants by treating runoff from large drainage areas, but they have lower removal efficiencies. Only the impervious area is assessed for costing because the available cost data are provided per impervious acre treated rather than for the total land area treated (Section 6.3.2).

As recommended by MDE's accounting for SW-WLA guidance (MDE 2021a) the County will consider the following practices; however, the County can choose practices based on available resources and priorities. Please refer to Appendix C for additional information on the types of BMPs in this WIP:

- Stream restoration
- Outfall stabilization
- Tree planting (forest planning, tree canopy, riparian buffers)
- Impervious to pervious (turf)
- Wet ponds (treating 3-inch rainfall)
- RR practices (treating 3-inch rainfall)

7.2.1 BMP Determination – Desktop Excel Analysis

The County could use many different combinations of BMPs to meet the load reductions for these TMDLs. However, the cost and lack of available space for implementation would make many of them unfeasible. The results of a cost-effectiveness analysis of various scenarios with different combinations of BMPs will assist the County in selecting a strategy that can work together most effectively to meet the load reduction targets at the lowest cost.

Given the large geographical area in the watershed for potential restoration, including factors such as land use/land cover types, soil classes, and existing developments without SWM controls, Microsoft Excel Solver Add-in was used to determine the most cost-effective scenarios to meet the load reductions for this WIP. Solver processes a set of conditions to meet the County's objective: *the lowest cost*. The main condition was meeting the load reduction target in every scenario. Other conditions set a range of implementation for RR practices, outfall stabilization, stream restoration, tree planting, and new wet ponds. For example, a scenario could limit RR practices to treat runoff to 100 acres of land, while another scenario allows for treatment of up to 250 acres. The amount of stream restoration and outfall stabilization was determined using information on known stream erosion issues from the MD DNR SCA (Section 3.4). Solver then determined the best value in that range for that scenario. In Solver, forest planting accounts for 10 percent of the total tree acres planted, with street trees 40 percent, urban tree canopy 45 percent, and riparian buffers at 5 percent. The total acres for forest planting and riparian buffers need to be greater than 0.5 acres each per their BMP definition.

The overall costs for ten scenarios ranged from $104 million to $310 million, with a median of $112 million. The scenario closest to the median cost (shown in Table 7-1) was selected for the WIP to provide the County with several options. The scenario that has been selected for presentation with this plan serves as a starting point for the County to make future decisions. The actual combination of BMPs implemented to meet the TMDL can change over time as adaptive management principles are applied to this plan. Table 7-2 presents a comparison of the ten most cost-effective scenarios. The low-cost scenarios maximized the amount of stream restoration, tree planting, and wet ponds. These practices have a lower cost per impervious acre treated than RR practices.

Table 7-1. Results of cost optimization to meet TMDL.

Variable (unit)	Value	Constraints
Stream restoration (linear feet)	30,490	50–300% of MD DNR SCA known erosion issues (section 3.4)
Outfall stabilization (outfalls)	4	50–200% of MD DNR SCA outfalls
Tree planting (acres planted)	12.8	0–15 acres
Impervious to turf (acres)	0	0–1 acre
New wet ponds (acres treated)	0	0–100 acres
RR practices (acres treated)	25	25–50 acres
Cost (January 2020 $M)	$109.8	Lowest cost for the constraints listed above.

Note: $M = in millions of dollars.

Table 7-2. Comparisons of top 10 cost optimization scenarios.

Practice (unit)	Top Five Low-Cost Scenarios				
	1 (Lowest)	2	3	4	5
Stream restoration (linear feet)	30,830	30,430	30,768	30,223	30,490
Outfall stabilization (outfalls)	4	8	0	4	4
Tree planting (acres planted)	12.8	12.8	12.8	12.8	12.8
Impervious to turf (acres)	0.0	0.0	0.0	0.0	0.0
New wet ponds (acres treated)	0	0	10	50	0
RR practices (acres treated)	0	0	25	0	25
Total cost ($M)	$104.2	$107.3	$107.6	$108.6	$109.8
Practice (unit)	Cost Scenarios 6–10				
	6	7	8	9	10
Stream restoration (linear feet)	30,236	18,510	12,071	6,268	4,621
Outfall stabilization (outfalls)	0	0	0	0	0
Tree planting (acres planted)	10	10	20	30	20
Impervious to turf (acres)	0	1	0	0	1
New wet ponds (acres treated)	41	1,000	1,500	1,834	2,000
RR practices (acres treated)	44.4	50.0	49.7	149.6	150.0
Total cost ($M)	$114.9	$201.3	$243.3	$294.0	$310.5

Note: $M = in millions of dollars.

7.2.2 Load Reductions

Table 7-3 and Table 7-4 restate the load calculations from earlier in the document (Table 5-3) along with new reductions for the different restoration activities relevant to this plan (BMPs and programmatic initiatives). The most significant reductions will be obtained through stream restoration.

Table 7-3. WIP TSS load reductions in the Piscataway Creek watershed.

Measure or Practice	TSS (lbs/yr)	% of Baseline Load
Information from Table 5-3		
Baseline load	33,476,091	100%
Target load	16,403,285	49%
Required reduction	**17,072,807**	**51%**
Current Restoration BMP Reductions (through June 30, 2023)	4,359,140	13%
Progress load	29,116,951	87%
Current load reduction gap	12,713,666	38%
Planned Restoration BMP Reductions (Identified in County BMP database)	4,844,495	14%
Planned load	24,272,455	73%
Remaining Restoration Gap to meet TMDL	7,869,171	24%
BMPs identified in this WIP to Meet Restoration Gap		
Stream restoration / outfall stabilization	7,660,624	23%
Tree planting	124,161	0%
Wet ponds	0	0%
RR practices	84,387	0%
Impervious to turf	0	0%
Total WIP	**7,869,172**	24%
Total restoration activities		
Current BMPs, planned BMPs, and WIP BMPs	**17,072,807**	51%

Notes:
lbs/yr = pounds per year.
See Section 5.1 for a discussion of the terminology in this table.

Table 7-4. Summary of WIP TSS load reductions in the Piscataway Creek watershed, as presented in the TIPP Tool.

Load Category	TSS	Units
Baseline *– Estimated load at time of TMDL*		
Impairment Baseline Load	33,476,091	lbs/yr
Target Reduction %	51.00%	%
Target Load	16,403,285	lbs/yr
Total Reduction Required	17,072,807	lbs/yr
Permit– *Estimated load at beginning of 2014 permit (includes BMP reductions since TMDL development)*		
Total Permit Load	33,295,366	lbs/yr
% of Total Reduction Required	1.06%	%
Progress – *Estimated load as of July 2023 (includes BMP reductions since TMDL development)*		
Total Progress Load	29,116,951	lbs/yr
% of Total Reduction Required	25.53%	%

Load Category	TSS	Units
Implementation (Milestone 1) – *Estimated load with Planned BMPs through 2025 (includes BMP reductions since TMDL development)*		
Total Load after Implementation	26,694,703	lbs/yr
% of Total Reduction Required	39.72%	%
Implementation (Milestone 1 + Milestone 2) – *Estimated load with Planned BMPs through 2027 (includes BMP reductions since TMDL development*		
Total Load after Implementation	24,272,455	lbs/yr
% of Total Reduction Required	53.91%	%
Implementation (Milestone 1 + Milestone 2 + Planned) – *Estimated load with Planned BMPs through 2027 and BMPs identified in this WIP (includes BMP reductions since TMDL development)*		
Total Load after Implementation	16,403,284	lbs/yr
% of Total Reduction Required	100.00%	%

Notes:
lbs/yr = pounds per year.
See Section 5.1 for a discussion of the terminology in this table.

7.3 Restoration Budget

The planning level costs per restoration activity are shown in Table 7-5, along with the estimated load reductions and cost per pound of sediment reduced for scenario #5. The overall cost for this plan is $109.8 million. These costs include the O&M of each new BMP over the lifespan of the BMP. The total cost does not include the O&M costs for existing BMPs, replacements of BMPs that have exceeded their lifespan, or aging stormwater infrastructure. Based on County experience, O&M costs account for 5 to 10 percent of the total construction cost. Appendix D has information on the County's funding sources.

The BMP unit costs from Table 6-1 were used to determine the restoration plan budget. Because this plan does not specify exact RR types, the average of the RR practices was used to determine the budget for the RR practices in Table 7-4. The most cost-effective strategy is planting trees, while impervious surface removal is the least cost-effective. Stream restoration and outfall stabilization are also relatively cost-effective, followed by creating new wet ponds and RR practices.

