Maryland Department of the Environment

Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated

Guidance for National Pollutant Discharge Elimination System Stormwater Permits

November 2021

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I. Introduction

The goals of Maryland's National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4) permits are to control stormwater pollution, improve water quality, and work toward meeting water quality standards. The permits require MS4 jurisdictions to implement restoration activities in order to meet stormwater wasteload allocations (SW-WLAs) included in Environmental Protection Agency (EPA) approved total maximum daily loads (TMDLs). The *2021 Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (Guidance) reflects updated permit crediting to address impervious acre restoration and nutrient load reductions consistent with Maryland's Phase III Watershed Implementation Plan (WIP) for the Chesapeake Bay TMDL and 2025 nutrient load targets.

The Guidance also incorporates the Phase 6 Chesapeake Bay Watershed Model (Phase 6 Model), new and updated best management practices (BMPs) approved by the Chesapeake Bay Program (CBP) expert panels, and stormwater management co-benefits. This Guidance was developed with the contributions of environmental non-governmental organizations, MS4 jurisdictions, State agencies, and EPA. The 2021 MS4 restoration credits and accounting principles supersede the 2014 guidance for reissued permits.

II. Restoration Credits and Accounting Principles

MS4 jurisdictions must use an impervious acre credit to account for MS4 restoration achieved through stormwater BMP implementation. The impervious acre credit is the MS4 permit's surrogate parameter for level of implementation required to show progress in total nitrogen (TN), total phosphorus (TP), and total suspended sediment (TSS) load reductions toward meeting Chesapeake Bay and local TMDLs. MS4 jurisdictions must also report load reductions achieved through BMP implementation. The procedures for calculating impervious acre credits and associated pollutant load reductions, and general accounting principles are summarized below and described in more detail in the body of this Guidance.

The impervious acre credit is used for accounting for upland BMPs that provide impervious acre water quality treatment. These BMPs are described in Chapters 3 and 5 of the *2000 Maryland Stormwater Design Manual* (Manual). The impervious acre credit is determined from three BMP variables: drainage area, impervious acres, and the rainfall depth treated. Impervious acres in the drainage area are considered treated 100% for water quality when the runoff from one inch of rainfall over the drainage area is captured and treated. More information on the impervious acre credit can be found in Section III. Impervious Acre Credits of Upland Best Management Practices.

Equivalent impervious acres (EIAs) are used to determine the impervious acre restoration credit for alternative BMPs that are not found in the Manual but are additional options for MS4 jurisdictions to reduce stormwater pollutants. Alternative BMPs include street sweeping, storm drain cleaning, floating treatment wetlands, land cover conversion, urban soil restoration, septic practices, shoreline management, stream restoration, and elimination of discovered nutrient discharges from grey infrastructure. A method has been developed using the CBP land cover unit loads and the reduction in pollutant loads from alternative BMPs for determining an EIA conversion factor (EIA_f). The EIA_f for all alternative BMPs for MS4 restoration crediting are presented in Table 1. More detailed information on the EIA credits is found in Section V: Alternative Best Management Practices

MS4 jurisdictions are required to document progress toward meeting local and Chesapeake Bay TMDLs by reporting TN, TP, and TSS load reductions when implementing stormwater BMPs. All BMPs found in the Manual, i.e., Chapter 3 structural practices and Chapter 5 environmental site design (ESD) practices, plus alternative BMPs are acceptable for restoration and may be used to calculate load reduction credits. The TN, TP, and TSS removal efficiencies for these BMPs must be calculated in accordance with the CBP expert panel reports, using the Phase 6 Model and delivery factors based on the BMP's proximity to the Chesapeake Bay. Additional information can be found in Section IV: Pollutant Load Reductions for Upland Best Management Practices.

Table 1. EIA_f and Load Reductions for Alternative BMPs

BMP	Load Reductions (lbs/unit/yr)			EIA_f
	TN	TP	TSS	
Advanced Sweeping				**Per Mile Swept**
1 pass/12 weeks	0.00	0.07	401	0.027
1 pass/8 weeks	0.26	0.14	802	0.059
1 pass/4 weeks	0.36	0.21	1,203	0.087
Spring 1 pass/1-2 weeks else monthly	0.36	0.28	1,404	0.106
Spring & Fall 1 pass/1-2 weeks else monthly	0.73	0.34	2,005	0.148
1 pass/2 weeks	0.73	0.34	2,206	0.156
1 pass/week	1.09	0.55	3,209	0.235
2 passes/week	1.46	0.69	4,211	0.304
Mechanical Broom Sweeping				**Per Mile Swept**
1 pass/4 weeks	0.00	0.00	20	0.001
1 pass/week	0.00	0.00	100	0.004
2 passes/week	0.00	0.00	201	0.008
Storm Drain Cleaning				**Per Ton Removed**
Organic	4.44	0.48	400	0.17
Inorganic	3.78	0.84	1,400	0.25
Floating Treatment Wetlands (% of pond wet surface area covered by FTW)				**Per Impervious Acre**
FTW1 (10%)	0.10	0.02	74	0.008
FTW2 (11-20%)	0.22	0.05	151	0.017
FTW3 (21-30%)	0.32	0.07	225	0.026
FTW4 (31-40%)	0.43	0.09	295	0.034
FTW5 (41-50%)	0.53	0.11	369	0.042
Land Cover Conversion				**Per Acre of Land Cover Converted**
Forest Planting	11.12	1.78	2,805	1.10
Riparian Forest Planting	14.34	2.50	4,411	1.50
Conservation Landscaping	5.24	0.53	0.00	0.37
Riparian Conservation Landscaping	6.75	0.74	0.00	0.50

BMP	Load Reductions (lbs/unit/yr)			EIA_f
	TN	TP	TSS	
Table 1 Continued				
Forest Conservation	10.57	1.10	2,465	0.46
Impervious Surface Reduction	6.96	0.45	5,241	0.71
Street Trees	3.10	0.76	1,404	0.40
Urban Tree Canopy Planting	3.20	0.50	206	0.28
Urban Soil Restoration of Compacted Pervious Surfaces (soil excavation depth in inches)				**Per Acre of Soil Treatment**
Level 1 (15 inches)	4.4	0.72	278	0.40
Level 2 (20 inches)	8.9	1.44	557	0.80
Urban Soil Restoration of Removed Impervious Surfaces (soil excavation depth in inches)				**Per Acre of Soil Treatment**
Level 1 (15 inches)	13.7	0.7	1,696	0.91
Level 2 (20 inches)	15.0	0.77	1,864	1.00
Septic[1]				**Per System**
Septic Pumping	0.00	0.00	0.00	0.02
Septic Denitrification	0.00	0.00	0.00	0.16
Septic to WWTP Connection	0.00	0.00	0.00	0.23
Shoreline Management[2]/Stream Restoration and Outfall Stabilization[3]				**Per Linear Foot**
Shoreline Management (Default Rate)	0.173	0.122	328	0.04
Stream Restoration (Planning Rate)	0.075	0.068	248	0.02
Outfall Stabilization (Planning Rate)	0.075	0.068	248	0.02
Elimination of Discovered Nutrient Discharges from Grey Infrastructure[4]				**Per Discharge**
Elimination of Eight Approved Discharge Types	Protocol	Protocol	0.00	Individually Calculated

Notes:
[1] Actual load reductions must be reported through the local health department. Septic system credits only apply to the impervious acre restoration requirement. (WWTP = wastewater treatment plant).
[2] Default load reduction values can be used in cases when the shoreline management practice parameters are unavailable for the protocols recommended by the panel, such as in some planning efforts, historic projects, and/or nonconforming projects.
[3] Load reduction values and EIA_f are used for planning purposes only and must always be replaced with individual site-specific values prior to reporting for nutrient and sediment reduction credit and EIA restoration credit.
[4] TN and TP load reductions for individual discharges are calculated based on the protocols approved in the CBP's 2014 Grey Infrastructure Report. The EIA_f is determined using Equation 5: EIA_f Calculation for Alternative BMPs.

The BMPs approved by the CBP for TN, TP, and TSS reductions have been documented to provide reductions for other pollutants associated with local TMDLs. The 2015 report *Potential Benefits of Nutrient and Sediment Practices to Reduce Toxic Contaminants in the Chesapeake Bay Watershed* published by Chesapeake Stormwater Network substantiates that stormwater BMPs are also effective for reducing toxic pollutants. More information on the latest guidance for showing progress toward meeting local TMDLs is found on the Department's website: mde.maryland.gov/programs/Water/TMDL/DataCenter/Pages/TMDLStormwaterImplementation.aspx.

III. Impervious Acre Credits of Upland Best Management Practices

Upland BMPs are stormwater BMPs that meet the water quality criteria and design standards in the Manual. Upland BMPs include structural practices, nonstructural practices, and alternative surfaces. Impervious acre credits may be achieved when upland BMPs are implemented as part of a restoration, retrofit, or redevelopment project that provides water quality treatment for previously unmanaged impervious surfaces. BMPs must function properly to ensure that the expected water quality improvements are achieved. Upland BMPs must be regularly maintained and inspected a minimum of every three years. BMP data must be submitted within the MS4 Geodatabase.

1. Structural Practices

The impervious acre credit for structural practices is based on the impervious acres in a BMP's drainage area, the depth of rainfall treated, and the water quality volume (WQ_v) standards found in the Manual. For restoration and impervious acre crediting, the rainfall depth treated may be less than the 1 inch required for the WQ_v. For the purposes of this Guidance, the rainfall depth treated in restoration practices is referred to as the water quality treatment volume or "WQ_T". Treatment of 1 inch of rainfall across the drainage area of the BMP will provide full credit for the impervious acres in the BMP's drainage area. This WQ_T is considered the minimum treatment level for 1 impervious acre credit of restoration. Opportunities for restoration that treat less than 1 inch of rainfall (i.e., $WQ_T < 1$ inch) can be pursued where they make sense to an MS4 jurisdiction for local water quality, flooding, or co-benefits. Where the WQ_T is less than 1 inch, the impervious acre credit will be pro-rated on the fraction of the rainfall depth treated (see Equation 1).

Equation 1. Impervious Acre Credits for Structural Practices

$$Impervious\ Acres\ in\ Drainage\ Area \times \left(\frac{Rainfall\ Depth\ Treated}{1\ inch}\right) = Impervious\ Acre\ Credit$$

Examples:

A structural BMP with a drainage area of 10 impervious acres receives the following credit based on the rainfall depth treated:

$$10\ Impervious\ Acres \times \left(\frac{1.0\ inch\ Rainfall\ Depth\ Treated}{1\ inch}\right) = 10\ Impervious\ Acres\ Credit$$

$$10\ Impervious\ Acres \times \left(\frac{0.75\ inch\ Rainfall\ Depth\ Treated}{1\ inch}\right) = 7.5\ Impervious\ Acres\ Credit$$

$$10\ Impervious\ Acres \times \left(\frac{0.5\ inch\ Rainfall\ Depth\ Treated}{1\ inch}\right) = 5\ Impervious\ Acres\ Credit$$

2. Nonstructural Practices

Nonstructural practices acceptable for MS4 restoration must meet the design criteria found in Chapter 5 of the Manual. These practices include disconnection of rooftop runoff, disconnection of non-rooftop runoff, and sheetflow to conservation areas. Nonstructural practices combine relatively simple features, grading, and landscaping to divert runoff into vegetated areas and away from conventional storm drain systems. Runoff flows over these areas, filters through the vegetation, and soaks into the ground.

Impervious acre credits for nonstructural practices are directly proportional to the amount of impervious acres in a watershed that are disconnected from the storm drain system (see Equation 2).

Equation 2. Impervious Acre Credits for Nonstructural Practices

$$Impervious\ Acres\ in\ Drainage\ Area \times Percent\ Disconnect = Impervious\ Acre\ Credit$$

Example

A drainage area of 10 impervious acres will receive the following credit based on the percentage of impervious acres that are disconnected:

$$10\ Impervious\ Acres \times 100\%\ Disconnect = 10\ Impervious\ Acres\ Credit$$

$$10\ Impervious\ Acres \times 75\%\ Disconnect = 7.5\ Impervious\ Acres\ Credit$$

$$10\ Impervious\ Acres \times 50\%\ Disconnect = 5\ Impervious\ Acres\ Credit$$

3. Alternative Surfaces in Chapter 5 of the Manual

Alternative surfaces accepted for MS4 restoration must meet the design criteria found in Chapter 5 of the Manual. These practices include green roofs, permeable pavements, and reinforced turf. Replacing one acre of impervious surface with an approved alternative surface provides a credit of one acre of impervious area restoration.

4. Redevelopment

Impervious acres that drain to upland BMPs where the State regulatory requirements for redevelopment are met or exceeded are eligible for restoration credit. Since 2010, State regulations require water quality (WQ) treatment for 1 inch of rainfall for fifty percent of the untreated existing impervious acres within the project's limit of disturbance (LOD). Additional credit may be granted for any untreated existing impervious acres that are treated to meet or exceed the fifty percent requirement (see Equation 3).

