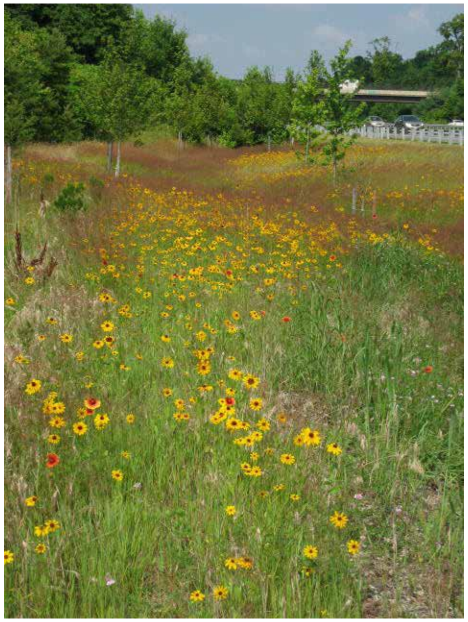
MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

# Patuxent River Segmentsheds PCB TMDL Implementation Plan

**PUBLIC REVIEW DRAFT** August 10, 2018



MDOT MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

# OPPORTUNITY FOR PUBLIC REVIEW AND COMMENT

***DRAFT IMPLEMENTATION PLAN FOR THE***
***TOTAL MAXIMUM DAILY LOAD (TMDL) OF POLYCHLORINATED BIPHENYLS IN THE***
***PATUXENT RIVER MESOHALINE, OLIGOHALINE AND TIDAL FRESH CHESAPEAKE BAY SEGMENTS***

The Maryland Department of Transportation State Highway Administration (MDOT SHA) was issued a National Pollutant Discharge Elimination System Municipal Separate Storm Sewer System (MS4) Permit, (Permit No. 11-DP-3313), by the Maryland Department of the Environment (MDE) on October 9, 2015. This permit covers stormwater discharges from the storm drain system owned or operated by MDOT SHA within Anne Arundel, Baltimore, Carroll, Cecil, Charles, Fredrick, Harford, Howard, Montgomery, Prince George's, and Washington Counties. The permit requires MDOT SHA to submit an implementation plan to MDE that addresses Environmental Protection Agency (EPA)-approved stormwater waste load allocations (WLAs) within one year of EPA approval.

EPA approved the ***Total Maximum Daily Load of Polychlorinated Biphenyls in the Patuxent River Mesohaline, Oligohaline and Tidal Fresh Chesapeake Bay Segments*** on September 19, 2017. The MDOT SHA Office of Environmental Design (OED) is soliciting comments on its draft Implementation Plan to meet this WLA as required under the MS4 Permit. A 30-day public comment period will take place from August 10, 2018 to September 10, 2018. The draft Implementation Plan is available on MDOT SHA's website at http://www.roads.maryland.gov/Index.aspx?PageId=362.

Comments should be submitted to MDOT SHA **on or before September 10, 2018** by emailing to wpd@sha.state.md.us, faxing to (410) 209-5003, or mailing to:

Maryland Department of Transportation
State Highway Administration
Office of Environmental Design, C-303
707 N. Calvert Street
Baltimore, MD 21202

Please note that comments should include the name and address of the person submitting the comments. Responses to comments will not be provided directly, but material comments received during the comment period will be considered and the draft Implementation Plan will be revised as appropriate prior to submittal to MDE. A summary of comments received will be included in the MDOT SHA MS4 annual report submitted to MDE annually on October 9 and posted to this website: http://www.roads.maryland.gov/Index.aspx?pageid=336.

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# PATUXENT RIVER SEGMENTSHEDS PCB TMDL IMPLEMENTATION PLAN

## A. WATER QUALITY STANDARDS AND DESIGNATED USES

TMDLs focus on offsetting the impacts of pollutants to waterway designated uses. The Federal Clean Water Act (CWA) established requirements for each state to develop programs to address water pollution including:

- Establishment of water quality standards (WQSs);
- Implementation of water quality monitoring programs;
- Identification and reporting of impaired waters; and
- Development of maximum allowable pollutant loads that when met and not exceeded will restore WQSs to impaired waters, called TMDL documents.

WQSs are based on the concept of designating and maintaining specifically defined uses for each waterbody. **Table 1** lists the designated uses for waterways in the State of Maryland. TMDLs are based on these uses.

One means for the EPA to enforce these standards is through the NPDES program, which regulates discharges from point sources. MDE is the delegated authority to issue NPDES discharge permits within Maryland and to develop WQSs for Maryland including the water quality criteria that define the parameters to ensure designated uses are met.

*Table 1: Designated Uses in Maryland*

| | Use Classes | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Designated Uses** | **I** | **I-P** | **II** | **II-P** | **III** | **III-P** | **IV** | **IV-P** |
| Growth and Propagation of Fish (not trout), other aquatic life and wildlife | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Water Contact Sports | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Leisure activities involving direct contact with surface water | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Fishing | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Agricultural Water Supply | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Industrial Water Supply | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Propagation and Harvesting of Shellfish | | | ✓ | ✓ | | | | |
| Seasonal Migratory Fish Spawning and Nursery Use | | | ✓ | ✓ | | | | |
| Seasonal Shallow-water Submerged Aquatic Vegetation Use | | | ✓ | ✓ | | | | |
| Open-Water Fish and Shellfish Use | | | ✓ | ✓ | | | | |
| Seasonal Deep-Water Fish and Shellfish Use | | | ✓ | ✓ | | | | |
| Seasonal Deep-Channel Refuge Use | | | ✓ | ✓ | | | | |
| Growth and Propagation of Trout | | | | | ✓ | ✓ | | |
| Capable of Supporting Adult Trout for a Put and Take Fishery | | | | | | | ✓ | ✓ |
| Public Water Supply | | ✓ | | ✓ | | ✓ | | ✓ |

Source: http://www.mde.maryland.gov/programs/water/TMDL/WaterQualityStandards/Pages/wqs_designated_uses.aspx

## MS4 Permit Requirements

The MDOT SHA MS4 Permit requires coordination with county MS4 jurisdictions concerning watershed assessments and development of a coordinated TMDL implementation plan for each watershed that SHA has a WLA. Requirements from the MDOT SHA MS4 Permit specific to watershed assessments and coordinated TMDL implementation plans include *Part IV.E.1.* and *Part IV.E.2.b.*, copied below.

### *Watershed Assessments (Permit Part IV.E.1.)*

*SHA shall coordinate watershed assessments with surrounding jurisdictions, which shall include, but not be limited to the evaluation of available State and county watershed assessments, SHA data, visual watershed inspections targeting SHA rights-of-way and facilities, and approved stormwater WLAs to:*

- *Determine current water quality conditions;*
- *Include the results of visual inspections targeting SHA rights-of-way and facilities conducted in areas identified as priority for restoration;*
- *Identify and rank water quality problems for restoration associated with SHA rights-of-way and facilities;*
- *Using the watershed assessments established under section a. above to achieve water quality goals by identifying all structural and nonstructural water quality improvement projects to be implemented; and*
- *Specify pollutant load reduction benchmarks and deadlines that demonstrate progress toward meeting all applicable stormwater WLAs.*

### *Coordinated TMDL Implementation Plans (Permit Part IV.E.2.b.)*

*Within one year of permit issuance, a coordinated TMDL implementation plan shall be submitted to MDE for approval that addresses all EPA approved stormwater WLAs (prior to the effective date of the permit) and requirements of Part VI.A., Chesapeake Bay Restoration by 2025 for SHA's storm sewer system. Both specific WLAs and aggregate WLAs which SHA is a part of shall be addressed in the TMDL implementation plans. Any subsequent stormwater WLAs for SHA's storm sewer system shall be addressed by the coordinated TMDL implementation plan within one year of EPA approval. Upon approval by MDE, this implementation plan will be enforceable under this permit. As part of the coordinated TMDL implementation plan, SHA shall:*

- *Include the final date for meeting applicable WLAs and a detailed schedule for implementing all structural and nonstructural water quality improvement projects, enhanced stormwater management programs, and alternative stormwater control initiatives necessary for meeting applicable WLAs;*
- *Provide detailed cost estimates for individual projects, programs, controls, and plan implementation;*
- *Evaluate and track the implementation of the coordinated implementation plan through monitoring or modeling to document the progress toward meeting established benchmarks, deadlines, and stormwater WLAs; and*

- *Develop an ongoing, iterative process that continuously implements structural and nonstructural restoration projects, program enhancements, new and additional programs, and alternative BMPs where EPA approved TMDL stormwater WLAs are not being met according to the benchmarks and deadlines established as part of the SHA's watershed assessments*.

# B. WATERSHED ASSESSMENT COORDINATION

According to the USGS (2016):

> *A watershed is an area of land that drains all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay, or any point along a stream channel. The word watershed is sometimes used interchangeably with drainage basin or catchment. The watershed consists of surface water--lakes, streams, reservoirs, and wetlands--and all the underlying ground water. Larger watersheds contain many smaller watersheds. Watersheds are important because the streamflow and the water quality of a river are affected by things, human-induced or not, happening in the land area "above" the river-outflow point.*

The 8-digit scale is the most common management scale for watersheds across the State, and therefore is the scale at which most of Maryland's local TMDLs are developed. See **Figure 1** for an illustration of the 8-digit watersheds in Maryland.

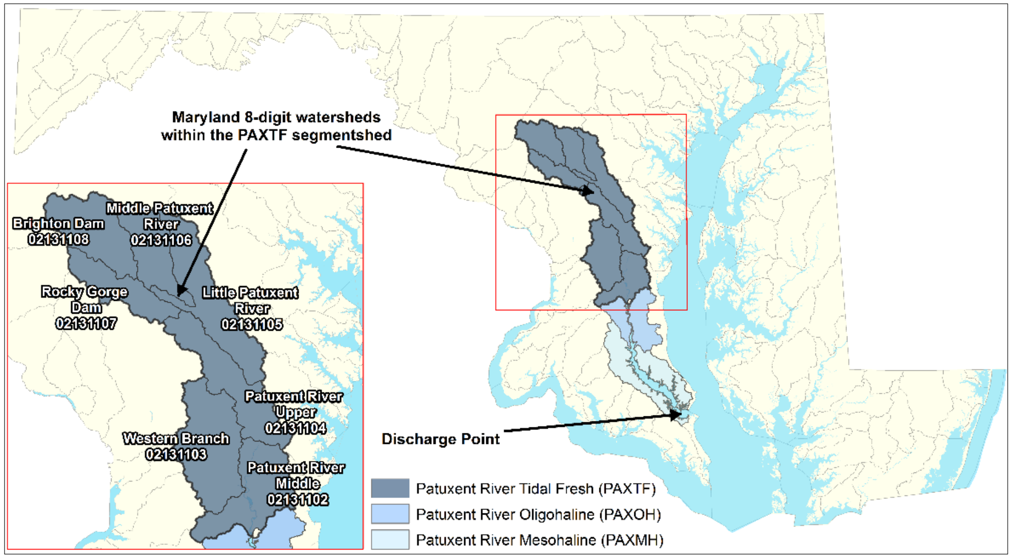



***Figure 1: Maryland 8-digit Watershed Example***

Segmentsheds are watersheds associated with tidal waters, which are referred to as segments. The Chesapeake Bay and its tidal tributaries are divided into 92 segments as shown in **Figure 2**. The Patuxent River comprises three of the 92 segments. The corresponding three segmentsheds are as follows: the Patuxent River Mesohaline segmentshed (designated as "PAXMF"), the Patuxent River Oligohaline segmentshed (designated as "PAXOH"), and the Patuxent River Tidal Fresh segmentshed (designated as "PAXTF").

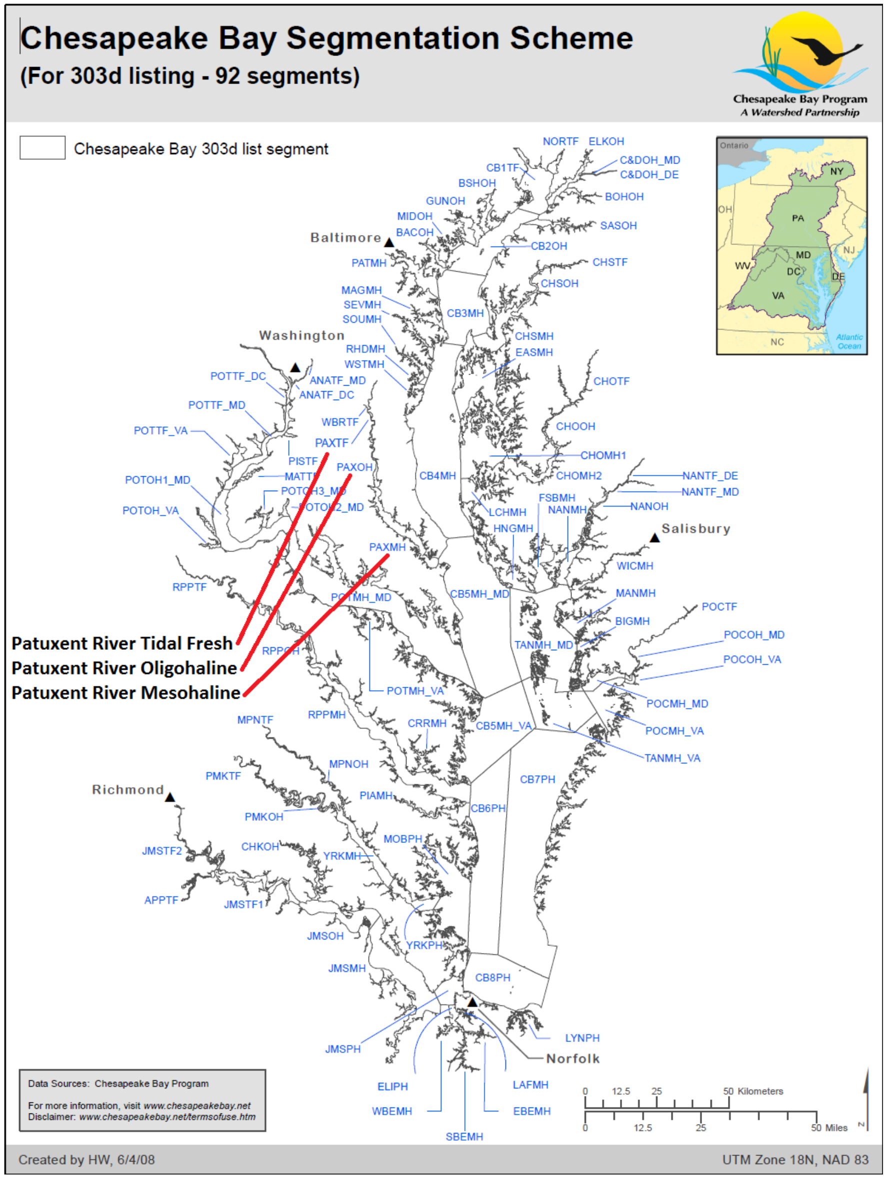



***Figure 2: Chesapeake Bay 92 Segments***

## County Watershed Assessments

Each MS4 county performs detailed assessments of local watersheds as a part of its MS4 permit requirements. These assessments determine current water quality conditions and include visual inspections; the identification and ranking of water quality problems for restoration; the prioritization and ranking of structural and non-structural improvement projects; and the setting of pollutant reduction benchmarks and deadlines that demonstrate progress toward meeting applicable WQSs. MDOT SHA relies on assessments performed by other jurisdictions in fulfilling its MS4 assessment requirement.