The median cost scenario serves as a starting point for the County to make future decisions. The actual combination of BMPs implemented to meet the TMDL can change over time as adaptive management principles are applied to this plan.

Table 7-5. Total BMP proposed implementation costs and cost efficiency by restoration strategy.

Practice	TSS (lbs/yr)	Budget	Cost ($/lb)	Impervious Credit (imp acre)	Cost ($/imp acre)
Stream restoration/ Outfall stabilization	7,660,624	$102,675,297	$0.67	617.79	$166,197
Tree planting	124,161	$452,892	$0.18	6.03	$75,105
Impervious to turf	0	$0	$0	0.00	$0
New wet ponds	0	$0	$0	0.00	$0

Practice	TSS (lbs/yr)	Budget	Cost ($/lb)	Impervious Credit (imp acre)	Cost ($/imp acre)
RR practices	84,387	$6,670,156	$3.74	9.45	$705,925
Total WIP	**7,869,172**	**$109,798,345**	**$0.70**	**633.27**	**$173,383**

Notes:
lbs/yr = pounds per year; $/lb = dollars per pound; $/imp acre = dollars per impervious acre.
Costs inflated to January 2020 dollars.

7.4 Implementation Schedule

This section provides the planning-level implementation schedule for the BMP and programmatic strategy necessary to meet TMDL compliance milestones. There is no mandated end date for the local TMDL WIPs; however, the County understands the public prefers an expedited restoration process and shares that sense of urgency. The County and its watershed partners are committed to finding site opportunities and expediting the planning, design, and construction phases for management activity to the maximum extent practicable. The County identifies specific BMP opportunities over a 6-year planning horizon, which becomes part of the approved annual county budget. These opportunities are included in the County's biannual Financial Assurance Plan (FAP) and summarized in the County's annual MS4 progress report. Planning, design, and construction activities follow a rigorous internal evaluation, including budget, CIP progress tracking, and necessary adjustments to implementation schedules due to unforeseen conditions. The result of this process is adjusted annually. Any BMPs installed by the County to address local TMDLs will help meet Chesapeake Bay load reduction goals.

Implementing the restoration activities in the proposed schedule will depend largely on future available funding and program capacity. The County has additional local nutrient and sediment TMDL WIPs in the Anacostia River, Mattawoman Creek, Rocky Gorge Reservoir, Lower Patuxent River, Middle Patuxent River, and the Upper Patuxent River watersheds and will need to allocate available funding and resources across those priority watersheds. These are competing funding priorities in addition to reducing bacteria and polychlorinated biphenyls (PCBs) for several local TMDLs through monitoring, source trackdown, and elimination.

DoE estimates that it can retrofit an average of 2 percent of its untreated impervious area per year (as per anticipated new NPDES permit conditions) over the course of WIP implementation. This estimate is backed up by MDE in its Phase III Chesapeake Bay WIP (MDE 2019a). Using that implementation average as a guide, we can determine the time needed to implement this WIP fully. There are 1,616 acres of untreated impervious area (for both existing and currently planned restoration BMPs) in the Piscataway Creek watershed. Meeting the TMDL will require treating 633 impervious acres based on the restoration scenario (Table 7-5).

This WIP is anticipated to be fully implemented by fiscal year (FY) 2044, including treating the identified impervious acres with BMPs and all programmatic activities. This end date considers the 2 percent implementation estimate, other competing priority WIPs, source identification, available BMP technologies, and ease of implementation, in addition to the County's need to pay more towards its restoration debt service during the implementation phase of this WIP. This is the date that implementation will be expected to be completed; however, complete improvements in stream health (e.g., benthic macroinvertebrates) are expected to lag until the aquatic organisms repopulate the streams. In addition, the County already has several BMPs in the planning or design phase for the watershed, including stream restoration, outfall stabilization, street trees, reforestation, forest conservation, and a wet pond conversion.

The projected end date was developed using estimates of the number of acres of impervious area that could be treated each year. During that period, the County will implement several other watershed WIPs, creating competing priorities that could limit the pace at which restoration is accomplished in the Piscataway Creek watershed. Faster implementation would require additional funding, staffing, and industry resources (e.g., bioretention soils, and plants) sooner. The County is working with its watershed protection restoration program to increase the County's TMDL reduction rates. The County continues to research and evaluate innovative practices to help increase BMP efficiencies while lowering costs. Additional staff at the local level and close coordination with the state would be needed to review and approve BMP plans and permits in a timely manner to avoid slowed implementation. Throughout the implementation of this WIP, implementation uncertainties could emerge that will require adjustments to the plan.

Table 7-6. presents the estimated average annual number of impervious acres treated and the estimated load reductions by year from BMP implementation based on a steady implementation rate. There will be 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. In addition, the County reserves the right to focus on specific areas of the County for restoration and not implement in certain watersheds in a given year. Table 7-6. also presents the overall target milestone timeline for this restoration effort. The County will continuously monitor this schedule to assess ways to increase the rate of implementation and to ensure practices are implemented as planned. Progress on this WIP will be monitored annually in the County's MS4 annual report based on its 5-year permit milestones.

Restoration activities on the scale of this plan are difficult to estimate to the exact acres treated per year. WIPs are planning guides for the estimated level of effort that could be needed to meet reduction goals. The number of impervious acres to be treated every year will vary depending on funding, program capacity, and availability of sites. It is always the County's goal to exceed those estimates to speed up the restoration process. The County realizes that some efforts might be more successful than others and reserves the right to prioritize specific watersheds with higher load reduction requirements. For that reason, this WIP offers an adaptive management (Section 8.3) component to ensure issues are identified and addressed early. The County expects to reevaluate this plan every five years based on program capacity, funding, priority watersheds, staffing, and industry resources.

Table 7-6. Proposed WIP cumulative number of impervious area (acres) and load reductions based on steady implementation rate.

Fiscal Year	Impervious Acres Treated	Estimated Cumulative Budget (Based on unit costs in Table 6-1.)	Cumulative TSS (lb/year)
2025	32.31	$5,602,170	401,504
2026	64.62	$11,204,340	803,007
2027	96.93	$16,806,510	1,204,511
2028	129.24	$22,408,680	1,606,015

Fiscal Year	Impervious Acres Treated	Estimated Cumulative Budget (Based on unit costs in Table 6-1.)	Cumulative TSS (lb/year)
2029	161.55	$28,010,850	2,007,518
2030	193.87	$33,613,020	2,409,022
2031	226.18	$39,215,190	2,810,526
2032	258.49	$44,817,360	3,212,029
2033	290.80	$50,419,531	3,613,533
2034	323.11	$56,021,701	4,015,037
2035	355.42	$61,623,871	4,416,540
2036	387.73	$67,226,041	4,818,044
2037	420.04	$72,828,211	5,219,548
2038	452.35	$78,430,381	5,621,051
2039	484.66	$84,032,551	6,022,555
2040	516.98	$89,634,721	6,424,059
2041	549.29	$95,236,891	6,825,562
2042	581.60	$100,839,061	7,227,066
2043	613.91	$106,441,231	7,628,569
2044	633.27	$109,798,345	7,869,172

8 Tracking Progress, Monitoring Stream Health, and Conducting Adaptive Management

The County is required by its MS4 permit to:

> …[e]valuate and track the implementation of WIPs through monitoring or modeling to document the progress toward meeting established benchmarks, deadlines, and stormwater WLAs.

The County will fulfill this requirement by producing its annual MS4 report, annual countywide implementation plan, and environmental monitoring. The County intends to track its implementation of this WIP and evaluate how well its efforts improve the conditions in the County's surface waters and adjust its restoration activities accordingly. The County will use the data from tracking and monitoring efforts to inform its adaptive management of this WIP.

At the end of each 5-year NPDES permit term, the County will assess the effectiveness of the strategies and their impact on the TMDL goals and recommend adjustments to the plan for MDE review. This could include changing implementation strategies that may not yield results and redirecting funding to strategies that are demonstrated to be more effective.

The overall adaptive management approach for this WIP is provided in Figure 8-1. The approach follows a cyclic process of planning, implementing, monitoring, evaluating, and adjusting. Each of these has its own list of tasks. For example, implementation includes BMP installation, public education and outreach, and BMP O&M.