Equation 3. Impervious Acre Credits for Redevelopment

$$Existing\ Untreated\ Impervious\ Acres \times \%\ of\ the\ Existing\ Untreated\ Impervious\ Acres\ Treated\ for\ WQ\ through\ Redevelopment = Impervious\ Acres\ Restoration\ Credit$$

Examples

Below are examples of the credits that a redevelopment project would achieve for treating different percentages of an existing 10 acres of untreated impervious surface within the LOD.

$$10\ Existing\ Untreated\ Impervious\ Acres \times 50\%\ of\ the\ Existing\ Untreated\ Impervious\ Acres\ Treated\ for\ WQ\ through\ Redevelopment = 5\ Impervious\ Acres\ Restoration\ Credit$$

$$10\ Existing\ Untreated\ Impervious\ Acres \times 75\%\ of\ the\ Existing\ Untreated\ Impervious\ Acres\ Treated\ for\ WQ\ through\ Redevelopment = 7.5\ Impervious\ Acres\ Restoration\ Credit$$

$$10\ Existing\ Untreated\ Impervious\ Acres \times 100\%\ of\ the\ Existing\ Untreated\ Impervious\ Acres\ Treated\ for\ WQ\ through\ Redevelopment = 10\ Impervious\ Acres\ Restoration\ Credit$$

IV. Pollutant Load Reductions for Upland Best Management Practices

Pollutant load reductions for upland BMPs are based on the pollutant removal efficiencies recommended by the CBP. In order for MS4 jurisdictions to address permit conditions, restoration activities and reporting need to be consistent with CBP recommendations. BMP pollutant removal performance is determined using the CBP approved publication, *Recommendations of the Expert Panel to Define Removal Rates for New State Stormwater Performance Standards* (Schueler and Lane, 2012 and 2015). This report offers a series of pollutant removal adjustor curves (see Appendix A) for BMPs that are classified as runoff reduction (RR) and stormwater treatment (ST) to determine nutrient and sediment load reductions. Table 2 provides a list of upland BMPs, identifying each as RR or ST.

Table 2. Stormwater BMPs for Upland Applications

Runoff Reduction (RR) Practices		Stormwater Treatment (ST) Practices	
Manual Reference	**Practice**	**Manual Reference**	**Practice**
Infiltration		**Ponds**	
M-3	Landscape Infiltration	P-1	Micro-Pool Extended Detention (ED)
M-4	Infiltration Berm	P-2	Wet Pond
M-5	Dry Well	P-3	Wet ED Pond
Filtering Systems[1]		P-4	Multiple Pond
F-6	Bioretention	P-5	Pocket Pond
M-2	Submerged Gravel Wetland	**Wetlands[2]**	
M-6	Micro-Bioretention	W-1	Shallow Wetland
M-7	Rain Garden	W-2	ED Shallow Wetland
M-9	Enhanced Filter	W-3	Pond/Wetland System
Open Channel Systems		W-4	Pocket Wetland
O-1	Dry Swale	**Infiltration[2]**	
M-8	Grass Swale	I-1	Infiltration Trench
M-8	Bio-Swale	I-2	Infiltration Basin
M-8	Wet Swale	**Filtering Systems**	
Alternative Surfaces		F-1	Surface Sand Filter
A-1	Green Roof	F-2	Underground Filter
A-2	Permeable Pavement	F-3	Perimeter Filter
A-3	Reinforced Turf	F-4	Organic Filter
Other Systems		F-5	Pocket Filter
M-1	Rainwater Harvesting		

Notes:

[1] A dry channel regenerative step pool stormwater conveyance system is considered a stormwater retrofit by the CBP Stream Restoration Expert Panel. This practice may use the BMP code SPSD and use the same pollutant load reductions as a filtering practice. The impervious area draining to these practices may be considered treated in accordance with the design rainfall depth treated (P_E) for crediting purposes.

[2] Stormwater wetlands, infiltration trenches, and infiltration basins are ST practices unless designed according to Section VI.

For commonly used rainfall depths, Table 3 provides pollutant removal efficiencies for RR and ST practices based on the CBP approved adjustor curves. The adjustor curves can also be used to determine pollutant removal efficiencies associated with redevelopment.

Table 3. TN, TP, and TSS Removal Efficiencies for Upland BMPs

Rainfall Depth Treated (inches)	TN Removal Efficiency (%)		TP Removal Efficiency (%)		TSS Removal Efficiency (%)	
	RR	ST	RR	ST	RR	ST
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.20	23.3	13.6	27.2	21.4	29.1	27.2
0.40	39.2	22.8	45.7	35.9	48.9	45.7
0.60	49.3	28.8	57.5	45.2	61.7	57.5
0.80	55.7	32.5	65.1	51.1	69.7	65.1
1.00	59.7	35.0	69.9	54.9	74.9	69.9
1.20	62.5	36.5	73.0	57.4	78.3	73.0
1.40	64.4	37.6	75.2	59.1	80.7	75.2
1.60	65.6	38.4	76.7	60.3	82.3	76.7
1.80	66.4	38.8	77.6	61.0	83.3	77.6
2.00	66.8	39.1	78.2	61.4	83.9	78.2
2.20	67.1	39.2	78.4	61.7	84.2	78.4
2.40	67.5	39.3	78.6	61.9	84.6	78.6
2.60[1]	67.9	39.4	78.8	62.1	85.0	78.8
2.80[1]	68.3	39.5	79.0	62.3	85.4	79.0
3.00[1]	68.6	39.6	79.2	62.5	85.8	79.2

Note:
[1] Values exceed the adjustor curves and are extrapolated from the CBP formulas.

Pollutant removal efficiencies can be applied to the appropriate urban land cover unit loads to calculate load reductions. Table 4 presents the available statewide CAST (i.e., Chesapeake Assessment Scenario Tool) No Action Scenario urban unit loads. Users must determine which load source represents a BMP's drainage area.

Phase 6 Model segment delivery factors are available in Appendix L. These factors translate edge-of-stream (EOS) load reductions to edge-of-tide (EOT) load reductions and are used in determining pollutant load reductions for the Chesapeake Bay TMDL. The delivery factors for a given project can also be found via the "EOT Factor Map" on the Department's water quality trading website under the Tools and Resources tab at: mde.maryland.gov/programs/Water/WQT/Pages/WQT_Tools_Resources.aspx.

Table 4. Statewide Edge-of-Stream Urban Unit Load Summary

Load Source[1]	Statewide EOS Urban Unit Load (lbs/acre/yr)		
	TN	TP	TSS
Aggregate Impervious	20.39	2.55	8,793
Impervious Road	36.43	6.89	20,055
Mixed Open	8.19	1.58	3,552
Septic	16.83	0.00	0.00
Tree Canopy over Impervious	33.33	6.13	18,651
Turf	13.43	2.10	3,552
Tree Canopy over Turf	10.23	1.60	3,346
True Forest	2.31	0.32	747
Total Urban	12.88	1.42	3,212

Note:
[1] For more information on Load Sources in the Phase 6 Model, see Appendix B.

The general formula for calculating these load reductions is presented below. An example calculation can be found in Appendix B.

Equation 4. TN, TP, and TSS Load Reductions

$$Load\ Reduction\ (lbs/yr) = Urban\ Unit\ Load\ (lbs/acre/yr) \times Impervious\ Surface\ in\ BMP\ Drainage\ Area\ (acres) \times \left[\frac{BMP\ Efficiency}{100}\right] \times Phase\ 6\ Modeling\ Segment\ Delivery\ Factor$$

The Department provides a set of technical resources for Maryland jurisdictions developing Stormwater WLA Implementation Plans to address TMDLs on the TMDL Stormwater Implementation Resources page in the Maryland TMDL Data Center (mde.maryland.gov/programs/water/tmdl/datacenter/pages/index.aspx). These resources include general and pollutant-specific guidance documents, tools for TMDL implementation modeling and accounting, and MS4 monitoring information.

V. Alternative Best Management Practices

The Department has developed the EIA_f (i.e., equivalent impervious acre conversion factor) for translating the pollutant load reductions from an alternative BMP into an EIA (i.e., equivalent impervious acre) credit. This is based on the difference in pollutant loads between aggregate impervious and true forest land covers. For the purpose of this Guidance, aggregate impervious includes the Phase 6 Model impervious road and impervious non-road land covers and true forest is the statewide average forest cover. The Phase 6 Model estimates that the annual TN load in runoff from an aggregate impervious acre is 20.39 lbs while the annual TN load from an acre of true forest is 2.31 lbs. The difference, or delta, between the two land covers is 18.08 lbs of TN per year. The deltas for TN, TP, and TSS loads are shown in Table 5. These deltas are used to set a level of implementation that alternative practices must meet to be equivalent to the quality of runoff from forest conditions.

Table 5. True Forest and Aggregate Impervious Pollutant Unit Load Deltas

Pollutant	Aggregate Impervious Unit Load (lbs/acre/yr)	True Forest Unit Load (lbs/acre/yr)	Delta (lbs/acre/yr)
TN	20.39	2.31	18.08
TP	2.55	0.32	2.23
TSS	8,793	747	8,046
Source: Phase 6 Model, Maryland aggregated statewide average unit loads without BMPs			

The pollutant load reduction for each alternative BMP is calculated from the land cover unit load and the approved BMP efficiency determined in the CBP expert panel reports. Alternative BMPs have different urban land cover unit loads. Some alternative BMPs, like street sweeping, are almost exclusively implemented on impervious surface areas (e.g., roads and parking lots). In these instances, the pollutant load associated with "impervious road" found in Table 4 is used to set the initial load rate and determine the pollutant load reduction. The efficiencies and land cover types to be used with each alternative BMP to calculate the TN, TP, and TSS load reductions are tabulated in Appendix C.

Alternative BMPs also use different units of implementation to calculate pollutant load reductions. For example, some BMPs, like street sweeping, use a street lane mile unit per year while others, like land cover conversion, use a per acre unit per year. Pollutant reductions are reported based on the specific unit of implementation.

The delta between aggregate impervious and true forest land cover loads for TN, TP, and TSS is divided into each alternative BMP's annual pollutant load reduction for each pollutant and then averaged to determine a single weighted equivalent impervious acre conversion factor (see Equation 5). Further details on how the EIA_f is calculated can be found in Appendix D.

Equation 5. EIA_f Calculation for Alternative BMPs

$$EIA_f = \frac{\left(\frac{TN\ Load\ Red.}{I-F_{TN}}\right)+\left(\frac{TP\ Load\ Red.}{I-F_{TP}}\right)+\left(\frac{TSS\ Load\ Red.}{I-F_{TSS}}\right)}{3}$$

Where:

EIA_f = Equivalent impervious acre conversion factor
TN Load Red. = BMP load reduction for TN (lbs/unit/yr)
TP Load Red. = BMP load reduction for TP (lbs/unit/yr)
TSS Load Red. = BMP load reduction for TSS (lbs/unit/yr)
$I – F_{TN}$ = Aggregate impervious unit load minus true forest unit load for TN (lbs/acre/yr)
$I – F_{TP}$ = Aggregate impervious unit load minus true forest unit load for TP (lbs/acre/yr)
$I – F_{TSS}$ = Aggregate impervious unit load minus true forest unit load for TSS (lbs/acre/yr)

Additional information on EIA_f and pollutant load reduction credits for specific alternative practices is found below. Alternative BMPs must follow inspection frequencies as specified by the CBP expert panels, with the exception of land cover conversion BMPs, which require inspections at least every three years. BMP data must be submitted within the MS4 Geodatabase.

1. Street Sweeping and Storm Drain Cleaning

Street sweeping and storm drain cleaning are annual practices that must be tracked and reported each year to receive credit. The CBP recommended updates to acceptable street sweeping methods and the removal rates for nutrients and sediments, as described in the 2016 report *Recommendations of the Expert Panel to Define Removal Rates for Street and Storm Drain Cleaning Practices* (2016 Street Sweeping Report). The expert panel developed these estimates using the Source Loading and Management Model for Windows (WinSLAMM). The mass loading method is no longer an acceptable method to calculate pollution reduction. The previous estimated rates were dependent on a strict twice-monthly frequency, whereas the updated load reduction credits allow greater flexibility because MS4 jurisdictions may choose from a range of sweeping schedules listed in Table 6. MS4 jurisdictions may generate credits by sweeping municipal and commercial parking lots when using advanced street sweeping technology (i.e., vacuum assisted sweepers and regenerative air sweepers). Mechanical sweeping of parking lots may not be used for credit because of the low amount of pollutants estimated to be collected.