Watershed assessment evaluations conducted by MDOT SHA focus on issues that MDOT SHA can improve through practices targeting MDOT SHA right-of-way (ROW) or infrastructure. This information is used to determine priority areas for BMP implementation and to identify potential project sites or partnership project opportunities. Summaries of these evaluations are included under **Section F**. MDOT SHA watershed assessment evaluations focus on the following:

- Impacts to MDOT SHA infrastructure such as failing outfalls and downstream channels;
- Older developed areas with little SWM and available opportunities to install retrofits;
- Degraded streams;
- Priority watershed issues such as improvements within a drinking water reservoir, special protection areas, or Tier II catchments;
- Identification of areas most in need of restoration;
- Description of preferred structural and non-structural BMPs to use within the watershed;
- Potential project sites for BMPs; and

- In watersheds with PCB TMDLs, identifying locations of any known PCB sources.

In addition to using information from the county watershed assessments, MDOT SHA also undertakes other activities to identify potential project sites and prioritize BMP implementation including:

- Coordination meetings with each of the MS4 counties to discuss potential partnerships with the mutual goal of improving water quality;
- Visual watershed inspections as described below; and
- Maximizing existing impervious treatment within new roadway projects (practical design initiative).

# C. VISUAL INSPECTIONS TARGETING MDOT SHA ROW

MDOT SHA methodically reviews each watershed for potential restoration projects within MDOT SHA ROW to meet the load reductions for current pollutant WLAs. Each watershed is assessed using a grid system in conjunction with detailed corridor assessments. The watershed review process includes two phases to visually inspect each watershed and identify all structural and non-structural water quality improvement projects to be implemented.

## Desktop Evaluation

Phase one is a desktop evaluation of the watershed using available county watershed assessments and MDOT SHA data. MDOT SHA has created a grid system of 1.5-mile square cells to track the progress of the visual ROW inspections, allowing prioritized areas to be targeted first. With this grid system, many spatial data sets are reviewed to determine the most effective use of each potential restoration site. The sites are documented geographically and stored in GIS. Viable sites are prioritized based on cost-effectiveness and those located within watersheds with the most pollutant reduction needs move forward to the second phase, which is to perform field investigations. Data reviewed includes:

- Aerial imagery;
- Street view mapping;
- Environmental features delineations such as critical area boundary, wetlands buffers, floodplain limits;
- County data such as utilities, storm drain systems, contour and topographic mapping;
- MDOT SHA ROW boundaries;
- Current MDOT SHA stormwater control and restoration practice locations; and
- Drainage area boundaries.

**Figure 8**, located in **Section F**, illustrates the 1.5-mile grid system for the PAXMH, PAXOH, and PAXTF segmentsheds.

## Field Investigations

Phase two is a field investigation of each viable site resulting from the watershed desktop evaluation. MDOT SHA inspects and assesses each site in the field to identify and document existing site conditions, water quality opportunities, and constraints. This information is used to determine potential restoration BMP types as well as estimated restoration credit quantities.

MDOT SHA will continue to prioritize visual inspections in the highest need watersheds. **Figure 3** is an example field investigation summary map that documents observations. A standardized field inspection form is used.

# D. BENCHMARKS AND DETAILED COSTS

Benchmarks and deadlines demonstrating progress toward meeting all applicable stormwater WLAs are provided in **Section F**. It contains generalized cost information that includes an overall estimated cost to implement the proposed practices. Detailed costs for specific construction projects are available on SHA's website (www.roads.maryland.gov) under the Contractors Information Center.

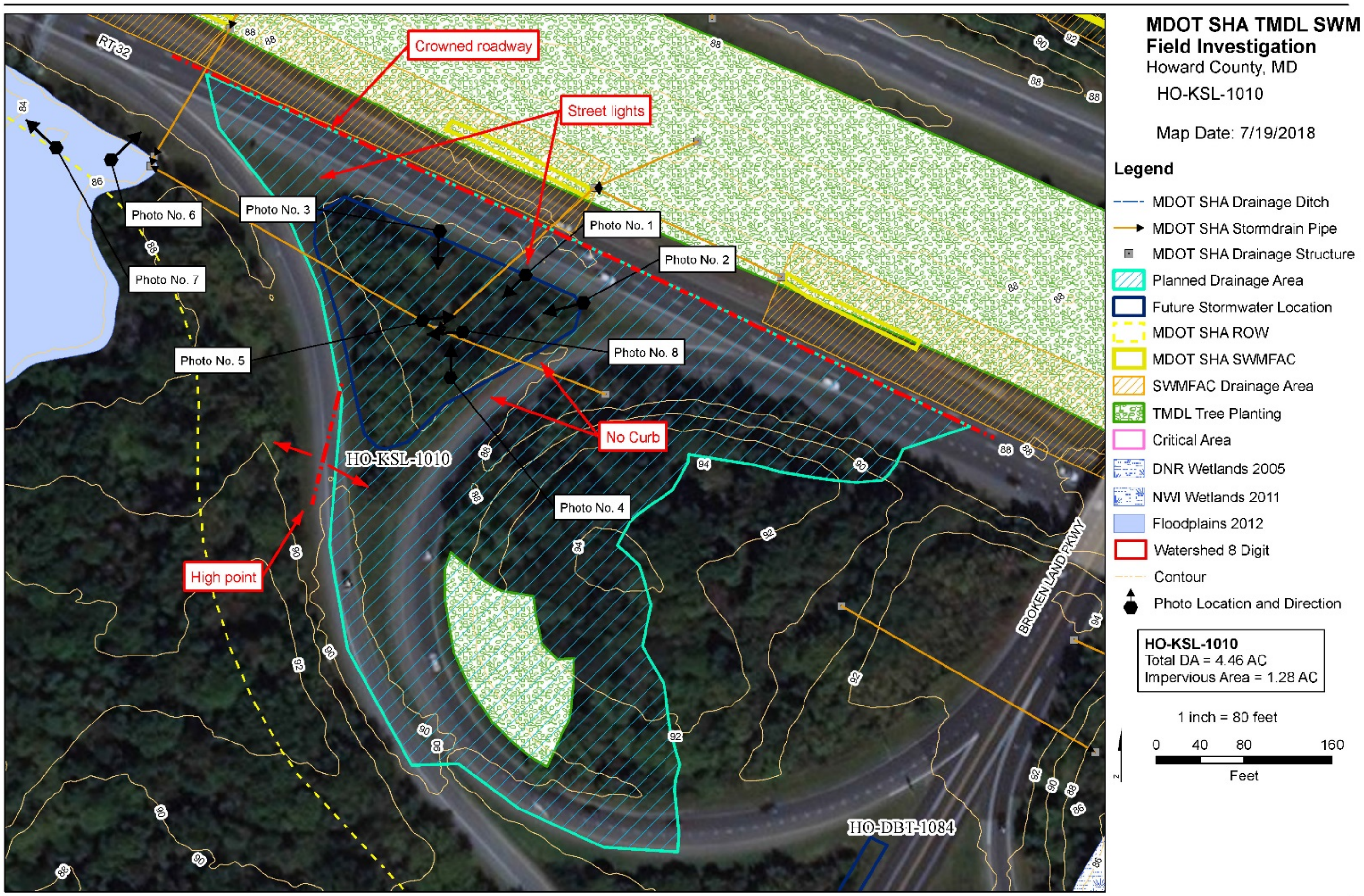



***Figure 3: Example Field Investigation Summary Map***

# E. POLLUTION REDUCTION STRATEGIES

## E.1. MDOT SHA TMDL Responsibilities

TMDLs define the maximum pollutant loading that can be discharged to a waterbody and still meet water quality criteria for maintaining designated uses. **Figure 4** illustrates the concept of maximum loading. The green area on the bar depicts the maximum load that maintains a healthy water environment for the pollutant under consideration. When this load is exceeded, the waterway is considered impaired as illustrated by the red portion of the bar. The example waterway needs restoration through implementation of practices to reduce the pollutant loading to or below the TMDL.

Generally, the formula for a TMDL is:

$$TMDL = \sum WLA + \sum LA + MOS$$

Where:

TMDL = total maximum daily load
WLA = wasteload allocation for point sources;
LA = load allocation for non-point sources; and
MOS = margin of safety.

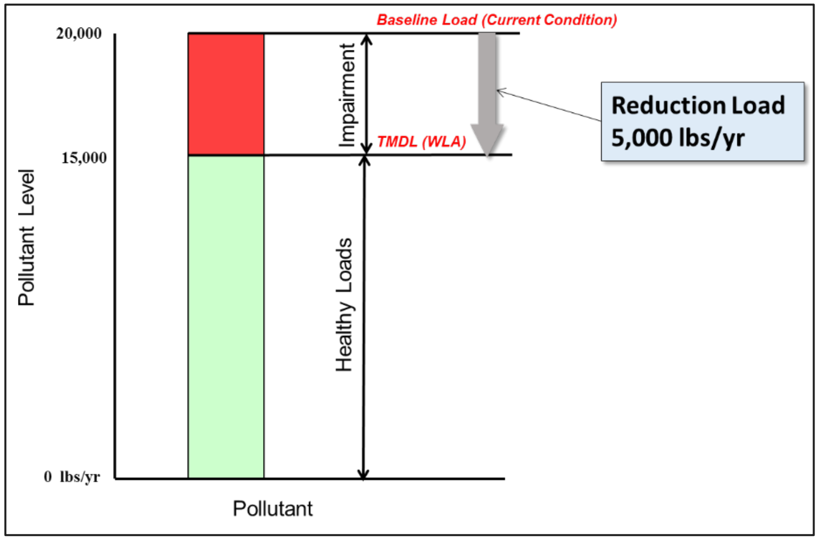



***Figure 4: Example TMDL and Reduction Requirement***

### Modeling Parameters

MDE requires that pollutant modeling follow the guidance in the MDE (2014a) document and if other methods are employed, they must be approved by MDE. MDOT SHA developed a restoration modeling protocol that describes the methods used for modeling pollutant load reductions for local TMDLs with MDOT SHA responsibility. This protocol was submitted to MDE as an appendix with the MDOT SHA MS4 2016 Annual Report. The protocol has been updated from the initial version of the Automated Modeling Tool (AMT) originally submitted to MDE on June 30, 2016 to take into account changes in the modeling approach resulting from MDE comments on MDOT SHA's 2016 Annual Report, along with other modifications to improve accuracy. This protocol can be found under the "Related Documents" section on the MDOT SHA website, https://www.roads.maryland.gov/Index.aspx?pageid=336.

Different modeling methods are used depending upon the pollutants and current reduction practices in use. Brief descriptions of modeling methods are included in the following section, but the MDOT SHA restoration modeling protocol should be consulted for a more detailed explanation.

### Aggregated Loads

WLAs may be assigned to each MS4 jurisdiction separately or as an aggregated WLA for all urban stormwater MS4 permittees that combines them into one required allocation and reduction target. The modeling approach developed by MDOT SHA uses MDOT SHA data (both impervious and pervious land as well as BMPs built before the TMDL baseline year, also known as baseline BMPs) to calculate baseline loads and calibrated reduction targets. Following this approach, disaggregation is done for each TMDL.

### Available Reduction Practices

MDOT SHA reserves the right to implement new BMPs, activities, and other practices that are not currently available to achieve local TMDL load reduction requirements. In the future, expert panels may be convened to study the effectiveness of new or modified BMPs on pollutants. MDOT SHA will modify reduction strategies as necessary based on new, approved treatment guidance and will include revised strategies in updates to this implementation plan.