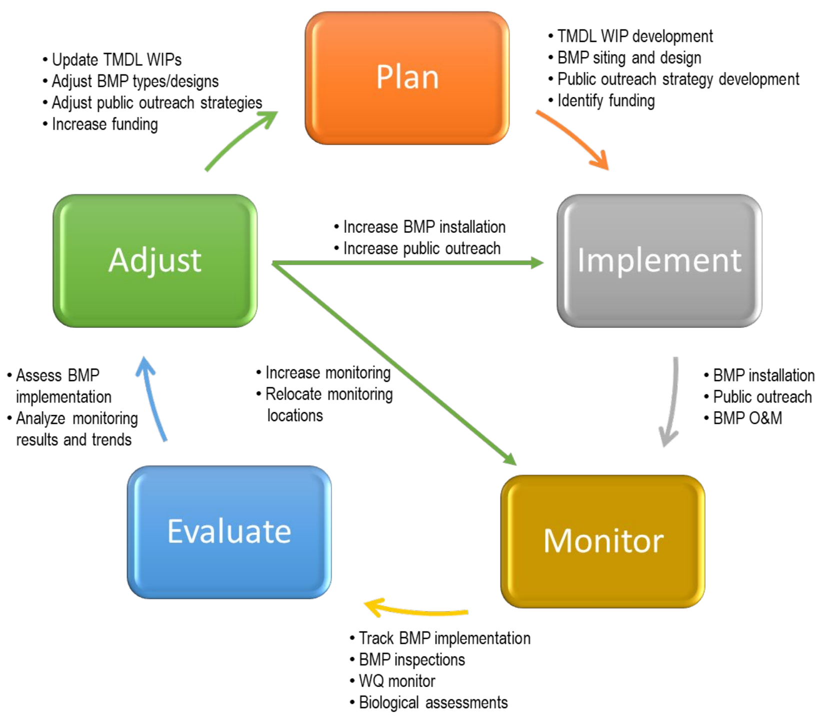


Figure 8-1. Generalized adaptive management approach.

8.1 Progress Tracking

The County's MS4 permit sets implementation goals for the permit term in terms of impervious acres treated over the 5-year permit term. To assess compliance with its permit, the County has a process to track and report impervious acres treated and pollutant load reductions. The County also reports the calculated load reductions using MDE's TIPP tool methodology, as per MDE's *Guidance for Developing Local Nutrient and Sediment TMDL (Total Maximum Daily Load) Stormwater Wasteload Allocation (SW-WLA) Watershed Implementation Plans (WIPs)* (MDE2022b), while also conducting watershed assessment monitoring. The County's annual MS4 report is the main mechanism for tracking permit activities and reporting them to MDE. While DoE is responsible for its submittal, it is a collaborative effort between the DPW&T and DPIE. The completed annual report and appendices are posted on DoE's stormwater management website.[9]

As specified in the County's permit, the annual report includes information about the County's BMP implementation, illicit discharge detection and elimination (IDDE), trash and litter control measures, public outreach and education initiatives, watershed assessments, and funding. It is the chief vehicle for tracking and reporting BMP implementation and programmatic initiatives. The annual report provides the following information:

- Estimated pollutant load reductions resulting from all completed structural and nonstructural water quality improvement projects and enhanced stormwater management programs. Load reductions will be calculated according to TIPP Tool methodology and data.
- Comparison of achieved load reductions to required load reductions by year to determine the degree to which the County is meeting its restoration goals (annual and total) or needs to adjust its programs to be more effective.

The annual report is accompanied by supplemental data about BMPs (including alternative practices such as stream restoration, septic system upgrades, and tree planting), funding, and water quality. Stormwater BMP data are provided in a georeferenced database. The database provides descriptive details for each BMP, including BMP type, project location, drainage area delineation, equivalent acres of impervious surface treated, maintenance records, year installed, and estimated load reductions. County staff update the database continuously with new and planned projects, which provides an indication if restoration is progressing as planned and allows for adjustments in future BMP implementation.

8.2 Monitoring Stream Health

The purpose of monitoring the conditions in the watershed is to determine the degree to which implementation of the WIP is resulting in the intended improvements. Past monitoring data (water quality, biological, geomorphic) can be compared to future monitoring data to show changes that can affect future restoration activities. This information is useful for project and BMP type selection, as it can provide insight into activities related to land use changes.

DoE recognizes that effective environmental monitoring requires a long-term commitment to routine and consistent sampling, measurement, analysis, and reporting. Although some of the

[9] https://www.princegeorgescountymd.gov/293/NPDES-MS4-Permit. Accessed June 2022.

monitoring requirements for assessing progress toward meeting TMDLs originate with MDE, others reflect the County's interest in providing additional meaningful information to policymakers and the public.

The County will continue evaluating options for its monitoring activities in consultation with MDE. Regardless of which monitoring activities are undertaken by the County, it will remain MDE's responsibility to perform the official monitoring for the state's Integrated Report assessments and impairment. MDE gathers monitoring data for every watershed in the state on a 5-year cycle.

8.2.1 Biological Monitoring

Biological indicators will continue to be used to document and report ecological conditions throughout the County. Other types of monitoring will contribute to understanding whether restoration activities are leading to the elimination, reduction, or otherwise more effective management of pollutants within the County. To ensure that the compiled data sets are accurate, monitoring is performed in accordance with a quality plan with standard operating procedures for sample collection. The County uses biological conditions as indicators of restoration activities. The data will be used to show overall changes in the watershed.

The biological condition of the County's streams is rated using MD DNR's BIBI, which is calculated based on the number of different kinds of organisms (benthic macroinvertebrates) found in samples taken along a stream section or reach. Because the types of organisms found reflect the cumulative influence of a variety of environmental factors, a low BIBI value alone is unlikely to point definitively to a pollutant or other stressor that should be reduced to improve the condition of the stream. Rather, the usefulness of the BIBI in the context of a stream restoration effort is that a sufficiently long record of BIBI values can be expected to reveal the overall effect of a broad restoration program aimed at eliminating, reducing, or otherwise managing known and potentially unknown stressors and their sources.

The County has been implementing biological monitoring since 1999. Sampling at each stream location encompassed benthic macroinvertebrate populations, physical habitat quality, and in situ water quality (pH, conductivity, temperature, and DO). Site locations were selected for each round using a stratified random process, where all wadeable, nontidal streams were stratified by subwatershed and stream order. Stream order designations (generally, first- through fourth-order) were based on the Strahler system of 1:100,000 map scale (Strahler 1957). Distribution of sample locations was more heavily weighted to smaller first- and second-order streams. The County started sampling round 5 in 2023 and it will run until 2025. For each subwatershed, the County will obtain a value for percent biological degradation from round 3, noting the intensity of impairment and any known or most probable sources of pollution or other stressors. It will then compare the percent degradation with the values found in round 5 to determine the direction and magnitude of changes.

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 the implementation of BMPs (and programmatic initiatives) so the County can adjust its restoration strategy, if needed.

The approach presented here assumes the continuation of routine, countywide monitoring of biological conditions for wadeable streams in round 5 and beyond, with potentially additional effort being applied to data analyses related to physical habitat characteristics, altered hydrology, and water chemistry. This not only provides insight into those stressors most likely causing biological degradation, but it also aids in identifying sources of stressors where additional restoration efforts would be beneficial.

8.2.2 Geomorphic Monitoring

The County is planning for future characterization and monitoring of fluvial geomorphic activity. This will focus on additional locations, as well as enhancing the calculation accuracy of (A) sediment yield and (B) nutrients (i.e., nitrogen, phosphorus). These enhancements will contribute to the DoE stream restoration crediting. The number and frequency of geomorphic surveys will increase, depending on budget constraints, to have a greater and more even coverage of the County and a frequency that will allow the County to be more immediately responsive to incremental changes in erosion rates as well as catastrophic bank failures. Initial thoughts on increased frequency are that monumented XS might be revisited every 3–5 years and could be done in a rotating basin design. The biomonitoring sites are selected using a stratified random approach but for channel erosion measures, it is likely more meaningful to have time-series data from fixed locations.

8.2.3 Water Quality Monitoring

Water quality monitoring is conducted to assess a set of upstream restoration practices. The 2022 MDE guidance for developing local TMDL nutrient and sediment WIPs includes suggested monitoring. Currently, the County does not have the resources to conduct watershed restoration and water quality monitoring at multiple locations. The County will consider targeted monitoring for TMDL compliance at the previous monitoring location as the County nears its load reduction goals. The County is enrolled in the pooled monitoring for BMP effectiveness as part of its NPDES MS4 permit requirements. Future monitoring will not be conducted at individual BMP sites to assess their effectiveness in reducing pollutant loads. Pollutant removal efficiencies have already been established for the proposed BMP types, so only new and innovative BMPs will need to be individually monitored to assess their load-reduction capabilities.

