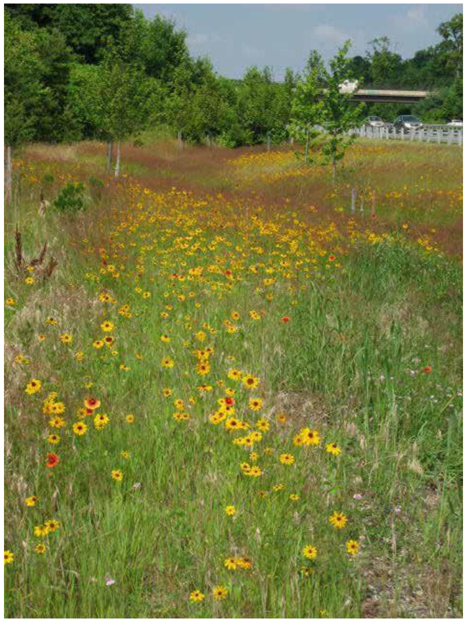
Part III

Coordinated TMDL Implementation Plan



III. COORDINATED TMDL IMPLEMENTATION PLAN

A. WATER QUALITY STANDARDS AND DESIGNATED USES

While the impervious restoration requirements discussed in **Part II** of this Plan focus on offsetting the impacts of urbanization to uncontrolled stormwater runoff, TMDLs focus on offsetting the impacts of pollutants to waterway designated uses. Both these perspectives address the quality of Maryland surface waters. The Federal Clean Water Act (CWA) established requirements for each State to develop programs to address water pollution including:

- Establishment of 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 3-1** lists the designated uses for waterways in Maryland. TMDLs are based upon 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 also to develop WQSs for Maryland including the water quality criteria that define the parameters to ensure designated uses are met.

Table 3-1: 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.state.md.us/programs/Water/TMDL/Water%20Quality%20Standards/Pages/programs/waterprograms/tmdl/wqstandards/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 MDOT SHA has a WLA. **Part IV, MDOT SHA Watershed TMDL Implementation Plans** contains implementation plans specific to each local TMDL watershed. It includes a brief description of each watershed including MDOT SHA facilities and land uses, MDOT SHA TMDLs within the watershed, MDOT SHA visual inventory of ROW, a summary of county assessment review, and MDOT SHA pollutant reduction strategies.

Requirements from the MDOT SHA MS4 Permit specific to watershed assessments and coordinated TMDL implementation plans are copied below and include *Part IV.E.1.* and *Part IV.E.2.b.* of the Permit (See **Part I, Program Introduction** for complete wording from *Part IV.E.* of the MDOT SHA MS4 Permit).

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 where all water that falls on it and drains off it flows to a common outlet. 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 non-tidal watersheds across the state, and therefore is the scale at which most of Maryland's local TMDLs are developed. These watersheds are referred to as 8-digit watersheds due to the numbering scheme used by MDE to identify them. See **Figure 3-1** for an illustration of an 8-digit watershed example in Maryland. The example watershed is the Lower Monocacy River watershed with a code of 02140302. The 8-digit watersheds are often a compilation of smaller streams and tributaries that all flow to the single discharge point. These smaller sub-watersheds in some cases, have their own TMDL documents.

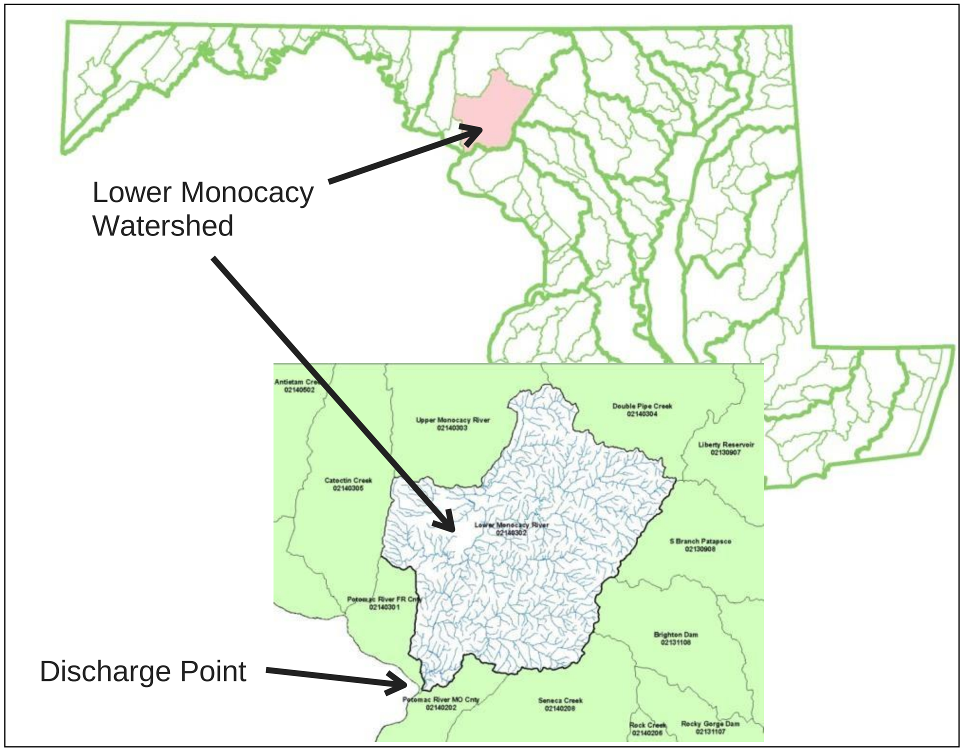


Figure 3-1: Maryland 8-digit Watershed Example

Segmentsheds are watersheds associated with tidal waters, which are referred to as tidal segments. The Chesapeake Bay and its tidal tributaries are divided into 92 segments as shown in **Figure 3-2**. The area draining to the tidal water is the segmentshed. TMDLs can also be written for a segmentshed.

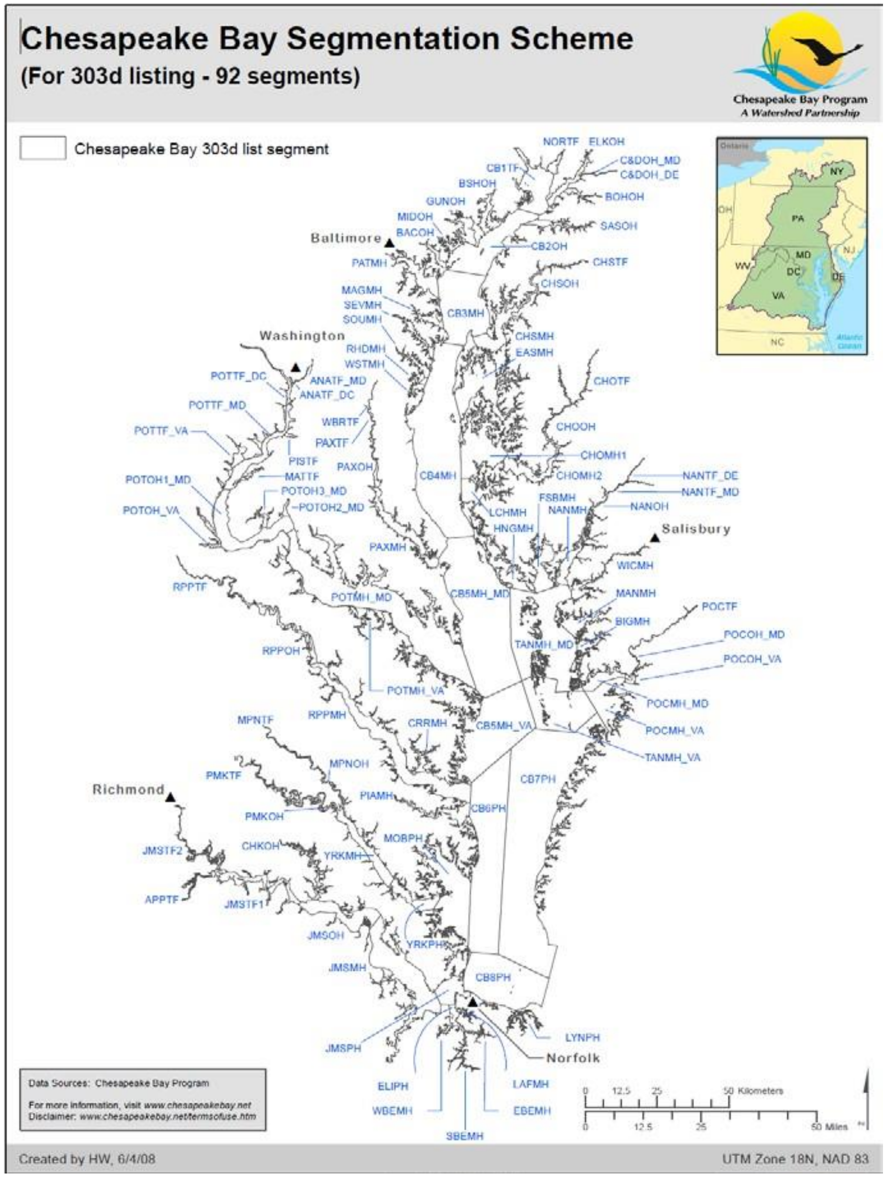


Figure 3-2: Chesapeake Bay 92 Segments

County Watershed Assessments

Each MS4 county performs detailed assessments of local watersheds as a part of its MS4 program. These assessments determine current water quality conditions and include visual inspections; identification and ranking of water quality problems for restoration; prioritization and ranking of structural and non-structural improvement projects; and pollutant reduction benchmarks and deadlines that demonstrate progress toward meeting applicable WQSs. MDOT SHA is not required to duplicate this effort, but coordinates with the MS4 jurisdictions to obtain and review their watershed assessments. Relying on assessments performed by local governments not only avoids redundant analysis but the agencies performing the assessments have close connection to local communities and watershed groups.

Watershed assessment evaluations by MDOT SHA focus on issues that MDOT SHA can improve through practices targeting MDOT SHA ROW or infrastructure. Summaries of watershed assessment evaluations are included in **Part IV, MDOT SHA Watershed Implementation Plans** for each individual watershed plan. Because MDOT SHA property is typically a fraction of land within each of these watersheds, there may be limited information pertinent to MDOT SHA. Results of watershed assessment evaluations are used by MDOT SHA to identify potential project sites or partnership project opportunities. 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:

- On-going coordination meetings with each of the MS4 jurisdictions to discuss potential partnerships with the mutual goal of improving water quality;
- Visual watershed inspections as described below;
- Modeling MDOT SHA load reductions within the watershed based on MDOT SHA land uses and ROW; and,
- Maximizing existing impervious treatment within new development roadway projects (practical design initiative).

C. VISUAL INSPECTIONS TARGETING MDOT SHA ROW AND RESTORATION SITE SEARCHES

C.1. Visual Inspections

MDOT SHA operations and maintenance forces are tasked with managing our built assets including roadways, offices, and shops and often identify and resolve areas with water quality problems or pollutant sources such as erosion or failed outfalls. The MDOT SHA maintenance shops will work with the Highway Hydraulics Division when drainage reports, engineering design, and/or permits are needed to rectify the problem. If problems are severe enough, emergency repairs and permitting may be necessary. Larger, costly repairs that are not emergencies will be reviewed for restoration project potential and if not feasible as restoration credit, will be prioritized based on funding availability.

C.2. Site Searches

The MDOT SHA ROW is also inspected to identify potential restoration projects and operations activities to meet pollutant reductions for current WLAs through both operations and capital programs. Site searches for restoration projects or activities are handled differently depending upon the BMP type. Certain best management practices including street sweeping, inlet cleaning, SW control structure retrofits, new stormwater control structures, grass swale upgrades, tree planting, and outfall stabilization are suited for implementation within the MDOT SHA ROW while others such as stream restoration, are located elsewhere in the watershed. Restoration project site search and assessment procedures are discussed below.

Designated TMDL Street Sweeping Routes

Each MDOT SHA maintenance shop identified specific routes within their shop responsibility boundaries that are swept two times per month and therefore qualify as impervious restoration and TMDL pollutant reduction credits. MDOT SHA has mapped these routes into a GIS and when overlaid with watershed boundaries, can discern load reductions that can be attributed to local TMDL reductions by comparing the overall route length with lengths within watersheds with WLA reduction requirements.

Although much more sweeping is performed by MDOT SHA operations forces than these designated routes, because the frequency requirement of two times per month is not met in other sweeping activities, they are not included in restoration progress numbers.

Enhanced Inlet Cleaning

MDOT SHA operations and maintenance forces routinely clean inlets and pipes along corridors with higher sediment and debris loads that are often characterized by frequently clogging inlet grates, boxes, or pipes and roadway flooding. MDOT SHA has recently sought to expand this on-going program with elements utilized in the Baltimore City inlet cleaning program including: contracted inlet cleaning crews, pre- and post-cleaning documentation of the inlet condition; and targeted loads outside routine corridors.

This enhanced program utilizes information developed through a pilot inlet inspection program that documented potential inlet loading and frequency reaching inlet storage capacity. This pilot has provided essential information to determine potential increases in pollutant reduction that can be achieved to direct the contractors to corridors within watersheds with needed pollutant reductions.

New SW Control Structures and Tree Planting

MDOT SHA has recently developed a process to methodically review MDOT SHA ROW within each watershed for new stormwater BMPs and tree planting. This new process adds a 1.5 X 1.5 mile grid system to track the progress of these investigations allowing prioritized areas to be targeted first and ensures that each watershed is systematically and thoroughly assessed. See **Figure 3-3** for an example of the grid system overlaid on the Anacostia watershed and **Figure 3-4** for a larger scale map of specific grid sections showing various BMP types proposed for restoration.

The watershed review process includes two phases. Phase one is a desktop evaluation of the MDOT SHA ROW using available GIS data, including

- Aerial imagery;
- Street-view mapping;
- Environmental features delineations such as critical area boundary, wetlands buffers, floodplain limit;
- 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.

Consultant teams review corridors and propose new stormwater BMPs and/or tree planting sites. The proposed sites are prioritized within watersheds with the highest pollutant reduction needs, as well as by numerous other criteria that address the construction viability of the site. The prioritized sites proceed forward to the second phase of review, field investigations.

Consultant teams use specific guidance to perform detailed field investigations to inspect and assess each site to capture existing conditions, water quality issues, and/or site constraints. This information is used to package restoration stormwater BMPs or tree plantings into design and construction contracts. **Figure 3-5** is an example field investigation summary map that documents observations from the field analysis. A standardized field inspection form is used.