# E.2. PCB Pollution Reduction Strategy

## E.2.a. PCB TMDLs Affecting MDOT SHA

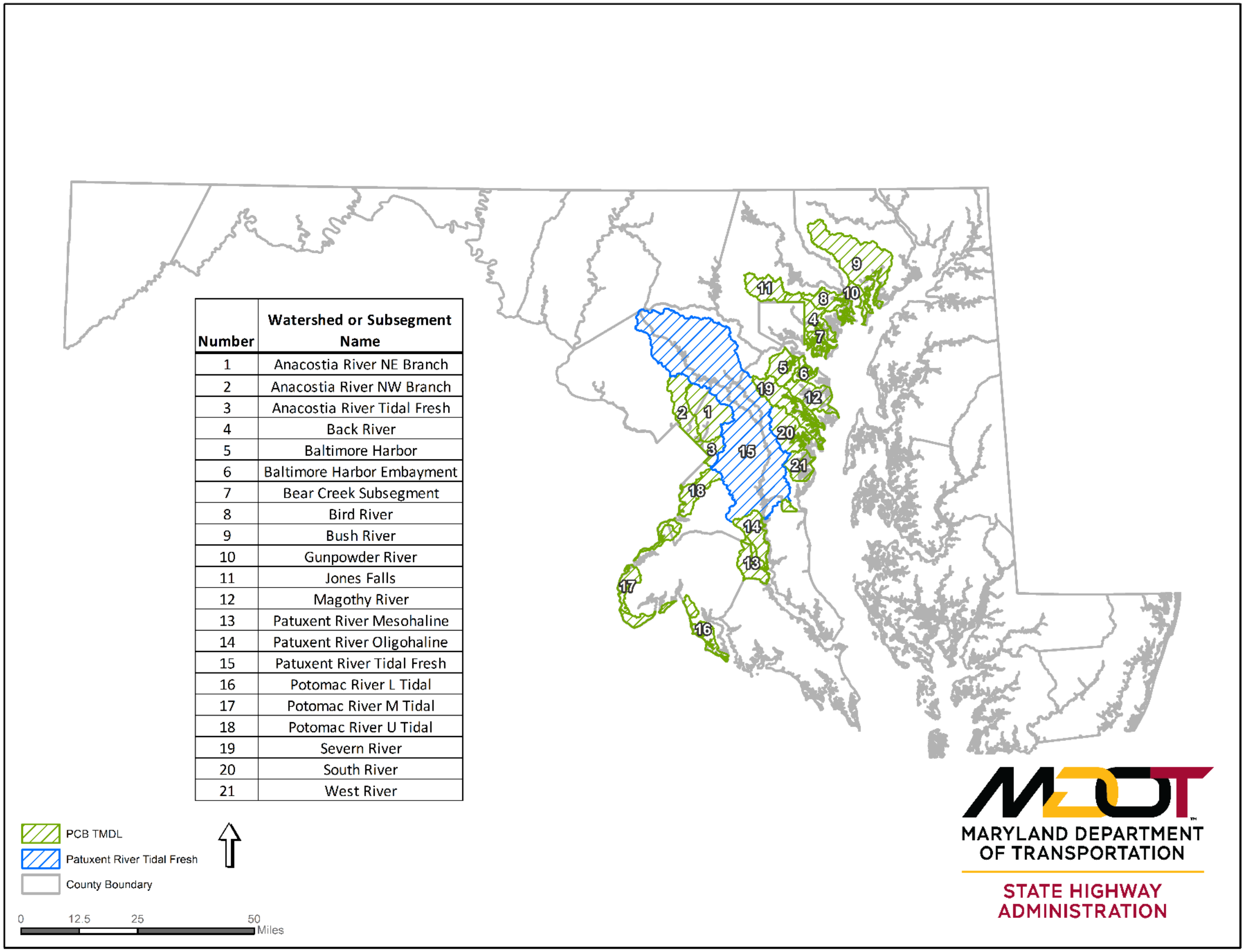
There are many EPA-approved PCB TMDLs within Maryland and **Figure 5** is a map showing MDOT SHA PCB TMDL responsibilities by watershed. The following is a list of TMDL documents for PCBs with MDOT SHA responsibility that are addressed in this plan:

- *Total Maximum Daily Load of Polychlorinated Biphenyls in the Patuxent River Mesohaline, Oligohaline, and Tidal Fresh Chesapeake Bay Segments, approved by EPA September 19, 2017*.

In **Table 2,** the MDOT SHA reduction target for the PAXMH and PAXOH PCB TMDL is 0 percent, or 0 g/yr. Due to MDOT SHA having a 0 gram per year reduction requirement in the PAXMH and PAXOH, meeting this TMDL will rely on meeting the reduction requirement in the PAXTF. The PAXTF segmentshed can safely receive 0.0 grams of PCB by MDOT SHA on a yearly basis without being considered impaired. MDOT SHA's reduction target is found by multiplying the MDOT SHA baseline load by the MDOT SHA reduction target percent. The MDOT SHA WLA is found by subtracting the MDOT SHA baseline load by the MDOT SHA target load. The projected reduction achieved is found by modeling the PCB load reduction that will be experienced by the construction of current and future BMPs in the PAXTF segmentshed. These BMPs are either currently under construction or are planned to be constructed in the future. It is estimated that these BMPs will reduce PBC loading by 0.14 grams to the segmentshed.

Based on the MDOT SHA current modeling of PCB reduction through the traditional practice of implementing stormwater BMPs, it is evident that meeting the PCB WLA cannot be achieved. Although building sediment reducing BMPs in this watershed that in turn reduce PCBs because the PCB particles are attached to the sediment is somewhat effective, it is understood that the order of magnitude needed to meet the WLA through stormwater BMPs is not the most effective approach. Thus, **Section E.2.c.** herein will discuss other BMPs and applications. However, it is currently difficult to model the positive effects that strategies such as bioremediation and sources elimination through partnering will have on the timeline of meeting this WLA.

Three dates are shown in **Table 2**: the EPA approval date, the baseline year set by MDE, and the Target Year. The baseline year published on the MDE Data Center will be used for MDOT SHA's implementation planning. This usually correlates to the time-period when monitoring data was collected for MDE's TMDL analysis. The Target Year is the year MDOT SHA proposes to meet the WLA




| Number | Watershed or Subsegment Name |
|---|---|
| 1 | Anacostia River NE Branch |
| 2 | Anacostia River NW Branch |
| 3 | Anacostia River Tidal Fresh |
| 4 | Back River |
| 5 | Baltimore Harbor |
| 6 | Baltimore Harbor Embayment |
| 7 | Bear Creek Subsegment |
| 8 | Bird River |
| 9 | Bush River |
| 10 | Gunpowder River |
| 11 | Jones Falls |
| 12 | Magothy River |
| 13 | Patuxent River Mesohaline |
| 14 | Patuxent River Oligohaline |
| 15 | Patuxent River Tidal Fresh |
| 16 | Potomac River L Tidal |
| 17 | Potomac River M Tidal |
| 18 | Potomac River U Tidal |
| 19 | Severn River |
| 20 | South River |
| 21 | West River |

***Figure 5: MDOT SHA PCB TMDL Responsibilities in Local Watersheds***

**Table 2: MDOT SHA PAXMH, PAXOH, and PAXTF Segmentsheds PCB Modeling Results**

| Watershed Name | Watershed Number | County/ Counties[1] | Pollutant | EPA Approval Date | WLA Type | Baseline Year | Unit | MDOT SHA Baseline Load | MDOT SHA % Reduction Target | MDOT SHA Reduction Target | MDOT SHA WLA | Current Modeled Reduction to be Achieved[2] | Projected Reduction to be Achieved as a % of Baseline Load | Target Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Patuxent River Mesohaline | 02131101-PAXMH | PG, CH | PCBs | 09/19/2017 | Aggregate by County | 2010 | g/yr | N/A | 0% | N/A | N/A | N/A | N/A | N/A- |
| Patuxent River Oligohaline | 02131101- PAXOH | AA, PG | PCBs | 09/19/2017 | Aggregate by County | 2010 | g/yr | N/A | 0% | N/A | N/A | N/A | N/A | N/A |
| Patuxent River Tidal Fresh | 02131102- PAXTF | AA, FR, HO, MO, PG | PCBs | 09/19/2017 | Aggregate by County | 2010 | g/yr | 6.1 | 99.9% | 6.1 | 0.0 | 0.14 | 2.3% | 2050 |

[1] Frederick County requires 0% reduction in the PAXTF segmentshed. Baseline loads and load reductions in the Frederick County portion of the PAXTF segmentshed are not included in this plan.
[2] Based on the MDOT SHA current modeling of PCB reduction through the traditional practice of implementing stormwater BMPs, it is evident that meeting the PCB WLA cannot be achieved. MDOT SHA is currently researching more effective strategies.

## E.2.b. PCB Sources

The objective to establish a TMDL for PCBs is to ensure that the designated use is protected in each of the impaired waterbodies. Monitoring to identify the impairment may have been performed in the water column, in sediments, or in fish tissue depending on whether the impairment was for water contact recreation or fish consumption.

PCBs do not occur naturally in the environment. Therefore, unless existing or historical anthropogenic sources are present, their natural background levels are expected to be zero. Although PCBs are no longer manufactured in the United States, they are still being released to the environment via accidental fires, leaks, or spills from PCB-containing equipment; potential leaks from hazardous waste sites that contain PCBs; illegal or improper dumping; and disposal of PCB-containing products into landfills not designed to handle hazardous waste. Once in the environment, PCBs do not readily break down and tend to cycle between various environmental media such as air, water, and soil.

Sources are not identified in detail, either by land use or other breakdowns. Two non-point sources are related to the waterbody itself: resuspension and diffusion from bottom sediments and tidal exchange with the Bay. Transport of PCBs from bottom sediments to the water column through resuspension and diffusion can be a source of PCBs; however, within the TMDLs it is considered internal loading and not assigned a baseline load or allocation. Tidal influences from the Bay or other tidewater can be either a source or sink. For the Magothy, Severn, South, and West and Rhode River TMDLs, the Bay tidal influence is the single major source of PCBs. Anacostia, Baltimore Harbor, Back River, Bird River, Bush River, Gunpowder River, and the Patuxent River on the other hand, export more PCBs to the Bay than they receive.

There are three diffuse watershed sources including atmospheric deposition, non-regulated watershed runoff, and NPDES regulated stormwater. Also, there are four discrete sources: contaminated sites, WWTP facilities, industrial process water and Dredged Material Containment Facilities (DMCF), which are described by name in the TMDL. **Table 3** shows which sources are described in the fourteen PCB TMDLs with MDOT SHA responsibility.

For PCBs, studies have shown the largest sources impacting stormwater are building demolition, building remodeling, and old industrial areas. The main pathways are runoff, wheel and foot tracking, and dust dispersion from industrial areas (San Francisco Estuary Institute [SFEI], 2010).

***Table 3: PCB Sources in Each TMDL***

| Source | Contaminant | TMDL Watershed | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Baltimore Harbor | Back River | Bird River | Bush River | Gunpowder River | Tidal Potomac/ Anacostia River | Non-Tidal Anacostia River | Lake Roland | Magothy River | Patuxent River Segments | Severn River | South River | West & Rhodes River |
| **Non-Point Sources** | Upstream Tributaries | | | | | ✓ | ✓ | | | | | | | |
| | Chesapeake Bay or Other Tidal Influence | | | ✓ | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Atmospheric Deposition | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Non-regulated Watershed Runoff | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Contaminated Sites | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | | | |
| **Point Sources** | Municipal WWTP and CSO | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| | Industrial Process Water | ✓ | | | ✓ | ✓ | | | | | ✓ | | | |
| | DMCF | ✓ | | | | | | | | | | | | |
| | NPDES Regulated Stormwater | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

### Significance for MDOT SHA

MDOT SHA roadways pass through or are near areas that contain facilities or industries that may contribute PCBs to the environment. Two of the controllable sources in **Table 3** appear to fall under MDOT SHA's responsibility: contaminated sites and NPDES-regulated stormwater. MDOT SHA has conducted research on our industrial sites and to date has not discovered any legacy PCB contamination. Thus, MDOT SHA is left with stormwater as the only source to be addressed. MDOT SHA does not plan to complete a comprehensive investigation of all MDOT SHA's ROW, but a method is being researched to identify outfalls that have PCB discharging in stormwater to identify potential source drainage area. Once these areas are narrowed down, sources of PCBs can be tracked, documented, and methods to remediate developed.

## E.2.c. PCB Reduction Strategies

MDOT SHA will implement an adaptive management process that relies on four main PCB reducing efforts. The first strategy will be to track PCBs reduction achieved from ongoing impervious restoration efforts for MDOT SHA's MS4 permit. The second effort will be to continue to monitor the development and implementation of new technologies that are shown to reduce PCB concentration through dechlorination. MDOT SHA will develop a monitoring and evaluation plan to study the effects of natural attenuation in our PCB TMDL watersheds. Lastly, partnering efforts to reduce PCB concentrations in the local watersheds will be explored with other jurisdictions where it is perceived to be mutually beneficial for both parties.

### Stormwater BMP Reduction Modeling

As a byproduct of meeting the impervious surface restoration required under the existing MS4 permit, many of the BMPs used to reduce sediment will provide a secondary benefit in removing PCBs associated with sediments.

The modeling results in **Table 2** show that minimal reductions are achieved through stormwater BMP implementation in the watershed. Based on these results, MDOT SHA has concluded that there is a need to explore other strategies to achieve MDOT SHA's WLA.

### Monitoring of Reductive Dechlorination Technology of PCB

MDOT SHA has begun to explore the current available research on bioremediation of PCBs using biofilms and varies plants. It is understood that there are bacteria that exist in a natural environment that are cable of aerobic degradation and anaerobic dechlorination of PCB congeners. There are some proprietary biofilms that have these bacteria introduced to them that when applied to soils with a PCB concentration can promote a faster mineralization of the PCBs. MDOT SHA will explore the possibility of using these biofilms. MDOT SHA will also have to determine appropriate locations in its ROW to place these biofilms.

### Monitoring and Evaluation Plan

MDOT SHA will continue to review industry reports and studies documenting the declining PCB concentrations in fish tissue samples due to natural attenuation. This process will involve obtaining PCB concentration data from other MS4 jurisdictions and or other approved sources.

### Partnering Efforts

MDOT SHA will implement partnering with other local jurisdictions to ensure that PCB WLAs are met. However, at this time it has not been determined what this effort will entail. There may be a possibility to work with another agency on a public education campaign or contribute effort or money to a PCB cleanup effort in a watershed in which there is an MDOT SHA responsibility. It is anticipated that an overall reduction of PCBs released in the watershed will have a positive load reduction on MDOT SHA's WLA reduction goals.

# F. MDOT SHA PATUXENT RIVER SEGMENTSHEDS PCB TMDL IMPLEMENTATION PLAN

## F.1. Segmentsheds Description

Located in Maryland's Western Shore, the Patuxent River is a tributary of the Chesapeake Bay. The tidal portion of the Patuxent River is approximately 70 kilometers (43 miles) long and, as previously stated in **Section B**, consists of three tidal segments: Mesohaline (PAXMH), Oligohaline (PAXOH), and Tidal Fresh (PAXTF). Together, the corresponding PAXMH, PAXOH, and PAXTF segmentsheds drain portions of eight Maryland Counties: Anne Arundel, Calvert, Charles, Frederick, Howard, Montgomery, Prince George's, and St. Mary's. In addition, several 8-digit watersheds are found within these three segmentsheds. PAXMF and PAXOH each contain a portion of the "Patuxent River Lower" 8-digit watershed (MD-02131101). PAXTF includes the following seven 8-digit watersheds: Brighton Dam (MD-02131108), Rocky Gorge Dam (MD-02131107), Middle Patuxent River (MD-02131106), Little Patuxent River (MD-02131105), Patuxent River Upper (MD-02131104), Western Branch (MD-02131103), and the Patuxent River Middle (MD-02131102). The PCB TMDL addressed in this plan (MDE, 2017b) includes the drainage area of the Western Branch Patuxent River Tidal Fresh (WBRTF) segment within the PAXTF boundary.