MS4 jurisdictions must enter information into the MS4 Geodatabase on schedule, locations, and sweeper technology. Additionally, MS4 jurisdictions must retain documentation as proof of sweeping activities to receive credit. Documentation may include a sweeping summary table, copies of receipts or contracts if sweeping is conducted by a contractor, or sweeper equipment maintenance records. This information must be made available to the Department upon request. The EIA credit for street sweeping is based on the annual number of miles swept averaged over the span of the 5 year permit term. Table 6 provides the nutrient and sediment load reductions and EIA_f values for different street sweeping options.

Table 6. Load Reductions and EIA_f for Street Sweeping

BMP	Load Reduced (lbs/lane mile/yr)			EIA_f per Lane Mile Swept
	TN	TP	TSS	
Advanced Sweeping				
1 pass/12 weeks	0.00	0.07	401	0.027
1 pass/8 weeks	0.26	0.14	802	0.059
1 pass/4 weeks	0.36	0.21	1,203	0.087
Spring 1 pass/1-2 weeks else monthly	0.36	0.28	1,404	0.106
Spring & Fall 1 pass/1-2 weeks else monthly	0.73	0.34	2,005	0.148
1 pass/2 weeks	0.73	0.34	2,206	0.156
1 pass/week	1.09	0.55	3,209	0.235
2 passes/week	1.46	0.69	4,211	0.304
Mechanical Broom				
1 pass/4 weeks	0.00	0.00	20	0.001
1 pass/week	0.00	0.00	100	0.004
2 passes/week	0.00	0.00	201	0.008
Note: Spring = March–April; Fall = October–November				

The CBP recommended a conservative approach for calculating credits attributed to storm drain cleaning. A credit is available when the mass of nutrient-rich catch basin sediments is measured and physically removed from the storm drain system. The EIA credit for storm drain cleaning is based on the annual aggregate load collected and averaged over the span of the 5 year permit term. Table 7 provides the nutrient and sediment load reductions and EIA_f values for storm drain cleaning options. Jurisdictions can visually determine the predominant material type and apply the associated EIA_f.

Table 7. Load Reductions and EIA_f for Storm Drain Cleaning

Material Removed	Load Reduced (lbs/ton/yr)			EIA_f per Ton Material Removed
	TN	TP	TSS	
Organic	4.44	0.48	400	0.17
Inorganic	3.78	0.84	1,400	0.25

There are three qualifying conditions to generate credit from storm drain cleaning:

1. To maximize nutrient load reductions, efforts should target catch basins that trap the greatest organic matter loads, streets with the greatest overhead tree canopy, and/or outfalls with high sediment or debris loads.

2. The nutrient loads must be tracked and verified using a field protocol to measure the mass or volume of solids collected within the storm drain system. The local MS4 jurisdiction must demonstrate that it has instituted a standard operating procedure to keep track of the mass of the sediments and/or organic matter that is removed.

3. Material must be properly disposed of so it cannot migrate back into the storm drain system.

The storm drain cleaning credit does not apply to sediment removal operations that occur during ditch maintenance along open section roads. It does apply to operations that occur in open, concrete-lined conveyance channels.

2. Floating Treatment Wetlands

Floating treatment wetlands (FTWs) are installed in existing stormwater management ponds to provide additional nutrient and sediment removal. FTWs are buoyant rafts of wetland vegetation that are planted in growing media and whose roots extend below the water's surface. The CBP determined nutrient removal rates based on the percent of pond wet surface area that the FTW covers. Coverage must be at least 10% but not more than 50% of the pond's wet surface area measured at the design permanent pool elevation. Pollutant load reductions and EIA credits are reported separately from credits that the stormwater pond provides. Table 8 provides the nutrient and sediment load reductions and EIA_f values for FTWs.

Table 8. Load Reductions and EIA_f for Floating Treatment Wetlands

BMP	% of Pond Wet Surface Area Covered by FTW	Load Reduced (lbs/acre/yr)			EIA_f per Impervious Acre
		TN	TP	TSS	
FTW1	10%	0.10	0.02	74	0.008
FTW2	11-20%	0.22	0.05	151	0.017
FTW3	21-30%	0.32	0.07	225	0.026
FTW4	31-40%	0.43	0.09	295	0.034
FTW5	41-50%	0.53	0.11	369	0.042

Equation 6 can be used to calculate the impervious acre credit. An example calculation is provided in Appendix F.

Equation 6. EIA_f for Floating Treatment Wetlands

$$Total\ Impervious\ Acres\ in\ Stormwater\ Pond\ Drainage\ Area \times EIA_f\ from\ Table\ 8 = Equivalent\ Impervious\ Acre\ Credit$$

3. Land Cover Conversion BMPs

Land cover conversion BMPs are those that involve the conversion of one land cover to another. Nutrient and sediment reductions for land cover conversion BMPs are calculated based on the load reduction that results from the change in unit loads from the original land cover to another land cover. Land cover conversion BMPs fall into three categories: Non-riparian land cover conversion BMPs, riparian land cover conversion BMPs, and forest conservation.

The difference in unit loads between land cover types are driven primarily by a change in hydrology. To reflect this improved hydrology, crediting land cover conversion BMPs is aligned with other upland stormwater treatment practices. The EIA_f for a land cover conversion BMP is calculated using the load reductions from the conversion of land cover divided by a "delta" equal to the treatment of 1 inch of rainfall on 1 acre of impervious land cover using stormwater treatment (ST) BMPs. (Refer to Appendix D for more information.)

a) Non-Riparian Land Cover Conversion BMPs

Pollutant load reductions resulting from land cover conversion that occurs completely outside of the riparian zone (i.e., not within 100 feet of a waterbody) are calculated as the difference between the unit loads of the original and converted land covers. The land cover types used in calculating pollutant load reductions for each BMP can be found in Appendix C. Table 9 provides the pollutant load reductions and EIA_f for non-riparian land cover conversion BMPs. The following BMPs are eligible for credit.

1. *Forest Planting.* The conversion of pervious turf to a forested land cover. Urban forest planting includes any contiguous tree planting greater than half an acre with an unmanaged understory (unfertilized, unmowed) on pervious, except those used to establish riparian forest buffers, which receive enhanced credit. Forest planting credit is available for planting occurring on 0.5 contiguous acre or greater. Planting should have a survival rate of 100 trees planted per acre. At least 50% of trees should have a 2 inch diameter or greater (4.5 feet above ground), or a 1 inch caliper at the time of planting (high likelihood of 2 inch diameter once 4.5 feet in height).

2. *Conservation Landscaping.* Land cover conversion from pervious turf to a meadow condition. Conservation landscaping refers to areas of managed turf that are converted into perennial meadows using species that are native to the Chesapeake Bay region.

3. *Impervious Surface Reduction.* A reduction in impervious surfaces to promote infiltration and percolation of stormwater runoff.

4. *Street Trees*. Any tree planting that occurs over an impervious surface (e.g., trees planted in sidewalk boxes on a roadside curb). One tree planted is the equivalent of 0.01 acre, or 100 trees is equivalent to one acre of implementation. Credit for street trees requires a survival rate of 100%. This BMP does not require trees to be planted in a contiguous area.

5. *Urban Tree Canopy*. The conversion of pervious turf to tree canopy over turf. The urban tree canopy BMP is applicable where the resulting understory remains managed (regularly mowed and/or fertilized). One tree planted is the equivalent of 0.01 acre, or 100 trees is equivalent to one acre of implementation. Credit for urban tree planting assumes a survival rate of 100%. This BMP does not require trees to be planted in a contiguous area.

Table 9. Load Reductions and EIA_f for Non-Riparian Land Cover Conversion BMPs

Non-Riparian Land Cover Conversion BMP	Load Reduced (lbs/acre/yr)			EIA_f per Acre of Land Cover Converted
	TN	TP	TSS	
Forest Planting	11.12	1.78	2,805	1.10
Conservation Landscaping	5.24	0.53	0.00	0.37
Impervious Surface Reduction	6.96	0.45	5,241	0.71
Street Trees	3.10	0.76	1,404	0.40
Urban Tree Canopy Planting	3.20	0.50	206	0.28

b) Riparian Land Cover Conversion BMPs

Riparian land cover conversion BMPs are forest planting and conservation landscaping practices that occur within 100 feet of a perennial stream.

1. *Riparian Forest Buffers*. Linear wooded areas that help filter nutrients, sediments, and other pollutants from runoff as well as remove nutrients from groundwater. The recommended buffer width is 100 feet, with a 35 foot minimum width required (Chesapeake Assessment Scenario Tool, i.e., CAST, 2019).

2. *Riparian Conservation Landscaping.* Grassland buffers that help filter nutrients, sediments, and other pollutants from runoff as well as remove nutrients from groundwater. These are buffers converted from managed turf land cover to a meadow use.

These practices are eligible for enhanced land cover conversion credit. The riparian land cover conversion BMP EIA_f credit is based on a baseline land cover conversion credit that accounts for hydrologic changes (Table 9) plus an additional credit for the upland areas treated because they drain through the riparian buffer zone (Table 10). The additional riparian credit provided is based on a ratio of one acre of upland impervious acre treatment to one acre of land cover conversion.

The additional load reductions for riparian forest planting are calculated by applying CAST Forest Buffer upland treatment efficiencies to the statewide weighted urban unit load. Conservation landscaping that occurs in the riparian zone does not have a CAST upland treatment efficiency. Therefore, those efficiencies and resulting load reductions were determined using the same proportionate relationship between the forest planting and conservation landscaping nutrients and sediment load reductions for non-riparian BMPs. The additional load reductions for riparian land cover conversion BMPs are found in Table 10.

Table 10. Additional Load Reductions and EIA_f for Land Cover Conversion BMPs Implemented in a Riparian Area

Land Cover Conversion BMP	Efficiency			Load Reduced (lbs/acre/yr)			EIA_f per Acre of Upland Treatment
	TN	TP	TSS	TN	TP	TSS	
Forest Planting Upland Treatment	25%	50%	50%	3.22	0.71	1,606	0.41
Conservation Landscaping Upland Treatment	12%[1]	15%[2]	0%	1.52	0.21	0.00	0.12

Notes:
[1] Conservation Landscaping Upland TN efficiency = Forest Planting Upland TN Efficiency × (Conservation Landscaping TN reduction / Forest Planting TN reduction).
[2] Conservation Landscaping Upland TP efficiency = Forest Planting Upland TP Efficiency × (Conservation Landscaping TP reduction / Forest Planting TP reduction).

Riparian land cover conversion BMP credit is the sum of the base land cover conversion BMP credit (Table 9) and the additional upland treatment credit (Table 10). The enhanced load reductions and the EIA_f available for forest planting and conservation landscaping in riparian areas are provided in Table 11.

Table 11. Enhanced Load Reductions and EIA_f for Riparian Land Cover Conversion BMPs

Land Cover Conversion BMP	Total Load Reduced (lbs/acre/yr)			EIA_f per Acre of Land Cover Converted[1]
	TN	TP	TSS	
Riparian Forest Buffers	14.34	2.50	4,411	1.50
Riparian Conservation Landscaping	6.75	0.74	0.00	0.50

Note:
[1] EIA_f for a riparian land cover conversion BMP is the sum of the base land cover conversion BMP credit (Table 9) and the additional upland treatment credit (Table 10).

c) Forest Conservation

EIA credit for forest conservation is available for the permanent conservation of existing acres of forest. Forest land cover has the lowest Phase 6 Model unit loads for nutrients and sediments, and conserving established forest acres that are vulnerable to development pressure is critical to ensuring that water quality does not worsen. Credit is available to MS4 jurisdictions that have implemented forest easements that limit development and go above and beyond the conservation programs incorporated into the Phase III WIP 2025 base land-use condition.

The Phase III WIP sets nutrient and sediment load reduction goals based on the projected growth in the State. *Maryland's Phase III Watershed Implementation Plan (August 2019)* utilizes the "Maryland Policy" Land Policy BMP scenario in the projected 2025 conditions, which includes assumptions about the continued conservation of forests due to existing policies in the State. State forest and agricultural conservation programs are estimated in projections out to the year 2025 using a trend of implementation of these programs in the past. The assumptions included in the Land Policy BMP scenario for Maryland are intended to reflect Maryland's continued implementation of the Forest Conservation Act, Critical Area Law, and other preservation programs. If an MS4 jurisdiction can establish that its forest conservation programs result in less development on forest than the WIP 2025 forecast, then it has successfully prevented a future load increase.

Requirements and Verification

Forest conservation credit is contingent upon the MS4 jurisdiction's ability to document that the easement exceeds the criteria described in Table 12 and is not part of a development required practice such as sheet flow to conservation area. Credit will only be available for the portion of the easement that goes above and beyond the conservation assumptions in Maryland's Phase III WIP. For example, if the Forest Conservation Act requires a minimum easement of 5 acres and a jurisdiction establishes a 10 acre easement, the forest conservation credit can be claimed for 5 acres.