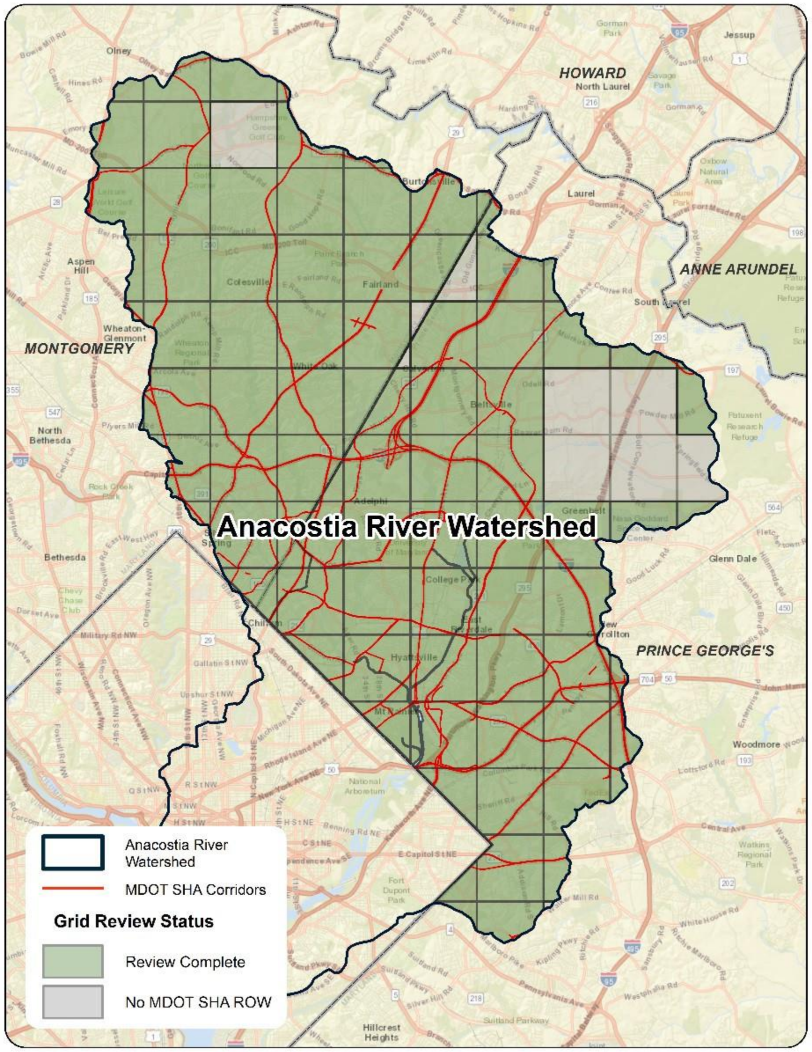


Figure 3-3: Example 1.5-Mile Grid System for Anacostia River Watershed

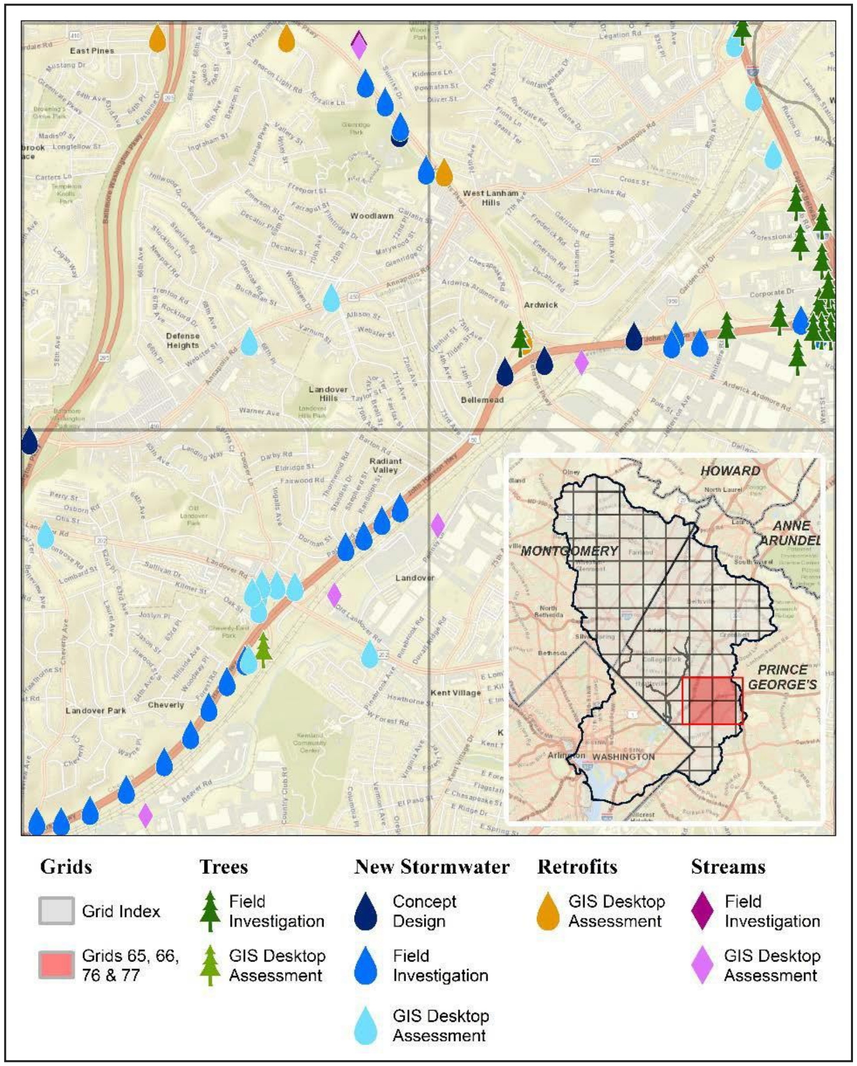


Figure 3-4: Anacostia River Grid Site Search Detail

Figure 3-5: Example Field Investigation Summary Map

Outfall Stabilization

Shortly after the Bay TMDL was issued, MDOT SHA developed an outfall inspection and assessment protocol and assessments were performed along corridors with known priority outfall stabilization issues. This data was captured and summarized in outfall and headwall prioritization reports and was used to target outfalls for field inspections. Standard field inspection sheets and pictures provided results of the field inspections and included assessments of the outfall structure, upstream/downstream channel conditions, and site constraints. Priority sites for restoration projects were chosen based on the reported site condition, potential restoration or TMDL credit, accessibility, property ownership including potential partnership projects, and constraints such as utilities. A final level of project vetting used the following information to determine constructability and design parameters:

- Steep channel slopes,
- Flow regime,
- Major to severe bank instability,
- High bank heights,
- Property ownership,
- Accessibility,
- Public safety, and
- Minimal length 50 feet.

Recently, MDOT SHA created a cross-divisional inspection process that will broaden the use of the outfall assessment to determine both restoration potential and maintenance and repair needs. This will ensure that all identified outfall stability problems will be accessible across divisions and can be incorporated into each division’s planning process. A Survey 123 tool is being developed and will collect outfall site inspection data that will aid in ranking and prioritizing future inspection sites for restoration and/or other remediation activities. The new tool and this new process will be implemented in 2019.

Retrofit of Existing SW Control Structures

The MDOT SHA site selection process for retrofits of existing SW control structures involves identifying existing MDOT SHA facilities that have little or no existing water quality treatment of impervious area. These facilities are typically dry ponds, dry-extended detention ponds, undersized wet ponds, undersized infiltration basins, and facilities built prior to the enforcement of the *2000 MDE Stormwater Management Design Manual* (MDE, 2009a). These sites are then prioritized based on factors such as cost effectiveness, net credit potential, site constraints (right-of-way, utilities, noise barriers, access, steep slopes, adjacent roadways, etc.), and environmental permitting requirements (MDE/USACE Non-tidal Wetlands and Waterways, MDE Small Pond, and MD Dam Safety).

Grass Swale Upgrades

MDOT SHA has identified corridors of open-section roadways for grass swale upgrades using specific criteria. Using the *MDOT SHA Existing Water Quality Grass Swale Identification Protocol* (MDOT SHA, 2016), grass swales were evaluated to determine which were currently meeting MDE criteria for water quality and some were identified as having potential to meet the WQ criteria with minor upgrades (classified as 2A swales). Medians and shoulder areas were targeted, and many of these areas were determined to be candidates for grass swale upgrade projects.

Because upgrading existing grass swales is more cost effective than installing a new SW control structure, some sites that were previously identified for new SW control structures have been reclassified as potential grass swale upgrade candidates. The corridors with the highest potential for swale upgrades were evaluated using desktop GIS methods and subsequently field investigated. The resulting data allowed a set of corridors to be selected for design and construction contracts.

Stream Restoration

A two-pronged approach is utilized to identify stream restoration projects. First, MDOT SHA identifies potential stream restoration projects through desktop analyses and review of existing watershed implementation plans. Second, potential sites may be identified through partnerships with local citizens, municipalities, counties and other State or federal government agencies. Once a potential stream restoration location has been identified, the process below is utilized to determine project potential.

Because stream restoration projects are typically located outside of MDOT SHA ROW, a separate digital tool has been used to review each watershed for potential restoration opportunities. The tool was designed to allow designers to fill out forms at each level of review to efficiently store information and prioritize potential restoration opportunities. The stream site investigations include two phases to identify potential stream restoration opportunities. Although not initially tied directly to the grid system described under the new SW control structure and tree discussion above, assessments for stream sites have been integrated into the grid system.

Like most of the other practices, stream sites undergo both a desktop GIS analysis followed by a field investigation. Key parameters that are considered in stream restoration site selection are the following:

- Site Characteristics
    - Existing landuse
    - Channelization
    - Erosion sources
    - Nutrient sources
    - Riparian buffer
    - Downstream stability

- Watershed Characteristics
    - Local TMDLs and other impairments
    - Impervious area draining to site

- Site Constraints
    - Utilities
    - Ownership (public, private)
    - Access
    - Wetlands
    - Rare, threatened, and endangered species

D. BENCHMARKS AND DETAILED COSTS

Benchmarks and target dates demonstrating planned progress toward meeting applicable stormwater WLAs are provided in individual watershed discussions in **Part IV, MDOT SHA Watershed TMDL Implementation Plans**.

Generalized cost information is included for each individual plan that includes an overall estimated cost for the proposed practices. Bid costs for specific construction projects are available on MDOT SHA's website (www.roads.maryland.gov) under Contractors Information Center.

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 3-6** illustrates the TMDL concept. 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 WLA.

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.

Pollutants for MDOT SHA Focus

Upon issuance of the MS4 Permit, MDOT SHA was named in TMDLs for five different pollutants within the MS4 coverage area including

- Bacteria,
- PCBs,
- Phosphorus,
- Sediment, and
- Trash.

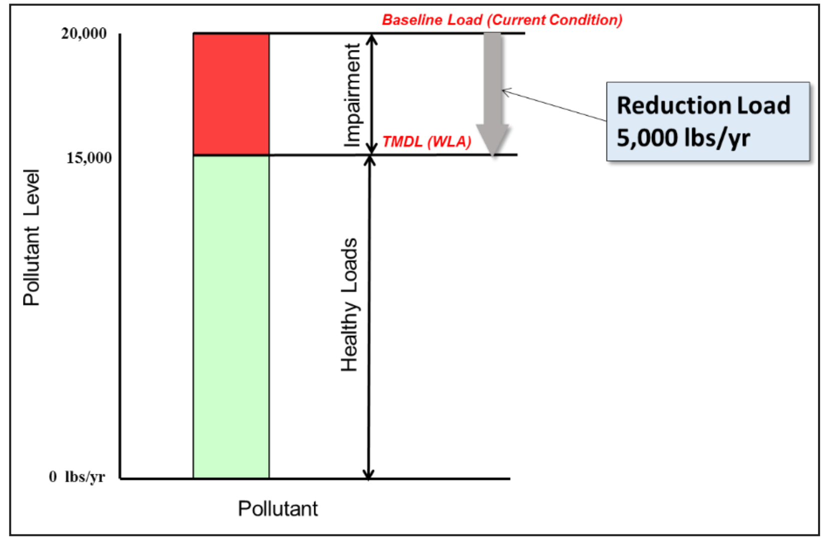


Figure 3-6: Example Wasteload Allocation and Reduction Requirement

The MDOT SHA MS4 Permit covers 11 Maryland counties that cross 84 8-digit watersheds. There are 47 EPA approved TMDL documents that assign MDOT SHA to either an individual WLA or an aggregate WLA. Each watershed may be impaired by multiple pollutants resulting in the development and approval of multiple TMDL documents, so there is not a direct correlation between the number of TMDL documents and the number of watersheds affected. Lists of the TMDL documents addressed by this plan for each pollutant are included in **Sections E.2** through **E.5.**

Figures 3-7A through 3-7D show pollutant specific maps with watersheds identified where MDOT SHA has TMDL reduction requirements. Following the figures is **Table 3-2** that summarizes MDOT SHA reduction targets within each of the watersheds for each pollutant, target end dates to meet the reductions, and projected benchmarks for interim target dates of FY2020 and FY2025. An explanation of the data contained in Table 3-2 is included prior to the tables.

Modeling Parameters

MDE requires that pollutant modeling follow the guidance in MDE's *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (MDE, 2014b); 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 originally submitted to MDE as Appendix E in the 2016 MDOT SHA MS4 annual report. Updates to this protocol will be periodically implemented and resubmitted for MDE consideration. Once approved, this protocol will be available on the MDOT SHA website.