8.3 Adaptive Management Approach

This WIP was developed using the best information available at the time the plan was developed. As implementation progresses, adaptive management allows for adjustments to restoration activities as new information becomes available from the state or different stakeholders, and opportunities to increase effectiveness and reduce costs emerge. The County will use new information as it becomes available to assess the effectiveness of its restoration program and adjust as needed.

To address the nutrient and sediment load reduction targets, MDE issued Prince George's County a permit that focused on treating untreated impervious surfaces. The County NPDES permit requires restoration to be reported as equivalent impervious acres as the main measurement of progress. The County will evaluate and analyze TMDL plans for necessary updates on a 5-year cycle, coinciding with the NPDES permit cycle. Depending on the impairment type, WIP adjustments could increase or decrease the timeline for milestones based on County regulatory priorities and community needs. WIP revisions will include new documented data, updated science, and modeling tools.

It will be important for the County, MDE, and watershed partners to work together to ensure successful ongoing implementation. Close coordination is especially valuable for adaptive management because of the possibility of unanticipated circumstances arising during WIP implementation. For example, the installed BMPs might remove significantly more or less than the amount of pollution expected. A natural disaster could affect the plan's implementation. If BMPs are being implemented at a slower rate than is called for in the WIP, the adaptive management process will need to include a look at the causes of the lag in implementation and either address those causes or otherwise propose additional activities to compensate for the lag. Additional factors include the following:

- County factors: Budgets, restoration opportunities, and community buy-in on certain types of projects addressing environmental justice concerns.
- MDE factors: Approval of new technologies, models, tools, and science, which are continuously being developed and evolving.

Implementation lags can be caused by a lack of available land, delays in obtaining the necessary permits for constructing BMPs, being denied permission to build a BMP on private land, and lapses in funding. The County has a process to prevent many issues through initial project discussions and planning. Some implementation issues are not preventable (e.g., weather). In these cases, the County will work to develop contingency plans to keep watershed restoration on or ahead of schedule through adaptive management.

In addition, new BMP technologies are being researched that will help lower costs, decrease BMP footprints, and increase removal efficiencies. MDE and the Chesapeake Bay Program will need to approve the technologies and assign them removal efficiencies in a timely manner. In addition to having new BMP technologies approved, the County looks to MDE to continue issuing grant funding for stormwater restoration activities and to help perform water quality monitoring in high-priority County watersheds.

The County will evaluate the progress of this WIP implementation during its next permit cycle following this adaptive management approach. The evaluation will use an updated BMP inventory, new BMP technologies, experience with the new programmatic initiatives, and more recent water quality data. The evaluation could provide the County with the opportunity to remove practices from consideration that are expensive and show no water quality improvement. For this WIP, adaptive management will involve ongoing biological monitoring, evaluating applied strategies, assessing progress, and incorporating any useful new knowledge into further restoration activities.

Several aspects of this WIP support the use of adaptive management:

- Large portions of the County's inner Beltway development predate stormwater management regulation first established in the regulations in 1985 where greater than 85 percent of development already occurred. This makes watershed restoration challenging and costly, where the watershed needs to address upland BMPs to be installed, while also addressing stream erosion through armoring banks, thereby protecting impacted properties from further erosion. Adaptive management will be important to help these challenges so that this plan can undergo adjustments in the future.

- The County has a stormwater management ordinance that requires developers to install BMPs to offset the increased impervious area due to new construction.
- The County will use adaptive management to determine the most appropriate restoration practices at the best locations. This means that the County will look across land uses to determine where restoration projects will be most cost-effective in achieving pollutant load reductions. The County reserves the right to use alternative restoration activities if the opportunity arises and the alternative practices will produce greater load reductions or a similar load reduction at a lower cost.
- Part of the adaptive management strategy is to help reduce long-term costs while increasing load reduction. The County recognizes that future BMP-related research could result in new, more efficient pollution reduction technologies becoming available. These advances could decrease cost, decrease the footprints of the BMPs, or increase load reduction efficiencies. Some of the advances could come from proprietary technologies, which the County will evaluate based on their cost and performance.
- Using biological monitoring results, DoE can adjust implementation priorities and target areas of poor stream health. The biological assessment results will be interpreted at multiple spatial scales as Degraded/Not Degraded (for specific stream sites) and percent degradation (for sets of sites within subwatersheds and the watershed as a whole). 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 additional or more intensive stormwater management is necessary to achieve ecologically meaningful pollutant reductions.

In the future, climate change will play a role in watershed restoration and BMP implementation. The County is becoming more aware of the potential effects of climate change and its impact on BMPs. The EPA conducted a modeling study investigating the resilience of BMPs with the potential for more extreme precipitation events due to climate change (USEPA 2018). The study's results (*Improving the Resilience of Best Management Practices in a Changing Environment: Urban Stormwater Modeling Studies*) found that BMPs designed for current conditions will most likely fail to treat and reduce runoff from the larger and more intense storm events projected in future conditions. This failure could cause stormwater to overflow BMPs; thus, the BMPs would not treat all the runoff and would not reduce runoff volume reaching the County's water bodies. This could result in downstream channel erosion and flooding impacts. BMPs built with current design standards will require a larger temporary storage volume or reconfigured outlet structures to reduce the likelihood of flooding and channel erosion.

MDE is working to address flooding issues. In June 2021, the Stormwater Management Law was signed. This requires the MDE to perform several actions to help address flooding issues in the state. MDE is to collect and report the most recent precipitation data, investigate flooding events since 2000, and update the state's stormwater quantity management standards for flood control. MDE has started working with municipalities and will adopt new regulations in 2023. MDE is also creating a stormwater management climate change action plan with their *Advancing Stormwater Resiliency in Maryland (A-StoRM)* program. Climate change challenges will be handled through adaptive management and future assessments of WIP implementation.

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APPENDIX A: CURRENT STORMWATER MANAGEMENT PROGRAMS

A.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, IDDE, 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 to 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 (Capital Improvement Program [CIP] SWM Program).*** The SWM Program is responsible for performing detailed assessments of impairments to address stormwater management and existing water quality. It also is responsible for preparing design plans for and overseeing the construction of regional stormwater management facilities and water quality control projects. Those activities contribute to annual load reductions through improved planning and assessment and implementation of BMPs that reduce pollutant loading.
- ***Clean Water Partnership* (*CWP*).** The County recently initiated this program, which is a community-based public-private partnership, to assist in addressing the restoration requirements of the Chesapeake Bay WIP program. The CWP program initially focused on ROW runoff management in older communities, which are primarily inside the Capital Beltway. The program is expected to be responsible for providing water quality treatment for impervious land.
- ***Alternative Compliance Program.*** The Alternative Compliance Program, administered by DoE, allows tax-exempt religious and nonprofit organizations to receive reductions in their CWA Fee if they adopt stormwater management practices. The organizations have three options and can use any combination to receive the credits. The options are to (1) provide easements so the County can install BMPs on their property; (2) agree to take part in outreach and education encouraging 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, and so forth; and (3) agree to use good housekeeping techniques to keep their lots clean and to use lawn management companies certified in the proper use of fertilizers.

- ***Rain Check Rebate and Grant Program.*** The Rain Check Rebate and Grant Program, administered by the DoE, allows property owners to receive rebates for installing County-approved stormwater management practices. It was established in 2012 through County Bill CB-40-2012 and implemented in 2013. The County will reimburse homeowners, businesses, and nonprofit entities (including housing cooperatives and places of worship) 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 entering 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 CWA Fee if they maintain the practice for three years. Currently, rebates are capped at $6,000 for residential properties and $20,000 for nonprofit groups and residential, commercial, industrial, and institutional properties and nonprofit groups.