Forest easements that are eligible for forest conservation credit should be proximate to a development in order to demonstrate that the easement is preventing a future load increase by preventing a loss of forest to an urban land use. Jurisdictions are required to submit locations and sizes of State-required forest conservation easements in order to verify the acres claimed for forest conservation credit do not overlap with State required mitigation. In addition, forest conservation easements should be demonstrably permanent, be at least 50% forest cover at the time of creation, and have a management plan that limits or restricts actions like mowing and tree removal.

Table 12. Easement Criteria based on the Phase III WIP Scenario Assumptions that must be Exceeded to Qualify for Forest Conservation Credit

Easement cannot be an area under easement for State required mitigation.
Easement cannot be a part of or reported to the following State programs: • Program Open Space • Rural Legacy • Maryland Agricultural Land Preservation Foundation (MALPF) • Maryland Environmental Trust (MET)
Easement cannot be part of a sheetflow to conservation area BMP.
Easement cannot be on a Land Use Conversion BMP.

To receive credit, MS4 jurisdictions must submit the following:

1. Documentation of forest conservation easements required by the Forest Conservation Act for mitigation within the jurisdiction.

2. Documentation of easements beyond State required forest conservation easements for which credit is requested, along with information on the development they are intended to prevent (e.g. development name, jurisdiction construction permit number).

3. Documentation of tri-annual inspections to ensure compliance with easement requirements and retention of credit.

Load reductions are based on the difference between a total urban (inclusive of urban impervious and turf) unit load and the forest unit load (Table 13). An example credit calculation can be found in Appendix F.

Table 13. Load Reductions and EIA_f for Forest Conservation BMPs

Land Conservation BMP	Load Reduced (lbs/acre/yr)			EIA_f per Acre of Forest Conserved
	TN	TP	TSS	
Forest Conservation	10.57	1.10	2,465	0.46

d) Urban Soil Restoration Credit

Soil restoration is the process of enhancing the porosity of soils compacted by human activity in urban areas. The technique involves the excavation or tilling of the compacted soils and amending the tilled soils, typically with compost. Soil restoration may be used to improve the performance of rooftop and non-rooftop disconnection applications, or as a filtering media within grass swales and bio-swales. Soil restoration techniques that are used in conjunction with another BMP whose design criteria already specified soil ripping/restoration do not receive this separate credit. Rather, the application is considered as a part of that BMP.

Soil restoration may also be used as a standalone restoration technique to reduce runoff and increase recharge in urbanized areas. The pollutant removal efficiencies and EIA_f

applied to this technique are based on the depth of soil excavation, the amount of amendments used, and the condition of the area prior to restoration. Soil restoration may be used to correct compacted pervious soils that have some, little, or no vegetation, or soils under impervious areas that have been removed. In each case, the level of restoration is determined by the depth of excavation and tilling. The following two levels of soil restoration are accepted for EIA credit:

- Level 1 is used where compaction is moderate. Compacted soils are ripped to a depth of 15 inches.

- Level 2 is used where compaction is severe or where a more permeable soil profile (e.g., hydrologic soil group B or C) is desired. Soils are excavated to a depth of 20 inches using the complete cultivation method.

Table 14 provides the pollutant removal efficiencies and EIA_f for each level and existing soil condition.

Table 14. Load Reductions and EIA_f for Urban Soil Restoration

Level	Depth (inches)	Load Reduced (lbs/acre/yr)			EIA_f per Acre of Soil Treatment
		TN	TP	TSS	
Compacted Pervious					
1	15	4.4	0.72	278	0.40
2	20	8.9	1.44	557	0.80
Impervious					
1	15	13.7	0.70	1,696	0.91
2	20	15.0	0.77	1,864	1.00

Soils where the depth to a water impermeable layer is less than 20 inches and/or the depth to the high water table is less than 24 inches are considered as hydrologic soil group (HSG) D when determining runoff characteristics. These soil characteristics are not available for the urban soil restoration credit. Appendix G provides the design criteria that must be met for each level of restoration.

4. Septic Practices

Impervious acre restoration credits for septic pumping, denitrification, and connections to a wastewater treatment plant (WWTP) can use the number of systems improved as the unit measure. Table 15 provides the EIA_f for these septic practices. Septic pumping is an annual practice. The EIA credit for septic pumping is based on the annual number of systems pumped averaged over the span of the 5 year permit term. The EIA credit for septic connection to an Enhanced Nutrient Removal (ENR) WWTP is based on the ratio between the septic denitrification and septic connection load reductions determined in the Maryland Phase III WIP.

For septic pumping credits, an MS4 jurisdiction can propose a comprehensive program for the Department's approval that includes septic system maintenance education and outreach, and homeowner registration and participation. Under this approach, each registered homeowner may be credited for every year of the permit term, without an annual pump-out, if the septic system is well maintained. The Department's approval is contingent upon the MS4 jurisdiction's septic maintenance program being able to ensure that registered homeowners pump out their septic tanks when the storage chambers reach capacity (i.e., bottom of the scum layer is within 6 inches of the bottom of the outlet, or top of the sludge layer is within 12 inches of the outlet), and the septic systems are inspected annually for maintenance verification.

Table 15. Load Reductions and EIA_f for Alternative Septic BMPs

BMP	Notes	Pollutant Removal Efficiency (%)[1]			EIA_f per System
		TN	TP	TSS	
Septic Pumping	Pumping system is maintained and verified for annual credit	0.00	0.00	0.00	0.02
Septic Denitrification	Permanent credit for installing enhanced septic denitrification	0.00	0.00	0.00	0.16
Septic Connection	Permanent credit for converting a septic system to a WWTP connection	0.00	0.00	0.00	0.23

Note:
[1] Actual load reductions must be reported through the local health department. Septic system credits only apply to impervious acre restoration requirements.

5. <u>Shoreline Management</u>

Shoreline management is defined by the expert panel report, *Recommendations of the Expert Panel to Define Removal Rates for Shoreline Management Projects*, amended November 2019 (2019 Shoreline Management Report), as any tidal shoreline practice that prevents and/or reduces tidal sediments to the Chesapeake Bay. Basic qualifying conditions for pollutant load reductions and EIA credits for shoreline management projects can be found in Appendix H and the 2019 Shoreline Management Report. Shoreline management should be implemented in areas where there is a demonstrated need to control erosion to the Bay and where there will be a water quality benefit from the practice. In accordance with Maryland's Living Shoreline Regulations (2013), improvements to protect a property against shoreline erosion must consist of marsh creation or other nonstructural shoreline stabilization measures that preserve the natural environment, and only under certain specific conditions shall structural measures be allowed (COMAR, i.e. Code of Maryland Regulations, 26.24.04).

Hard shore armor negatively impacts nearshore habitats and is not the recommended shoreline management practice in the Bay. The State regulatory review process will evaluate these projects on a case by case basis. Refer to the 2019 Shoreline Management Report and Appendix H of this Guidance for basic qualifying conditions. If those conditions are not met, the practice would not be reported to the CBP for model credit, and it would not be eligible for EIA credits.

The CBP Shoreline Management Panel developed four general protocols to define the pollutant load reductions. In cases when the shoreline management practice parameters are unavailable for the protocols, such as in some planning efforts, historic projects, and/or nonconforming projects, default reduction values can be used. The Department considers non-conforming projects to include those where Protocol 1 (Prevented Sediment) reductions are negligible, but the project results in ecological lift, such as when a hardened shoreline is replaced by a living shoreline. The panel recommended that the shoreline management credits be limited to 5 years, although the credits can be renewed based on a field inspection that verifies the project still exists, is adequately maintained, and is operating as designed.

Table 16 provides the nutrient and sediment load reductions and EIA_f for the shoreline management default rate. The default rate provided in this Guidance is calculated to be consistent with Protocol 1, which assumes that a practice is 100% effective at reducing fast-land erosion. For any shoreline projects, monitoring data can be substituted for the protocol load reductions to calculate load reductions and an EIA.

Table 16. Load Reductions and EIA_f for the Shoreline Management Default Rate

BMP	Load Reduced (lbs/ft/yr)			EIA_f per Linear Foot
	TN	TP	TSS	
Shoreline Management (Default Rate)	0.173	0.122	328	0.04

6. Stream Restoration and Outfall Stabilization

The stream restoration BMP was revised in 2014 to reflect four general protocols to define the pollutant load reductions associated with individual stream restoration projects with the understanding that every project is unique with respect to its design, stream order, landscape position, and function. In 2019, a fifth protocol was approved for outfall and gully stabilization. Updates to protocols 1, 2, and 3 were approved in 2020. Details on the protocols, basic qualifying conditions, and reporting requirements can be found in the *Recommendations for Crediting Outfall and Gully Stabilization Projects in the Chesapeake Bay Watershed, Consensus Recommendations for Improving the Application of the Prevented Sediment Protocol for Urban Stream Restoration Projects Built for Pollutant Removal Credit*, and *Consensus Recommendations to Improve Protocols 2 and 3 for Defining Stream Restoration Pollutant Removal Credits*. Basic qualifying conditions for pollutant load reductions and EIA credits can also be found in Appendix H.

Planning rates are used for estimating purposes only and must always be replaced with individual site-specific values prior to reporting for nutrient and sediment reduction credit and impervious acre restoration credit. The planning rates will not be accepted as a credit after a new project has been completed. If an MS4 jurisdiction did not collect the necessary data required in the stream restoration/outfall stabilization protocols, the project will not receive an equivalent impervious acre credit. MS4 jurisdictions must also follow post-construction verification requirements set by CBP.

Table 17 provides the pollutant load reductions and EIA_f for the stream restoration project and outfall stabilization project planning rates. Appendix D provides the methodology used to calculate the EIA_f for alternative practices, including stream restoration. Appendix E provides the methodology for determining stream bed and bank (STB) loads that were used in the EIA_f calculation.

Table 17. Load Reductions and EIA_f for Planning Stream Restoration and Outfall Stabilization Projects

BMP	Load Reduced (lbs/ft/yr)			EIA_f per Linear Foot
	TN	TP	TSS	
Stream Restoration (Planning Rate)	0.075	0.068	248	0.02
Outfall Stabilization (Planning Rate)	0.075	0.068	248	0.02

7. <u>Elimination of Discovered Nutrient Discharges from Grey Infrastructure</u>

The CBP approved the *Recommendations of the Expert Panel to Define Removal Rates for the Elimination of Discovered Nutrient Discharges from Grey Infrastructure* (2014 Grey Infrastructure Report). This BMP is applicable to the Illicit Discharge Detection and Elimination (IDDE) program activities required under the MS4 permit. Nutrient reductions are calculated on a per-discharge basis and the calculation depends on the type of discharge eliminated. Refer to the 2014 Grey Infrastructure Report for the protocols required to calculate reductions for each type of discharge. The following individual discharges are eligible for TN and TP reductions within the Phase 6 Model:

N-1 Laundry Washwater
N-2 Commercial Car Washing
N-3 Floor Drains
N-4 Miscellaneous High Nutrient Non-Sanitary Discharges
N-5 Sanitary Direct Connections
N-6 Sewage Pipe Exfiltration
N-7 Drinking Water Transmission Loss
N-8 Dry Weather Sanitary Sewer Overflows

The Watershed Technical Workgroup (WTWG) developed a technical appendix to describe how the expert panel's recommendations would be integrated into the modeling tools. This BMP was developed and approved under the Phase 5 Model. The WTWG discussed Phase 6 Model implications, including a recommendation to cap nutrient reductions from this practice if the grey infrastructure loads were not explicitly simulated (*Appendix E: Technical Requirements for the Reporting and Crediting of the Elimination of Discovered Nutrient Discharges from Grey Infrastructure in Scenario Building and the Watershed Model*, page 108). Grey infrastructure loads are not explicitly simulated in the Phase 6 Model. Therefore, the Department determined a maximum EIA credit based on assumptions provided in the 2014 Grey Infrastructure Report.

The 2014 Grey Infrastructure Report estimated that nutrient discharges from grey infrastructure potentially contribute 20% of the dry weather load. The expert panel defined the dry weather load as 20% of the total annual nitrogen and phosphorus discharged from urban pervious land, also known as the turf unit load. Furthermore, the expert panel limited the lifespan of an eliminated discharge to 10 years under the assumption that grey infrastructure will continue to deteriorate over time. Consistent with the 2014 Grey Infrastructure Report, an individual discharge credit must be taken off of the impervious acre restoration progress once it surpasses 10 years. In order to maintain impervious acres restored after the 10 year lifespan expires, new discharges will need to be eliminated and reported.

An example calculation to determine the maximum total EIA for eliminating individual discharges is found in Table 18. The following example assumes that 60,000 acres of the MS4 jurisdiction is pervious.

The EIA earned for eliminating individual discharges are additive, but the sum total EIA claimed can at no point exceed the calculated maximum credit. In the below example, the 1,348 acres represents the maximum total credit allowable at any given time, regardless of year or permit term.