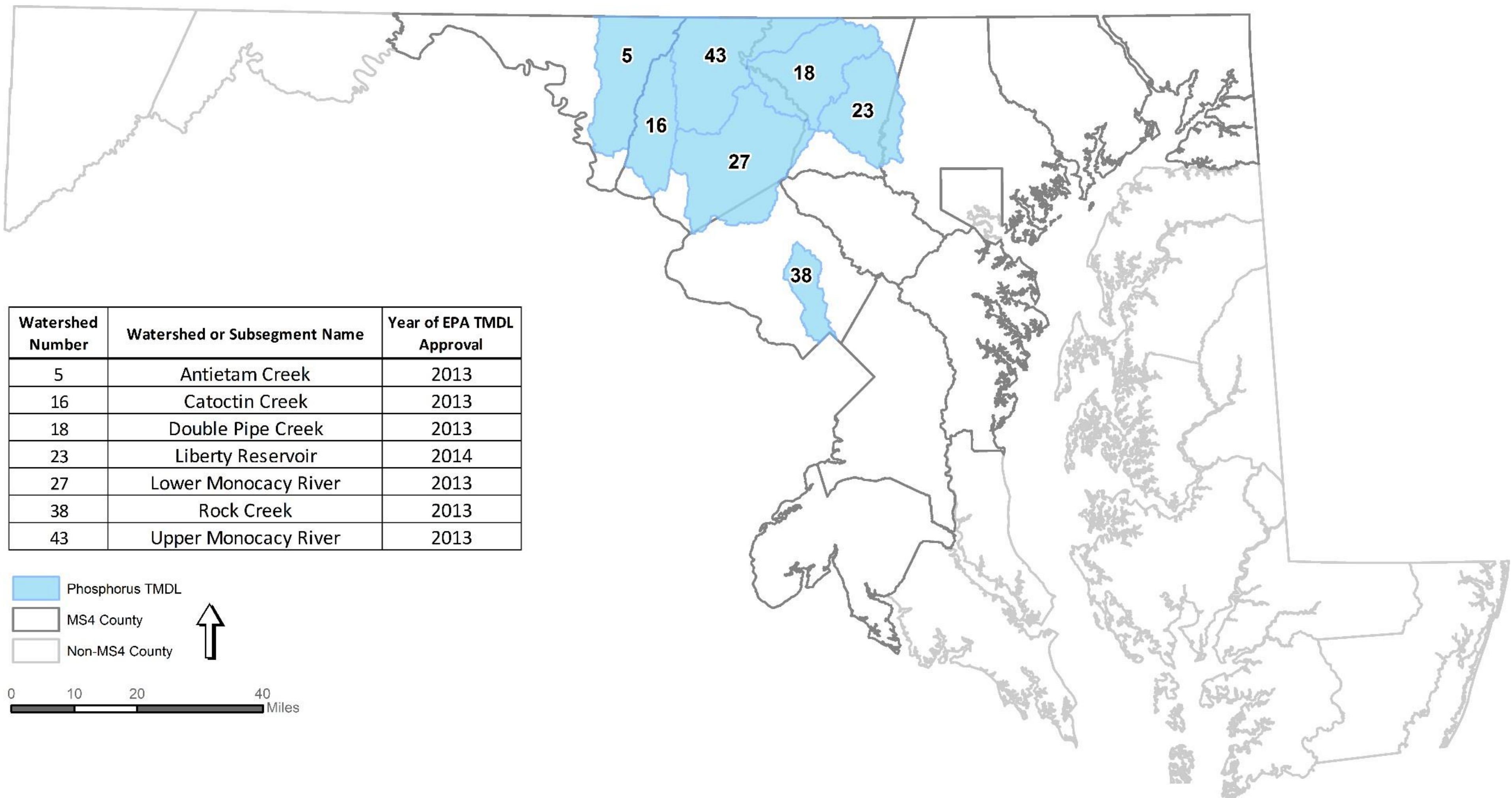
Different modeling methods are used depending upon the pollutants and current reduction practices in use. The *MDOT SHA Restoration Modeling Protocol* (MDOT SHA, 2018) should be consulted for detailed descriptions.

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.

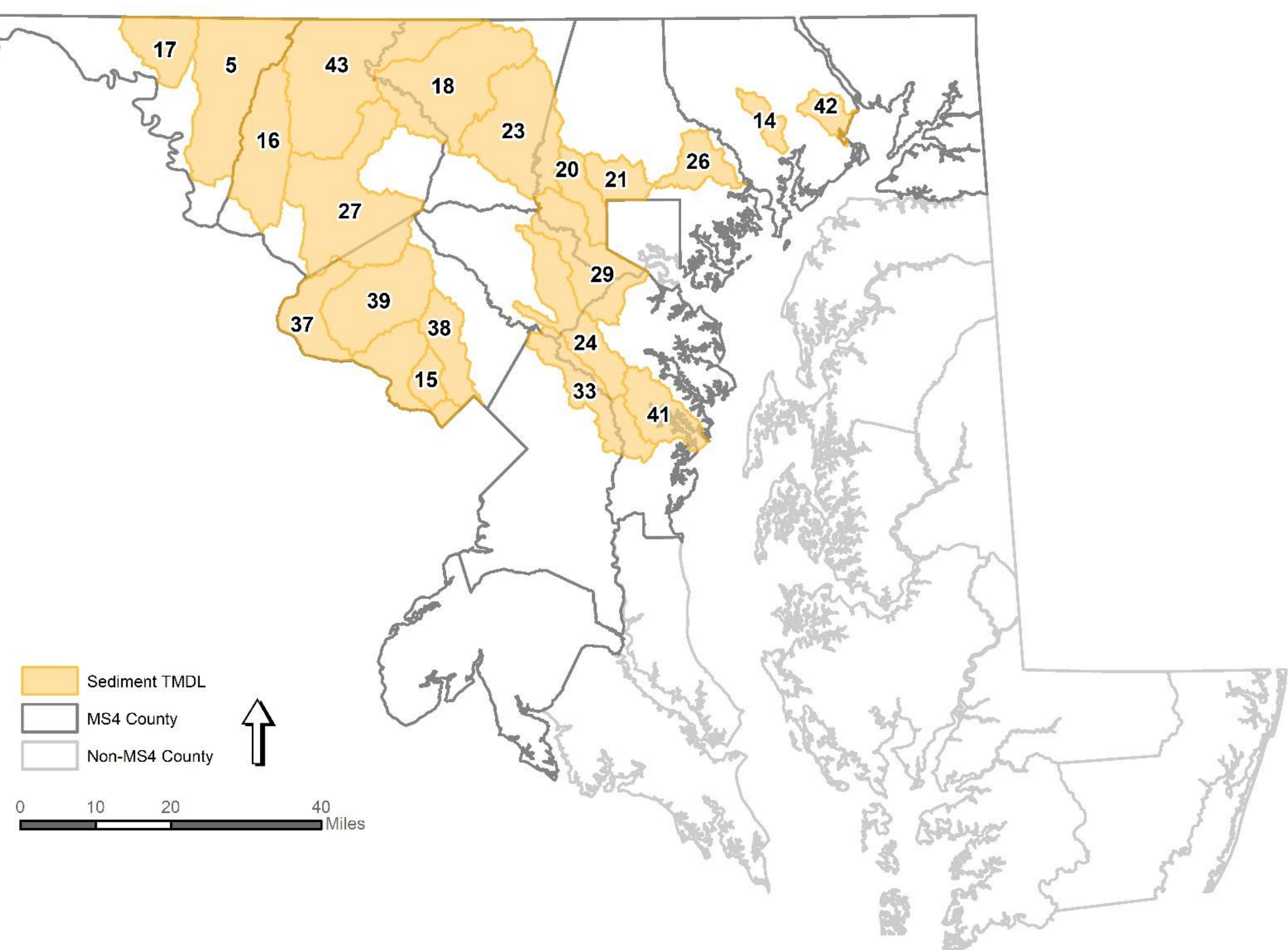
Available Reduction Practices

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. 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.



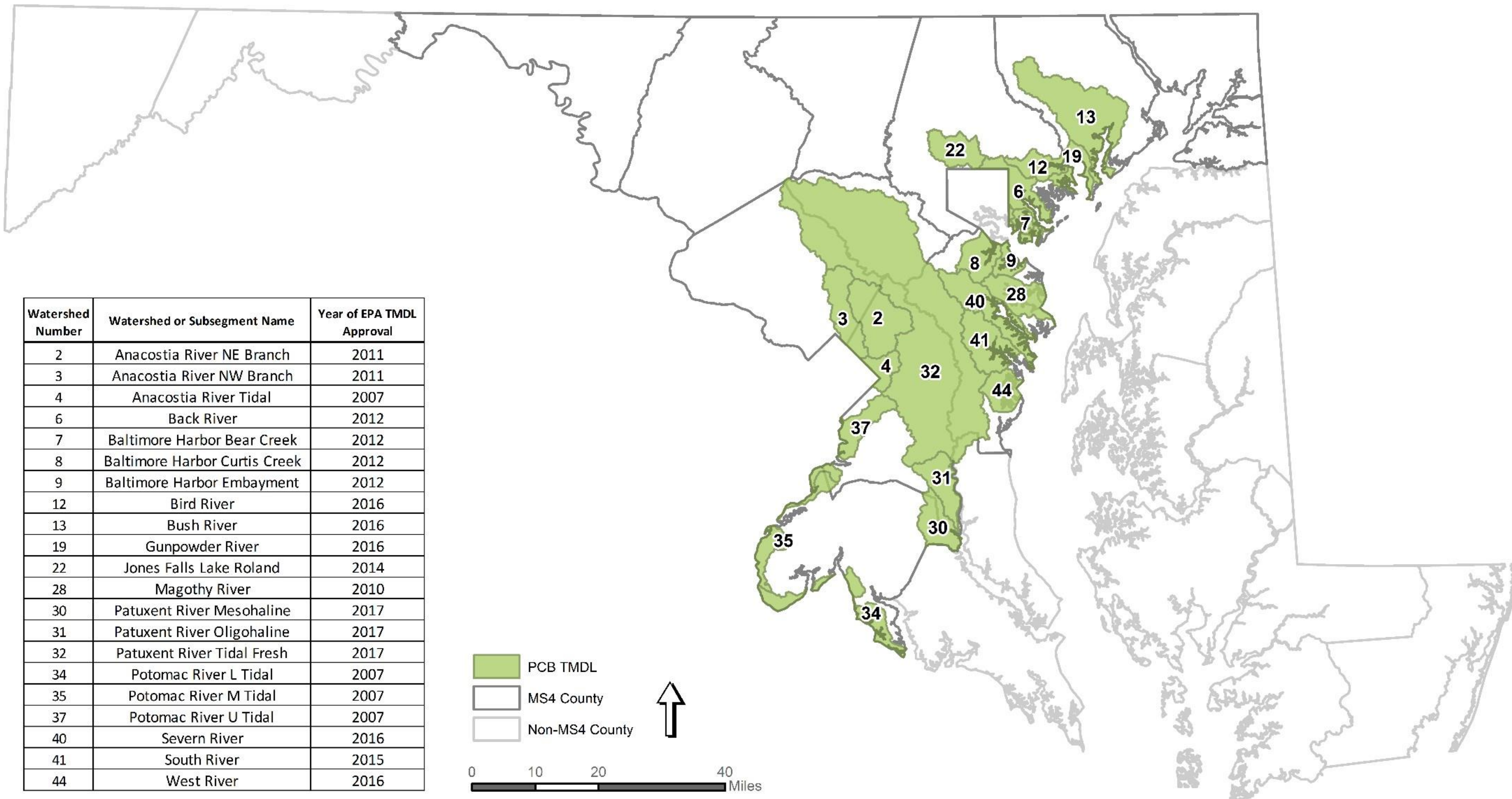
Watershed Number	Watershed or Subsegment Name	Year of EPA TMDL Approval
5	Antietam Creek	2013
16	Catoctin Creek	2013
18	Double Pipe Creek	2013
23	Liberty Reservoir	2014
27	Lower Monocacy River	2013
38	Rock Creek	2013
43	Upper Monocacy River	2013

Figure 3-7A: Watersheds with MDOT SHA Phosphorus TMDLs



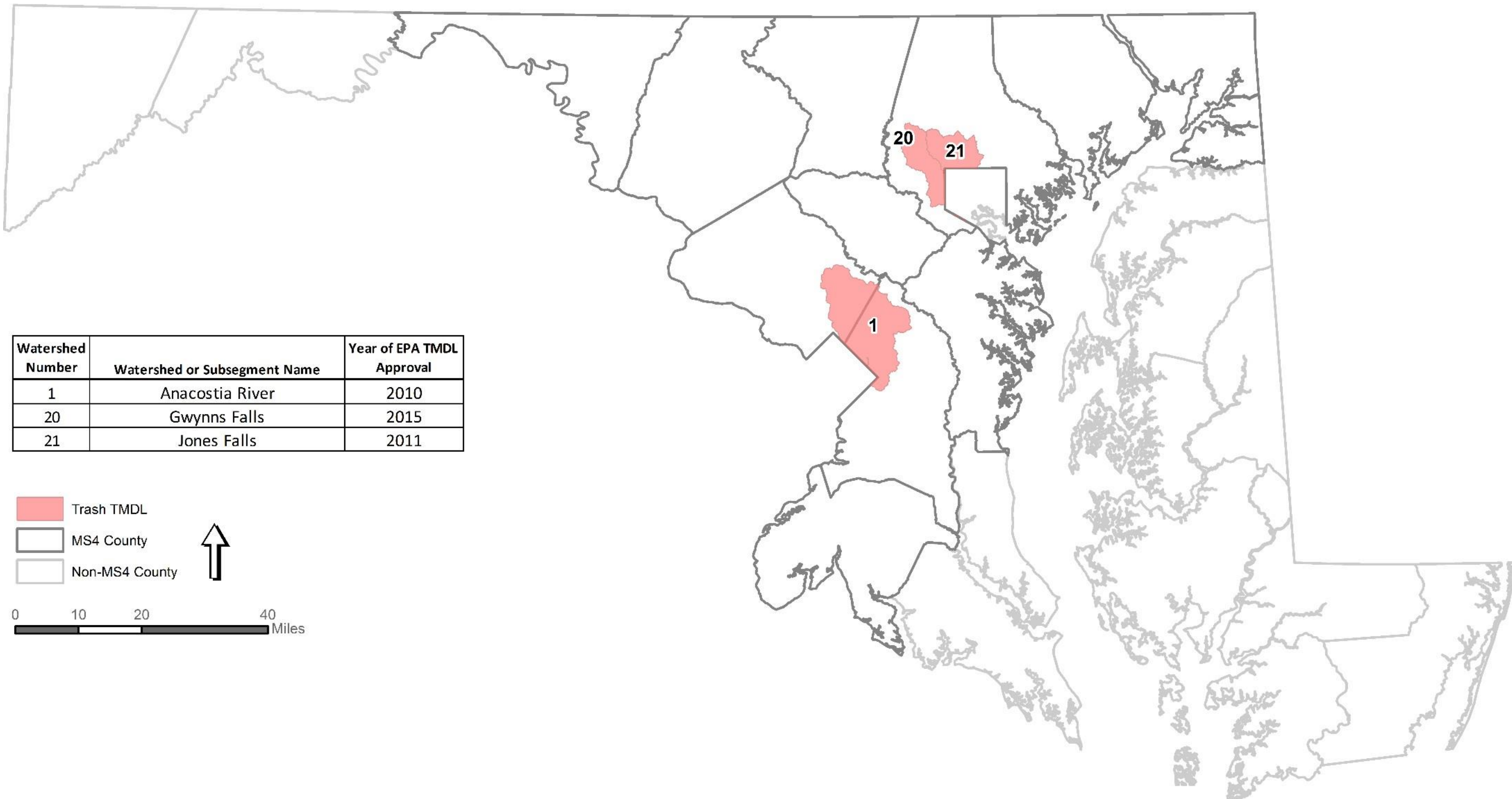
Watershed Number	Watershed or Subsegment Name	Year of EPA TMDL Approval
5	Antietam Creek	2008
14	Bynum Run	2011
15	Cabin John Creek	2011
16	Catoctin Creek	2009
17	Conococheague Creek	2008
18	Double Pipe Creek	2009
20	Gwynns Falls	2010
21	Jones Falls	2011
23	Liberty Reservoir	2014
24	Little Patuxent River	2011
26	Lower Gunpowder Falls	2017
27	Lower Monocacy River	2009
29	Patapsco River L N Br	2011
33	Patuxent River Upper	2011
37	Potomac River MO Cnty	2012
38	Rock Creek	2011
39	Seneca Creek	2011
41	South River	2017
42	Swan Creek	2016
43	Upper Monocacy River	2009