The designated use of the PAXMH, PAXOH, and PAXTF segments is Use Class II – Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting (MDE, 2017b).

Waters within the PAXMH, PAXOH, and PAXTF segments are subject to the following impairments as noted on MDE's 303(d) List:

- PAXMH
  - PCBs in Fish Tissue;
  - Fecal Coliform;
  - Nitrogen (Total);
  - TSS; and
  - Phosphorous (Total)
- PAXOH
  - PCBs in Fish Tissue;
  - Fecal Coliform;
  - Nitrogen (Total);
  - TSS; and
  - Phosphorous (Total)
- PAXTF
  - PCBs in Fish Tissue;
  - Fecal Coliform;
  - Sedimentation/siltation;
  - Phosphorus (Total);
  - Temperature (water);
  - TSS;
  - Chlorides;
  - Mercury in Fish Tissue;
  - *E. Coli*;
  - Sulfates;
  - Nitrogen (Total); and
  - Biochemical Oxygen Demand (BOD)

MDOT SHA is included in the PCB TMDL (MDE, 2017b). PCBs for PAXTF are to be reduced by 99.9 percent, as shown in **Table 2**. Because MDOT SHA does not have a reduction requirement in the PAXMH and PAXOH segmentsheds, **Section F.2.**, **Section F.3.**, and **Section F.4.** below only pertain to the PAXTF segmentshed.

The PAXMH, PAXOH, and PAXTF segmentshed areas are approximately 182 square miles (116,480 acres), 115 square miles

(73,600 acres), and 581 square miles (371,840 acres), respectively, for a total watershed area of 878 square miles (561,920 acres). Each segmentshed contains several small tributaries of the Patuxent River. PAXTF includes three major tributaries as well: the Little Patuxent River, the Middle Patuxent River, and the Western Branch.

There are 18.16 centerline miles of MDOT SHA roadway located within PAXMH. The associated ROW encompasses 203.45 acres, of which 82.53 acres are impervious. MDOT SHA facilities located within the segmentshed consist of 5 park and rides and 1 salt storage facility.

There are 17.38 centerline miles of MDOT SHA roadway located within PAXOH. The associated ROW encompasses 131.66 acres, of which 64.47 acres are impervious. MDOT SHA facilities located within the segmentshed consist of 1 highway garage and/or shop, 1 park and ride, and 1 salt storage facilities.

There are 398.82 centerline miles of MDOT SHA roadway located within PAXTF. The associated ROW encompasses 9775.23 acres, of which 3712.54 acres are impervious. MDOT SHA facilities located within the segmentshed consist of 2 welcome centers, 3 weigh stations, 5 highway garages and/or shops, 13 park and rides, and 7 salt storage facilities.

See **Figure 6** for a map of the MDOT SHA facilities located within the PAXMH, PAXOH, and PAXTF segmentsheds.

**Figure 7** provides a close-up of the MDOT SHA facilities, the county boundaries, and the 8-digit watersheds within the PAXTF. Note that the Patuxent River follows the county boundary line between the counties from the top of the PAXTF downward towards the PAXOH.

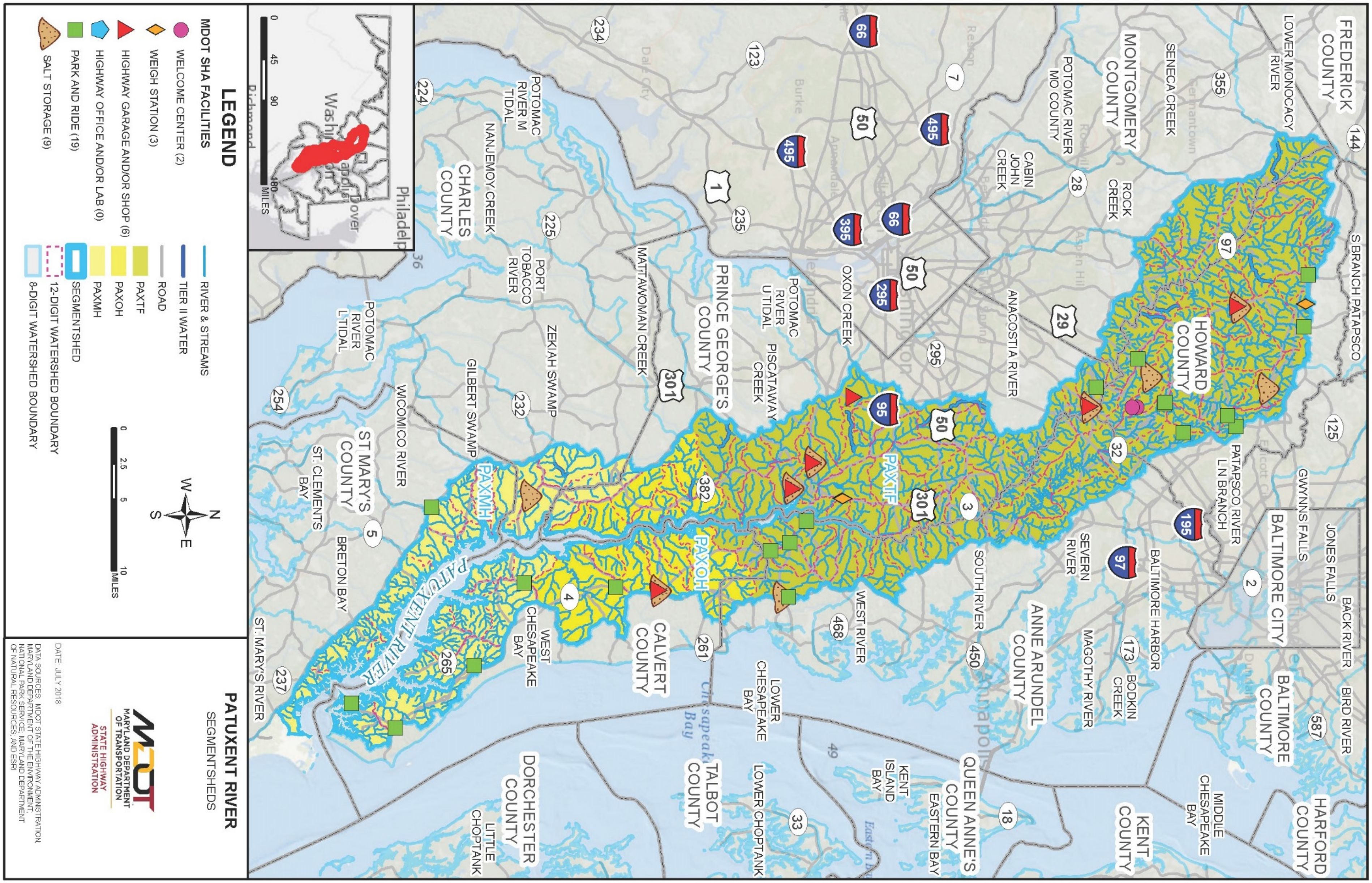



*Figure 6: PAXMH, PAXOH, and PAXTF Segmentsheds*

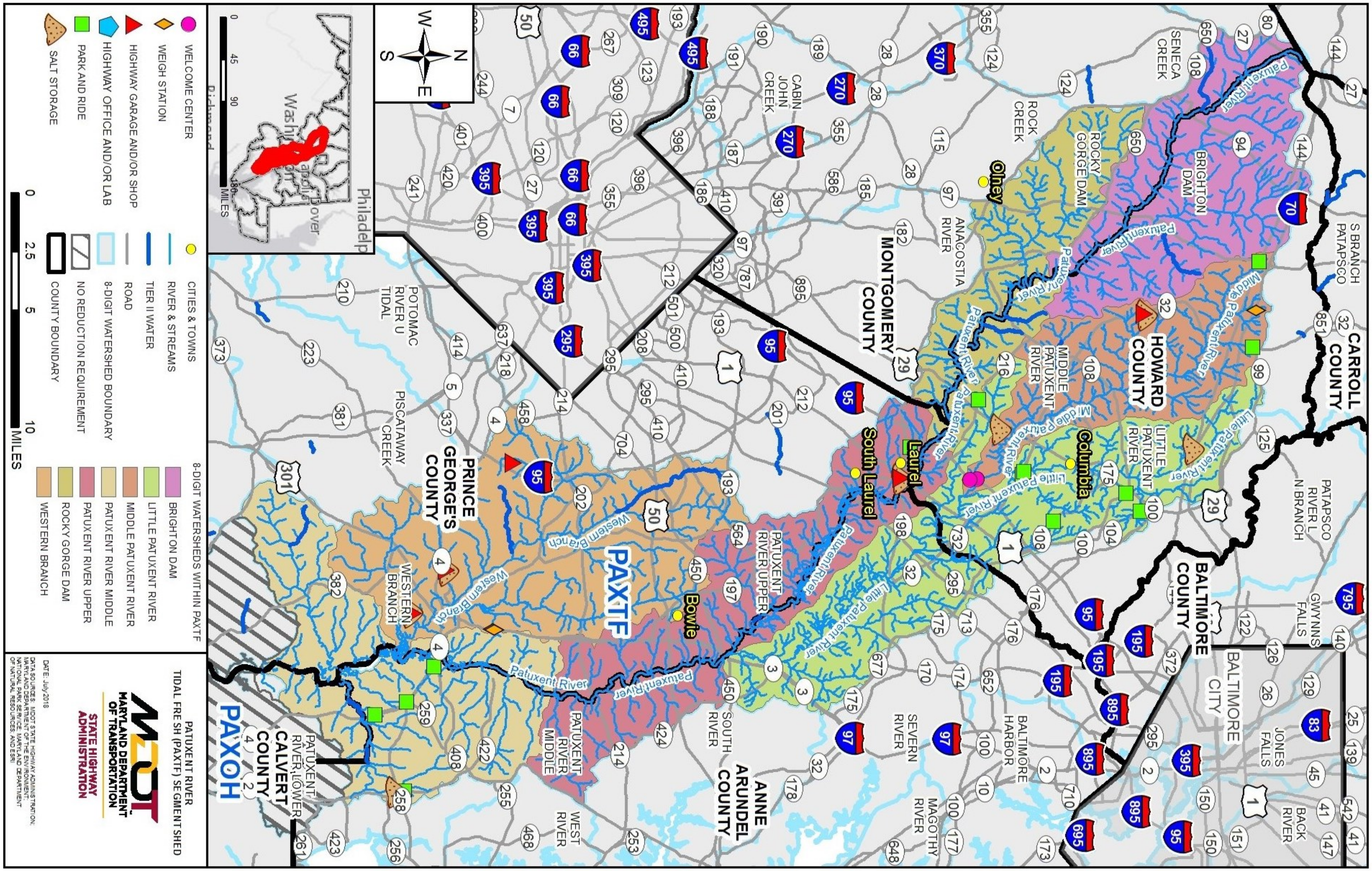



*Figure 7: PAXTF Segmentshed*

## F.2. Summary of County Assessment Review

As stated in **Section F.1.**, MDOT SHA does not have a reduction requirement in the PAXMH and PAXOH segmentsheds; therefore, only the county watershed assessments that cover the PAXTF are summarized below. The following four Maryland counties contain 8-digit watersheds within the PAXTF: Montgomery, Howard, Anne Arundel, and Prince George's. (Note: While the PAXTF segmentshed does drain a very small portion of Frederick County, it is not a large enough area to be included in this section's county assessment summaries. In fact, the PCB TMDL states that "[n]o reduction was applied to the Frederick County portion of the NPDES regulated stormwater baseline load within the PAXTF tidal segment as it only accounts for a relatively small percentage of the total baseline load (0.01%) and is considered insignificant" (MDE, 2017b, p. 41).

Organized by county and their corresponding 8-digit watersheds, the assessments completed by the aforementioned four counties for the areas composing the PAXTF are summarized below. The summaries are best read while referring periodically back to **Figure 7**. This is because in addition to providing a close-up of the MDOT SHA facilities in the PAXTF, **Figure 7** was also labeled with the relevant cities and roads that serve as points of reference in the summaries.

### Montgomery County Assessment

**Brighton Dam and Rocky Gorge Dam (Montgomery County)**

The 2012 *Patuxent Watershed Implementation Plan (including Pre-Assessment)* (Versar et al., 2012c)—hereinafter referred to as the "Montgomery County Plan"—serves as Montgomery County's assessment of the 8-digit Brighton Dam and Rocky Gorge Dam watershed portions within Montgomery County.

The Montgomery County portion of the Brighton Dam watershed (referred to in the Montgomery County Plan as the "Upper Patuxent River" subwatershed) is a 21-square-mile area located in the northern/northeastern region of the County. Land use within this portion of the watershed consists of rural lands (38 percent), forests (27 percent), and low density residential (23 percent). Streams within Montgomery County's portion of the Brighton Dam watershed are generally of high quality: the streams naturally support a healthy brown trout population with many of the streams serving as reference streams for the County's stream monitoring program (Versar et al., 2012c).

The Montgomery County portion of the Rocky Gorge Dam watershed (referred to in the Montgomery County Plan as the "Hawlings River" and the "Lower Patuxent River" subwatersheds) is a 39-square-mile area located in the northeastern/eastern region of the County. Land use within the Montgomery County portion of the Rocky Gorge Dam consists of medium (25 percent) and low (21 percent) density residential, forests (20 percent), and rural development (17 percent). Streams in the Montgomery County portion of the Rocky Gorge Dam watershed are subject to more impairment than the streams in the Montgomery County portion of the Brighton Dam watershed (Versar et al., 2012c).

The total impervious cover within Montgomery County's portions of Brighton Dam and Rocky Gorge Dam are 312 acres and 1,321 acres, respectively (Versar et al., 2012c). Major impervious elements include roads, parking lots, roofs, sidewalks, and paved courts. Of these various impervious cover types, roads and roofs make up the majority of the impervious surface (note: driveways were not included in the impervious cover calculations) (Versar et al., 2012c).

Currently, there are 173 structural stormwater BMPs in place within Montgomery County's Brighton Dam and Rocky Gorge Dam watersheds (Versar et al., 2012c). The great majority of these existing structural stormwater BMPs occur south of Reddy Branch surrounding the city of Olney (Versar et al., 2012c). The total drainage area treated is 1,298.8 acres, 336.5 of which are impervious acres (Versar et al., 2012c).