- ***Stormwater Stewardship Grant Program.*** Through the County's Stormwater Stewardship Grant Program, the Chesapeake Bay Trust currently funds requests for the construction of water quality improvement projects. The Trust also funds citizen engagement and behavior change projects implemented by various nonprofit groups, including homeowner associations (HOAs). Nonprofit organizations, municipalities, watershed organizations, education institutions, community associations, faith-based organizations, and civic groups can be awarded $50,000 to $150,000 for water quality projects and $50,000 to $100,000 for tree planting projects. Projects must complete on-the-ground restoration that will improve 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.
- ***Countywide Green/Complete Streets Program.*** 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 into DPW&T's capital improvement projects. The types of projects that can contribute to pollutant load reductions include ESD practices, tree shading, alternative pavements, and landscape covers.
- ***Erosion and Sediment Control.*** MDE has assigned the responsibility for conducting erosion and sediment control enforcement to the County. For new developments, this responsibility is assigned to DPIE. It involves conducting site inspections and providing Responsible Personnel Certification courses, which educate construction site operators to conscientiously manage disturbed land areas commonly found at construction sites. These

control measures prevent excess sediment entering County water bodies from active construction sites.

- ***Street Sweeping.*** The County conducts street sweeping operations on select arterial, collector, and industrial roadways. Residential subdivisions are swept on a request-only basis. Street sweeping can reduce the amount of debris, including sediment, that reaches waterways.
- ***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.
- ***Storm Drain Maintenance: Inlet, Storm Drain, and Channel Cleaning.*** These are systematic water quality-based storm drain programs that provide routine inspections and cleanouts of 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 major channels on a 3-year cycle. Additionally, the County performs storm drain vacuuming that removes sediments from the storm drain system.
- ***Storm Drain Stenciling.*** The Storm Drain Stenciling Program continues to raise community awareness and alert community members to the connection between storm drains and the Chesapeake Bay. 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.

- ***Illicit Connection and Enforcement Program.*** DoE conducts field screening and outfall sampling to detect and eliminate nonpermitted discharges from the County's MS4.

A.2 Tree Planting and Landscape Revitalization Programs

Significant hydrologic and water quality benefits accrue when localities convert urban land to forest. Tree planting typically occurs piecemeal across the urban landscape, whereas reforestation usually occurs on a much larger scale. In either case, to claim pollutant reduction credits from those plantings, a survival rate of 100 or more trees per acre is necessary, with at least 50 percent of the trees being 2 inches or more in diameter at 4.5 feet above ground level (MDE 2021a).

The pollutant load reduction credit for planting trees 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.

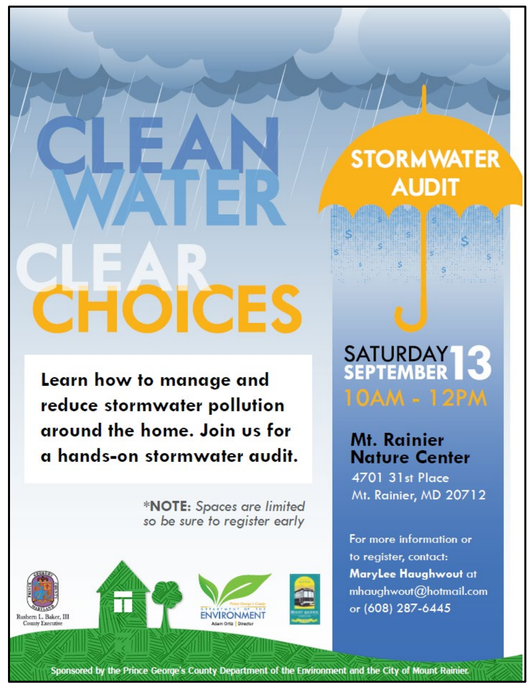
- ***Volunteer Tree Planting.*** DPW&T oversees volunteer tree planting in October of every year. Trees are planted by organizations (e.g., HOAs) in public spaces (e.g., parks and institutional areas). Approximately 2,000–2,500 trees are planted under the program every year.
- ***Tree ReLeaf Grant Program.*** DoE's Tree ReLeaf Grant Program is funded by fees-in-lieu; therefore, it only supports planting projects on public property. The program funds neighborhood, civic, and community/homeowner organizations; schools; libraries; and municipalities for tree and shrub planting projects in public spaces or common areas. The goals of the program include increasing the native tree canopy to improve air and water quality, conserve energy, and reduce stormwater runoff. Organizations can receive up to $5,000 under the program, and municipalities are eligible for grants up to $10,000.
- ***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 developing and implementing initiatives and projects designed to revitalize neighborhoods. The Neighborhood Design Center develops plans for parks, 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***. Arbor Day Every Day provides free trees to schools to plant and maintain on school grounds. This program educates students on the everyday importance of native trees, empowers them to enhance their community, and provides funds for planting projects.
- ***Tree Planting Demonstrations.*** The Sustainable Initiatives Division recently began a tree planting demonstration program to increase tree canopy and promote tree care.

A.3 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. At public outreach events, DoE staff provide handouts, answer questions, make presentations, promote programs, and display posters and real-world examples of stormwater pollution prevention materials (e.g., sample rain barrels and samples of permeable pavement). The County also has published a series of brochures to raise stormwater pollution awareness and educate the residential, business, and industrial sectors on their roles in preventing stormwater pollution. Topics include stormwater BMPs such as rain gardens, cisterns, and pavement removal.

Following 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.*** County staff support multiple outreach events to provide presentations, displays, and handouts; answer questions; and promote environmental stewardship. At these events, County staff provide information on the importance of trees and tree planting, stormwater pollution prevention, lawn care, Bayscaping (replacing turf with plants native to the Chesapeake Bay region), and trash prevention and cleanup.
- ***Stormwater Audit Program.*** DoE conducts stormwater audits on residential properties. During the audits, County staff walk a property with the homeowner and make suggestions on the most appropriate types and potential locations for stormwater BMPs.



- ***Master Gardeners.*** Master Gardeners are volunteer educators who provide horticultural education services to individuals, groups/ institutions, and communities. The program's mission 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 the overall reduction of fertilizer and pesticide use as well as promote increases in stormwater practices such as installing rain gardens and using rain barrels.
- ***Flood Management.*** 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 encouraging 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.

APPENDIX B: BMP REMOVAL EFFICACIES

MDE's *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (MDE 2021a) incorporates recent Chesapeake Bay Program recommendations for sediment load reduction removal efficiencies associated with implementing BMPs. This information is incorporated into their TIPP Tool (MDE 2022c). By using those removal efficiencies in its reduction calculations, the County is consistent with regional efforts to meet the Chesapeake Bay TMDL.

Pollutant removal efficiencies were calculated by runoff depth treated and are provided in Table B-1. MDE (2021a) separates BMPs into three broad classes—runoff reduction (RR), stormwater treatment (ST), and alternative BMP practices (ALT). RR practices reduce pollutants through infiltration interception by vegetation and adsorption by soil (e.g., bioswales and permeable pavement). ST practices reduce pollutants through filtration or settling (e.g., sand filters and wet ponds). RR practices have a higher level of pollutant removal than ST practices because of their removal mechanisms. ALT practices are restoration activities such as stream restoration. For RR and ST practices, the removal efficiency increases as more runoff volume is treated. The table also illustrates that RR practices consistently reduce pollutant loads at a higher efficiency than structural practices at all treatment volumes. The RR curves should be used in locations where RR practices are used or other acceptable RR practices predominate. Otherwise, the ST practice curves should be used. If a BMP did not have a reported runoff depth treated, it was assumed to be 0.5 inches.

Table B-1. Pollutant removal rates for 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	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%

Source: MDE 2021a.

Typical RR practices include:

- Bioretention
- Bioswale

- Dry swale
- Dry well
- Enhanced filter
- Grass swale
- Green roof
- Landscape infiltration
- Micro-bioretention
- Permeable pavements
- Rain gardens
- Rainwater harvesting
- Reinforced turf
- Wet swale

Typical ST practices include:

- Extended detention–wetland
- Extended detention structure, wet
- Micro-pool extended detention pond
- Pocket pond
- Pocket wetland
- Retention pond (wet pond)
- Infiltration basin
- Infiltration trench
- Sand filter
- Shallow marsh
- Submerged gravel wetlands
- Underground filter

Table B-2 presents the pollutant reduction efficiency of several ALT practices, including stream restoration (for which the load reduction efficiencies are only for planning purposes). Once the stream restoration projects are installed, the County will use the approved protocols—based on design and field measurements—to determine their actual load reductions.

Table B-2. Pollutant removal efficiencies of selected alternative BMPs.