Figure 3-7B: Watersheds with MDOT SHA Sediment TMDLs



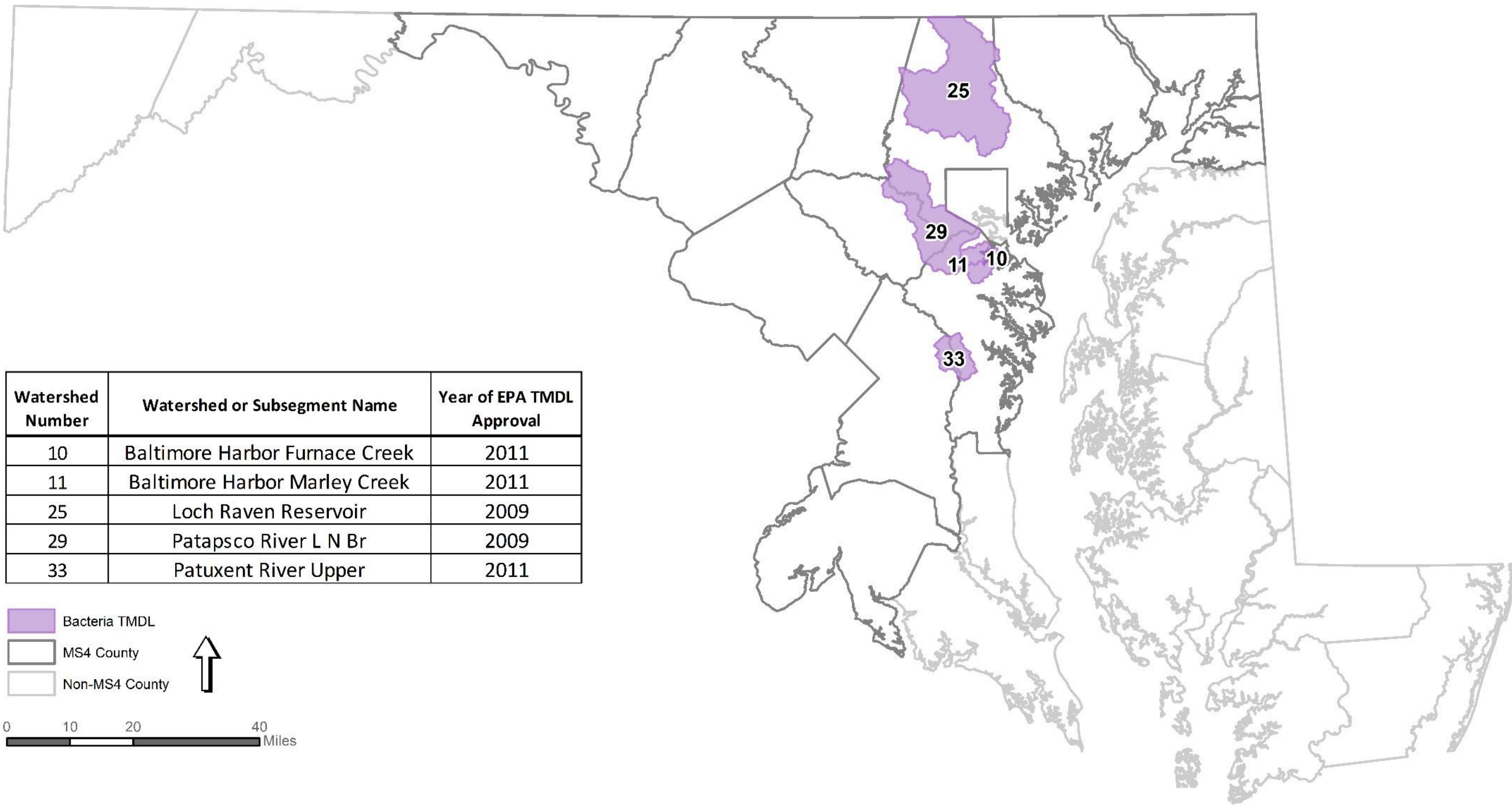
Watershed Number	Watershed or Subsegment Name	Year of EPA TMDL Approval
2	Anacostia River NE Branch	2011
3	Anacostia River NW Branch	2011
4	Anacostia River Tidal	2007
6	Back River	2012
7	Baltimore Harbor Bear Creek	2012
8	Baltimore Harbor Curtis Creek	2012
9	Baltimore Harbor Embayment	2012
12	Bird River	2016
13	Bush River	2016
19	Gunpowder River	2016
22	Jones Falls Lake Roland	2014
28	Magothy River	2010
30	Patuxent River Mesohaline	2017
31	Patuxent River Oligohaline	2017
32	Patuxent River Tidal Fresh	2017
34	Potomac River L Tidal	2007
35	Potomac River M Tidal	2007
37	Potomac River U Tidal	2007
40	Severn River	2016
41	South River	2015
44	West River	2016

Figure 3-7C: Watersheds with MDOT SHA Polychlorinated Biphenyl (PCB) TMDLs



Watershed Number	Watershed or Subsegment Name	Year of EPA TMDL Approval
1	Anacostia River	2010
20	Gwynns Falls	2015
21	Jones Falls	2011

Figure 3-7D: Watersheds with MDOT SHA Trash TMDLs



Watershed Number	Watershed or Subsegment Name	Year of EPA TMDL Approval
10	Baltimore Harbor Furnace Creek	2011
11	Baltimore Harbor Marley Creek	2011
25	Loch Raven Reservoir	2009
29	Patapsco River L N Br	2009
33	Patuxent River Upper	2011

Figure 3-7E: Watersheds with MDOT SHA Bacteria TMDLs

Summary of Modeling Results

Table 3-2 summarizes results of MDOT SHA TMDL modeling for the pollutants depicted in the mapping above organized by pollutants and then watersheds. Modeling is performed according to parameters documented in the *MDOT SHA Restoration Modeling Protocol* (MDOT SHA, 2018). Results for phosphorus, sediment, PCB, trash, and bacteria modeling are grouped together in **Table 3-2** following a traditional TMDL method of determining baseline loading, calculating reduction requirement, determining BMPs to meet the reduction, and modeling projected loading for the proposed implementation plan.

In the table, information concerning the TMDL document is shown to the left in columns with gray headings including watershed name, watershed number, county, pollutant, EPA approval date, baseline year, and unit of measure for the pollutant. MDOT SHA modeling results include both load reduction requirements and projected reduction benchmarks by target years. MDOT SHA modeled requirements are shown in the middle with green headings including MDOT baseline loading, percent reduction target, and reduction target in unit measure (e.g., lbs./year). Projected benchmarks are shown to the right of the reduction requirements with tan headings including FY 2020 interim target, FY 2025 interim target. To the far right also in tan are the projected reduction to be achieved by the target year and the target year proposed to meet the reduction requirement. Two additional columns are included with blue headings that provide comparative assessments of the 2025 interim reduction target to be achieved relative to the modeled MDOT SHA baseline and relative to the reduction target.

For all pollutants, the MDOT SHA percent reduction target (green heading) is from the published TMDL document. The baseline year is published on the MDE Data Center and will be used for MDOT SHA implementation planning. This usually correlates to the time-period when monitoring data was collected for the MDE TMDL analysis.

The Target Year (tan heading at far right) is the year MDOT SHA proposes to meet the WLA or show significant progress in efforts toward meeting the WLA. In cases were MDOT SHA does not believe they can meet the WLA by the target year, discussion is added to the reduction strategy sections to analyze the conditions that preclude MDOT SHA from meeting the target reductions with currently available modeling methods, loading, reduction efficiencies, and/or practices. Progress implementing BMPs toward meeting benchmark reductions and target years will be documented in the MDOT SHA annual MS4 reports for each fiscal year. Thus, MDE will be able to track the increase in the reduction achieved from year to year.

Lists of proposed practices and costs to achieve the reduction targets are included in individual watershed plans included as **Part IV, MDOT SHA Watershed TMDL Implementation Plans.**

Table 3-2: MDOT SHA Nutrient, Sediment, PCB and Trash Modeling Results

Watershed Name	Watershed Number	County	Pollutant	EPA Approval Date	Baseline Year	Unit	MDOT SHA Baseline Load	MDOT SHA % Reduction Target	MDOT SHA Reduction Target	2020 Interim Reduction Target	% 2020 Reduction Relative to Reduction Target	2025 Interim Reduction Target	% 2025 Reduction Relative to Reduction Target	Projected Reduction to be Achieved by Target Year	% Reduction to be Achieved Relative to Reduction Target	Target Year
Nutrient and Sediment TMDLs																
Antietam Creek	02140502	WA	Phosphorus	09/25/2013	2000	EOS-lbs/yr	1,295	21.4%	277	102	36.8%	277	100.0%	277	100.0%	2030
			Sediment	12/18/2008	2000	EOS-lbs/yr	1,734,045	58.1%	1,007,480	108,098	10.7%	238,281	23.7%	1,007,480	100.0%	2045
Bynum Run	02130704	HA	Sediment	09/30/2011	2005	EOS-lbs/yr	125,987	19.3%	24,316	16,469	67.7%	24,316	100.0%	24,316	100.0%	2030
Cabin John Creek	02140207	MO	Sediment	09/30/2011	2005	EOS-lbs/yr	1,012,693	22.9%	231,907	79,327	34.2%	98,008	42.3%	231,907	100.0%	2045
Catoctin Creek	02140305	FR	Phosphorus	09/24/2013	2009	EOS-lbs/yr	1,704	9.0%	153	153	100.0%	153	100.0%	153	100.0%	2025
			Sediment	07/31/2009	2000	EOS-lbs/yr	1,210,465	49.1%	594,338	280,379	47.2%	509,359	85.7%	594,338	100.0%	2035
Conococheague Creek	02140504	WA	Sediment	11/24/2008	2000	EOS-lbs/yr	1,152,566	45.3%	522,112	43,821	8.4%	100,574	19.3%	522,112	100.0%	2045
Double Pipe Creek	02140304	FR, CL	Phosphorus	04/26/2013	2009	EOS-lbs/yr	1,575	66.0%	1,040	585	56.3%	1,040	100.0%	1,040	100.0%	2030
		FR, CL	Sediment	02/20/2009	2000	EOS-lbs/yr	972,329	46.8%	455,050	371,013	81.5%	455,050	100.0%	455,050	100.0%	2030
Gwynns Falls	02130905	BA	Sediment	3/10/2010; WLA revised 8/31/2015	2005	EOS-lbs/yr	1,368,169	36.4%	498,014	37,415	7.5%	110,058	22.1%	498,014	100.0%	2050

Table 3-2: MDOT SHA Nutrient, Sediment, PCB and Trash Modeling Results

Watershed Name	Watershed Number	County	Pollutant	EPA Approval Date	Baseline Year	Unit	MDOT SHA Baseline Load	MDOT SHA % Reduction Target	MDOT SHA Reduction Target	2020 Interim Reduction Target	% 2020 Reduction Relative to Reduction Target	2025 Interim Reduction Target	% 2025 Reduction Relative to Reduction Target	Projected Reduction to be Achieved by Target Year	% Reduction to be Achieved Relative to Reduction Target	Target Year
Jones Falls	02130904	BA	Sediment	09/29/2011	2005	EOS-lbs/yr	436,719	21.7%	94,768	64,214	67.8%	94,768	100.0%	94,768	100.0%	2025
Liberty Reservoir	02130907	BA, CL	Phosphorus	05/07/2014	2009	EOS-lbs/yr	1,251	45.0%	563	82	14.5%	563	100.0%	563	100.0%	2035
			Sediment		2009	EOS-lbs/yr	1,126,330	45.0%	506,848	68,649	13.5%	506,848	100.0%	506,848	100.0%	2035
Little Patuxent River	02131105	AA, HO	Sediment	09/30/2011	2005	EOS-lbs/yr	1,454,208	36.1%	524,969	524,969	100.0%	524,969	100.0%	524,969	100.0%	2025
Lower Gunpowder Falls	02130802	BA	Sediment	05/04/2017	2009	EOS-lbs/yr	254,358	67.0%	170,420	170,420	100.0%	170,420	100.0%	170,420	100.0%	2030
Lower Monocacy River	02140302	CL, FR, MO	Phosphorus	05/22/2013	2009	EOS-lbs/yr	4,474	25.0%	1,119	1,108	99.0%	1,119	100.0%	1,119	100.0%	2025
		FR, MO	Sediment	03/17/2009	2000	EOS-lbs/yr	1,648,092	60.8%	1,002,040	384,523	38.4%	834,913	83.3%	1,002,040	100.0%	2045
Patapsco LN Branch	02130906	AA, BA, HO	Sediment	09/30/2011	2005	EOS-lbs/yr	2,631,967	18.0%	473,754	309,836	65.4%	473,754	100.0%	473,754	100.0%	2030
Patuxent River Upper	02131104	AA, HO, PG	Sediment	09/30/2011	2005	EOS-lbs/yr	343,714	11.4%	39,183	39,183	100.0%	39,183	100.0%	39,183	100.0%	2025
Potomac River MO County	02140202	MO	Sediment	09/28/2011	2005	EOS-lbs/yr	885,933	36.2%	320,708	48,320	15.1%	155,573	48.5%	320,708	100.0%	2045
Rock Creek	02140206	MO	Phosphorus	09/23/2013	2009	EOS-lbs/yr	1,106	32.0%	354	354	100.0%	354	100.0%	354	100.0%	2023
			Sediment	09/29/2011	2005	EOS-lbs/yr	1,757,766	37.9%	666,193	661,381	99.3%	666,193	100.0%	666,193	100.0%	2030