Table 18. Example Calculation of the Maximum Total EIA Credit for the Elimination of Individual Discharges from Grey Infrastructure

	TN (lbs/acre/yr)	TP (lbs/acre/yr)	TSS (lbs/acre/yr)
Statewide Turf Unit Load (pervious unit load)	13.43	2.10	3,552
Total Pervious Load (turf unit load multiplied by the total pervious acres in an MS4 jurisdiction[1])	805,800	126,000	213 M
Total Dry Weather Load (20% of the total pervious load)	161,160	25,200	42.6 M
Maximum Load Attributable to Grey Infrastructure (20% of the dry weather load)	32,232	5,040	0.00[2]
	TN EIA	**TP EIA**	**TSS EIA**
Equivalent Impervious Acres (calculated using the aggregate impervious – true forest delta as explained in Section V.)	1,782	2,260	0.00
Maximum Total EIA Credit	**1,348 acres**		

Notes:
[1] For the purposes of this example, the calculation is based on an MS4 jurisdiction consisting of 60,000 pervious acres.
[2] No TSS reduction is assigned to this BMP by the 2014 Grey Infrastructure Report.

Equation 7 and Equation 8 provide a simplified 2-step process for calculating the maximum total EIA.

Equation 7. Step 1 –Maximum TN and TP Load Reductions Used to Determine the Maximum Total EIA Credit for Eliminating Individual Nutrient Discharges

$$\begin{aligned} \mathit{Maximum\ Load\ Reduction} \\ &= \mathit{Statewide\ Turf\ Unit\ Load}\ (\mathit{TN\ or\ TP}) \\ &\times \mathit{Pervious\ Acres\ in\ the\ MS4\ Jurisdiction} \times 0.04 \end{aligned}$$

Equation 8. Step 2 –Maximum Total EIA Credit for Eliminating Individual Nutrient Discharges

$$\mathit{Maximum\ Total\ EIA\ Credit} =$$

$$\frac{\left[\left(\frac{[\mathit{Maximum\ TN\ Load\ Reduction}]}{[I-F_{TN}]}\right)+\left(\frac{[\mathit{Maximum\ TP\ Load\ Reduction}]}{[I-F_{TP}]}\right)+0\right]}{3}$$

Where:

$I - F_{TN}$ = Aggregate impervious unit load minus true forest unit load for TN (i.e., 18.08 lbs/acre/yr)
$I - F_{TP}$ = Aggregate impervious unit load minus true forest unit load for TP (i.e., 2.23 lbs/acre/yr)

Qualifying Conditions

The following qualifying conditions must be met to receive an EIA for the elimination of individual illicit discharges:

- An MS4 jurisdiction must implement an advanced program as defined by the 2014 Grey Infrastructure Report (Table 7, page 30) to demonstrate that the jurisdiction's program is not merely meeting minimum permit requirements. The MS4 jurisdiction will need to provide documentation demonstrating that the program fulfills these criteria.
- Creditable discharges are those discovered through active implementation of dry weather outfall screenings or commercial/industrial visual surveys under the IDDE program to demonstrate a proactive versus reactive program. Credits are also applicable to the elimination of illicit discharges resulting from an investigation that was prompted by a citizen report. Reported discharges that are unexpected nutrient discharges from pipe breaks, spills, leaks, and overflows that require immediate emergency repairs to stop the discharge are not creditable.
- The corrective measures taken must not be used to fulfill any other regulatory mandate (e.g., work conducted under a sanitary sewer consent decree).
- The values and calculations must follow the protocols assigned to each type of discharge as detailed in the 2014 Grey Infrastructure Report.

Reporting Requirements

The following information must be submitted with the MS4 jurisdiction's annual report to receive restoration credit:

- Type of discharge eliminated
- Total nitrogen and phosphorus removed (lbs)
- EIA credit
- Protocol used
- Nutrient concentrations (mg/l)
- Discharge flow volume (gallons)
- Discharge flow rate (gallons per day)
- Estimated flow duration (days, up to a maximum of 365)
- River basin segment where the discharge was corrected
- Year that the discharge was eliminated
- Verification that the discharge was eliminated. Refer to the 2014 Grey Infrastructure Report for verification requirements assigned to each type of discharge
- On a case by case basis, the Department may request additional information deemed necessary to verify that nutrient reductions are calculated in accordance with the 2014 Grey Infrastructure Report

VI. Incentivizing Stormwater Management Co-Benefits

As discussed in Section IV: Pollutant Load Reductions for Upland Best Management Practices, pollutant load reduction crediting for stormwater BMPs is based on the CBP ST or RR adjustor curves (see Appendix A). The impervious acre credit for upland BMPs is based on the impervious acres in a BMP's drainage area and the depth of rainfall treated. Treatment of a rainfall depth of 1 inch ($P_E = 1$ inch) is required to receive credit equal to the impervious acres in the BMP's drainage area. This water quality treatment volume for a P_E of 1 inch is referred to as the WQ_T. When treating more than 1 inch of rainfall depth, or when providing greater temporary storage in the form of extended detention, or when enhancing the natural functions of a BMP, additional impervious acre credits may be available.

There are three ways of obtaining additional impervious acre credit using upland BMPs:

1. Providing WQ_T for a rainfall depth above 1 inch ($P_E > 1$ inch) in a practice that follows water quality design criteria for BMPs in the Manual;

2. Providing additional storage above a treated rainfall depth of 1 inch ($P_E > 1$ inch) via extended detention; or

3. Using green stormwater infrastructure.

1. Credit for Additional Water Quality Treatment Volume

There will be instances where an upland BMP or BMP retrofit provides water quality treatment for more than 1 inch of rainfall depth. Impervious acre credits are available for a water quality treatment volume (i.e., WQ_T) for a rainfall depth up to 3.0 inches. Following the CBP adjustor curves, there is a 1:1 linear relationship between rainfall depth treated and pollutant removal efficiencies up to a rainfall depth treated of 1 inch. However, for BMPs treating more than 1 inch of rainfall depth, the ratio of pollutant removal efficiency to rainfall depth treated decreases to 0.25:1. Specifically, for any additional WQ_T provided for a rainfall depth treated over 1 inch up to 3.0 inches, an additional 25% impervious acre credit is available.

Equation 9. WQ_T Credit for Rainfall Depths Greater than 1 Inch and Less than or Equal to 3 Inches

$$WQ_T\ Credit = \left[\frac{1\ inch + \ [(P_E - 1\ inch) \times 0.25]}{1\ inch}\right] \times IA$$

Where:

WQ_T = Water quality treatment volume
P_E = Rainfall depth treated
IA = Impervious acres in the drainage area

2. **Credit for Additional Storage (Watershed Management Credit)**

Upland BMPs with greater storage volume may be more resilient to changing weather patterns such as increasing annual precipitation and more frequent, intense short duration storms. The Department provides an additional impervious acre credit when the rainfall depth treated for Watershed Management (WM) is greater than the minimum 1 inch ($P_E > 1$ inch) using extended detention according to Appendix D.11 of the Manual. The WM credit incentivizes additional storage volume that helps to reduce downstream flooding and channel erosion. WM credits are available for this temporary storage volume for a rainfall depth between 1 inch and 3.0 inches. Specifically, for any additional rainfall depth treated for WM over 1 inch using 24 hour extended detention, an additional 25% impervious acre credit is available. This credit is added to the WQ_T credit. The WM credit applies only to the extended detention volume above the WQ_T for the practice. As shown below, Equation 10 calculates the additional credit available for the extended detention storage volume for a P_E greater than 1 inch and less than or equal to 3.0 inches.

Equation 10. WM Credit for Rainfall Depths Greater than 1 Inch and Less than or Equal to 3.0 Inches Managed with Extended Detention

$$WM\ Credit = \left[\frac{(P_E - P_{WQT}) \times 0.25}{1\ inch}\right] \times IA$$

Where:

WM = Watershed Management
P_E = Rainfall depth treated
P_{WQT} = Rainfall depth treated for water quality
IA = Impervious acres in the drainage area

3. **Green Stormwater Infrastructure Credit**

The Green Stormwater Infrastructure (GSI) credit is provided when a BMP provides water quality treatment and incorporates natural processes using vegetation and soils. BMPs with enhanced design features that use natural processes provide healthy, sustainable, and functional ecosystems. BMPs with these features also mimic the pollutant load reduction efficiencies of RR practices. BMPs considered RR practices by the CBP are 35% more effective at removing TN, TP, and TSS than ST practices (see the CBP's BMP Removal Rate Adjustor Curves in Appendix A). Therefore, these practices achieve a GSI credit equal to 1.35 × impervious acre credit achieved through water quality treatment. As noted in Section III: Impervious Acre Credits of Upland Best Management Practices, all Chapter 5 BMPs constructed to meet the required design criteria listed in the Manual are considered RR practices and therefore automatically receive the GSI credit.

A subset of Chapter 3 BMPs (see Table 19) constructed to meet the required design criteria in the Manual can incorporate the additional enhanced design features listed in Table 20 to achieve the GSI credit.

Table 19. Eligibility for Green Stormwater Infrastructure Credits

Upland BMPs	Must Meet Required Manual Design Criteria	Must Meet Required Manual Design Criteria and Provide Enhanced Features
Chapter 5 Practices		
Green Roofs	X	
Permeable Pavements	X	
Reinforced Turf	X	
Disconnection of Rooftop Runoff	X	
Disconnection of Non-Rooftop Runoff	X	
Sheetflow to Conservation Areas	X	
Rainwater Harvesting	X	
Submerged Gravel Wetlands	X	
Landscape Infiltration	X	
Dry Wells	X	
Micro-Bioretention and Rain Gardens	X	
Bio-Swales, Grass Swales, Wet Swales, Dry Swales	X	
Chapter 3 Practices (Sections 3.1 and 3.2 of the Manual)		
Micropool Extended Detention Pond		X
Wet Pond		X
Wet Extended Detention Pond		X
Multiple Pond System		X
Pocket Pond		X
Shallow Wetland		X
Extended Detention Shallow Wetland		X
Pond/Wetland System		X
Pocket Wetland		X
Chapter 3 Practices (Sections 3.3 and 3.4 of the Manual Except Otherwise Noted[1])		
Infiltration Trench		X
Infiltration Basin		X
Surface Sand Filter		X
Organic Filter		X
Pocket Sand Filter		X
Bioretention		X

Note:
[1] Infiltration trenches under pavement, underground sand filters, and perimeter sand filters are not eligible for GSI credit.

Table 20. Green Stormwater Infrastructure Enhanced Features

Chapter 3.1 - 3.2 Stormwater Ponds and Wetlands
Required
1. Flow paths must be 1.5:1 (length relative to width). 2. Surface area of the wetland must be at least 1.5% of the total drainage area to the facility. 3. Any extended detention volume must not comprise more than 50% of the total wet pool volume, and the maximum extended detention water surface elevation must not extend more than three feet above the normal pool. 4. There must be at least 3 separate hydrologic zones (e.g., deep water pool, shallow water bench, shoreline fringe, riparian fringe; see Appendix A of the Manual). 5. These hydrologic zones must be planted throughout with at least 5 wetland species and include a variety of plant types (e.g., grasses, shrubs, trees). For more information on plant types, see *Vegetation in Stormwater Best Management Practices* (MDE, November 2019). 6. Vegetation must be established to cover a minimum of 50% of the pond surface, as measured at the permanent pool design water surface elevation. 7. The landscaping plan must include plants (i.e., aquatic, emergent, upland) along the aquatic bench, safety bench, and side slopes. 8. A vegetated buffer must extend 25 feet outward from the maximum water surface elevation with an additional 15 foot setback to structures (e.g., houses, sheds, roads).
Recommended
1. At least 25% of the total design volume (P_E) should be in deepwater zones with a minimum depth of 4 feet. 2. A minimum of 35% of the total surface area should have a depth of 6 inches or less. 3. At least 65% of the total surface area should be shallower than 18 inches. 4. The vegetated buffer and interior side slopes should be managed as a meadow or forest (mowing twice per year at a maximum).
Chapter 3.3 - 3.4 Stormwater Infiltration and Filtering Systems
Required
1. A minimum 85% vegetation cover must be established within 3 years including at least 5 species and a variety of plant types (grasses, shrubs, trees). For more information, see *Vegetation in Stormwater Best Management Practices* (MDE, November 2019). 2. The landscaping plan must not include invasive species or vines, and these must be removed as they are discovered during maintenance. 3. A vegetated buffer must extend 25 feet outward from the maximum design water surface elevation with an additional 15 foot setback to structures.
Recommended
1. Native plant species are strongly encouraged in the landscaping plan. 2. The vegetated buffer and interior side slopes should be managed as a meadow or forest (mowing twice per year at a maximum).