Applicable types of restoration practices being considered for future BMPs include new Environmental Site Design (ESD) retrofit practices (rainwater harvesting, upland reforestation, green roofs, etc.); ESD upgrades (retrofit ESD practices within existing publicly owned or privately owned stormwater infrastructure); voluntary ESD implementation (Low Impact Development [LID] practices installed as a result of County education and incentive programs [e.g., rainscape incentives offered in priority neighborhoods]); programmatic and operational practices (e.g., lawn care education); traditional retrofits (e.g., new ponds); credit for BMP maintenance upgrades; and riparian reforestation (Versar et al., 2012c).

Priority status for stormwater BMP retrofit projects are categorized as high, medium, or low priority. Low priority BMP projects include low scoring residential neighborhoods and golf courses. Medium priority projects include land-use types involving commercial/industrial, churches, private schools, apartments and condominiums (multi-family residential), townhouse units, and high and medium scoring residential neighborhood assessment areas. High priority projects are projects that modify existing BMPs that were permitted before 1986 (Versar et al., 2012c).

Current watershed restoration opportunities within the Montgomery County portion of the Brighton Dam watershed include an ESD (low priority) involving the Damascus Library. In the Montgomery County portion of the Rocky Gorge Dam watershed, there are several stream restoration opportunities (low priority), mostly along the Hawlings River and Reddy Branch. In addition, there is one ESD (high priority) opportunity at Longwood Community Center and two ESDs (low priority) opportunities at Ross Boddy Recreation Center near the city of Olney and at the Burtonsville Park and Ride. There are also several retrofit opportunities, including a retrofit (low priority) of the dry pond at the Sandy Spring Meadow community in Olney (Versar et al., 2012c).

## Howard County Assessments

### Brighton Dam, Rocky Gorge Dam, and Patuxent River Upper (Howard County)

The 2017 *Patuxent River: Brighton Dam, Rocky Gorge Dam, and Patuxent River Upper Watershed Assessment* (KCI, 2017)—hereinafter referred to as the "2017 Howard County Assessment"—serves as Howard County's assessment of the 8-digit Brighton Dam, Rocky Gorge Dam, and Patuxent River Upper watershed portions within Howard County. The Howard County portion of the Brighton Dam watershed is a 57.7-square-mile area located in northwestern Howard County. The Howard County portion of the Rocky Gorge Dam watershed is a 12.5-square-mile area located in the southwestern region of the County. Lastly, the Howard County portion of the Patuxent River Upper watershed is a small, 2.7-square-mile area located in the southernmost region of the County (KCI, 2017).

In Howard County, land use within the Brighton Dam, Rocky Gorge Dam, and Patuxent River Upper watersheds varies greatly. Primary land uses in Brighton Dam are split between agricultural, urban, and forest, while the Rocky Gorge Dam and Patuxent River Upper are primarily urban, followed by forest. The "urban" use in all three of these watersheds is predominantly residential. More specifically, land use within the Brighton Dam watershed is as follows: agricultural (37.5 percent), urban (34.5 percent), and forest (26.6 percent). Land use within the Rocky Gorge Dam watershed is urban (47.1 percent), agricultural (14.6 percent), and forest (34.1 percent); land use within the Patuxent River Upper watershed is urban (63.2 percent), agricultural (4.1 percent), and forest (27.7 percent) (KCI, 2017).

All three watersheds are impaired with various pollutants, with completed TMDLs for *E. coli*, phosphorus, and sediment (KCI, 2017).

The majority of soils within the Brighton Dam and Rocky Gorge Dam watersheds have moderate infiltration rates, while the Patuxent River

Upper watershed has a much larger proportion of soil groups with higher runoff potential and lower infiltration rates. Accordingly, in regard to the Patuxent River Upper watershed, the 2017 Howard County Assessment states: "[t]he low infiltration rates of these soils means that they are more susceptible to flooding and provide a poor porous medium for stormwater ponds and Environmental Site Design (ESD) opportunities, so opportunities should be considered carefully, using local-scale information" (KCI, 2017, p. 16).

There are many existing BMPs (includes septic practices, tree planting, outfall stabilization, stream restoration, and stormwater structures) in each of watersheds. According to the 2017 Howard County Assessment, Brighton Dam, Rocky Gorge Dam, and Patuxent River Upper have 800, 303, and 134 BMPs, respectively. The corresponding acres that these BMPs treat in Brighton Dam, Rocky Gorge Dam, and Patuxent River Upper are 390.0 acres (0.6 square miles), 108.5 acres (0.2 square miles), and 86.1 acres (0.1 square miles), respectively (KCI, 2017).

In order to further treat the three watersheds, the 2017 Howard County Assessment examined five types of potential retrofit and restoration opportunities: (1) BMP conversions, (2) new BMPs, (3) tree planting, (4) stream restoration, and (5) outfall stabilization (KCI, 2017). **Table 4** presents the examples provided by Howard County under each category. Both field site selections and desktop analyses were used to identify areas for BMP retrofit or restoration within each watershed.

Of the 123 potential project site recommendations across the three watersheds, 35 project concept plans for the top-ranked projects have been developed. The approved concept plans include 6 BMP conversions, 8 new BMPs, 3 tree plantings, 14 stream restorations, and 4 outfall stabilizations projects.

The concept plans provide the location of the project, current site conditions, implementation information, potential impervious treatment or pollution reduction credits, and a cost estimate. (The complete set of concept plans is available in Appendix G of the 2017 Howard County Assessment [KCI, 2017]).

**Middle Patuxent River (Howard County)**

The 2015 *Middle Patuxent River Watershed Assessment* (Versar, 2015b)—hereinafter referred to as the "2015 Howard County Middle Patuxent Assessment"—serves as Howard County's assessment of the 8-digit Middle Patuxent River watershed. Located entirely within Howard County, the Middle Patuxent River watershed is the only other 8-digit watershed besides the Western Branch (entirely in Prince George's County) in the PAXTF that does not cross over into another county or counties.

The Middle Patuxent River watershed is a 58-square-mile area located in central Howard County. Land use within the Middle River Patuxent watershed is as follows: agricultural (33.7 percent), residential (33.1 percent), and forest (26.7 percent) (Versar, 2015b).

Impervious surface cover was used to assess urban impacts to streams within the Middle Patuxent River watershed. According to Howard County's impervious cover data, 9.9 percent of the watershed is impacted by impervious surfaces (Versar, 2015b). A 9.9 percent impervious cover indicates that streams in the watershed are sensitive to becoming degraded. BMPs treat approximately 40 percent of the impervious surfaces in the Middle Patuxent River watershed (Versar, 2015b).

Soil conditions help determine water quantity and quality aspects of streams and rivers. Most soils in the Middle Patuxent River watershed fall into the U.S. Department of Agriculture Group B. Group B soils are loam and silt loam types with moderate infiltration and water transmission rates. Consequently, Group B soils provide good opportunities for stormwater management ponds as well as ESD. The southeastern portion of the watershed; however, features Group D soils.

Group D soils are poorly drained and need careful consideration regarding stormwater management (Versar, 2015b).

Biological monitoring conducted by the Maryland Department of Natural Resources (DNR) Maryland Biological Stream Survey (MBSS) was used to assess stream health in the Middle Patuxent River watershed. The rating categories included Good, Fair, Poor, and Very Poor. The results indicated that 24 percent of the sites assessed were in Good condition, 46 percent were in Fair condition, 19 percent were Poor, and 12 percent were Very Poor. More sites in the Good condition were found in the upper portion of the Middle Patuxent River watershed, while the middle and the lower portion of the watershed had a relatively even distribution of stream conditions (Versar, 2015b). In addition, Howard County also evaluated the watershed's stream habitat condition by using the EPA's Rapid Bioassessment Protocol (RBP). Monitoring results indicated that many of the streams within the Middle Patuxent River watershed are experiencing some level of habitat degradation (Versar, 2015b).

**Table 4** shows examples of the following five categories of BMPs that Howard County considers to be major strategies towards addressing the County's Bay TMDL and NPDES MS4 permit requirements: (1) BMP conversions, (2) proposed new BMPs, (3) tree planting, (4) stream restoration, and (5) outfall stabilization (Versar, 2015b).

Howard County's overall (applicable across all project types) recommendations for restoration/preservation projects within the Middle Patuxent River watershed were based on the consideration of four pre-developed categories. The first consideration is "permit contribution," i.e., to what degree a project will help meet the County's NPDES MS4 requirements for pollution reduction and impervious surface treatment. The second consideration is "biological uplift," i.e., whether a project will provide additional biological uplift benefits such as the protection of wetlands. The third category—"programmatic benefit"—considers whether a project would have value beyond its primary purpose such as serving as a visible demonstration project or providing public education. The fourth and final category is "feasibility," i.e., the feasibility of project implementation. This includes whether the project site is privately or publicly owned, the accessibility of the site, and whether a repair is already required at the site (would minimize costs by upgrading the facility during the course of other required repairs) (Versar, 2015b).

Out of the 193 potential projects that the County identified and ranked, four-page concept plans were produced for each of the 39 top-ranked opportunities. (The complete set of concept plans is available in Appendix H of the 2015 Howard County Middle Patuxent Assessment [Versar, 2015b]). Overall, of the five recommended project types shown in **Table 4**, the 39 concept plans consisted of: 5 BMP conversions, 0 new BMPs, 13 tree plantings, 15 stream restoration projects, and 6 outfall stabilizations (Versar, 2015b).

**Little Patuxent River (Howard County)**

On behalf of the Howard County Department of Public Works, Versar completed the 2015 *Little Patuxent River Watershed Assessment* (Versar, 2015c)—hereinafter referred to as the "2015 Howard County Little Patuxent Assessment."

In 2014-2015, Howard County's Stormwater Management Division conducted an assessment of the Little Patuxent River watershed within Howard County in order to assess current conditions and recommend watershed restoration opportunities. As a result of the assessment, the project team recommended several opportunities including upgrades to existing stormwater BMPs, new BMPs, tree plantings, stream restoration, and stabilization of stormwater outfalls. Overall, this assessment yielded 760 potential projects and concept plans for 109 of the top-ranked opportunities identified (Versar, 2015c).

The portion of the Little Patuxent River watershed within Howard County drains 59 square miles (37,760 acres). The predominant land use is residential (41.0 percent). This is followed by commercial-industrial-institutional (18.6 percent), which occurs mostly in the southern half of the watershed. Forested areas (21.1 percent) occur mostly along the watershed's stream corridors and the Little Patuxent River mainstem. The watershed includes 9,043 acres of woods and 190 miles of streams (Versar, 2015c). More residential and commercial development is expected to take place in the future, especially around the planned community of Columbia (Versar, 2015c).

About 25.6 percent of the Little Patuxent River watershed within Howard County contains impervious cover; at this percentage, stream degradation is readily observed. As of 2015, there are 1,746 existing stormwater BMPs treating approximately 47 percent of this impervious area. The impervious cover includes roads, parking lots, driveways, major buildings, bridge decks, sidewalks, pathways, and swimming pools (Versar 2015c). Overall, the majority of the soils located in the watershed have high runoff potential; however, some upper parts (around Hammond Branch, for example) predominantly contain soils that have well to moderately well drained soils.

Stream conditions in Howard County's Little Patuxent River watershed were also assessed. While some sites were in Good condition in the upper parts of the watershed (including the upper reaches of Hammond Branch), most sites in the lower part of the watershed (including Dorsey Run) were in Poor to Very Poor condition (Versar, 2015c). In addition, stream habitat conditions were also evaluated. The results indicated that many streams in the Little Patuxent River watershed have been affected by habitat degradation (Versar, 2015c). This degradation, however, was more prevalent in the heavily developed urban areas. Consequently, conditions are generally better in the more rural parts of the County; however, stream degradation can still occur in the rural areas due to large lot development and nearby agricultural activities (Versar, 2015c).

For future treatment, the following five restoration opportunity types were considered: (1) BMP conversions, (2) proposed new BMPs, (3) tree planting, (4) stream restoration, and (5) outfall stabilization. Candidate project sites were identified that would benefit from these five restoration strategies (Versar, 2015c). **Table 4** presents the examples provided by Howard County under each category.

The County utilized and collected GIS data as the first step towards identifying candidate retrofit and restoration sites for further investigation in the field. Initially selected candidate sites were reviewed by Howard County staff to finalize the list of field sites to be visited. Ultimately, 530 sites and 50 stream miles were selected for field investigation, and another 72 sites previously assessed in other studies were scheduled for desktop assessments (Versar, 2015c).

Ranking criteria were developed according to the same four categories described in the previous summary of the 2015 Howard County Middle Patuxent Assessment: permit contribution, biological uplift, programmatic benefit, and feasibility (Versar, 2015c). In addition, a two-part, standardized method was developed for ranking and prioritizing the identified project opportunities. Each project was first ranked against all other projects of the same type. Then, all projects were pooled together and ranked against one another to enable ranking across project type and to determine which projects should be taken to the next design phase (Versar, 2015c).

Out of the 760 potential projects identified, ranking scores were used to select the 109 highest-ranked projects for concept plan development. (The complete set of concept plans is available in Appendix H of the 2015 Howard County Little Patuxent Assessment [Versar, 2015c]). Overall, of the aforementioned five restoration opportunity types, the 109 concept plans consisted of the following: 15 BMP conversions, 10 new BMPs, 19 tree plantings, 45 stream restorations, and 20 outfall stabilizations (Versar, 2015c).