Table 3-2: MDOT SHA Nutrient, Sediment, PCB and Trash Modeling Results

Watershed Name	Watershed Number	County	Pollutant	EPA Approval Date	Baseline Year	Unit	MDOT SHA Baseline Load	MDOT SHA % Reduction Target	MDOT SHA Reduction Target	2020 Interim Reduction Target	% 2020 Reduction Relative to Reduction Target	2025 Interim Reduction Target	% 2025 Reduction Relative to Reduction Target	Projected Reduction to be Achieved by Target Year	% Reduction to be Achieved Relative to Reduction Target	Target Year
Seneca Creek	02140208	MO	Sediment	09/30/2011	2005	EOS-lbs/yr	1,328,366	44.9%	596,436	363,663	61.0%	426,812	71.6%	596,436	100.0%	2045
South River	02131003	AA	Sediment	09/28/2017	2009	EOS-lbs/yr	229,305	28.0%	64,205	64,205	100.0%	64,205	100.0%	64,205	100.0%	2025
Swan Creek	02130706	HA	Sediment	09/30/2016	2010	EOS-lbs/yr	59,038	13.0%	7,675	5,400	70.4%	7,675	100.0%	7,675	100.0%	2025
Upper Monocacy River	02140303	CL, FR	Phosphorus	05/07/2013	2009	EOS-lbs/yr	1,808	3.0%	54	54	100.0%	54	100.0%	54	100.0%	2025
		CL, FR	Sediment	12/03/2009	2000	EOS-lbs/yr	842,512	49.0%	412,831	65,776	15.9%	346,081	83.8%	412,831	100.0%	2035
PCB TMDLs																
Anacostia River Tidal	02140205	PG	PCBs	10/31/2007	2005	g/yr	16.10	99.9%	16.08	0.97	6.1%	0.97	6.1%	16.08	100.0%	2050
Back River Oligohaline Tidal	MD-BACOH	BA	PCBs	10/01/2012	2001	g/yr	19.31	53.4%	10.31	0.36	3.5%	0.45	4.4%	10.31	100.0%	2045
Baltimore Harbor - Embayment	02130903	AA, BA	PCBs	10/01/2012	2004	g/yr	6.20	91.1%	5.65	1.36	24.0%	1.36	24.0%	5.65	100.0%	2038
Baltimore Harbor - Bear Creek	MD-PATMH-BEAR-CREEK	BA	PCBs	10/01/2012	2004	g/yr	6.33	91.5%	5.79	0.64	11.1%	0.64	11.1%	5.79	100.0%	2038
Bird River	MD-GUNOH-02130803	BA	PCBs	10/03/2016	2010	g/yr	1.25	70.0%	0.88	0.08	8.9%	0.09	10.6%	0.88	100.0%	2050

Table 3-2: MDOT SHA Nutrient, Sediment, PCB and Trash Modeling Results

Watershed Name	Watershed Number	County	Pollutant	EPA Approval Date	Baseline Year	Unit	MDOT SHA Baseline Load	MDOT SHA % Reduction Target	MDOT SHA Reduction Target	2020 Interim Reduction Target	% 2020 Reduction Relative to Reduction Target	2025 Interim Reduction Target	% 2025 Reduction Relative to Reduction Target	Projected Reduction to be Achieved by Target Year	% Reduction to be Achieved Relative to Reduction Target	Target Year
Bush River Oligohaline	MD-BSHOH-02130701	HA	PCBs	08/02/2016	2010	g/yr	11.06	62.0%	6.85	0.34	4.9%	0.39	5.6%	6.85	100.0%	2050
Baltimore Harbor - Curtis Creek/Bay	MD-PATMH-CURTIS_BAY_CREEK	AA	PCBs	10/01/2012	2004	g/yr	31.30	93.5%	29.26	1.39	4.7%	1.39	4.7%	29.26	100.0%	2038
Gunpowder River Oligohaline	MD-GUNOH-02130801	BA, HA	PCBs	10/03/2016	2010	g/yr	N/A	0.0%	-	-	-	-	-	-	-	-
Lake Roland	MD-02130904-Lake_Roland	BA	PCBs	09/30/2013	2010	g/yr	16.07	29.3%	4.71	0.22	4.7%	0.30	6.3%	4.71	100.0%	2025
Magothy River Mesohaline	MD-MAGM-02131001	AA	PCBs	03/16/2015	2010	g/yr	N/A	0.0%	-	-	-	-	-	-	-	-
NE Branch Anacostia River	02140205	MO, PG	PCBs	09/30/2011	2005	g/yr	7.89	98.6%	7.78	0.23	2.9%	0.40	5.1%	7.78	100.0%	2045
NW Branch Anacostia River	02140205	MO, PG	PCBs	09/30/2011	2005	g/yr	7.70	98.1%	7.55	0.36	4.7%	0.36	4.7%	7.55	100.0%	2045
Patuxent River Mesohaline	02131101-PAXMH	CH, PG	PCBs	09/19/2017	2010	g/yr	N/A	0.0%	-	-	-	-	-	-	-	-

Table 3-2: MDOT SHA Nutrient, Sediment, PCB and Trash Modeling Results

Watershed Name	Watershed Number	County	Pollutant	EPA Approval Date	Baseline Year	Unit	MDOT SHA Baseline Load	MDOT SHA % Reduction Target	MDOT SHA Reduction Target	2020 Interim Reduction Target	% 2020 Reduction Relative to Reduction Target	2025 Interim Reduction Target	% 2025 Reduction Relative to Reduction Target	Projected Reduction to be Achieved by Target Year	% Reduction to be Achieved Relative to Reduction Target	Target Year
Patuxent River Oligohaline	02131101-PAXOH	AA, PG	PCBs	09/19/2017	2010	g/yr	N/A	0.0%	-	-	-	-	-	-	-	-
Patuxent River Tidal Fresh	02131102-PAXTF	AA, FR, HO, MO, PG	PCBs	09/19/2017	2010	g/yr	5.10	99.9%	5.09	0.14	2.7%	0.20	3.9%	5.09	100.0%	2050
Potomac River Lower Tidal	02140101	CH	PCBs	10/31/2007	2005	g/yr	N/A	5.0%	-	-	-	-	-	-	-	-
Potomac River Middle Tidal	02140102	CH, PG	PCBs	10/31/2007	2005	g/yr	N/A	5.0%	-	-	-	-	-	-	-	-
Potomac River Upper Tidal	02140201	CH, PG	PCBs	10/31/2007	2005	g/yr	1.24	92.1%	1.14	0.06	5.0%	0.06	5.4%	1.14	100.0%	2050
Severn River Mesohaline	MD-SEVMH-02131002	AA	PCBs	07/19/2016	2010	g/yr	N/A	0.0%	-	-	-	-	-	-	-	-
South River Mesohaline	MD-SOUMH-02131003	AA	PCBs	04/27/2015	2010	g/yr	N/A	0.0%	-	-	-	-	-	-	-	-
West and Rhode Rivers Mesohaline	MD-WST-RHDMH-02131004	AA	PCBs	01/08/2016	2010	g/yr	N/A	0.0%	-	-	-	-	-	-	-	-

Note: MDOT SHA does not have a PCB WLA reduction responsibility for the following watersheds presented in this table: Gunpowder River, Magothy River Mesohaline, Patuxent River Mesohaline, Patuxent River Oligohaline, Potomac River Lower Tidal, Potomac River Middle Tidal, Potomac River Upper Tidal-Prince George's County portion, Severn River Mesohaline, South River Mesohaline and West and Rhode Rivers Mesohaline. **Table 1-1** indicates that these watersheds list MDOT SHA for PCB responsibility and the reasons there are no reduction requirements for MDOT SHA are mentioned in **Section E.3.**

Table 3-2: MDOT SHA Nutrient, Sediment, PCB and Trash Modeling Results

Watershed Name	Watershed Number	County	Pollutant	EPA Approval Date	Baseline Year	Unit	MDOT SHA Baseline Load	MDOT SHA % Reduction Target	MDOT SHA Reduction Target	2020 Interim Reduction Target	% 2020 Reduction Relative to Reduction Target	2025 Interim Reduction Target	% 2025 Reduction Relative to Reduction Target	Projected Reduction to be Achieved by Target Year	% Reduction to be Achieved Relative to Reduction Target	Target Year
Trash TMDLs																
Anacostia	02140205	MO	Trash	09/21/2010	2009	lbs/yr	N/A	100%	6,044	3,273	54.2%	4,764	78.8%	6,044	100.0%	2035
		PG					N/A	100%	14,134	5,604	39.6%	10,344	73.2%	14,134	100.0%	2035
Patapsco - Gwynns Falls	MD-PATMH-0213095	BA	Trash & Debris	01/05/2015	2011	lbs/yr	N/A	100%	2,415	2,415	100.0%	2,415	100.0%	2,415	100.0%	2025
Patapsco - Jones Falls	MD-PATMH-02130904	BA	Trash & Debris	01/05/2015	2011	lbs/yr	N/A	100%	1,490	1,490	100.0%	1,490	100.0%	1,490	100.0%	2025
Bacteria TMDLs																
Baltimore Harbor - Furnace Creek	MD-PATMH FURNACE _ CREEK	AA	Enterococci	03/10/2011	2006	billion counts / day	34,094	77.8%	26,525	1,300	4.9%	1,300	4.9%	26,525	100.0%	2050
Baltimore Harbor - Marley Creek	MD-PATMH-MARLEY_ CREEK	AA	Enterococci	03/10/2011	2006	billion counts /day	20,684	75.8%	15,678	3,050	19.5%	3,050	19.5%	15,678	100.0%	2050
Loch Raven Reservoir	02130805	BA, CL, HA	E. coli	12/03/2009	2004	billion MPN /yr	113,344	87.6%	99,289	1,818	1.8%	1,818	1.8%	99,289	100.0%	2050
Patapsco River LN Branch	02130906	AA, BA, CL, HO	E. coli	12/03/2009	2003	billion MPN /yr	231,593	14.8%	34,276	1,829	5.3%	1,829	5.3%	34,276	100.0%	2050

Table 3-2: MDOT SHA Nutrient, Sediment, PCB and Trash Modeling Results

Watershed Name	Watershed Number	County	Pollutant	EPA Approval Date	Baseline Year	Unit	MDOT SHA Baseline Load	MDOT SHA % Reduction Target	MDOT SHA Reduction Target	2020 Interim Reduction Target	% 2020 Reduction Relative to Reduction Target	2025 Interim Reduction Target	% 2025 Reduction Relative to Reduction Target	Projected Reduction to be Achieved by Target Year	% Reduction to be Achieved Relative to Reduction Target	Target Year
Patuxent	02131104	AA, PG	E. coli	08/09/2011	2009	billion MPN /yr	26,200	45.3%	11,869	45	0.4%	45	0.4%	11,869	100.0%	2050

E.2. Nutrient and Sediment Implementation Plan

E.2.a. Nutrient and Sediment TMDLs with MDOT SHA Responsibility

There are 26 EPA approved phosphorus or sediment TMDLs with MDOT SHA responsibility spanning 20 Maryland 8-digit watersheds The following TMDL documents for phosphorus and sediment are addressed in this plan:

- *Total Maximum Daily Load of Phosphorus in the Antietam Creek Watershed, Washington County, Maryland*, approved by EPA September 25, 2013;
- *Total Maximum Daily Load of Phosphorus in the Catoctin Creek Watershed, Frederick County, Maryland*, approved by EPA September 24, 2013;
- *Total Maximum Daily Load of Phosphorus in the Double Pipe Creek Watershed, Frederick and Carroll Counties, Maryland*, approved by EPA April 26, 2013;
- *Total Maximum Daily Loads of Phosphorus and Sediments for Liberty Reservoir, Baltimore and Carroll Counties, Maryland*, approved by EPA May 7, 2014;
- *Total Maximum Daily Load of Phosphorus in the Lower Monocacy River Watershed, Frederick, Carroll and Montgomery Counties, Maryland*, approved by EPA May 22, 2013;
- *Total Maximum Daily Load of Phosphorus in the Upper Monocacy River Watershed, Frederick and Carroll Counties, Maryland*, approved by EPA May 7, 2013;
- *Total Maximum Daily Load of Phosphorus in the Rock Creek Watershed, Montgomery County, Maryland,* approved by EPA September 26, 2013;
- *Total Maximum Daily Load of Sediment in the Antietam Creek Watershed, Washington County, Maryland*, approved by EPA December 18, 2008;
- *Total Maximum Daily Load of Sediment in the Bynum Run Watershed, Harford County, Maryland*, approved by EPA September 30, 2011;

- *Total Maximum Daily Load of Sediment in the Cabin John Creek Watershed, Montgomery County, Maryland*, approved September 30, 2011;
- *Total Maximum Daily Load of Sediment in the Catoctin Creek Watershed, Frederick County, Maryland*, approved by EPA July 31, 2009;
- *Total Maximum Daily Load of Sediment in the Conococheague Creek Watershed, Washington County, Maryland*, approved by EPA November 24, 2008;
- *Total Maximum Daily Load of Sediment in the Double Pipe Creek Watershed, Frederick and Carroll Counties, Maryland*, approved by EPA February 20, 2009;
- *Total Maximum Daily Load of Sediment in the Gwynns Falls Watershed, Baltimore City and Baltimore County, Maryland*, approved by EPA March 10, 2010 and revised August 31, 2015;
- *Total Maximum Daily Load of Sediment in the Jones Falls Watershed, Baltimore City and Baltimore County, Maryland*, approved September 29, 2011;
- *Total Maximum Daily Load of Sediment in the Little Patuxent River Watershed, Howard and Anne Arundel Counties, Maryland*, September 30, 2011;
- *Total Maximum Daily Load of Sediment in the Lower Gunpowder Falls Watershed, Baltimore County, Maryland,* approved by EPA May 4, 2017;
- *Total Maximum Daily Load of Sediment in the Lower Monocacy River Watershed, Frederick, Carroll, and Montgomery Counties, Maryland*, approved by EPA March 17, 2009;
- *Total Maximum Daily Load of Sediment in the Patapsco River Lower North Branch Watershed, Baltimore City and Baltimore, Carroll, Howard, and Anne Arundel Counties, Maryland*, approved by EPA September 30, 2011;
- *Total Maximum Daily Load of Sediment in the Patuxent River Upper Watershed, Howard, Anne Arundel, and Prince George's Counties, Maryland*, approved by EPA September 30, 2011;
- *Total Maximum Daily Load of Sediment in the Potomac River Montgomery County Watershed, Montgomery and Frederick Counties, Maryland*, approved by EPA June 19, 2012;
- *Total Maximum Daily Load of Sediment in the Rock Creek Watershed, Montgomery County, Maryland*, approved by EPA September 29, 2011;
- *Total Maximum Daily Load of Sediment in the Seneca Creek Watershed, Montgomery County, Maryland*, approved by September 30, 2011;
- *Total Maximum Daily Load of Sediment in the Non-tidal South River Watershed, Anne Arundel County, Maryland,* approved by EPA September 28, 2017;
- *Total Maximum Daily Load of Sediment in the Swan Creek Watershed, Harford County, Maryland,* approved September 30, 2016; and
- *Total Maximum Daily Load of Sediment in the Upper Monocacy River Watershed, Frederick and Carroll Counties, Maryland*, approved December 3, 2009.