BMP Type	Units	TSS Removal
Stream restoration (planning only)	lb/ft/yr	248
Outfall stabilization (planning only)	lb/ft/yr	248
Shoreline management (planning only)	lb/ft/yr	328
Impervious surface reduction (imp. to turf)[a]	lb/ac/yr	3,590
Forest planting (turf to forest)[a]	lb/ac/yr	1,409
Street trees (imp. to tree canopy over imp.)[a]	lb/ac/yr	529
Urban tree canopy planting (turf to tree canopy over turf)[a]	lb/ac/yr	101
Riparian forest planting (turf to forest) [a]	lb/ac/yr	2,342

Source: MDE 2021a.
Notes:
lb/ac/yr = pound per acre per year; lb/ft/yr = pound per foot per year.
[a] Varies by major watershed based on land use loading rates.

APPENDIX C: BMP IDENTIFICATION AND SELECTION

C.1 BMP Identification and Selection

The MDE 2000 *Stormwater Design Manual* provides guidance for designing several types of structural BMPs, which include wet ponds, wetlands, filtering practices, infiltration practices, and swales (MDE 2009). MDE also describes nonstructural BMPs that include programmatic, educational, and pollution prevention practices that work to reduce pollutant loadings. Examples of nonstructural BMPs include diverting stormwater from impervious to pervious areas, street sweeping, and homeowner and landowner education campaigns (MDE 2009). Additionally, the County will use the MDE's *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated: Guidance for National Pollutant Discharge Elimination System Stormwater Permits* (MDE 2021a).

Figure C-1 presents conceptual art of an urban area with a variety of practices. It includes some practices not specifically mentioned in the plan, but that could be incorporated into the County's overall strategy.

Credit: EPA Office of Wetlands, Oceans and Watersheds.

Figure C-1. Conceptual urban area with ESD practices.

C.1.1 Urban Stream Restoration

Urban impacts on streams typically include bank and channel erosion, stream health degradation, and loss of natural habitat. Multiple techniques for restoring a stream can be used to mimic the natural state of the stream, provide stability to the channel bed and banks, and improve stream health and habitat in nontidal areas. Various kinds of in-stream structures can be used to restore the main channel by providing stable flow steering and energy dissipation as well as creating pools where natural habitats can develop. In addition to in-stream structures, the increase in riparian vegetation can help to stabilize stream banks, further reducing in-stream erosion in high-velocity areas. The County recently completed a major stream restoration project (7.7 miles) in the upper reaches of the Tinkers Creek subwatershed. This project removed 2,000 tons of sediment. The County is planning another 2.7 miles of stream restoration and outfall stabilization in the watershed, with an estimated sediment removal of over 1,500 tons.

C.1.2 Outfall Stabilization

Storm drainage systems in the County terminate at outfall structures that usually discharge to surface drainage features such as channels or streams. The outfall structures are often the initial source of stream erosion and degradation because they are the delivery point for the increased runoff from impervious areas. As the stream channel erodes and downcuts, it often undercuts the outfall structure, resulting in outlet failure. Outfall stabilization typically involves repairing localized areas of erosion below a storm drainpipe and addressing structural and functional problems associated with exposed infrastructure. Because the failing outfalls actively contribute to stream erosion and sediment generation, they present many restoration opportunities. Many outfalls have been in place for 50 years, and the County should inspect and prioritize old and failing previously installed outfalls to prevent sediment releases in the watershed. As part of their regular maintenance, the DPW&T storm drain division inspects and evaluates outfalls to determine their condition for potential improvements and repairs.

C.1.3 Structural Practices

The County will consider opportunities to implement BMPs on all types of land uses, wherever there is a need to provide treatment to currently untreated impervious surfaces. Some BMPs are better suited to certain land uses than others, and this section discusses examples of those land uses and their primary corresponding but nonexclusive BMPs. The County will also look for BMPs upstream from the ongoing stream restoration project to help reduce flow and future erosion in the restored stream.

C.1.3.1 Rights-of-Way

The County owns and maintains ROWs, which are public space along streets and roadways. They contribute to the impervious runoff impact and represent a high-priority area for restoration and will be a major focus of the County watershed restoration efforts. If opportunities to implement BMPs in ROW areas present themselves, possible retrofits for different types of ROW are available (Table C-1).

Table C-1. Potential BMP types per urban road ROW 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
Curbside filter systems		X	X		X
Curb extension with bioretention or bioswale		X	X		X

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
Curb cuts to underground storage/infiltration or detention device		X	X		X
Grass swales and bioswales				X	
Green street (bioretention or bioswales) to convert an ROW				X	X
Infiltration trenches with underdrains				X	

C.1.3.2 Institutional Land Use

Existing institutional land uses also offer opportunities for BMP retrofits. The land uses include County and nonprofit organization properties such as schools, libraries, places of worship, parks, government buildings, fire and police stations, and hospitals. The County has implemented the Alternative Compliance Program, administered by DoE, which allows nonprofit organization property owners to reduce their CWA Fee by installing approved stormwater management practices. Most of the properties have substantial areas of impervious cover, including rooftops, driveways, and parking areas, that offer opportunities for cost-effective retrofits. A BMP retrofit matrix can be applied to these sites based on impervious cover type (Table C-2). The retrofit matrix will help in the selection process and identify practical and feasible practices that offer the highest pollutant removal at the lowest cost.

Table C-2. Typical impervious area BMP retrofit matrix for institutional property.

BMP Description	Impervious Cover Elements				
	Roofs	Driveways	Parking	Sidewalks	Other[a]
RR practices					
Permeable pavements		X	X	X	X
Rainwater harvesting	X				
Submerged gravel wetlands			X		
Landscape infiltration	X	X	X		X
Dry wells	X				
Bioretention / rain gardens / swales		X	X		X
Enhanced filters	X	X	X	X	X
ST practices					
Wet ponds/wetlands			X		X
Infiltration practices[b]			X		X
Filtering practices		X	X	X	X
Tree planting and reforestation					
Impervious urban to pervious		X	X		X
Planting trees on impervious urban		X	X		X

BMP Description	Impervious Cover Elements				
	Roofs	Driveways	Parking	Sidewalks	Other[a]
Other					
Disconnection of rooftop runoff	X				
Disconnection of nonrooftop runoff		X	X	X	X
Sheet flow to conservation areas		X	X		

Notes:
[a] Includes miscellaneous other impervious surfaces (e.g., basketball courts, tennis courts, patios).
[b] Considered ST unless designed according to Section VI of MDE 2021a.

C.1.3.3 Commercial/Industrial Land Use

Much like institutional properties, commercial and industrial properties are characterized by large areas of impervious cover, including roofs, driveways, parking lots, and other paved areas. From a technical standpoint, the opportunities for implementing a variety of BMPs in those areas are similar to the opportunities in institutional areas (Table C-2). However, most of the commercial and industrial facilities are privately owned. Consequently, the County has limited influence on the use of BMPs in those areas except along the public roads that serve them. The Rain Check Program currently offers financial incentives for property owners to implement approved stormwater management practices. Property owners can benefit through rebates, grants, or a reduction in a portion of their CWA Fee.

C.1.3.4 Residential Land Use

Residential areas comprise roughly 31 percent of the watershed and have varying amounts of impervious cover, such as roofs, driveways, walkways, and patios. Many of the practices in Table C-2 can be used on residential land. The most common practices for individual homeowners are permeable pavement, rooftop disconnection, rainwater harvesting (e.g., rain barrels), landscape infiltration, rain gardens, and planting trees. For row houses, the most common practices are likely permeable pavement (on sidewalks leading to houses and alleyways), rooftop disconnection, rainwater harvesting (e.g., rain barrels), and rain gardens. Apartment and condominium communities could install any of the practices listed in Table C-2.

It is difficult to implement BMPs on residential properties, however, because they are privately owned. As with commercial and industrial property owners, the Rain Check Program offers financial incentives for residential property owners to implement approved stormwater management practices. Additionally, the County could explore opportunities to provide further education and awareness outreach on residential BMPs to help property owners learn about their benefits.

C.2 Prioritizing BMP Locations

The location of a BMP or other restoration practice significantly impacts how successful the restoration will be. For instance, a lawn care campaign will have little effect in areas with few homeowners to implement the strategy. In identifying the best locations for BMPs, the County will consider sites where the most significant water quality benefits will be realized for available funding, and the BMPs can be installed in a desirable time frame with minimal disruption. Three main considerations for prioritizing BMP locations are land ownership and site access, location in the stream watershed, and locations of known issues and existing treatment.