Additional reductions could also be accomplished by activities such as street sweeping; erosion/sediment control; and public outreach efforts such as watershed trash cleanup campaigns, conservation landscaping, and pet waste education. Over the next several years, the County may add these types of activities as needed to meet TMDL goals (Versar, 2015c).

| *Table 4: Howard County Suggested BMPs within the Howard County Portions of the PAXTF* |
| --- |
| **BMP Conversions** |
| • Extended detention wet ponds/wetlands, shallow wetlands<br>• Bioretention<br>• Non-bioretention filtering practices<br>• Infiltration practices<br>• Swales<br>• Addition of pre-treatment or post-treatment BMPs within existing dry or wet pond boundaries<br>• **New BMP retrofits outside of existing dry or wet pond boundaries but which would drain into an existing pond or capture and treat stormwater just outside of the existing pond (e.g., step pool conveyance)** |
| **New BMPs** |
| • Extended detention wet ponds/wetlands, shallow wetlands<br>• Bioretention<br>• Non-bioretention filtering practices<br>• Infiltration practices<br>• Swales<br>• Green roofs<br>• Replacement of impervious cover with pervious pavement<br>• Impervious cover removal<br>• Rain barrels<br>• Rain gardens<br>• **Rooftop disconnection** |
| **Tree Planting** |
| • **Reforestation of stream buffers**<br>• **Reforestation of upland areas** |
| **Stream Restoration (restoring degraded stream channels for erosion control and enhanced nutrient processing)** |
| **Outfall Stabilization** |
| • Rip Rap stabilization<br>• Step Pool Conveyance (SPSC)/Regenerative Stormwater Conveyance (RSC) stabilization<br>• Installing a drop structure or other stabilization of the outfall channel |
| ***Sources: KCI (2017); Versar (2015b); and Versar (2015c)*** |

## Anne Arundel County Assessments

**Little Patuxent River (Anne Arundel County)**

In 2016, the Anne Arundel County Department of Public Works completed the *Little Patuxent Watershed Assessment Comprehensive Summary Report* (LimnoTech & Versar, 2016)—hereinafter referred to as the "2016 Report." For assessment purposes, the Little Patuxent River watershed was broken up into 21 subwatersheds. Each subwatershed was given a name to match the geographic area (stream or landmark) and assigned a number if there were multiple subwatersheds related to that geographic area (e.g., Dorsey Run 1, Dorsey Run 2, etc.) as well as a three-digit code beginning with "LP" for Lower Patuxent. Ten of the subwatersheds codes were given numbers: LP0 – LP9; the rest were given letters: LPA – LPK. For simplicity, the names, not codes, of the 21 subwatersheds are referenced in this summary.

There are a variety of jurisdictions in the watershed, including Fort Meade, the Patuxent Research Refuge, and the Maryland Sunrise Farm (formerly the U.S. Naval Academy Dairy Farm). In addition to the Little Patuxent River, major streams in Anne Arundel County's portion of the Little Patuxent River watershed include Dorsey Run, Rogue Harbor Branch, and Towsers Branch. Several major roads also traverse the watershed: MD 32, I-95, I-295 (Baltimore-Washington Parkway), MD 175 (Jessup Road), Piney Orchard Parkway, MD 3, MD 198, MD 50, MD 301 and MD 424. The watershed also contains the Crofton County (or Golf) Club in its southernmost portion.

The watershed has many sensitive environmental features such as wetlands and greenways. The majority of wetlands are located along the Little Patuxent River. With the exception of Fort Meade, greenways are located throughout the watershed. Forest (approximately 45.9 percent) makes up the biggest portion of land cover in the watershed. The largest land ownership types are "Natural Lands within County jurisdiction," the U.S. Department of Defense (Fort Meade), and the U.S. Fish and Wildlife Service (Patuxent Research Refuge). Of the property owned by the County, the private high density residential and County roads/facilities constitute the largest impervious areas.

According to the 2016 Report, MDOT SHA owns about 387.9 acres in Anne Arundel County's portion of the Little Patuxent River watershed. Of the 387.9 acres, 159.5 acres are impervious (41 percent). The fastest development in the watershed occurred in the Crofton Golf subwatershed from 1960 through 1979. In the 2000-2015 time period, the "Towsers Branch 3" subwatershed experienced the highest rate of new development (Towsers Branch is located in the most southern portion of the watershed near MD 3.)

Approximately 38 percent (majority) of the soils in the Little Patuxent watershed are classified as hydrologic soil Group C. Group C soils have a moderately high runoff potential when thoroughly wet and water transmission through the soil is somewhat restricted. The most common (47 percent) soil erodibility class present in the Little Patuxent River watershed is "potentially highly erodible land" (LimnoTech & Versar, 2016).

Based on the calculated Maryland Physical Habitat Index (MPHI) score, each stream reach was assigned a condition category of Severely Degraded, Degraded, Partially Degraded, or Minimally Degraded. Standard MPHI category breakpoints used by the Maryland Department of Natural Resources (DNR) are as follows:

- 0 to 50.9 – Severely Degraded
- 51.0 to 65.9 – Degraded
- 66.0 to 80.9 – Partially Degraded
- 81.0 to 100 – Minimally Degraded

The 2016 Report states that the average stream-weighted MPHI score for the Little Patuxent River watershed is 79.3, which corresponds to the "Partially Degraded" condition. Riparian buffer impacts and erosion had the highest total cumulative impact score of all the inventoried features.

Riparian buffer impacts were mostly due to encroachment from residential lawns (LimnoTech & Versar, 2016).

The County has also selected several different types of restoration strategies. The County's selection criteria for restoration projects includes the cost effectiveness relative to the quantity of pollutant removed, maintenance needs, life expectancy, and public acceptance of the proposed project (LimnoTech & Versar, 2016).

The County's strategy is broken down into three primary categories:

- **Core Strategies** – Generally large capital improvement projects that represent the bulk of the load reductions and capital expenditures. Goals include obtaining compliance with WQSs and restoring stream stability, connectivity with floodplains, biological health.
- **Core Tier II Strategies** – Generally smaller scale capital projects or programmatic strategies collectively intended to close the County's gap on achieving its final 2025 required nutrient load reductions.
- **Potential Load Reductions Outside of the Core Strategy WIP Areas** – Credits that may be achieved from installation of stormwater management practices on private property as a result of potential future implementation of a County stormwater utility fee and associated credit program (LimnoTech & Versar, 2016).

The following represent the Core Strategies that will be employed in the Little Patuxent River watershed:

- Outfall Retrofits;
- Stormwater Pond Retrofits;
- Stream Restoration; and
- Programmed Projects (Programmed environmental restoration projects to be implemented by the County, including outfall retrofits, stream restorations, and BMP retrofits.)

The following represent the Core Tier II Strategies that will be employed in the Little Patuxent River watershed:

- Street Sweeping;
- Inlet Cleaning;
- Public Land Reforestation; and
- Stormwater to the Maximum Extent Practicable (MEP) (This strategy includes retrofitting existing impervious surfaces to the MEP with stormwater management practices, including but not limited to green roofs, permeable pavement, bioretention, and downspout disconnection. The 2016 Report states that these retrofits will be limited to County-owned properties including the County's Board of Education and Recreation and Park facilities (LimnoTech & Versar, 2016).

For the third category strategy, "Potential Load Reductions Outside of the Core Strategy WIP Areas," the County assumes that these credits are limited to areas outside of existing areas covered by the Core Strategies and Core Tier II Strategies. Therefore, the following two broad types of restoration activities were considered in this category (LimnoTech & Versar, 2016):

- Private Commercial/Industrial Stormwater Management (credit accounts for stormwater management retrofits to private commercial and industrial properties)
- Private Residential Stormwater Management (credit accounts for retrofitting rooftops in high density residential areas with practices such as rain water harvesting or rain gardens)

**Patuxent River Upper (Anne Arundel County)**

On behalf of the Anne Arundel County Department of Public Works, LimnoTech completed the *Upper Patuxent River Watershed Overall Summary Recommendation Report* in September of 2008 (LimnoTech, 2008)—hereinafter referred to as the "Recommendation Report." The Recommendation Report explains that Anne Arundel County's portion of the Patuxent River Upper watershed is divided into 19 subwatersheds, named UP1 – UP9 and UPA – UPJ. The watershed was also split into northern and southern sections near where MD 3 intersects the watershed. The northern section contained UP1 – UP7; the southern section consisted of UP8, UP9, and UPA – UPJ.

According to the Recommendation Report, the entire portion of the Patuxent River Upper watershed within Anne Arundel County drains 22,500 acres, with impervious land cover comprising approximately 14 percent of the watershed as a whole. Land use, however, was assessed separately for the northern and southern sections of the watershed. In the northern section, the predominant land use was forest (76 percent), followed by residential (7 percent). Only 1 percent of the northern section is used for agriculture. In the southern section, the predominant land use was also forest (43 percent), followed by residential (22 percent). Agriculture was the third most common land use, making up 19 percent of the southern section.

The Recommendation Report used three methods to assess restoration and preservation potential within the watershed: a stream restoration assessment, a subwatershed restoration assessment, and a subwatershed preservation assessment. As part of these assessments, chemical and physical data were collected, and various GIS layers were updated.

The assessed stream reaches were placed into one of four categories: Good, Fair, Poor, and Very Poor. The stream reaches in the Patuxent River Upper watershed were predominantly Good to Fair on the rating scale. The full results of the stream restoration assessment are provided in the Recommendation Report (see “Table 2” on p. 7 of LimnoTech [2008]).

The subwatershed restoration assessment was intended to identify subwatersheds where conditions warranted restoration activities on a large scale, such as BMP retrofitting. Likewise, the subwatershed preservation assessment was intended to identify subwatersheds where conditions warranted consideration for preservation activities.

The subwatersheds were placed into one of four categories based on the results of the restoration and preservation assessments: Good, Fair, Poor, and Very Poor. For the subwatershed restoration assessment, subwatersheds UP2 (in northern section near the city of Laurel) and UPB (in southern section directly below MD 50/MD 301) were both rated Very Poor and were therefore the highest priority for restoration. For the subwatershed preservation assessment, subwatersheds UP1, UP6, and UP7 (UP1 and UP6 are in the northern section near the city of South Laurel; UP7 is the southernmost subwatershed in the northern section, extending down to where the northern section becomes the southern section near MD 3) were rated as Good and were therefore the best candidates for preservation. The full list of restoration and preservation rankings results can be found in the Recommendation Report (see “Table 4” and “Table 6” on p. 9 and p. 10, respectively, of LimnoTech [2008]).

Known impairments of the County’s portion of the Patuxent River Upper watershed include nutrients and sediments. Therefore, the Recommendation Report also conducted water quality modeling to better understand the potential for future water quality improvements. Existing and future development scenarios were modeled that included assumptions for impervious cover, stormwater management, and septic loading. For each scenario, BMP pollutant removal efficiencies and event mean concentration (EMC) values for the different land cover types were used to predict pollutant loading for a set of water quality parameters. These parameters included total nitrogen, total phosphorus, nitrates, fecal coliform, TSS, and metals. Loading determinations were made for the typical TMDL categories (urban, agricultural, and other) and were calculated separately with and without BMPs or ESD retrofits.

Two existing conditions scenarios were modeled: with fully maintained BMPs, and with failed urban BMPs. Eighteen different future condition scenarios were also modeled. Examples of conditions used in the future models included with or without various BMP implementation and maintenance, septic upgrades, implementation of the Sewer Master Plan, and varying levels of ESD retrofits, to name a few.

For some subwatersheds and water quality parameters, all current and future development scenarios met County loading goals. For other subwatersheds and water quality parameters, none of the scenarios met loading goals. The Recommendation Report generally concluded that ESD retrofits in County right-of-ways and select private lands provide the best opportunity for pollutant reduction.

**Patuxent River Middle (Anne Arundel County)**

In June 2018, KCI and Coastal Resources completed the *Herring Bay, Middle Patuxent, and Lower Patuxent Watershed Assessment Comprehensive Summary Report* (KCI & Coastal Resources, 2018) (hereinafter referred to as the “2018 Report”). The 2018 Report serves as Anne Arundel County’s assessment of the 8-digit Patuxent River Middle watershed portion within Anne Arundel County (referred to as the “Middle Patuxent” watershed in the 2018 Report).

For the 2018 Report, the Anne Arundel County portion of the Patuxent River Middle watershed, which is located in the southern portion of the County, was divided into 33 subwatersheds. Each subwatershed was given a name to match the surrounding geographic area (stream or landmark) and assigned a number if there were multiple subwatersheds related to that geographic area (e.g., Rock Branch 1, Rock Branch 2, etc.) as well as a three-digit code beginning with “MP” for Middle Patuxent. Ten of the subwatersheds were given numbers: MP0 – MP9; the rest were given letters: MPA, MPB, MPD – W, and MPZ. While not discussed in this summary, MPC, MPX, and MPY are three subwatersheds that are in the Patuxent River Lower watershed that were in grouped in with the Patuxent River Middle watershed for analysis and reporting in the 2018 Report. For simplicity, the names, not codes, of the 33 subwatersheds are used in this summary.

The Anne Arundel County portion of the Patuxent River Middle watershed is approximately 29,820 acres in area in the southern portion of the County. The watershed includes several named streams including Rock Branch, Wilson Owens Branch, Lyons Creek, Cabin Branch, Galloway Creek, and the middle branch of the Patuxent River.

In the Patuxent River Middle, the fastest development occurred in the Galloway Creek subwatershed between 1920 and 1999. Development is expected to continue to occur. The majority of future residential development will likely take place in and around the Wilson Owens Branch and Galloway Creek subwatersheds.

Impairments in the Patuxent River Middle watershed include nitrogen, phosphorus, TSS, and most recently, PCBs addressed by the PCB TMDL (MDE, 2017b).

The stormwater BMPs in the Patuxent River Middle watershed are typically owned by private land owners, the County, or other State agencies, such as the MDOT SHA. While the majority of BMPs in the watershed are privately owned, the MDOT SHA-owned BMPs account for about half of the managed drainage areas within the Patuxent River Middle watershed within Anne Arundel County (KCI & Coastal Resources, 2018). Examples of privately owned BMPs include small biorention cells and ESD facilities such as rain gardens and downspout disconnection.

Four types of assessments were conducted for the Patuxent River Middle watershed in Anne Arundel County: stream restoration, subwatershed restoration, subwatershed preservation, and parcel scale. All four types of assessments utilized a prioritization rating scale of High, Medium High, Medium, or Low.

Results of the stream restoration showed that when compared with all of the major watersheds in Anne Arundel County, the Patuxent River Middle watershed has relatively few stream reaches rated High for restoration, with most of the reaches falling in the Medium and Low category. The "Lyons Creek 10" subwatershed had the most stream reaches in the High category with four reaches rated as High priority for restoration.

The subwatershed restoration assessment used a suite of indicator ratings that were weighed and combined to obtain a single restoration rating for each subwatershed. The indicators were grouped into one of seven categories: stream ecology, 303(d) list, septics, BMPs, H&H, water quality, and landscape. In the Patuxent River Middle watershed, only 4 subwatersheds out of the 33 subwatersheds received a rating of High for restoration priority: "Galloway Creek," "Wilson Owens Branch 2," "Lyons Creek 7," and "Lyons Creek 8."