Table 3-2 shows a summary of the reduction requirements and projected reduction benchmarks by target years for the current MDOT SHA nutrient and sediment TMDLs. Refer to the *MDOT SHA Restoration Modeling Protocol* (MDOT SHA, 2018) for modeling methods, **Figure 3-7A** for watersheds with phosphorus TMDLs, **Figure 3-7B** for watersheds with sediment TMDLs, and **Part IV** for detailed watershed level implementation plans.

E.2.b. Nutrient and Sediment Sources

Discussions in the TMDLs concerning nutrient and sediment sources focus on types of land use with information derived from the Chesapeake Bay Program Watershed Model (CBP WM). Cropland and regulated urban land tend to be the most significant sources, followed by other agricultural uses and wastewater sources. MDOT SHA researched a number of other references and determined sources beyond land uses that are summarized in **Table 3-3**. Sources of phosphorus are manure, fertilizers used for crops, residential lawn care, and wastewater discharges. Sources of sediment include surface erosion from construction sites and cropland as well as stream erosion.

Table 3-3: Nutrient and Sediment Sources from Various References

Land Use	Nutrient Sources	Sediment Sources
Agriculture	Chemical Fertilizer Manure	Soil Erosion
Urban	Pet Waste Lawn Fertilizer Parking Lot, Roof, and Street Runoff	Construction Erosion Parking Lot, Roof, and Street Runoff
Wastewater	Municipal Industrial Failed Septic Systems Combined Sewer Overflow (CSO) / Sanitary Sewer Overflow (SSO) Leaking Sewers	
Natural	Atmospheric Deposition	Stream Erosion Shoreline Erosion
References used to develop the table are MDE, 2014c; EPA, 2010; Hoos et al., 2000; and Schueler, 2011.		

MDOT SHA Loading Sources

SHA-owned land is a small portion of each of the TMDL watersheds and it consists of relatively uniform land uses including roadways and roadside vegetation. In urbanized areas, the MDOT SHA ROW may extend to include sidewalks and portions of driveways. There are also parking areas associated with MDOT SHA land such as park and ride facilities, office complexes, and maintenance facilities.

Of the land uses in **Table 3-3**, MDOT SHA is a contributor of nutrients and sediments mostly through urban and natural sources. MDOT SHA has no responsibility for agriculture sources.

E.2.c. MDOT SHA Nutrient and Sediment Reduction Strategies

To date, MDOT SHA has used a variety of structural, non-structural, and alternative BMPs to reduce nutrient and sediment in the watersheds that have a corresponding TMDL. However, we have not limited our load reduction activities to just BMP implementation. The use of nutrient credit trading will also be explored as a tool in reaching load reduction targets. When MDOT SHA partners on projects with other MS4 jurisdictions, load splitting can also be used to achieve WLA reductions.

BMP Implementation

In conjunction with restoration efforts for 20 percent of currently untreated impervious surface area, MDOT SHA intends to build or implement BMPs used for impervious restoration in watersheds that also have a local TMDL where possible. Watershed-level pollutant load reductions are modeled from implementation of currently constructed BMPs and BMPs planned for future implementation. The results of this analysis are presented in **Table 3-2** and a chart of the different types of practices used to achieve the results are shown in **Figures 3-8** and **3-9** on the following pages. Proposed practices to be implemented for each watershed are shown in **Part IV, MDOT SHA Watershed TMDL**

Implementation Plan under the specific watersheds with phosphorus and sediment WLAs.

A significant challenge encountered with building BMPs is that there can be a lack of available ROW for BMP placement opportunities. There are instances where MDOT SHA roadway encompasses most of the area in the ROW leaving very little land to construct BMPs. The visual watershed inspection process has indicated areas where BMP placement is possible and where it is not feasible do to utility relocation, conflicts with other MDOT SHA projects, site access problems, and a host of other issues. Therefore, MDOT SHA is continually seeking new opportunities and partnerships to install BMPs.

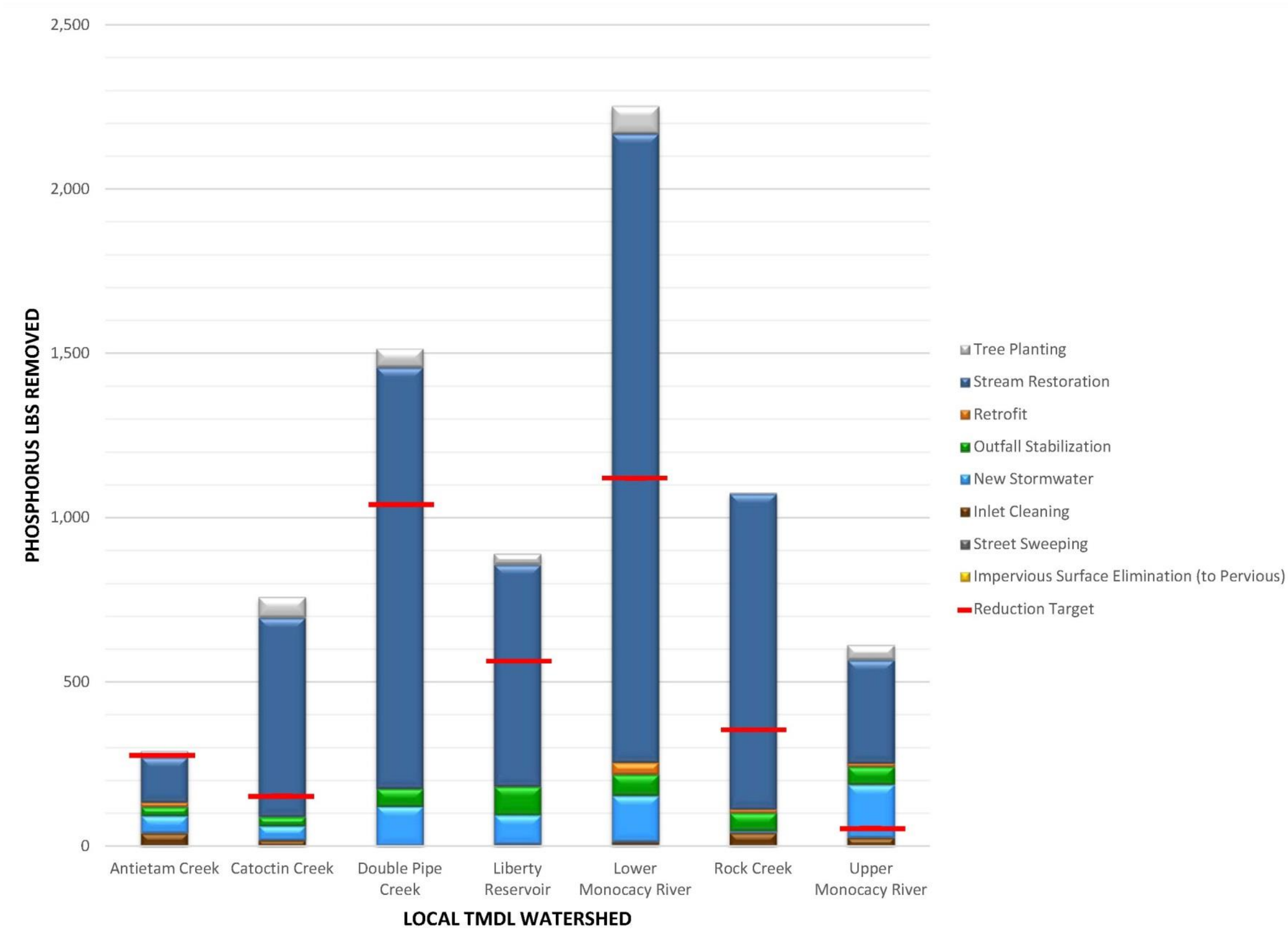


Figure 3-8: Phosphorus WLA Reductions by Watershed with BMP Menu

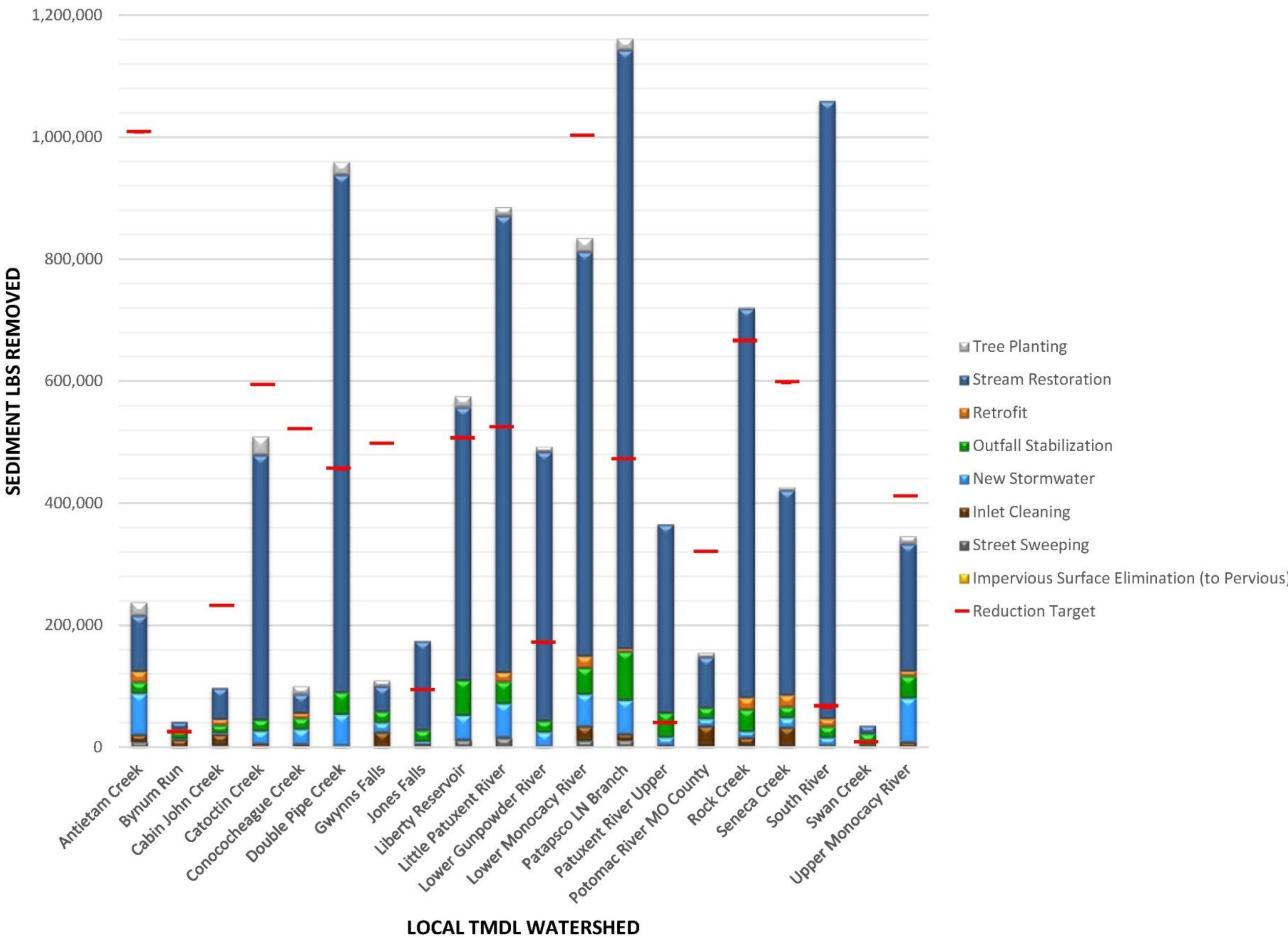


Figure 3-9: Sediment WLA Reductions by Watershed with BMP Menu

Nutrient Credit Trading

MDOT SHA will explore nutrient credit trading when MDE implements a trading policy and modifies the current permit to allow trading. It is anticipated that MS4 jurisdictions will have the ability to purchase phosphorus, nitrogen, sediment, and impervious treatment credits in quantities to fill gaps in current implementation plans. Once the trading regulations and guidance are finalized and approved by EPA, MDOT SHA may to utilize this program to meet TMDL pollutant reduction requirements.

Credit Splitting

MDOT SHA is partnering with other MS4 permittees and government agencies to implement projects that will reduce nutrients and sediments. The goal is to produce projects that will have a mutual benefit to the watershed and both parties in meeting load reduction requirements. Parameters concerning splitting of reductions achieved will be documented through project specific agreements.

TMDL End Dates and Adaptive Management

Currently, when modeling projected reductions for setting interim and final target dates, MDOT SHA only considers potential restoration practices that have some level of certainly based on site search and evaluation processes in place. Also, our modeling only looks forward to 2025 and not beyond. Predictions have been used based on historic data indicating the percent of BMPs removed from projects as project specific constrains are encountered (such as bedrock or property owners deciding not to sell) as they move from site search to construction.

Although MDOT SHA is committed to meeting the WLAs by the listed target years, our current modeling only looks forward to 2025, which may not achieve 100 percent of all required reductions. For some watersheds, 100 percent or greater of the target reduction goal has already been achieved or is anticipated to be achieved for the 2025 milestone. For other watersheds, the 2025 reduction achieved is less than 100 percent. MDOT SHA will work to increase expected reductions and will explore other possibilities such as of nutrient credit trading, partnering with load and credit splitting, or currently unknown alternative methods which cannot be modeled at this time.