C.2.1 Land Ownership and Site Access

DoE and CWP are actively installing BMPs countywide. The most suitable locations to install BMP practices are municipally owned land such as town halls, police stations, public schools, libraries, and the ROWs or easements along roads and stormwater outfalls. For example, the County has site access to stormwater outfalls (usually available as flood easements), which allows the County to proceed without the delays that would sometimes result from negotiating with private landowners—this accelerates implementation and reduces the resources spent on interacting with landowners.

In some instances, the County is granted permission from a property owner to install a BMP on their property. For example, the County's Alternative Compliance Program provides incentives to faith-based and other nonprofit organizations to allow the County to install BMPs on their properties. The organizations are granted credit toward their CWA Fee. The aesthetics of a restoration project are often preferred to the condition of the site before the BMP was installed. Attractive examples of watershed restoration efforts can be used in an outreach effort to encourage property owners to grant access to their own properties. A public education campaign highlighting those examples can build public support for implementing BMPs on private properties.

C.2.2 Location in the Watershed

Another factor to consider in BMP placement is how close the location is to the stream headwaters. Improvements to water quality and stream stability in stream headwaters will provide benefits along the entire length of the stream. Restoring downstream reaches first, on the other hand, will later expose the restored reaches to sediment from upstream, increasing the risk that the restored channel will fail because of the fresh sediment deposits. Water quality improvement projects that address excess sediment from stream erosion are most appropriately placed in smaller headwater (first- and second-order) subwatersheds. Adding BMPs to headwaters above stream restoration projects will help protect the stream reaches that have been restored. Restoring conditions in the headwaters makes it easier to detect and attribute the water quality improvements to each restoration project because the complexity of factors that could be affecting water quality tends to decrease with drainage area.

C.2.3 Locations of Known Issues and Existing Treatment

A third key consideration in determining where to place BMPs includes identifying known areas of erosion and poor biological health and locating treatment practices that are in place but still need to be adequately implemented. Figure 3-7 shows the biological narrative ratings for the watershed. The contributing drainage areas to locations that were rated as Poor or Very Poor should be targeted for upland restoration. Table 3-2 presents the results of geomorphic assessments in the watershed. This information can be used in combination with the information from Figure 3-13, which presents the known stream and outfall erosion areas. These locations can be targeted for stream restoration, outfall stabilization, and upland measures to reduce the amount of flow (and sediment) entering the stream.

APPENDIX D: FUNDING

D.1 Budget Funding

Funding refers to sources of revenue used to pay for annual operating expenditures, including maintenance and administrative costs; pay for management activities directly out of current revenues; and repay debt issued to finance capital improvements projects.

D.1.1 Sources of Funding

The County has relied mainly on stormwater bonds, general obligation bonds, federal and state grants, and the State Revolving Fund to pay for the stormwater CIP, including watershed restoration projects. The County's Stormwater Enterprise Fund pays for debt service on the bond sales and agency operating costs.

In 2013, the County enacted a CWA 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 WIPs, and the NPDES MS4 permit (independent of the ad valorem tax and General Fund). The CWA 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 collects 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.

Most stormwater restoration funds are from the CWA Fee, stormwater ad valorem tax, and CIP budget. Federal, state, or other grants are expected to provide a minor but essential contribution to funding. The ad valorem tax is based on property assessment, which will vary annually, and supports the DPIE's development process and DPW&Ts long-term stormwater management maintenance program. The County has successfully obtained various grants in the past and expects that trend to continue. The County will continue to 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 and nonprofits) to identify and apply for grant opportunities.

The County expects current Stormwater Enterprise Fund sources and funding levels to remain consistent with the County's biannual FAP, expected to reoccur over the life of this WIP. The countywide dollars for restoration average no more than $70 million per year for all stormwater restoration. The available funding will need to compete across multiple local WIPs, including the Chesapeake Bay WIP; however, many of the activities in the WIP can be counted toward local WIPs. As part of its NDPES permit requirements, the County updates and submits its 2-year FAP to MDE for review. The FAP includes planned restoration projects of 5-year periods and the funding commitment for the next two fiscal years. The most recent plan approved by County Resolution is for FY 2023 and FY 2024. The County has created a new in spring 2025.

D.1.2 Budget for Restoration Activities

The stormwater CIP contains project construction budget projections for the next six years for the entire county. For countywide watershed or water quality restoration projects, the County primarily relies on two CIP projects: the CWP Project and NPDES MS4 Permit Compliance and Restoration. Other stormwater CIP projects include funding appropriation for restoration activities.

Table D-1 provides a list of countywide stormwater CIP projects included in the County's FAP that include aspects of watershed restoration, a portion of which are available for projects in the Piscataway watershed. The projects generally fund new watershed restoration activities or rehabilitation of existing assets to improve water quality. Specific watershed restoration projects or locations are not listed. However, the County maintains a project list that is used to determine the proposed funding. Once this WIP is completed, the County will start incorporating proposed restoration scenarios subject to funding availability.

The County's stormwater CIP budget has, in the past, appropriated up to $50 million per year for countywide watershed or water quality restoration activities. For current funding capacities, the County typically prioritizes programs and shifts funding between watersheds. By doing so, the County can prioritize and shift year-to-year load reduction goals between watersheds; however, the County aims to achieve the targeted completion dates.

Table D-1. FY 2023 to FY 2028 FAP budget for countywide stormwater management projects.

CIP ID	Project Name	Project Class	Total FY23–FY28 Budget ($000)
5.54.0016	Bear Branch Subwatershed	Rehabilitation	$7,439
5.54.0018	Clean Water Partnership NPDES/MS4	Rehabilitation	$99,961
5.54.0019	MS4/NDPES Compliance & Restoration	Rehabilitation	$115,351
5.54.0006	Participation Program Countywide	New construction	$3,000
5.66.0002	Stormwater Management Countywide Restoration	Rehabilitation	$47,138
5.66.0004	Stormwater Structure Restoration and Construction	New construction	$45,500

Source: Prince George's County 2022.
Note: $000 = Dollars in thousands.

APPENDIX E: PUBLIC OUTREACH AND INVOLVEMENT

The County recognizes that involving the public in planning and implementing restoration is important to the success of its stormwater management efforts. It welcomes any ideas citizens have to improve the restoration process, recognizing that the people who live and work in the watersheds are most familiar with them. They can act as the eyes and ears of the County on a day-to-day basis to identify water quality issues, pollutant spills, or potential BMP opportunities. Residents can stay informed on the County's progress through the annual MS4 report to MDE, which is posted on the County's website and contains information on BMP implementation, public outreach events, and other County programs that can help meet TMDL goals. In addition, the County welcomes public input on restoration activities and potential BMP types or locations.

Besides staying informed, homeowners, nonprofit organizations, and business associations can play a more active role in the restoration process. Residents can take a pledge to clean up after their pets and practice environmentally friendly lawn care. In addition, the public can participate in the Rain Check Rebate and Tree ReLEAF Grant Programs and nonprofits can participate in the Alternative Compliance Program. Private landowners and nonprofit organizations can aid in restoring the watersheds by installing BMPs (e.g., rain barrels, rain gardens, permeable pavement) on their properties to help minimize their impact on the overall pollution loading to the County's water bodies. Installing BMPs on private property reduces the owner's CWA Fee. Although those practices might seem insignificant, the overall load reductions can be significant if enough private landowners get involved. Organizations such as HOAs, neighborhood associations, and business organizations can also help by promoting the programmatic initiatives outlined in this WIP.

DoE has initiated a wide range of initiatives to inform County residents about the impacts their daily activities have on the health of their watershed and local water bodies. During FY 2019, the County hosted more than 500 events to promote environmental awareness, green initiatives, and community involvement in reducing the amount of pollution entering the County's waterways, during which nearly 33,000 members of the public participated (DoE 2019). DoE's outreach and educational programs encourage volunteerism and environmental stewardship among community organizations, businesses, and citizens. Under DoE's Sustainability Division, the Natural Resource Protection & Stewardship Programs Section (Programs Section) is the lead office managing and administering most of the education and outreach initiatives described in this section.

Current outreach programs are discussed in Appendix A. Beyond those targeted efforts, the County will work with watershed partners to ensure the public is informed of implementation progress and that active public involvement is pursued throughout the process.