The subwatershed preservation assessment also used a suite of indicator ratings that were weighed and combined to obtain a single preservation rating for each subwatershed. The indicators were grouped into one of five categories: stream ecology, future departure of water quality conditions, soils, landscape, and aquatic living resources. Ten subwatersheds out of the 33 subwatersheds (30 percent) were rated High priority for preservation: "Ferry Branch 1," "Galloway Creek," "Cabin Branch 1," "Two Run Branch 2," "Pindell Branch," "Lyons Creek 2," "Lyons Creek 9," "Cabin Branch 2," "Two Run Branch 1," and "Wilson Owens Branch 4." The 2018 Report further noted that two "Tier II High Quality Waters" stream segments exist in the "Cabin Branch 1" and the "Lyons Creek 10" subwatersheds.

As stated above, the "Cabin Branch 1" subwatershed received a preservation ranking of High. The nearby "Lyons Creek 10" subwatershed received a preservation ranking of Medium High. These two ratings coupled with the fact that several adjacent subwatersheds draining to the reaches in the "Cabin Branch 1" and "Lyons Creek 10" subwatersheds also rated High for preservation makes "…this an important area for implementing preservation measures" (KCI & Coastal Resources, 2018, p. 90).

Lastly, a parcel scale assessment was conducted. The 2018 Report noted that this additional assessment was completed due to the fact that the general land use conditions in the southern portions of Anne Arundel County differ from the rest of the County in that the southern areas are less developed and contain more agricultural and forest cover. Consequently, the amount of impervious surface area in the southern portions of the County is "considerably less" than in other parts of the County (KCI & Coastal Resources, 2018, p. 91). (Impervious surface accounts for only 4.8 percent of the total area in the Patuxent River Middle watershed.) Based on this information, the County has recognized that preservation is critical in the Patuxent River Middle watershed. Therefore, the County supplemented its subwatershed preservation assessment with three separate but related prioritization models that identified areas at the parcel level as good candidates for (1) preservation, (2) tree planting and/or riparian buffer restoration, and (3) impervious treatment (removal and conversion to pervious). At the parcel level, there were too many sites identified to provide a meaningful summary. Accordingly, the 2018 Report provides a visual summary of the identified good candidate sites for these actions in the form of several large maps (see Map 4.4 for the good candidate sites for preservation, Map 4.5 for the good candidate sites for reforestation, and Map 4.6 for the good candidate sites for impervious treatment in the 2018 Report).

## Prince George's County Assessments

### Rocky Gorge Dam and Patuxent River Upper (Prince George's County)

In 2015, Prince George's County Department of the Environment published the *Restoration Plan for the Upper Patuxent River and Rocky*

*Gorge Reservoir Watersheds in Prince George's County* (Tetra-Tech, 2015) (hereinafter referred to as the "2015 Restoration Plan").

There is a very small portion (approximately 530 acres or 0.83 square miles) of the Rocky Gorge Dam (referred to as the "Rocky Gorge Reservoir" watershed in the 2015 Restoration Plan) within Prince George's County. Prince George's portion of the Rocky Gorge Dam watershed is impaired with phosphorus associated with both upstream point and nonpoint sources. Almost all of the watershed contains hydrologic Group B soils. Land use in Prince George's portion of the Rocky Gorge Dam consists of mostly forest (more than 51 percent), followed by urban (less than 23 percent) and agricultural (more than 18 percent). Approximately 6.1 percent of the land in Prince George's part of the Rocky Gorge Dam watershed is impervious (Tetra-Tech, 2015).

Prince George's portion of the Patuxent River Upper watershed (referred to as the "Upper Patuxent River" watershed in the 2015 Restoration Plan) is approximately 31,881 acres (49.8 square miles) and includes several municipalities such as the cities of Laurel, South Laurel, and Bowie. It also includes a large area of the Patuxent Research Refuge owned and operated by the U.S. Fish and Wildlife Service. Streams in the portion of the watershed surrounding the city of Bowie are impaired with fecal coliform bacteria (Tetra-Tech, 2015). Sediment is listed as an impairment throughout the entire watershed (both the Rocky Gorge Dam and Patuxent River Upper). Almost half of the Patuxent River Upper watershed contains hydrologic Group B soils, while a combination of Group C and Group D soils make up the remainder of the watershed. Land use in Prince George's portion of the Patuxent River Upper watershed is mostly urban (about 51 percent, largely residential land); however, there is significant forested land (more than 38 percent) among the non-urban portions of the watershed. Approximately 18 percent of the land in Prince George's part of the Patuxent River Upper watershed is impervious (Tetra-Tech, 2015).

For the 2015 Restoration Plan, Prince George's portion of the Patuxent River Upper watershed was divided into 38 subwatersheds, named as PX-1 through PX-38. With the exception of PX-38, which is near the southern portion of the watershed, the subwatersheds start out with PX-37 near the northern most part of the watershed and progress in numerical order down the length of the watershed until PX-1 is reached at the southernmost tip.

An evaluation of each subwatershed in the Patuxent River Upper watershed was performed to aid in the selection of BMPs in the areas with the highest required pollutant load reductions. The County prioritized the subwatersheds by ranking the necessary total load reduction for each TMDL parameter and then averaging the individual ranks to obtain an overall rank for the subwatershed. According to the 2015 Restoration Plan, "Although not included in this restoration plan, PCBs are included in the subwatershed ranking" (Tetra-Tech, 2015, p. 63). Therefore, the TMDL parameters included in the ranking were total nitrogen (TN), total phosphorus (TP), TSS, BOD, fecal coliform bacteria, and PCBs. These six TMDL parameters are also noted as the "contaminants of most concern in the County" (Tetra-Tech, 2015, p. 107).

The highest ranked watersheds tended to be in areas with the largest amount of impervious cover. Subwatersheds PX-28, PX-30, and PX-34 were among the highly ranked watersheds. These subwatersheds encompass the cities of Laurel and South Laurel in the upper portion of the Patuxent River Upper watershed. Subwatersheds PX-12, PX-13, PX-14, and PX-17 were also highly ranked, with PX-13 emerging as the highest ranked subwatershed overall. These subwatersheds encompass the city of Glenn Dale and portions of the city of Bowie. The County noted that "[t]hese areas are dominated by commercial and residential areas with some minor institutional areas that could be used for BMP implementation in the future." (Tetra-Tech, 2015, p. 63) No ranking was completed for the Rocky Gorge Dam portion; however, its entire drainage area was included in the County's modeling calculations (Tetra-Tech, 2015).

**Western Branch and WBRTF (Prince George's County)**

The Western Branch, which includes the WBRTF segmentshed within its boundary, is located solely within Prince George's County. As of July 2018, a watershed restoration plan for the Western Branch is not available online at Prince George's Watershed Restoration Planning Site (http://pgcdoe.net/pgcountyfactsheet/Factsheet/Default). However, Prince George's County has prepared several Watershed Existing Condition Reports, including one from 2014 that covers the Western Branch and is summarized below. These reports were the initial step in the restoration plan development process for the watersheds in the County that have EPA-approved TMDLs. The reports characterize the watersheds, provide a review of existing reports and data, and present some additional data and spatial analyses.

In December 2014, Prince George's County Department of the Environment published the *Watershed Existing Condition Report for the Upper Patuxent River, Western Branch, and Rocky Gorge Reservoir Watershed* (Tetra-Tech, 2014)—hereinafter referred to as the "Watershed Existing Condition Report."
The Watershed Existing Condition Report stated that TSS issues in the Western Branch can be attributed to agricultural and urban land uses and stream bank erosion from increased stormwater sources. Located solely within Prince George's County, the Western Branch also has a problem with BOD, which can be an indicator of organic pollution. Lower DO in streams near discharges from WWTPs, agriculture feed lots, and septic systems is also a problem.

In the Western Branch, the land use is primarily forest and agriculture, which show areas of higher nutrient loads (Tetra-Tech, 2014). Stormwater ponds, which usually treat residential and non-urban areas, are the most implemented BMP in the Western Branch watershed. While this practice treats larger areas, they are less efficient than other practices at removing pollution.

Infiltration practices are the second most implemented stormwater control in the Western Branch; they treat smaller areas but remove pollution with greater efficiency. The oil and grit separators are known for treating more area but have lower removal efficiencies than infiltration practices. Existing BMPs in the Western Branch include bioretention, grass swales, infiltration, oil/grit separators, and ponds (Tetra-Tech, 2014).

There were two sites mentioned in the Watershed Existing Condition Report regarding benthic invertebrates and Benthic Index of Biotic Integrity (BIBI) sampling within the Western Branch watershed; these sites are (Tetra-Tech, 2014):

- Southwest Branch – a total of 7 streams were sampled: 6 first order and 1 second order. One was rated Very Poor, three were rated Poor, and the remaining were rated as Fair.

- Collington Branch – a total of 12 streams were sampled. One was rated Very Poor, three were rated Poor, seven were rated as Fair, and one was rated as Good.

Prince George's County has also engaged in street sweeping, public outreach to promote environmental awareness, green initiatives, and community involvement in protecting natural resources. Past public outreaches conducted include distributing educational brochures on stormwater pollution, the "Can the Grease" program to decrease SSOs, and implementing recycling programs (Tetra-Tech, 2014).

**Patuxent River Middle (Prince George's County)**

As of July 2018, a watershed restoration plan is not available online at Prince George's Watershed Restoration Planning Site (http://pgcdoe.net/pgcountyfactsheet/Factsheet/Default) that covers the Patuxent River Middle watershed portion within Prince George's County. A Watershed Existing Condition Report covering the Patuxent River

Middle portion within Prince George's County is also currently not available on the site.

## F.3. MDOT SHA Visual Inventory of ROW

The MS4 Permit requires MDOT SHA to perform visual assessments. **Section C** describes the MDOT SHA visual assessment process. The implementation teams have preliminarily evaluated each grid and major State route corridors within the segmentshed as part of a desktop evaluation. The grid-system for these segmentshed is shown in **Figure 8**.

The current results of this visual assessment are as follows

- 292 total grids have been reviewed, which encompasses portions of 87 State route corridors (**Figure 8**).
- Six new SWM facilities resulting in 10.96 acres of impervious restoration have been constructed including four bioretentions and two wet ponds. A number of potential locations have been identified as possible candidate sites for new SWM BMPs; however, MDOT SHA is currently evaluating the cost-effectiveness of these potential opportunities.
- 315.40 acres of tree plantings have been constructed resulting in 119.85 acres of impervious restoration. There are an additional 87.04 acres of tree plantings that are currently in design, proposed, or under construction. It is anticipated that these will be planted by 2025, which will result in 33.08 acres of impervious restoration.
- 6,890 linear feet of stream restoration have been restored resulting in 68.9 acres of impervious restoration. There are an additional 34,559.2 linear feet of stream restoration that are currently in design or proposed. It is anticipated that these will be restored by 2025, which will result in 345.6 acres of impervious restoration.

Teams will continue to pursue the most viable and cost-effective BMPs that are currently within the existing pool of sites based on site feasibility.

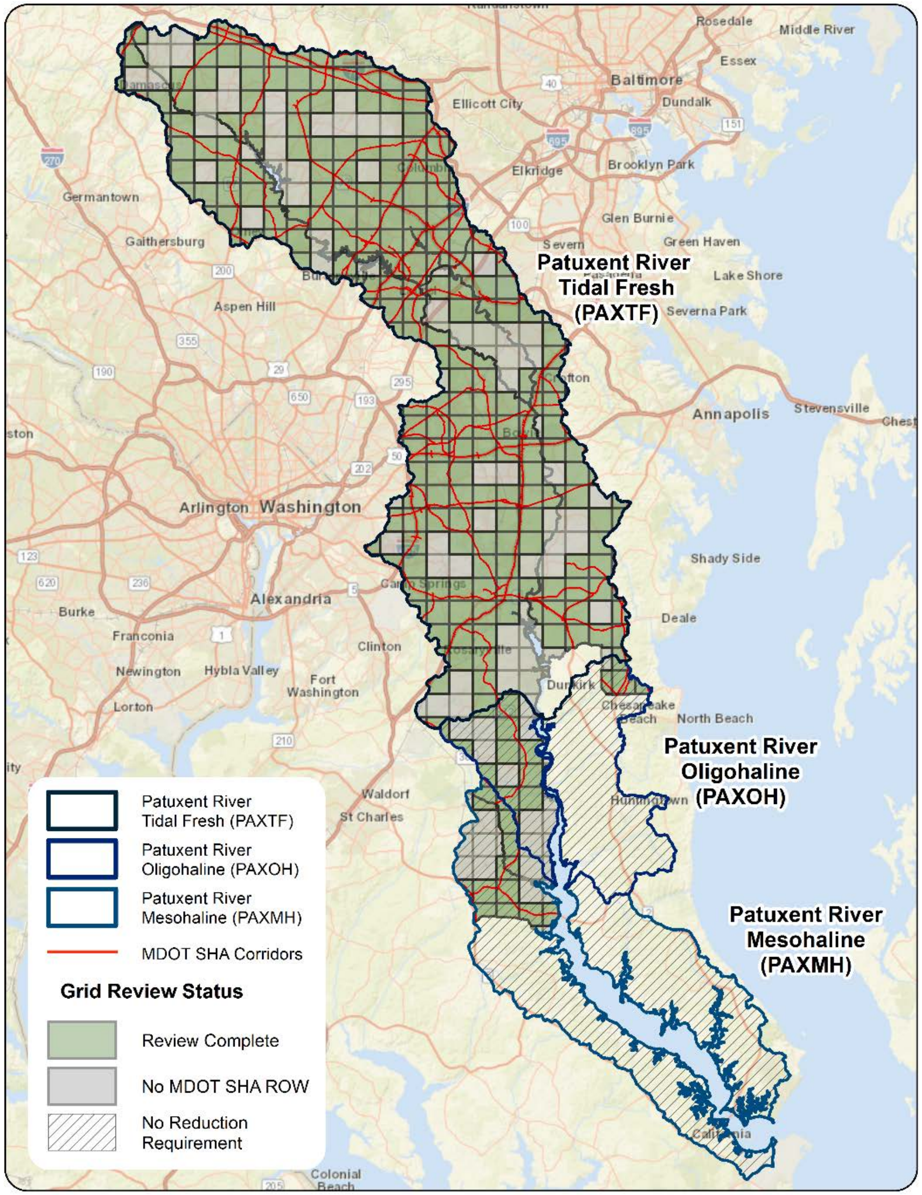



*Figure 8: PAXMH, PAXOH, and PAXTF Segmentsheds Site Search Grids*

## F.4. MDOT SHA Pollutant Reduction Strategies

Proposed practices that are currently programmed for implementation to meet the PCB reductions in the PAXTF segmentshed are shown in **Table 5**. Projected PCB reductions using these practices are 0.14 g/yr which is 2.3% of the required reduction. Three timeframes are included in the table below:

- BMPs built before the TMDL baseline. In this case, the baseline is 2010;
- BMPs built after the baseline through calendar year 2018; and
- BMPs built after calendar year 2018 through 2050, the projected target date.