The following equations are used to calculate the GSI credits:

Equation 11. GSI Credit for Chapter 5 Practices Meeting all Required Design Criteria

$$GSI\ Credit = 1.35 \times \left\{ \left[\frac{(1\ inch + [(P_E - 1\ inch) \times 0.25]}{1\ inch} \right] \times IA \right\}$$

Where:

GSI = Green stormwater infrastructure
P_E = Rainfall depth treated
IA = Impervious acres in the drainage area

Equation 12. Credit for Chapter 3 Practices Meeting all Required Design Criteria

$$Impervious\ Acre\ Credit = Impervious\ Acre\ Credit\ Achieved\ through\ WQ_T$$

Equation 13. GSI Credit for Subset of Chapter 3 Practices Meeting all Required Design Criteria and all Required Enhanced Features

$$GSI\ Credit = 1.35 \times \left\{ \left[\frac{(1\ inch + [(P_E - 1\ inch) \times 0.25]}{1\ inch} \right] \times IA \right\}$$

Where:

GSI = Green stormwater infrastructure
P_E = Rainfall depth treated
IA = Impervious acres in the drainage area

4. **Combining Water Quality Treatment Credits, GSI Credits, and WM Credits**

Upland BMPs may include additional WQ_T, greater WM storage volume, or enhanced GSI design features, or a combination of any of the three credits. If the GSI credit is applicable, it replaces the WQ_T credit. If an upland BMP can claim the WM credit and the GSI credit, the WM credit above the WQ_T volume is added to the GSI credit for the total available credit for the project. Example scenarios of all three credits and how to combine credits can be found in Appendix I.

For water quality practices with extended detention, the volume of storage provided in extended detention that is equal to the wet pool WQ_T can be credited as WQ_T. Instead of using WM credits, this volume can be used for WQ_T credits up to a total treatment volume for a P_E of 3.0 inches (i.e., when the wet pool WQ_T is 1.5 inches and the extended detention volume is an additional 1.5 inches). This is because 50% of the total water quality volume provided in these BMPs can be in the form of extended detention. While the total value of credits calculated using this approach is the same, using this alternative method to calculate the credits becomes especially beneficial if the BMP receives GSI credit. An example of this scenario can be found in Appendix I.

VII. Water Quality Trading

MS4 jurisdictions may acquire TN, TP, and TSS credits in accordance with the requirements of the Maryland Water Quality Trading Program (WQTP), COMAR 26.08.11, to meet impervious acre restoration requirements in their MS4 permits.

1. Calculating Credits

In order to use nutrient credits acquired through the WQTP to meet the MS4 permit impervious acre restoration requirements, the impervious acres must be translated into WQTP credits. This is a two-step process, where the impervious acres are first translated into EOS load reductions and then the load reductions are converted into WQTP credits.

The translation of the impervious acres into TN, TP, and TSS load reductions follows the same method used to account for alternative practices through an EIA_f. Using this method, a treated impervious acre is estimated to be equivalent to the TN, TP, and TSS load reductions achieved from converting one acre of aggregate impervious land into true forest. Thus, the requirement to treat an impervious acre can be met through the WQTP under this permit by acquiring 18.08 lbs of TN (EOS), 2.23 lbs of TP (EOS), and 8,046 lbs of TSS (EOS).

Because a WQTP credit is defined as a pound of TN, TP, or TSS delivered to the Bay, referred to as EOT, the EOS load must be converted to an EOT load. MS4 jurisdictions can use the conversion factors shown in Table 21. These factors were calculated based on jurisdiction-wide weighted average watershed delivery factors. The MDOT/SHA delivery factors are based on statewide-weighted averages.

Table 21. Conversion Factors for EOT Loads used for Water Quality Trading Program Calculations

EOS-EOT conversion factor	Anne Arundel	Baltimore	Baltimore City	Carroll	Charles	Frederick	Harford	Howard	Montgomery	Prince George's	State Highway Administration
TN	0.91	0.69	0.81	0.49	0.83	0.73	0.85	0.49	0.62	0.78	0.80
TP	0.86	0.66	0.82	0.46	0.77	0.60	0.75	0.49	0.51	0.73	0.74
TSS	0.74	0.51	0.70	0.35	0.66	0.53	0.60	0.22	0.39	0.47	0.56

Equation 14. Calculating TN, TP, and TSS Trading Credits for Impervious Acre Restoration

$$TN\ Credits\ to\ be\ Acquired = Impervious\ Acres\ to\ be\ Acquired \times 18.08\ (lbs/acre) \times TN\ EOS\text{-}EOT\ Conversion\ Factor$$

$$TP\ Credits\ to\ be\ Acquired = Impervious\ Acres\ to\ be\ Acquired \times 2.23\ (lbs/acre) \times TP\ EOS\text{-}EOT\ Conversion\ Factor$$

$$TSS\ Credits\ to\ be\ Acquired = Impervious\ Acres\ to\ be\ Acquired \times 8{,}046\ (lbs/acre) \times TSS\ EOS\text{-}EOT\ Conversion\ Factor$$

MS4 jurisdictions can meet their restoration requirements by acquiring credits of TN, TP, and TSS using Equation 14. Alternatively, the requirements can be achieved by acquiring an excess amount of one of the pollutants in lieu of acquiring another. Under this option, 18.08 lbs of TN (EOS) is equivalent to 2.23 lbs of TP (EOS), or 8,046 lbs of TSS (EOS). For example, if an MS4 jurisdiction opted to meet the restoration requirements through the WQTP by purchasing nitrogen credits alone, it would need to purchase 54.24 lbs of TN (EOS) per EIA.

2. **Credit Vintage**

To meet its restoration requirements with WQTP credits, an MS4 jurisdiction must secure the required number of credits from the same year (vintage year) as that of the permit expiration.

3. **Qualifying Credit**

The WQTP crediting procedures should not be used to acquire credits from practices listed in Table 1 or Table 2 of this document and implemented within an MS4's jurisdictional boundary. The Department recommends that any restoration projects and credits within an MS4's jurisdictional boundary include a memorandum of understanding or other legal document that formalizes credit ownership and long-term maintenance responsibility. Nutrient credits for BMPs implemented within an MS4's jurisdictional boundary, but from which credits have been certified and traded to another entity through the WQTP, cannot be claimed by that jurisdiction as restoration credit (i.e., double-counting of nutrient credits).

BMPs in this Guidance that are implemented on agricultural land must comply with the following:

- Federal and State cost share funds, such as Conservation Reserve Enhancement Program (CREP) and Maryland Agricultural Water Quality Cost-Share (MACS) Program, must not be used to acquire MS4 credit.
- To acquire MS4 credit for work performed on land with an Agricultural Use Assessment as determined by the Department of Assessments and Taxation, farming operations must first be compliant with State laws and regulations (e.g., nutrient management plans, excluding livestock from stream setbacks, phosphorus management requirements).
- Any federal or State cost share conservation practices disturbed or removed as a result of

construction must be re-established consistent with the Natural Resources Conservation Service (NRCS) standard and specifications as determined by a local soil conservation district.

- Credit will not be given for new conservation practices to offset the removal of existing ones.

4. **Geography**

Nutrient credits acquired for MS4 compliance must be generated by a source located within a Chesapeake Bay TMDL watershed that overlaps with the MS4's jurisdictional boundary. A dynamic map showing watershed and jurisdictional boundaries can be accessed at: arcg.is/1TKjqG.

5. **Generating Tradeable Credit**

An MS4 jurisdiction may generate tradeable credit for the WQTP once it has fully met its restoration requirement. The Department has developed a calculator that can be used to estimate pollutant load reductions for urban stormwater management practices intended for sale on the nutrient trading market. This calculator is located on the WQTP webpage under the Tools and Resources tab and will automatically generate the load reduction credit once users input geographic information for their project and other project specific data (e.g., BMP type, drainage area, land cover acres, water quality treatment). If an MS4 jurisdiction performs these calculations on its own, it must provide the Department supplemental information sufficient to demonstrate that the pollutant load reductions were calculated correctly.

VIII. Expert Panel Updates and Innovative Practices

1. <u>Future Chesapeake Bay Program Expert Panel Updates</u>

The CBP periodically approves new BMPs or revises efficiencies of existing BMPs. The Department will share this information with Maryland's MS4 regulated community, provide guidance on proper application in Maryland, and place Technical Memorandums on the Department's webpage.

2. <u>Proposal of Innovative BMPs for MS4 Credit</u>

MS4 jurisdictions are encouraged to continue to explore innovative practices and new solutions to improve water quality. Several new BMPs were discussed with MS4 jurisdictions and environmental non-governmental organizations during the Guidance committee meetings. These BMPs include non-forested riparian buffer protection, forest regeneration, and self-converted wetland ponds. Additional programmatic BMPs that have been of interest include pet waste reduction, stormwater education, and trash removal.

When monitoring data exist to support additional credits for new practices, MS4 jurisdictions may submit that information to the Department for consideration. The Department can approve certain practices when proper documentation and monitoring are provided to verify pollutant removal efficiencies. The policies and procedures for the approval of new and innovative technologies may be found on the Department's website. These must be followed for all MS4 jurisdictions interested in pursuing new practices or products either for approval as an acceptable BMP for new development and redevelopment or for use in retrofit applications. The Department's approval for using these practices to meet MS4 restoration requirements is subject to the following:

1. Any MS4 jurisdiction requesting approval of an innovative stormwater practice for restoration must submit to the Department documentation demonstrating practice effectiveness. At a minimum, this documentation must include:

    a. Clear representations of the specific pollutant removal efficiencies for the device in a typical mode of use and under conditions that would be expected normally within the jurisdiction;

    b. Pollutant removal efficiencies that are supported using one or more of the following:

        i. Monitoring data collected under typical field conditions using a methodology consistent with the standards described in the Department's *Alternative/Innovative Technology Review Checklist* (October 2019);

        ii. Monitoring studies conducted by the MS4 jurisdiction and approved by the Department; or

        iii. Review and approval of the practice by EPA or the CBP.

c. Product specifications, installation requirements, and operation and maintenance procedures;

d. Hydraulic performance specifications (e.g., treatment volume, throughput);

e. References and examples of actual installations of the practice;

f. Minimum and recommended maintenance requirements for the practice and any components;

g. Discussion of any special licensing, hauling, or access requirements, and safety issues associated with the operation and maintenance of the practice; and

h. Proof that the practice has been submitted to the CBP Water Quality Goal Implementation Team (WQGIT) or Urban Stormwater Workgroup (USWG) for consideration as an EPA-recognized stormwater BMP.

2. If credit is sought under an MS4 jurisdiction's WIP or MS4 permit, the practice must be documented in that jurisdiction's TMDL implementation plan;

3. All practices must be maintained in accordance with State requirements as defined in COMAR 26.17.02;

4. The MS4 jurisdiction is responsible for determining the appropriate impervious acre reduction for MS4 restoration efforts for the specific practices based on the methodology described in this Guidance; and

5. If formal documentation listed in Section 1.b above is absent, interim pollutant removal efficiencies may be established by the Department based on supporting documentation provided by the applicant until monitoring is conducted. These interim efficiencies will be recognized for a period not to exceed two years. If no further monitoring is provided after two years, the practice will be disallowed as an acceptable stormwater retrofit BMP.

The Department will evaluate all information to make a determination on credit toward meeting pollutant load reduction targets under established TMDLs and impervious acre treatment requirements. The Department will work closely with the CBP workgroups to determine a credit system that is equitable and consistent with other activities in the Chesapeake Bay region. As new technology, innovative practices, monitoring, and research offer additional information, the Department will make that information available to the MS4 regulated community.