E.1 Outreach to Support Implementation Activities

The County's outreach efforts continue to specifically target TMDL pollutants and pollutant-generating behaviors. Over the past several years, the Programs Section has sponsored the following activities and projects to target TMDL pollutants and encourage the adoption of pollutant-reducing behaviors:

- ***Inventory of Environmental Outreach Programs in and around Prince George's County***. The Programs Section inventoried existing local programs (e.g., nonprofits and educational institutions) that are working toward shared goals of environmental stewardship or stormwater pollution reduction and already have ongoing or planned outreach efforts in and around the County. This was done to identify potential outside partners and overlapping programs/efforts. The Programs Section researched which programs and materials have been successful and are available to share and cross-market to target audiences.
- ***Audience Research Analysis: A Review of Target Audience Characteristics in Prince George's County for a Stormwater Outreach Strategy.*** The County is made up of a diverse population in terms of age, race, culture, language, education, and income. As a result, the Programs Section analyzed U.S. Census data and secondary research to gain an understanding of the potential target audiences and their specific characteristics as well as possible barriers to environmental messages (e.g., lack of homeownership, native language, age, household economics). This analysis helped determine the best way to reach diverse groups and identify different messaging and methods that would resonate with target audiences.
- ***Priority Watersheds Analysis***. The County has nine major watersheds, each with different water quality concerns. The Programs Section identified location-specific outreach needs based on water quality priorities and areas where the County should target its outreach efforts. Coupled with the Audience Research Analysis, this analysis recommended target locations and audiences for developing topic-specific outreach campaigns (e.g., pet waste and lawn care).
- ***Prince George's County Stormwater Outreach and Engagement Strategies***. The Programs Section developed seven individual campaign strategies: pet waste disposal, increasing the tree canopy, stormwater management and implementation, antilittering, lawn stewardship, household hazardous waste, and residential car care. Each campaign included goals, target audiences, priority locations, key messages, delivery techniques (e.g., events, materials, trainings, social media, developing and promoting programs), metrics, potential partnerships, and priority neighborhoods. The campaigns also included slogans and messages on what citizens should be doing (e.g., using fertilizer only if soil tests dictate a need) and not be doing (e.g., spilling fertilizer on driveways). The Programs Section is using these outreach and engagement strategies to plan and implement programs, events, and other efforts to encourage residents to adopt pollutant-reducing behaviors.
- ***Enhancing and Growing Partnerships***. The County's numerous partnerships with groups such as Master Gardeners, Chesapeake Bay Trust, and the University of Maryland Environmental Finance Center continue to be fostered and supported so that outreach efforts piggybacking on the efforts undertaken by those groups can continue to grow. In addition, new partnerships with groups such as landscapers, nursery suppliers, HOAs, and local boy scout or girl scout groups help broaden stormwater outreach and reach citizens who have not been reached in the past.

Although the results of outreach and involvement efforts are difficult to quantify in terms of pollutant reductions, these activities make a difference by slowly changing the mindsets and behaviors of County residents over time.

E.2 Public Involvement to Support Implementation Activities

Community organizations and citizen groups can participate in restoration activities by getting involved in local nonprofit groups with which the County is currently partnering. This section lists ways County residents and organizations can stay informed and help promote pollutant-reducing behaviors. These activities will also reduce the demand on the County's resources and staff's limited time.

- **Learn about County programs that promote tree plantings, cleanup events, and community awareness**. The Programs Section manages numerous programs in which citizens can get involved and promote pollutant-reducing behaviors. Residents can either organize or participate in volunteer efforts by working with their civic associations or schools or one-on-one with property owners. The public can visit the Community Outreach web page at https://www.princegeorgescountymd.gov/departments-offices/environment/sustainability/community-outreach for more information on the Programs Section programs and how to contact the County. Appendix A for details about the County's tree planting and landscape revitalization programs. Other volunteer programs included:
  - **Volunteer Neighborhood Cleanup Program** provides interested communities with technical assistance and materials such as trash bags, gloves, and roll-off containers (depending on availability). The public can visit the website at https://www.princegeorgescountymd.gov/464/Volunteer-Neighborhood-Cleanup-Program.
  - **Volunteer Storm Drain Stenciling Program** helps spread the word to prevent water pollution by stenciling/inlet marking the storm drains in neighborhoods with "Don't Dump – Chesapeake Bay Drainage." Stenciling serves as a visual reminder to neighbors that anything dumped in the storm drain contaminates the Chesapeake Bay. The Programs Section provides the supplies and helps design a storm drain stenciling/inlet marking project that can be accomplished with any size team or age group at https://www.princegeorgescountymd.gov/465/Volunteer-Storm-Drain-Stenciling-Program.
- **Apply for grants to implement projects through the Chesapeake Bay Trust**, which manages the Rain Check Rebate and Stormwater Stewardship programs as well as the Litter Reduction and Citizen Engagement Mini Grant. See Appendix A for details on the Rain Check Rebate and Stormwater Stewardship programs. The public can find more information about the grants at https://cbtrust.org/grants/.
  - **Litter Reduction and Citizen Engagement Mini Grants** support efforts that engage and educate residents, students, and businesses on ways to make their communities cleaner and greener. Up to $2,500 can be awarded to HOAs and nonprofits to develop and implement projects such as community cleanups, "Adopt-a-Stream" projects to remove litter from a local stream, and storm drain stenciling.
- **Stay informed**. The County provides numerous ways for residents to stay informed about community events, trainings, emergencies, and County news:
  - **Monitor the County's social media accounts** to become aware of trainings and community events that promote environmental education and include opportunities to provide feedback to the County. See the County's accounts at Facebook (PGC

Department of the Environment), Twitter (PGC Environment @PGCsprout), and Instagram (pgcsprout).

  - **Monitor the County's website** to view information about upcoming events, meetings, recent news, and details about the County's programs at https://www.princegeorgescountymd.gov/.
  - **Sign up to receive "Alert Prince George's"** to receive emergency alerts, notifications, and updates to registered devices. Example notifications include traffic conditions, government closures, public safety incidents, and severe weather. More information is available at http://www.princegeorgescountymd.gov/794/Alert-Prince-Georges.

- **View the Clean Water Map,** an interactive tool to help the community stay informed about the health of County waters and know where restoration efforts are taking place. Residents can view BMPs, BMP drainage areas, and locations of activities such as Rain Check Rebates and Stormwater Stewardship Grants at https://princegeorges.maps.arcgis.com/apps/webappviewer/index.html?id=dc168a43d3554905b4e4d6e61799025f.
- **Provide feedback**. The County heard through numerous outreach and engagement events that several citizens and watershed groups want to provide information and feedback about on-the-ground support for BMP implementation projects, programmatic initiatives, and other outreach efforts to support implementation. Ways to provide this feedback include:
  - **Attend a public involvement meeting.** The County holds public outreach and involvement meetings as part of restoration planning efforts and other programs. At these meetings, residents can suggest specific locations for biological or water quality monitoring activities to be carried out based on surrounding land uses/ changes, historical water quality problems, or public desires. The County also welcomes suggestions on potential BMP types or locations so that the County can help communities identify and install the best BMPs for specific areas.
  - **Use County Click 3-1-1.** A call center (available weekdays from 7 a.m. to 7 p.m.) and website application (download CountyClick311Mobile) allow County residents to request services or report problems. This tool could be used to report on visual inspections of installed BMPs and is available at www.countyclick311.com.
- **Help foster partnerships.** Residents and civic and environmental groups can work directly with an organization or commercial business with a significant amount of untreated impervious surface, such as large parking lots or a large building footprint. The groups can help obtain a commitment from the business to participate in the Rain Check Rebate Program or Alternative Compliance Program, or they can 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 before working with the property owner. Groups can also work with established organizations such as the Alice Ferguson Foundation (https://fergusonfoundation.org/) to participate in cleanup events or provide volunteer hours.
- **Become educated through partner trainings and events**. Numerous organizations in Prince George's County always need volunteers. They also provide meaningful education

programs in which participants learn about the issues through hands-on educational experiences. Those organizations include:

- **Watershed Stewards Academy** equips and supports community leaders to recognize and address local pollution problems in their nearby streams and rivers. They provide community leaders with the tools and resources they need to bring solutions to those problems, restoring their local waterways and the communities they affect. More information is available at http://extension.umd.edu/programs/environment-natural-resources/program-areas/watershed-protection-and-restoration-program/watershed-stewards-academy/.
- **Alice Ferguson Foundation** has training and outreach events to unite students, educators, park rangers, communities, regional organizations, and government agencies throughout the Washington, DC, metropolitan area to promote the environmental sustainability of the Potomac River watershed. More information is available at https://fergusonfoundation.org/.
- **Anacostia Watershed Society** has numerous educational programs, river restoration programs, and community events. More information is available at https://www.anacostiaws.org/.