The currently programmed BMPs will not meet the reduction requirement shown in **Table 2**, although some small reductions are achieved through stormwater BMPs for PCB TMDLs. Based on these results, MDOT SHA has concluded that bioremediation, source tracking, and elimination may be a more effective way of achieving PCB load reductions.

Estimated Capital Budget costs to design and construct the programmed practices within the PAXTF segmentshed total $203,084,000. These projected costs are based on an average cost per impervious acre treated that is derived from cost history for a group of completed projects for each BMP category. In addition to Capital Budget costs, $332,000 from the Operations Budget is estimated for annual inlet cleaning and street sweeping.

**Figure 9** is a map of MDOT SHA's restoration practices in the PAXTF segmentshed, including those that are under design or construction. Inlet cleaning is not reflected on this map.

| Table 5: PAXTF PCB BMP Implementation | | | | | |
|---|---|---|---|---|---|
| BMP[1] | Unit | Baseline (Before 2010) | Restoration BMPs | | Cost |
| | | | Progress (2010 – FY18) | Future (After FY18) | |
| New Stormwater | drainage area acres | 1,687.8 | 144.7 | 41.1 | $195,757,000 |
| Retrofit | drainage area acres | | 15.8 | 139.8 | $7,279,000 |
| Impervious Surface Elimination | acres removed | | 0.2 | | $48,000 |
| Inlet Cleaning[2] | tons | | 56.4 | | $322,000 |
| Street Sweeping[2] | acres swept | | 102.0 | | $10,000 |
| [1] *Tree planting, outfall stabilization, and stream restoration BMPs do not contribute to PCB load reductions; therefore, these practices are not included in this table.* | | | | | |
| [2] *Inlet cleaning and street sweeping are annual practices.* | | | | | |

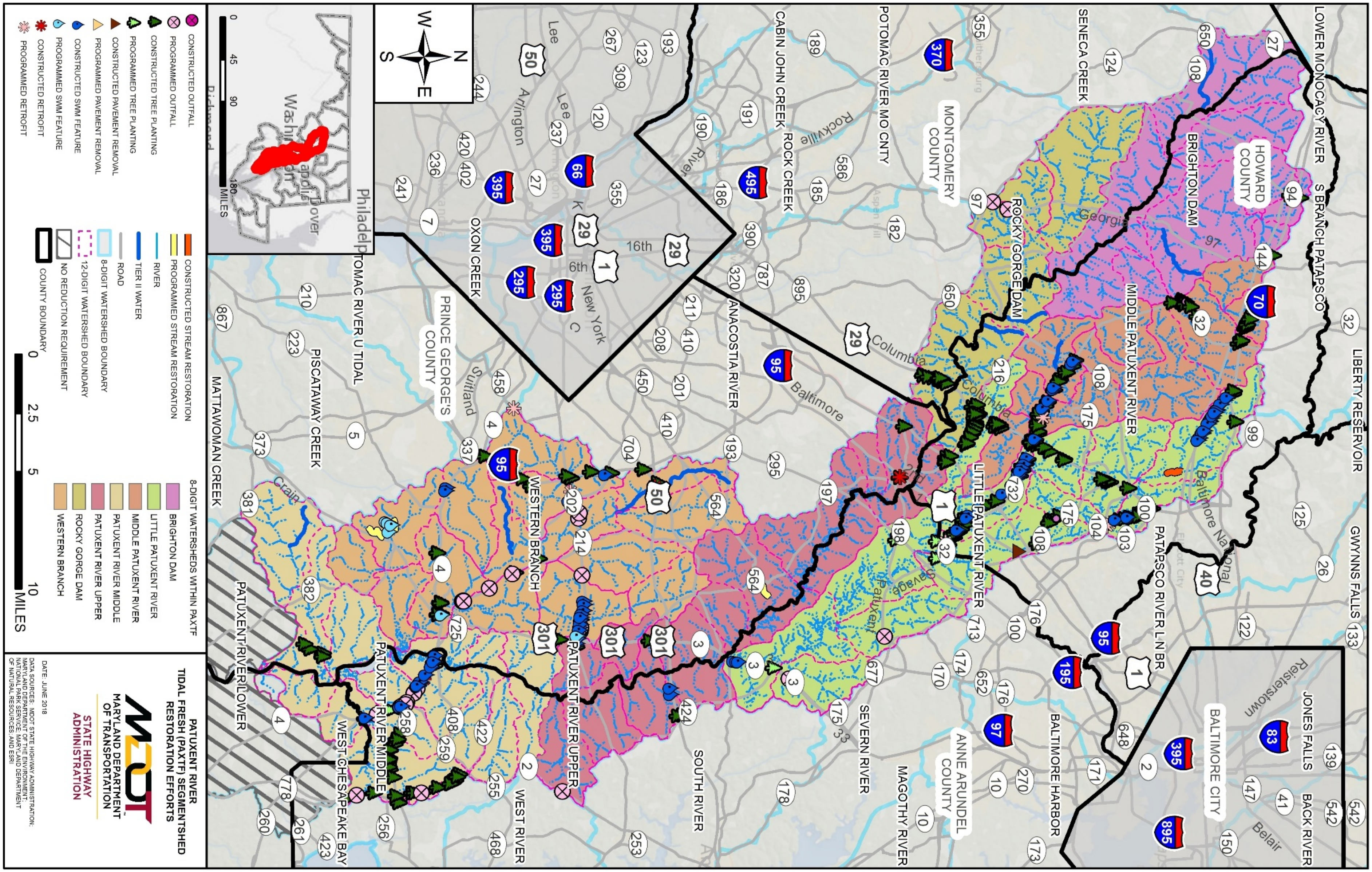



*Figure 9: MDOT SHA Programmed Restoration Strategies within the PAXTF Segmentshed*

# ABBREVIATIONS

Note: This list of abbreviations was developed for the MDOT SHA 2016 Impervious Restoration and Coordinated TMDL Implementation plan (available at www.roads.maryland.gov). Many of the abbreviations may not apply to this document.

| | |
|---|---|
| AA | Anne Arundel (County) |
| AA-DPW | Anne Arundel County, Department of Public Works |
| AAH | Adopt-A-Highway |
| AASHTO | American Association of State Highway and Transportation Officials |
| ac | Acre |
| AFB | Air Force Base |
| Alt | Alternative |
| AMT | Automated Modeling Tool |
| AMT, Inc. | A. Morton Thomas and Associates, Inc. |
| ATV | All-terrain vehicle |
| BA | Baltimore (County) |
| BARC | Beltsville Agriculture Research Center |
| Bay | Chesapeake Bay |
| BBO | Beaverdam Run, Baisman Run, and Oregon Branch Subwatersheds of the Loch Raven Reservoir Watershed |
| BC-DEPRM | Baltimore County, Department of Environmental Protection and Resource Management |
| BC-DEPS | Baltimore County, Department of Environmental Protection and Sustainability |
| BIBI | Benthic Index of Biotic Integrity |
| BMP | Best Management Practice |
| BOD | Biochemical Oxygen Demand |
| BSID | Biological Stressor Identification |
| BST | Bacterial Source Tracking |
| CAFO | Concentrated Animal Feeding Operation |
| CBP | Chesapeake Bay Program |
| CBWM | Chesapeake Bay Watershed Model |
| CC | Charles (County) |
| CC-BRM | Carroll County, Bureau of Resource Management |
| CC-DPGM | Charles County, Department of Planning & Growth |
| CCMS | Customer Care Management System |
| CFR | Code of Federal Regulations |
| CIP | Capital Improvement Project |
| CL | Carroll (County) |
| CRP | Community Reforestation Program |
| CSN | Chesapeake Stormwater Network |
| CSO | Combined Sewer Overflow |
| CTP | Consolidated Transportation Program |
| CWA | Clean Water Act |
| CWAPTW | Clean Water Action Plan Technical Workgroup |
| CWP | Center for Watershed Protection |
| DC | District of Columbia |
| DO | Dissolved Oxygen |
| DEL | Delivered Loads |
| DMCF | Dredged Material Containment Facilities |
| DNR | Maryland Department of Natural Resources |
| DRMO | Defense Reutilization and Marketing Office |
| ECD | Environmental Compliance Division (MDOT SHA) |

| | |
|---|---|
| *E. coli* | *Escherichia coli* |
| ED | Extended Detention |
| EMC | Event Mean Concentration |
| EMS | Environmental Management System |
| EOS | Edge of Stream |
| EPA | United States Environmental Protection Agency |
| EPD | Environmental Programs Division |
| ESC | Erosion and Sediment Control |
| ESD | Environmental Site Design |
| FC | Fecal Coliform |
| FC-DPW | Frederick County, Division of Public Works |
| FEMA | Federal Emergency Management Administration |
| FIB | Fecal Indicator Bacteria |
| FIBI | Fish Index of Biotic Integrity |
| FMD | Facility Maintenance Division (MDOT SHA) |
| FR | Frederick (County) |
| FY | Fiscal Year |
| GIS | Geographic Information System |
| HA | Harford (County) |
| HC-DPW | Harford County, Department of Public Works |
| HO | Howard (County) |
| HUC | Hydrologic Unit Code |
| HWG | Horsley Witten Group, Inc. |
| ICPRB | Interstate Commission on the Potomac River Basin |
| IDDE | Illicit Discharge Detection and Elimination |
| ISWBMPDB | International Stormwater BMP Database |
| LA | Load Allocations |
| lbs | Pounds (weight) |
| LF | Linear Feet |
| LN | Lower North |
| LNB | Lower North Branch |
| LRE | Loch Raven East subwatershed |
| LJF | Lower Jones Falls (Watershed) |
| LU | Land Use |
| MAA | Maryland Aviation Administration |
| MAST | Maryland Assessment Scenario Tool |
| MC-DEP | Montgomery County, Department of Environmental Protection |
| MD | Maryland |
| MDA | Maryland Department of Agriculture |
| MDE | Maryland Department of the Environment |
| MDOT | Maryland Department of Transportation |
| MDP | Maryland Department of Planning |
| MEP | Maximum Extent Practicable |
| MEPA | Maryland Environmental Policy Act |
| MGF | Middle Gwynns Falls (Watershed) |
| MO | Montgomery (County) |
| MOS | Margin of Safety |
| MPR | Maximum Practicable Reduction |
| MS4 | Municipal Separate Storm Sewer System |
| NBOD | Nitrogenous Biochemical Oxygen Demand |
| NEPA | National Environmental Policy Act |
| NFHL | National Flood Hazard Layer |
| NJF | Northeastern Jones Falls (Watershed) |
| NPDES | National Pollutant Discharge Elimination System |

| | |
|---|---|
| NSQD | National Stormwater Quality Database |
| OCRI | Office of Customer Relations and Information (MDOT SHA) |
| OED | Office of Environmental Design (MDOT SHA) |
| OOM | Office of Maintenance (MDOT SHA) |
| OP | Orthophosphate |
| OPPE | Office of Planning and Preliminary Engineering (MDOT SHA) |
| PACD | Pennsylvania Association of Conservation Districts |
| PB | Parsons Brinckerhoff |
| PCB | Polychlorinated Biphenyl |
| $P_E$ | Rainfall Target Used To Size ESD Practices |
| PERC | Perchloroethylene |
| PG | Prince George's (County) |
| PGC-DoE | Prince George's County, Department of the Environment |
| RBP | Rapid Bioassessment Protocol |
| RGP | Regional General Permit |
| ROW | Rights-Of-Way |
| Reqd | Required |
| RR | Runoff Reduction |
| RSPSC | Regenerative Step Pool System Conveyance |
| SAH | Sponsor-A-Highway |
| SB | Spring Branch subwatershed |
| SCA | Stream Corridor Assessment |
| SFEI | San Francisco Estuary Institute |
| SGW | Submerged Gravel Wetlands |
| SHA | State Highway Administration |
| SPR | State Planning and Research |
| SSO | Sanitary Sewer Overflow |
| ST | Stormwater Treatment |
| SW | Stormwater |
| SWAP | Small Watershed Action Plan |
| SWM | Stormwater Management |
| SWS | Subwatershed |
| SW-WLA | Stormwater Wasteload Allocation |
| TBD | To Be Determined |
| TBR | Tidal Back River (Watershed) |
| TBS | To Be Specified |
| TCWG | Toxic Contaminants Work Group |
| TMDL | Total Maximum Daily Load |
| TN | Total Nitrogen |
| TP | Total Phosphorus |
| tPCB | Total Polychlorinated Biphenyl |
| TSS | Total Suspended Solids |
| TWGCB | Toxics Work Group Chesapeake Bay Partnership |
| UBR | Upper Back River (Watershed) |
| UGF | Upper Gwynns Falls (Watershed) |
| UJF | Upper Jones Falls (Watershed) |
| US | United States |
| USACE | United States Army Corps of Engineers |
| USDA-NRCS | United States Department of Agriculture, Natural Resources Conservation Service |
| USGS | United States Geological Survey |
| USWG | Urban Stormwater Work Group |
| WA | Washington (County) |

| | |
|---|---|
| WC-DPW | Washington County, Division of Public Works |
| WCSCD | Washington County Soil Conservation District |
| WIP | Watershed Implementation Plan |
| WLA | Wasteload Allocation |
| WPD | Water Programs Division (MDOT SHA) |
| WQLS | Water Quality Limited Segment |
| WQSs | Water Quality Standards |
| WQv | Water Quality Volume |
| WQGIT | Water Quality Goal Implementation Team |
| WRAS | Watershed Restoration Action Strategy |
| WTM | Watershed Treatment Model |
| WTWG | Watershed Technical Work Group |
| WWTP | Waste Water Treatment Plant |
| yr | Year |
| 12-SW | Maryland General Permit for Discharges from Stormwater Associated with Industrial Activities |

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Note: This list of references was developed for the MDOT SHA 2016 Impervious Restoration and Coordinated TMDL Implementation plan (available at www.roads.maryland.gov). Many of the references may not apply to this document.

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