IX. Acronyms

BAT	Best Available Technology
BMP	Best Management Practice
CAST	Chesapeake Assessment Scenario Tool
CBP	Chesapeake Bay Program
CEAP	Conservation Effects Assessment Project
COMAR	Code of Maryland Regulations
CREP	Conservation Reserve Enhancement Program
Department	Maryland Department of the Environment
ED	Extended Detention
EIA	Equivalent Impervious Acre
EIA_f	Equivalent Impervious Acre Conversion Factor
EOS	Edge-of-Stream
EOT	Edge-of-Tide
EPA	U.S. Environmental Protection Agency
ESD	Environmental Site Design
FTW	Floating Treatment Wetlands
GSI	Green Stormwater Infrastructure
HSG	Hydrologic Soil Group
I – F	Aggregate Impervious Unit Load Minus True Forest Unit Load
IA	Impervious Acre
IDDE	Illicit Discharge Detection and Elimination
LOD	Limit of Disturbance
MACS	Maryland Agricultural Water Quality Cost-Share Program
MALPF	Maryland Agricultural Land Preservation Foundation
Manual	Maryland Stormwater Design Manual (2000)
MEP	Maximum Extent Practicable
MET	Maryland Environmental Trust
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
PCB	Polychlorinated Biphenyl
P_{design}	Rainfall Treated by Stormwater Management Practices (inches)
P_E	Rainfall Target Used to Size ESD Practices
Q	Rainfall Depth Treated per Impervious Acre (inches)
RR	Runoff Reduction
SPARROW	Spatially Referenced Regressions On Watershed Attributes
ST	Stormwater Treatment
STB	Stream Bed and Bank Load
SW-WLA	Stormwater Wasteload Allocation
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Sediment
USDA	U.S. Department of Agriculture

USGS	U.S. Geological Society
USWG	Urban Stormwater Workgroup
WinSLAMM	Source Loading and Management Model for Windows
WIP	Watershed Implementation Plan
WM	Watershed Management
WQGIT	Water Quality Goal Implementation Team
WQ_T	Water Quality Treatment Volume
WQTP	Maryland Water Quality Trading Program
WQ_V	Water Quality Volume
WRTDS	Weighted Regressions on Time, Discharge and Season
WTWG	Watershed Technical Workgroup
WWTP	Wastewater Treatment Plant

X. References

This Guidance reflects the contributions of multiple stakeholders. In 2018, the Department convened a committee representing environmental non-governmental organizations and medium and large municipal separate storm sewer system (MS4) jurisdictions. Monthly meetings covered accounting for stormwater management co-benefits, incentivizing green infrastructure, encouraging restoration activities in upland areas, new best management practice (BMP) efficiencies, restoration cost considerations, and new BMPs not currently credited. The Department thanks the Audubon Naturalist Society; Blue Water Baltimore; Chesapeake Bay Foundation; Clean Water Action; Maryland League of Conservation Voters; Potomac Conservancy; Anne Arundel, Baltimore, Carroll, Harford, and Montgomery Counties; Baltimore City; and the U.S. Environmental Protection Agency for their time, expertise, invaluable ideas, and commitment to improving water quality in the Chesapeake Bay and Maryland's local streams.

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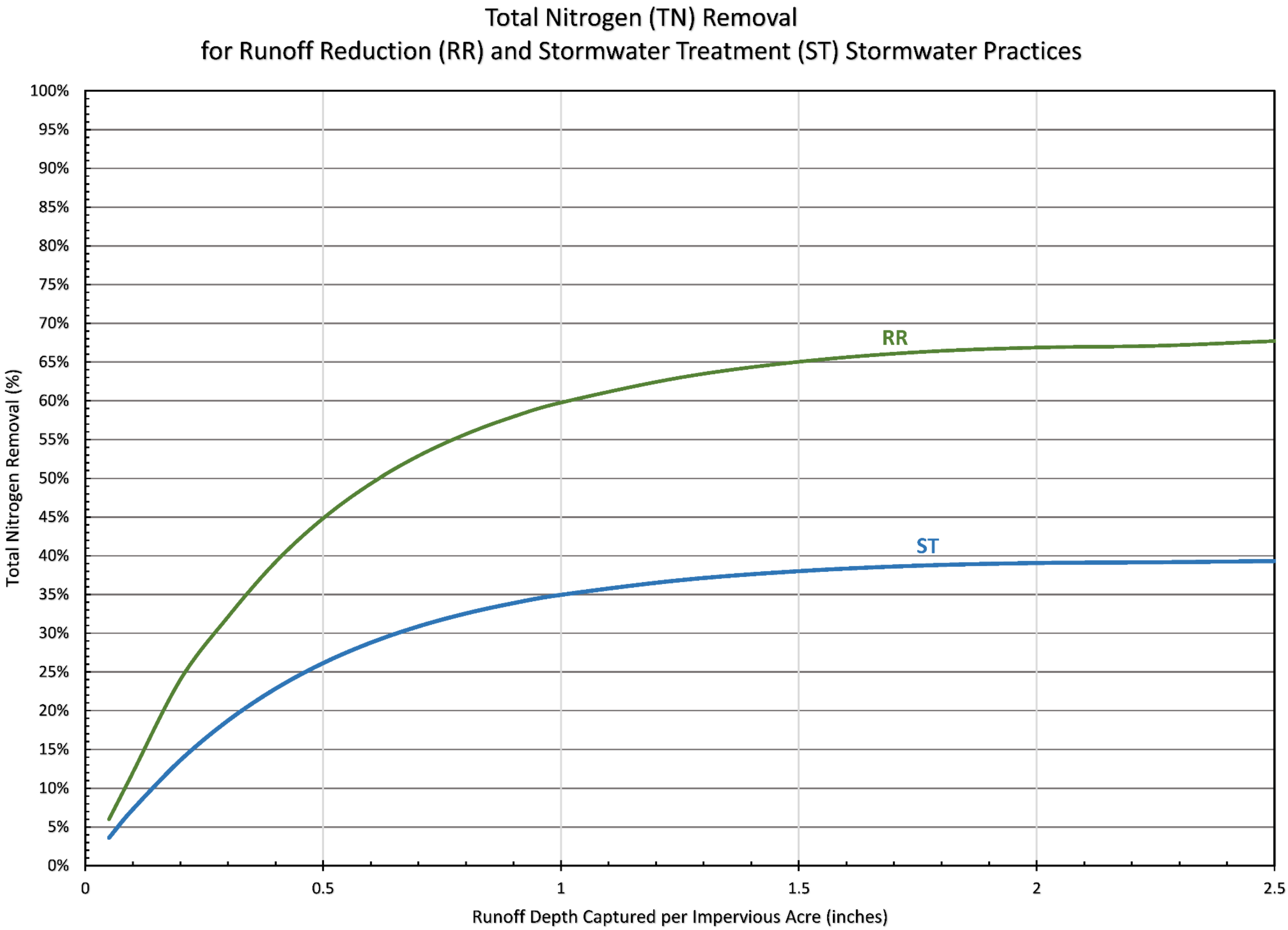
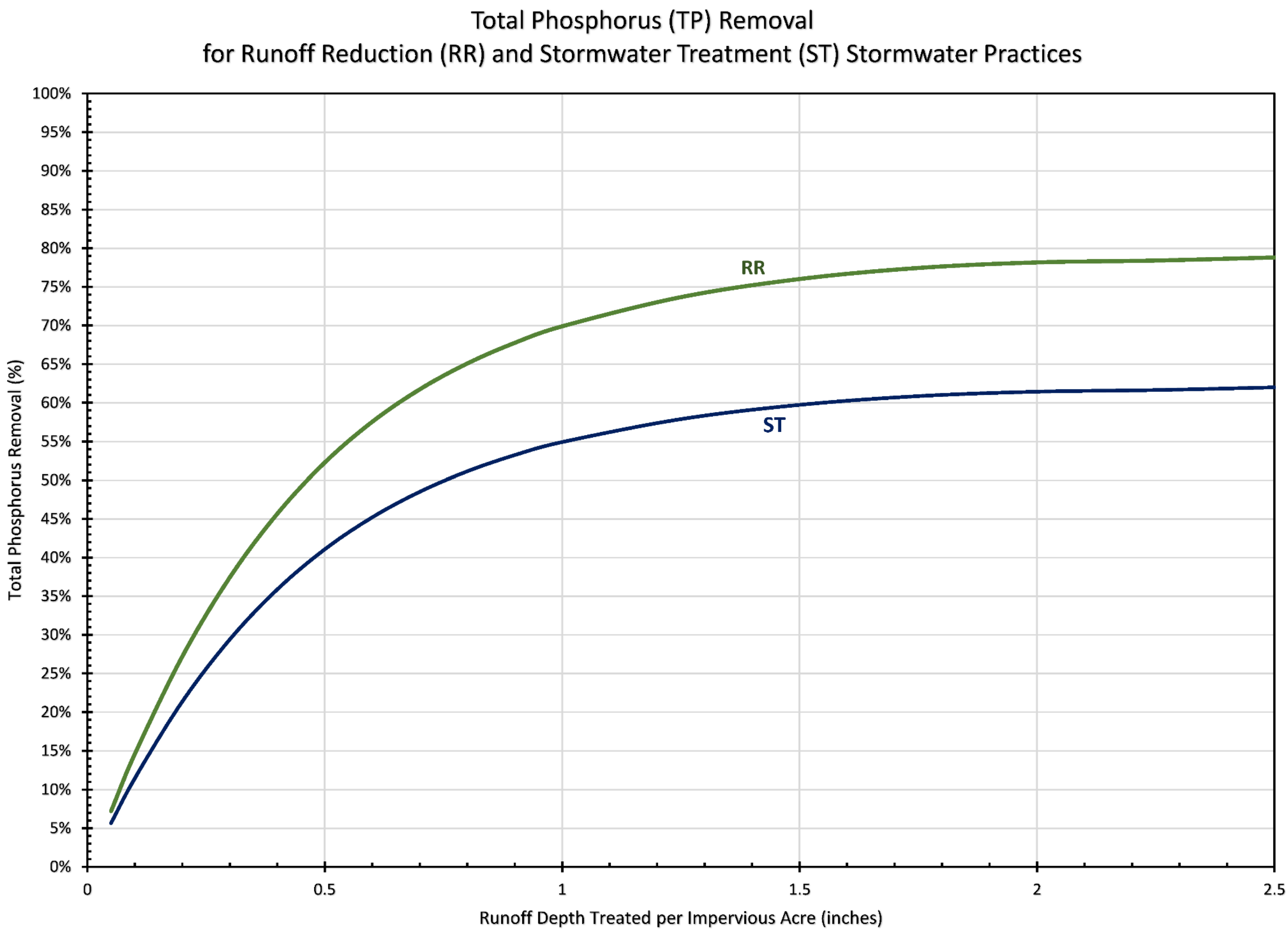
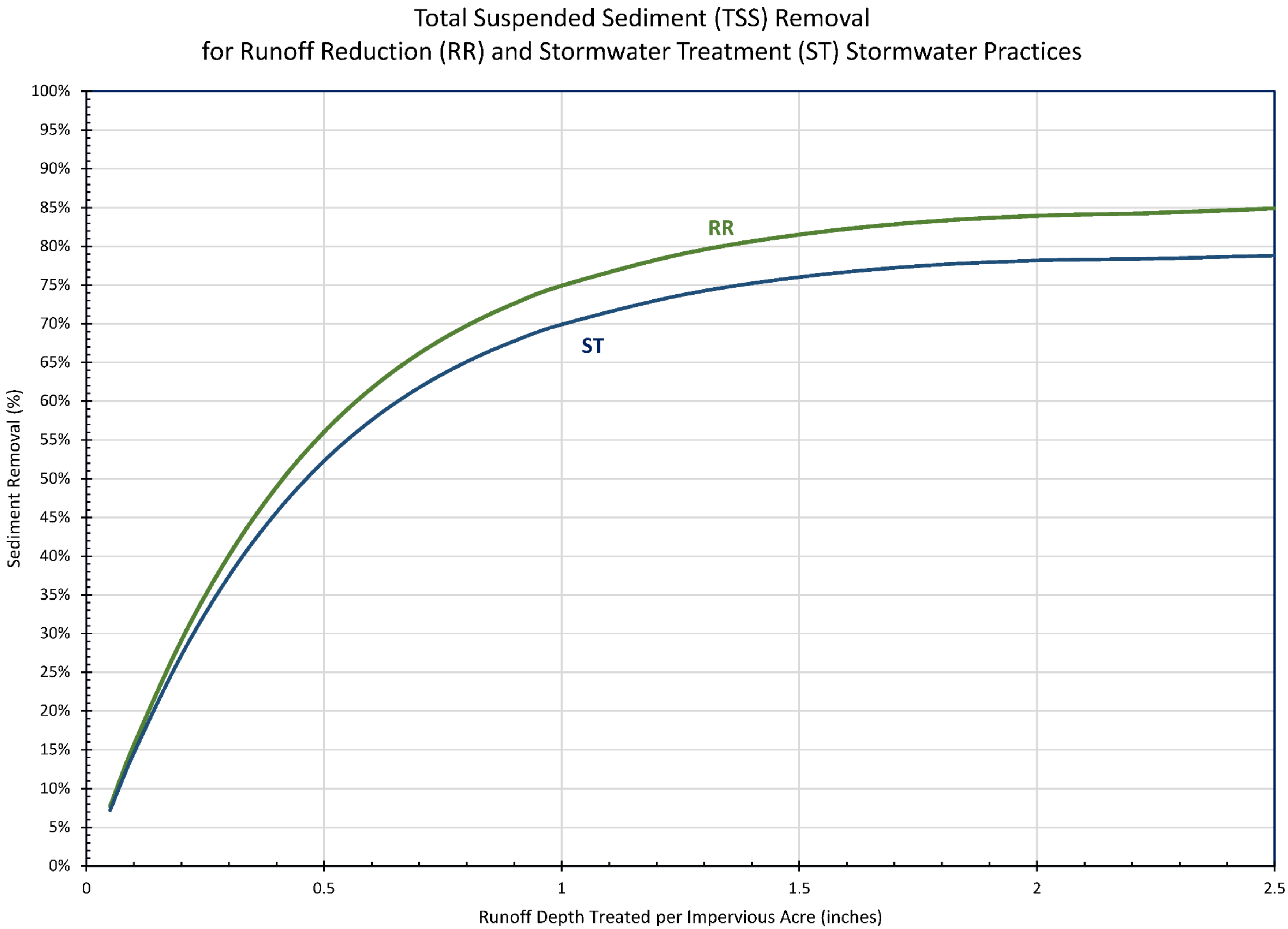
Appendix A: Adjustor Curves

The following pollutant removal adjustor curves are from the Chesapeake Bay Program (CBP) publication *Recommendations of the Expert Panel to Define Removal Rates for New State Stormwater Performance Standards* (Schueler and Lane, 2012 and 2015). The curves provide pollutant removal efficiencies for nutrient and sediment load reductions for best management practice (BMP) implementation. BMPs are classified as either runoff reduction (RR) or stormwater treatment (ST) as outlined in Table 2 (see Section IV).