E.3. Polychlorinated Biphenyls (PCBs) Implementation Plan

E.3.a. PCB TMDLs Affecting MDOT SHA

There are 12 EPA approved polychlorinated biphenyls (PCBs) TMDLs with MDOT SHA responsibility spanning 21 Maryland 8-digit watersheds**.** The following TMDL documents for PCBs are addressed with this plan:

- *Total Maximum Daily Loads of Polychlorinated Biphenyls for Tidal Portions of the Potomac and Anacostia Rivers in the District of Columbia, Maryland, and Virginia*, approved by EPA October 31, 2007;
- *Total Maximum Daily Loads of Polychlorinated Biphenyls in the Northeast and Northwest Branches of the Nontidal Anacostia River, Montgomery and Prince George's County, Maryland*, approved by EPA September 30, 2011;
- *Total Maximum Daily Load of Polychlorinated Biphenyls in the Back River Oligohaline Tidal Chesapeake Bay Segment, Maryland*, Baltimore City and Baltimore County, Maryland, approved by EPA October 1, 2012;
- *Total Maximum Daily Loads of Polychlorinated Biphenyls in the Baltimore Harbor, Curtis Creek/Bay, and Bear Creek Portions of the Patapsco River Mesohaline Tidal Chesapeake Bay Segment, Maryland,* Baltimore City, Anne Arundel County, and Baltimore County, Maryland, approved by EPA October 1, 2012;
- *Total Maximum Daily Load of Polychlorinated Biphenyls in the Bush River Oligohaline Segment, Harford County, Maryland, approved by EPA August 2, 2016;*
- Total Maximum Daily Load of Polychlorinated Biphenyls in the Gunpowder River and Bird River Subsegments of the Gunpowder River Oligohaline Segment, Baltimore County and Harford County, Maryland, approved by EPA October 3, 2016;
- *Total Maximum Daily Load of Polychlorinated Biphenyls in Lake Roland of Jones Falls Watershed in Baltimore County and Baltimore City, Maryland*, approved by EPA June 30, 2014;
- *Total Maximum Daily Load of Polychlorinated Biphenyls in the Magothy River Mesohaline Chesapeake Bay Tidal Segment, Anne Arundel County, Maryland*, approved by EPA March 16, 2015.;
- *Total Maximum Daily Load of Polychlorinated Biphenyls in the Patuxent River Mesohaline, Oligohaline and Tidal Fresh Chesapeake Bay Segments,* Anne Arundel, Calvert, Charles, Frederick, Howard, Montgomery, Prince George's, and St. Mary's Counties, Maryland, approved by EPA September 19, 2017;
- *Total Maximum Daily Load of Polychlorinated Biphenyls in the Severn River, Mesohaline Chesapeake Bay Tidal Segment, Anne Arundel County, Maryland, approved by EPA July 19, 2016;*
- *Total Maximum Daily Load of Polychlorinated Biphenyls in the South River Mesohaline Chesapeake Bay Segment, Anne Arundel County, Maryland, approved by EPA April 27, 2015; and*
- *Total Maximum Daily Load of Polychlorinated Biphenyls in the West River and Rhode River, Mesohaline Segments, Anne Arundel County, Maryland, approved by EPA January 8, 2016.*

Table 3-2 shows a summary of the reduction requirements and projected reduction benchmarks by target year for the current MDOT SHA PCB TMDLs. Refer to the *MDOT SHA Restoration Modeling Protocol* (MDOT SHA, 2018) for modeling methods, **Figure 3-7C** for watersheds with PCB TMDLs, and **Part IV** for detailed watershed level implementation plans.

E.3.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. Bottom sediments were not considered a source in any of the TMDLs, since the PCBs stayed within the waterbody. The Bay tidal influence can be either a source or sink. For the Magothy, Severn, South, West and Rhodes River TMDLs, the Bay tidal influence is the single major source of PCBs. Back River, on the other hand, exports more PCBs to the Bay than it receives.

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 3-4** shows which sources are described in the thirteen watersheds.

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 3-4: 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	Bottom Sediments					✓								
	Chesapeake Bay Mainstem 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 SHA

Two of the controllable sources in **Table 3-4** that warrant further investigation relative to MDOT SHA are NPDES-regulated stormwater and contaminated sites. MDOT SHA roadways pass through or near facilities, campuses, or industries that may contribute PCBs to the environment and may as a result, convey PCBs in stormwater runoff from these adjacent areas. Also, MDOT SHA roadways themselves may be sources contributing to contaminated runoff.

The MDOT SHA Environmental Compliance Division (ECD) has conducted inspections on our industrial sites and other maintenance or storage facilities and has not discovered any legacy contaminated sites. Although a comprehensive investigation of MDOT SHA ROW may not be feasible, innovative ways to discover sources within MDOT SHA ROW and other adjacent land uses can be investigated as well.

E.3.c. Proposed No-Action for Certain Watersheds

MDOT SHA is proposing no action for PCBs in several impaired watersheds for the following reasons:

- Tidal influence is largely the source of PCBs,
- Reduction percentage falls within the MOS, and
- Zero percent reduction assigned to regulated stormwater by MDE.

Tidal Influence

In several TMDLs for PCB, MDE modeling demonstrates that tidal influence from the Chesapeake Bay to tidal tributaries contributes most PCB pollution to the waterway. Because loads from resuspension and diffusion from bottom sediments are not considered to be directly controllable loads, see **Table 3-4,** they are not included in the total Polychlorinated Biphenyl (tPCB) baseline load and TMDL allocations. Furthermore, MDE determined that attenuation within the Bay was predictable within specific timeframes and reducing watershed loads by 100 percent would not appreciably change this timeframe. For these reasons, in the following TMDLs MDE assigned a zero percent load reduction to the regulated stormwater sources.

In the Magothy River TMDL (MDE, 2015a), modeling shows that tidal flows from the Chesapeake Bay mainstem to the river were the source of 98.7 percent of PCBs and regulated stormwater was less than 0.2 percent. Modeling predicted attenuation in the Bay within 43.4 years.

In the South River TMDL (MDE, 2015b), tidal influence was the source of 97.8 percent of PCBs and regulated stormwater was less than 0.2 percent. Modeling predicted attenuation of PCBs in the Bay within 12.3 years.

In the Severn River TMDL (MDE, 2016a), tidal influence was the source of 98.2 percent of PCBs and regulated stormwater was less than 0.4 percent. Modeling predicted attenuation of PCBs in the Bay within 46.2 years.

In the West and Rhode Rivers TMDL (MDE, 2016b), modeling shows that tidal influence was the source of 96.8 percent of PCBs and regulated stormwater was less than 0.2 percent. Modeling predicted attenuation in the Bay within 16.8 years.

Reduction within MOS

In the Potomac and Anacostia River TMDL (Haywood & Buchanan, 2007), the Potomac River Lower Tidal, Middle Tidal, and the Charles County portion of Potomac River Upper Tidal watersheds have a reduction requirement of 5 percent, which is entirely due to the MOS. Without the MOS, no additional reduction is required. The reduction attributed to the MOS is expected to be treated through a 93 percent reduction in atmospheric deposition.

Zero Reduction Assigned

In the Gunpowder River and Bird River TMDL (MDE, 2016c), there are separate reduction requirements for the two subsegments that contribute to this TMDL. MDOT SHA has a zero percent reduction target for the Gunpowder River segment.

Similarly, MDE has provided separate reduction requirements for the three segmentsheds, within the Patuxent River TMDL (MDE, 2017a). These segmentsheds are the PAXMH, PAXOH, and PAXTF. For the PAXMH and the PAXOH segmentsheds there are zero percent reductions.

E.3.d. PCB Reduction Strategies

MDOT SHA will implement an adaptive management process that relies on four main PCB reducing efforts:

- Track PCB reductions achieved from ongoing impervious restoration efforts implemented under the MDOT SHA MS4 permit,
- Continue to monitor the development and implementation of new technologies that are shown to reduce PCB concentrations through dichlorination or other methods,

- Continue to develop methods to identify sources or contaminated sites either on MDOT SHA ROW or directly affecting MDOT SHA stormwater runoff and work with appropriate State or federal agencies to eliminate sources, and
- Initiate partnering efforts to reduce PCB concentrations in local watersheds with other jurisdictions where it is perceived to be mutually beneficial for both parties.

Stormwater BMP Reduction Modeling

BMPs used to reduce sediment will provide a secondary benefit in removing PCBs associated with sediments. Modeling results in **Table 3-2** show that minimal reductions are achieved through stormwater BMP implementation alone and there is a need to supplement SW control structures with other strategies to achieve PCB reductions.

Development and Implementation of PCB-Reducing Technologies

The MDOT SHA is reviewing current research on bioremediation of PCBs using biofilms, plants, and other mechanisms. It is understood that there are bacteria in the natural environment that are capable of aerobic dichlorination and anaerobic degradation of PCB congeners. Other technologies such as activated charcoal may also be promising for future implementation. MDOT SHA will continue to explore the possibility of using these new technologies and will implement pilot programs when deemed appropriate.

Source Identification

Methods to improve both the identification of PCBs in MDOT SHA roadway stormwater runoff and sources will be pursued. This can include research coupled with practical applications.

Partnering

When appropriate, MDOT SHA will initiate partnering with other local jurisdictions or agencies to work cooperatively towards PCB reduction targets.

E.4. Trash Implementation Plan

E.4.a. Trash TMDLs Affecting MDOT SHA

There are two EPA approved trash TMDLs with MDOT SHA responsibility spanning three Maryland 8-digit watersheds. The following TMDL documents for trash are addressed with this plan:

- *Total Maximum Daily Loads of Trash for the Anacostia River Watershed, Montgomery and Prince George's Counties, Maryland and the District of Columbia*, approved by EPA September 21, 2010; and

- *Total Maximum Daily Loads of Trash and Debris for the Middle Branch and Northwest Branch Portions of the Patapsco River Mesohaline (PATMH) Tidal Chesapeake Bay Segment, Baltimore City and County, Maryland*, approved by EPA January 5, 2015.

Table 3-2 shows a summary of the reduction requirements and projected reduction benchmarks by target year for the current MDOT SHA trash TMDLs. Refer to the *MDOT SHA Restoration Modeling Protocol* (MDOT SHA, 2018) for modeling methods, **Figure 3-7E** for watersheds with trash TMDLs, and **Part IV** for detailed watershed level implementation plans.

These trash TMDLs (MDE, 2010a; MDE, 2015c) are not written as traditional TMDLs. They are expressed in terms of a quantity to be removed, rather than in terms of the maximum allowable pollutant input. See **Figure 3-10** for an illustration of the trash TMDL concept. Because they are focused on a load to be removed, the term 'baseline' represents the desired level of trash removal and the trash TMDL endpoint is 100 percent removal of the baseline load. A TMDL target equal to 100 percent removal of the baseline load is not the same as zero trash in the watershed, but that the assigned baseline loads are to be removed in their entirety each year.

The reduction goal for MDOT SHA compliance with the TMDLs are listed in **Tables 3-5 and 3-6**.

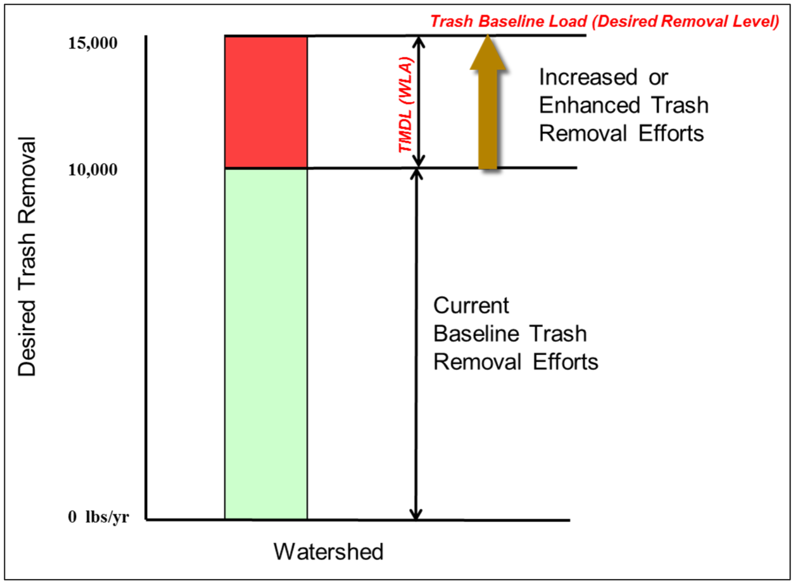


Figure 3-10: Trash TMDL Baseline and WLAs

Table 3-5: Summary of Anacostia River Watershed Baseline Loads and TMDL for MDOT SHA

Watershed	Annual WLA	5% MOS	Annual TMDL (WLA + 5% MOS)
	Lbs/Year	Lbs/Yr	Lbs/Yr Removed
Anacostia River (MO County)	5,756	287.8	6,044
Anacostia River (PG County)	13,461	673.05	14,134
Totals	**19,217**	**960.85**	**20,178**

Table 3-6: Summary of PATMH Tidal Bay Segment Baseline Loads and TMDL for MDOT SHA

Watershed	Annual WLA	5% MOS	Annual TMDL (WLA + 5% MOS)
	Lbs/Year	Lbs/Yr	Lbs/Yr Removed
Gwynns Falls (BA County)	2,300	115	2,415
Jones Falls (BA County)	1,419	70.9	1,490
Totals	**3,718.7**	**185.9**	**3,905**

E.4.b. Trash Sources and Loading Rates

Sources

The baseline year for this TMDL Implementation Plan is 2010. MDOT SHA has determined this baseline year because the PATMH study was performed in 2010 and 2011, and TMDL loading rates were determined using 2010 land use data. Additionally, the Anacostia River Watershed Trash TMDL was approved in 2010.

Baseline loads and subsequent TMDL allocations are split between point and non-point sources:

- Wasteload Allocation (WLA) addressing point source trash items that can enter the storm sewer system; and
- Load Allocation (LA) assigned to nonpoint source larger trash and debris, usually associated with dumping activities.

WLAs have been assigned to MDOT SHA for trash in these watersheds, although MDOT SHA can demonstrate removal of trash such as dumping, that qualifies as LA removal, it is not credited as WLA load removal.

Loading Rates

Loading rates for different land uses are assigned in the TMDL documents and for MDOT SHA they are 2.22 lbs/ac/yr (Anacostia) and 2.06 lbs/ac/yr (PATMH). Different sampling methodologies were used to determine the baseline trash loading rates for each of the trash TMDLs:

- The Anacostia River TMDL sampling methodology is based on stormwater outfall sampling – storm drain data were collected downstream of outfalls through the use of either trash fencing or trash nets.

- The PATMH sampling methodology is based on sampling within SW control structures – trash was collected within the fenced boundary of the facilities.

Any upstream practices that were already in place during the trash monitoring studies are inherently captured in these baseline rates. The differing sampling methodologies listed above have implications as to which MDOT SHA trash removal processes were captured in the measured baseline rates. Because the Anacostia sampling was performed downstream of outfalls, all upstream practices including SW control structures are included in the baseline. Alternatively, since the PATMH sampling was performed within SW control structures, trash reductions they provided were not included in the baseline. Therefore, MDOT SHA includes any SW control structures whether built prior to and after 2010 as program enhancements for the PATMH TMDL reductions, but only includes SW control structures built after 2010 for the Anacostia TMDL reductions.

E.4.c. Baseline Trash Reduction

Part I.F.7 lists and describes BMPs used for pollutant source control and includes descriptions of the current MDOT SHA 'litter reduction, collection, and disposal' efforts including maintenance crew clean-ups, contracted crew clean-ups, AAH, and SAH. These current programs cover the Jones Falls, Gwynns Falls, and Anacostia River watersheds and were in existence prior to 2010. Because these practices were in existence prior to 2010, they are inherently captured in the 2010 baseline rates for each trash TMDL. **Tables 3-7 and 3-8** list BMPs that are considered baseline alongside BMPs that will be quantified as enhancements.

Since no significant changes or enhancements have occurred to these programs since 2010, these roadside clean-up activities are not included in modeling for the WLA reduction and attempts to quantify them relative to 2010 have been abandoned.

E.4.d. Enhanced Trash Reduction

Demonstrating and quantifying trash reduction enhancements is key to meeting the WLAs. Certain existing programs have been enhanced since 2010 and other new programs are under development and when in place will be quantified as reduction credit for future interim benchmarks to meet the WLAs. These are listed in **Tables 3-7 and 3-8** and discussed below. See **Table 3-2** for proposed reductions and benchmark timeframes for each watershed and **Part IV** for individual plans that provide lists of trash removal activities to address the WLAs in each watershed. Refer to the *MDOT SHA Restoration Modeling Protocol* (MDOT SHA, 2018) for reduction computational methods.

Table 3-7: Anacostia River Baseline / Enhanced / Initiated Practices

Practice or Activity	Baseline	Enhanced after 2010	Initiated after 2010
Roadside Cleanups	X		
Inlet Cleaning	X	X	
Street Sweeping	X	X	
Stormwater Management Facilities	X		X
Media Relations (Use of Free Media)		X	
Outreach Programs			X
Stream Clean-ups			X

Table 3-8: PATMH Baseline / Enhanced / Initiated Practices

Practice or Activity	Baseline	Enhanced after 2010	Initiated after 2010
Roadside Cleanups	X		
Inlet Cleaning	X	X	
Street Sweeping	X	X	
Stormwater Management Facilities	X		X
Media Relations (Use of Free Media)		X	

Inlet Cleaning

MDOT SHA routinely cleans storm drain inlets and catch basins to remove sediment, gross solids, litter, and debris that accumulate inside. Currently, MDOT SHA staff perform these activities in response to complaints, flooding, or as routine practice. Recently, MDOT SHA has focused on educating our operations forces concerning the value of cleaning the inlet boxes rather than just the surface debris on grates and developing improved data collection methods. This is the first level of enhancement our inlet cleaning program has undergone.

The second level of inlet cleaning enhancement involves using contracted crews to clean significantly increased numbers of inlets in targeted watersheds. Additional funds have been secured for the operations budget to support this work. It is anticipated that this enhancement will take effect in fiscal year 2019. The Anacostia, Jones Falls, and Gwynns Falls watersheds fall within this enhanced inlet cleaning area.

In conjunction with these enhancements a research study (MSU & CWP, 2018) was performed that characterized inlet material and determined that approximately 5 lbs. of trash is removed from an inlet based on a literature review of inlet debris characterization studies and reviewing and documenting MDOT SHA inlet cleaning operations.

Street Sweeping

The TMDL street sweeping program was created in fiscal year 2014 for the purpose of gaining impervious acre credits. MDOT SHA dedicated select urban routes throughout its MS4 area for bi-weekly sweeping. For this newly created program all the trash reduction associated with TMDL street sweeping will be counted towards the trash WLA.

Loading rates discussed in **Section E.4.b**, acres of annual bi-weekly swept roadways, and a 32 percent calculated effectiveness based on the San Francisco Bay trash TMDL technical report, *Trash Load Reduction Tracking Method* (Bay Area Stormwater Management Agencies Association [BASMAA], 2012), are used in determining reductions achieved.

Table 3-9: Summary of Trash Load Reduction Credits from BASMAA (2012)

Alternative Practice	Credit	Qualifiers
Outreach to School-age Children or Youth	2%	Annual Reduction; Min. 8 events if >250,000 population
Media Relations (Use of free media)	1%	Annual Reduction
Community Outreach	2%	Annual Reduction; Min. 8 events if >250,000 population
Enhanced Street Sweeping	32%	Wet weather effectiveness based on >9 days between sweepings[2]; H-4.5/S

1. Source: *Trash Load Reduction Tracking Method* (BASMAA, 2012)
2. H = effectiveness, S = number of days between sweepings.

Stormwater Management Facilities

MDE *Guidance for Developing Stormwater Wasteload Allocation Implementation Plans for Trash/Debris Total Maximum Daily Loads* lists structural stormwater controls as an allowable trash load reduction practice (MDE, 2014d). Regular maintenance, which includes trash collection, is performed on SW control structures.

Estimated reductions from SW control structures are calculated using the loading rates discussed in **Section E.4.b**, a 95 percent removal efficiency, as described in the Baltimore County Trash TMDL Implementation Plan (BA-EPS, 2016) and the Anacostia Watershed Implementation Plan (Biohabitats et al., 2012a), and drainage area land use acreages. SW control structures with trash collecting capabilities include:

- Bioretention
- Dry Extended Detention Pond
- Dry Pond
- ED Shallow Wetland
- Infiltration Basin
- Micro-Bioretention
- Micropool Extended Detention Pond
- Other Filtering
- Pond/Wetland System
- Shallow Marsh
- Submerged Gravel Wetland
- Wet Extended Detention Pond
- Wet Pond
- Wet Swale

Based on the methodology used in the PATMH trash TMDL, MDOT SHA can calculate reductions from SW control structures (pre- and post-baseline monitoring) and apply them towards the WLA reduction. The Anacostia River watershed trash TMDL does not allow MDOT SHA use SW control structures that were in place prior to the baseline year for reductions, but facilities constructed after the baseline year can provide trash reductions.

Media Relations (Use of Free Media)

The technical report cited in the Baltimore City trash implementation plan, *Trash Load Reduction Tracking Method* (BASMAA, 2012), provides methods to assign reduction efficiencies for several alternative practices including outreach, stream clean-up, and enhanced street sweeping as detailed in **Table 3-9**.

MDOT SHA has a robust media relations program. Besides continual contact with traditional media outlets (radio, TV/Cable) this program was recently enhanced to utilize multiple forms of social media. Additionally, the MDOT SHA 'We Live Here Too' campaign initiated in 2017 has brought attention to the problem of roadside litter and dumping.

Outreach

Outreach activities for both school aged/youth and communities will be pursued as needed to achieve trash load reductions. See Table 3-9 and the reverence technical report for details.

Stream Clean-ups

Described in **Part II.F.7**, stream cleanups include programmed cleanup activities as well as structural installations of trash traps at outfalls or in-stream. Implementation of these practices will provide a pound for pound reduction.

E.5. BACTERIA IMPLEMENTATION PLAN

E.5.a. Bacteria TMDLs Affecting MDOT SHA

There are four EPA approved bacteria TMDLs with MDOT SHA responsibility spanning five Maryland 8-Digit watersheds. The following TMDL documents for bacteria are addressed with this Plan:

- *Total Maximum Daily Loads of Bacteria for Impaired Recreational Areas in Marley Creek and Furnace Creek of Baltimore Harbor Basin in Anne Arundel County, Maryland*, approved by EPA March 10, 2011;

- *Total Maximum Daily Loads of Fecal Bacteria for Loch Raven Reservoir Watershed in Baltimore, Carroll and Harford Counties, Maryland*, approved by EPA December 3, 2009;

- *Total Maximum Daily Loads of Fecal Bacteria for Lower North Branch Patapsco River Watershed in Baltimore, Carroll, Anne Arundel, Howard Counties and Baltimore City, Maryland*, approved by EPA December 3, 2009; and

- *Total Maximum Daily Loads of Fecal Bacteria for the Patuxent River Upper Basin in Anne Arundel and Prince George's Counties, Maryland*, approved by EPA August 9, 2011.

Table 3-2 shows a summary of the reduction requirements and projected reduction benchmarks by target year for the current MDOT SHA bacteria TMDLs. Refer to the *MDOT SHA Restoration Modeling Protocol* (MDOT SHA, 2018) for modeling methods, **Figure 3-7E** for watersheds with bacteria TMDLs, and **Part IV** for detailed watershed level implementation plans.

E.5.b. Bacteria Sources

Fecal indicator bacteria (FIB) are used to identify the presence of fecal matter, which indicates potential presence of pathogens associated with fecal matter. FIBs are not pathogens. A pathogen is a bacterium, virus, or other microorganism that can cause disease. MDE identified the FIB for which MDOT SHA is responsible, including:

- *E. coli*, and
- *Enterococcus.*

For most of the bacteria TMDLs, MDE has included some type of Bacterial Source Tracking (BST), which is a method of estimating the source of the bacteria by matching DNA or RNA with a library of samples from known species. BST has been used to categorize the fraction of bacteria coming from four general sources:

- humans,
- domestic pets,
- wildlife, or
- livestock.

It is important to note that BST is performed on samples from the impaired water body, and thus the estimate of the fraction from each source is relative to the watershed, not from particular locations, jurisdictions, or permittees. The sources of bacteria in the four categories can be categorized in further detail, as shown in **Table 3-10**. These have been derived from MDE's stormwater WLA bacteria guidance (MDE, 2014e) and Watershed Protection Techniques Article 17 (Schueler, 2000), which describes the sources to be addressed for load reduction in an implementation plan.

Table: 3-10 Bacteria Sources

Sector	MS4 Point Source	Non-Point Source
Human	Sanitary sewer illicit discharge	Septic systems
	Sanitary sewer exfiltration	SSO
	Homeless populations	CSO
		Recreational boating
Domestic Pets	Pets, urban areas	Pets, rural areas
Wildlife	Urban wildlife	Non-urban wildlife
Livestock		Agriculture, hobby farms
		Concentrated Animal Feeding Operations (CAFOs)

The bacteria sources listed as MS4 sources are all diffuse sources that enter the storm drain system either through runoff or cross-connections. MDOT SHA, as a MS4 permittee, by definition only has point source discharges. These sources can be treated by stormwater practices or load reduction strategies. Loads from the non-point source list are either discrete sources, which can only be addressed through a load reduction approach, or diffuse rural sources that do not flow through storm drains.

The sources are significant in relation to permit conditions. The TMDL SW-WLA is the only load that must be addressed to meet the permit requirements, so that reduction of loads from livestock, sewer overflows, or septic systems would not be applicable to meet the permit requirement. Bacteria from these sources generally enter the receiving waters directly.

Bacteria concentrations in stormwater runoff are typically elevated above the primary contact recreation standards, regardless of the type of land use in the watershed (Clary et al., 2008). This type of pollution is significant because, unlike the water that goes down a sink or toilet in your home and is fed to a WWTP or septic system, stormwater runoff that is not intercepted by a BMP, is untreated and drains directly to lakes, rivers, and ultimately the Bay.

MDOT SHA Bacteria Loading Sources

The MDOT SHA-owned land is a small portion of each of the TMDL watersheds. Very few of the bacteria sources listed in **Table 3-10** exist within MDOT SHA land. However, there is some very limited potential for bacteria to originate from MDOT SHA ROW.

MDOT SHA owns only two septic systems in these watersheds; one at the Hereford shop in Loch Raven Reservoir watershed and one at a salt storage facility in Patapsco Lower North Branch watershed. The MDOT SHA Facility Maintenance Division (FMD) has standard operating procedures that includes regular inspections and maintenance for facilities with onsite septic systems. This helps to prevent sanitary overflows that may cause bacteria pollution.

The MDOT SHA does not own or maintain sanitary sewers, although some of these utilities may be present within the ROW. However, there is potential for a sewage leak from one of these utilities. The MDOT SHA has a program that conducts regular inspections and testing for any suspected illicit discharge within the drainage system. If an illicit discharge is confirmed, the MDOT SHA works with local jurisdictions to disconnect the discharge from the drainage system.

Potential for human or animal waste contamination from MDOT SHA runoff is minimal. There are no residents or livestock pasture lands in the ROW, so the only source of animal waste bacteria would be feral animals, adjacent residents walking pets along MDOT SHA roads, drainage washing from pasture lands, or homeless individuals. Wildlife sources are typically generated as a non-point source throughout the watershed, and are typically deterred from MDOT SHA ROW for safety reasons.

E.5.c. Bacteria Reduction Strategies

The MDOT SHA bacteria reduction strategy will be an iterative process to address bacteria sources with the greatest impact on water quality, while considering difficulty of implementation and cost. The MDOT SHA first started with using the Watershed Treatment Model (WTM). Next, MDOT SHA will develop local monitoring data of stormwater outfalls in the MDOT SHA drainage system. Then, the data from the outfall monitoring effort is analyzed to identify any BMP in which water flowing from or in the BMP are not meeting bacteriological WQSs set by MDE. Source elimination will follow the analysis of the local monitoring data. In the source elimination stage MDOT SHA will seek to remove the source of the bacteria.

Watershed Treatment Modeling

The WTM was used to better understand what bacteria load reduction MDOT SHA can capture using the portfolio of BMPs that will be used to meet the required 20 percent impervious restoration goal. The idea is to determine what impact the impervious surface restoration has on reducing bacteria in the local watersheds. The expectation is where fecal bacteria are transported through our MS4 conveyance system, stormwater BMPs implemented to control urban runoff should help in reducing fecal bacteria loads in the watershed. The results of the WTM are shown in **Table 3-2**.

Local Monitoring Effort

MDOT SHA will develop a protocol for monitoring stormwater outfalls and/or other BMPs that may have possible contaminated flow. This protocol is expected to be developed and approved by MDE by 2021. After the monitoring protocol is in place, MDOT SHA will start with sampling outfalls and BMPs in the watershed with a bacteria TMDL.

It is expected that during the local monitoring effort, MDOT SHA will be able to determine if there are any waters flowing from the MS4 drainage system where water quality is not meeting bacteriological WQSs. Once locations are identified, an effort to further investigate the source of the bacteria will be undertaken. The MDOT SHA will review MDE's BST data for the identified area and make a determination on what the potential source(s) of contaminate are. MDE's BST data tests microbial isolates collected from water samples and compares the isolates with a library from known sources to identify the host organism the bacteria came from. Once the BST data is examined a source can be identified and source elimination efforts can be focused.

Source Elimination

The effort to eliminate bacteria sources will focus on achieving load reductions for domestic pets, wildlife loads, and human waste. These actions may include but not be limited to:

- Eliminating illicit sewer discharges to stormwater conveyance systems;
- Addressing areas frequented by homeless populations in cooperation with local public health agencies; and
- Installing pet waste disposal bins within MDOT SHA ROW that have a high pet usage.