Throughout the Guidance, the impervious acre credit is used to account for MS4 restoration achieved through BMP implementation. The impervious acre credit is also the surrogate parameter for showing progress in total nitrogen (TN), total phosphorus (TP), and total suspended sediment (TSS) load reductions for meeting Chesapeake Bay and local TMDLs. For an impervious surface, the runoff depth captured is 95% of the rainfall depth treated by a BMP. Therefore, when using these adjustor curves, the rainfall depth treated may be used as a substitute for the runoff depth captured (X axis) when determining pollutant removal efficiencies.


Total Nitrogen (TN) Removal
for Runoff Reduction (RR) and Stormwater Treatment (ST) Stormwater Practices
Total Nitrogen Removal (%)
100%
95%
90%
85%
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
RR
ST
0
0.5
1
1.5
2
2.5
Runoff Depth Captured per Impervious Acre (inches)


Total Phosphorus (TP) Removal
for Runoff Reduction (RR) and Stormwater Treatment (ST) Stormwater Practices
Total Phosphorus Removal (%)
100%
95%
90%
85%
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0
0.5
1
1.5
2
2.5
RR
ST
Runoff Depth Treated per Impervious Acre (inches)



Total Suspended Sediment (TSS) Removal
for Runoff Reduction (RR) and Stormwater Treatment (ST) Stormwater Practices
100%
95%
90%
85%
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
Sediment Removal (%)
RR
ST
0
0.5
1
1.5
2
2.5
Runoff Depth Treated per Impervious Acre (inches)

Appendix B: Phase 6 Chesapeake Bay Watershed Model Land Cover Runoff Loads and Load Reductions

As part of the Chesapeake Bay total maximum daily load (TMDL) midpoint assessment, the Chesapeake Bay Program (CBP) transitioned from the Phase 5 to the Phase 6 Chesapeake Bay Watershed Model (Phase 6 Model). The new model was developed using a multiple model approach, drawing upon total nitrogen (TN), total phosphorus (TP), and total suspended sediment (TSS) loading estimates from the U.S. Geological Society's (USGS) SPARROW model (an empirical regression model), the Phase 5 Chesapeake Bay Watershed Model, and the U.S. Department of Agriculture's (USDA) Conservation Effects Assessment Project (CEAP) model. The overall calibration of input loads to the Bay using USGS's Weighted Regressions on Time, Discharge and Season (WRTDS) observations represents an improvement over Phase 5. The Phase 6 Model also includes significant improvements in the resolution and accuracy of model inputs. These improvements include the following:

- High resolution (i.e., 1 meter) land cover data were used as the base dataset for developing the model land cover.
- Refined Load Sources with unique unit loads were incorporated, particularly in the developed sector. The Phase 5 Model simulated aggregate impervious and pervious urban land cover classifications. The Phase 6 Model simulates both road and non-road impervious surfaces, tree canopy over impervious, turfgrass, and tree canopy over turfgrass.
- In the Phase 5 Model, stream bed and bank (STB) loads were implicitly included in all land cover loads due to the nature of the data used to inform the unit loads. The Phase 6 Model explicitly simulates STB loads as a discreet source, as well as tidal shoreline loads.
- The Phase 6 Model incorporates updated and refined historic best management practice (BMP) data. The CBP partnership spent several years collecting updated information on historic BMPs for model incorporation.
- The Phase 6 Model incorporates many new BMPs for which expert panel reports were developed and approved, and it includes refinements to the TN, TP, and TSS reduction efficiencies for existing BMPs.

This Guidance refers to two primary spatial scales at which loads are estimated. In the Phase 6 Model, edge-of-stream (EOS) loads represent the input loads to smaller, headwater streams in a watershed and edge-of-tide (EOT) loads represent the input loads to the tidal Chesapeake Bay. To ensure consistency in the calculation of equivalent impervious acres (EIA), the Department developed a revised total EOS unit load, which is the sum of the STB load attributed to each Load Source and the Load Source's terrestrial load. More information on the methodology and reasoning behind the development of the revised unit loads and how they are used in calculating the EIA_f (i.e., equivalent impervious acre conversion factor) can be found in Appendix D. Revised EOS loads in the Phase 6 Model are used for estimating loads to local, non-tidal watersheds.

EOT loads correspond to Delivered Loads in the Phase 5 Model. Chesapeake Bay TMDLs and watershed implementation plans (WIPs) are presented in terms of EOT loads. The EOT load can be calculated outside of the model as follows:

Equation 15. Edge-of-Tide Loads

$$EOT\ Load\ (lbs/yr) = EOS\ Load\ (lbs/yr) \times Delivery\ Factor$$

The delivery factors are unique per Phase 6 modeling segment and are provided in Appendix L of this Guidance. Generally speaking, the greater the proximity of a modeling segment to the tidal Bay, the greater the TN, TP, and TSS delivery. Delivery factors also decrease for modeling segments draining to impoundments. In addition to Appendix L, these factors can be found via the "EOT Factor Map" on the Department's water quality trading website: mde.maryland.gov/programs/Water/WQT/Pages/WQT_Tools_Resources.aspx.

Load Sources are aggregated for the purposes of calculating pollutant load reduction credits in this Guidance, since the distinction between some individual Load Sources in the model is merely arbitrary. For example, any minimal differences between "MS4" and "Non-Regulated" unit loads within a modeling segment are merely a product of model calibration and do not reflect actual differences in relative unit loads.

There are two major types of impervious surface simulated in the Phase 6 Model: road impervious and non-road impervious. In order to keep data collection efforts for load reduction credit calculations simple, these calculations will be based on an aggregate impervious surface unit load. Therefore, MS4 jurisdictions do not need to collect data on how much road and non-road impervious surface drains to a given BMP. There are certain BMPs, however, such as "Street Trees" (i.e., land cover conversion BMP representing a shift from Impervious Road to Tree Canopy over Impervious) and street sweeping, which make the assumption that only Impervious Road surface is being treated. In these instances, the calculations apply the specific Impervious Road surface unit load (see Table 4). Appendix C presents the specific Load Sources used in the formulas for each BMP.

When crediting TN, TP, and TSS load reductions toward permit and TMDL goals, these reductions should be calculated from a No Action, or No BMP, modeling scenario. Statewide average, No Action TN, TP, and TSS EOS revised unit loads (i.e., loading rates) for applicable urban and natural Load Sources are presented in Table 4. Steps for calculating load reductions for TN are listed below.

TN Load Reductions of Stormwater Best Management Practices

Steps for calculating EOT TN load reductions:

1. Determine the Phase 6 modeling segment delivery factor (see Appendix L).

2. Determine the impervious drainage area treated by the practice.

3. If the project is not a retrofit of an existing stormwater management facility, use Equation 4 of this Guidance, and repeated below, to directly calculate the TN load reduction.

$$Load\ Reduction\ (lbs/yr) = Urban\ Unit\ Load\ (lbs/acre/yr) \times Impervious\ Surface\ in\ BMP\ Drainage\ Area\ (acres) \times \left[\frac{BMP\ Efficiency}{100}\right] \times Phase\ 6\ Modeling\ Segment\ Delivery\ Factor$$

4. If the project is a retrofit, determine the pre-restoration stormwater BMP type, inches of rainfall depth threated, and the corresponding upland BMP TN efficiency. Calculate the pre-restoration TN load reduction using Equation 4.

5. Determine the post-restoration stormwater BMP type, inches of rainfall depth treated, and the corresponding upland BMP TN efficiency. Calculate the post-restoration TN load reduction using Equation 4.

6. Subtract the result of the pre-restoration TN load reduction from the post-restoration load reduction to determine the updated TN credit obtained from the stormwater BMP:

$$TN\ Credit\ (lb/yr) = Post\text{–}Restoration\ TN\ Load\ Reduction\ (lbs/yr) - Pre\text{–}Restoration\ TN\ Load\ Reduction\ (lbs/yr)$$

Example – Retrofit in modeling segment H24021PM1_3510_4000:

1. Phase 6 Modeling Segment Delivery Factor = 0.65 (See Appendix L)

2. Drainage Area = 100 acres "Impervious"

3. Pre-restoration stormwater BMP type = Stormwater treatment (ST) practice, 0.2 inches rainfall depth treated. Upland BMP TN efficiency = 13.6% (see Table 3)

$$\begin{aligned} &Pre\text{–}Restoration\ TN\ Load\ Reduction\ (lbs/yr) \\ &= 20.39\ (lbs/acre/yr) \times 100\ (acres) \times 0.136 \times 0.65 \\ &= 180.25\ (lbs/yr) \end{aligned}$$

4. Post-restoration stormwater BMP type = ST practice, 1 inch rainfall depth treated. Upland BMP TN efficiency = 35% (see Table 3)

$$\begin{aligned} &Post\text{–}Restoration\ TN\ Load\ Reduction\ (lbs/yr) \\ &= 20.39\ (lbs/acre/yr) \times 100\ (acres) \times 0.35 \times 0.65 \\ &= 463.87\ (lbs/yr) \end{aligned}$$

5. $TN\ Credit\ Calculation = 463.87\ (lbs/yr) - 180.25\ (lbs/yr) = 283.62\ (lbs/yr)$

Appendix C: Best Management Practice Load Reduction Formulas and Pollutant Removal Efficiencies

BMP	Load Reduction Formula	TN Efficiency/Per Unit Load Reduction	TP Efficiency/Per Unit Load Reduction	TSS Efficiency/Per Unit Load Reduction
Efficiency BMPs				
Structural				
Stormwater Treatment (ST)	[Aggregate Imp. Unit Load (lbs/acre/yr) × Imp. Area (acres) × ST Efficiency]	ST efficiency variable by P_E (see Table 3)	ST efficiency variable by P_E (see Table 3)	ST efficiency variable by P_E (see Table 3)
Runoff Reduction (RR)	[Aggregate Imp. Unit Load (lbs/acre/yr) × Imp. Area (acres) × RR Efficiency]	RR efficiency variable by P_E (see Table 3)	RR efficiency variable by P_E (see Table 3)	RR efficiency variable by P_E (see Table 3)
Nonstructural				
Street Sweeping – Advanced Technology				
1 pass/12 weeks	[Road Imp. Unit Load (lbs/acre/yr) × Imp. Area (acres) × Efficiency]	0%	1%	2%
1 pass/2 weeks	[Road Imp. Unit Load (lbs/acre/yr) × Imp. Area (acres) × Efficiency]	2%	5%	11%
1 pass/4 weeks	[Road Imp. Unit Load (lbs/acre/yr) × Imp. Area (acres) × Efficiency]	1%	3%	6%
1 pass/8 weeks	[Road Imp. Unit Load (lbs/acre/yr) × Imp. Area (acres) × Efficiency]	1%	2%	4%
1 pass/week	[Road Imp. Unit Load (lbs/acre/yr) × Imp. Area (acres) × Efficiency]	3%	8%	16%
2 passes/week	[Road Imp. Unit Load (lbs/acre/yr) × Imp. Area (acres) × Efficiency]	4%	10%	21%
Spring & Fall pass/1-2 weeks else monthly	[Road Imp. Unit Load (lbs/acre/yr) × Imp. Area (acres) × Efficiency]	2%	5%	10%
Spring 1 pass/1-2 weeks else monthly	[Road Imp. Unit Load (lbs/acre/yr) × Imp. Area (acres) × Efficiency]	1%	4%	7%
Street Sweeping – Mechanical Broom Technology				
1 pass/4 weeks	[Road Imp. Unit Load (lbs/acre/yr) × Imp. Area (acres) × Efficiency]	0%	0%	0%

BMP	Load Reduction Formula	TN Efficiency/Per Unit Load Reduction	TP Efficiency/Per Unit Load Reduction	TSS Efficiency/Per Unit Load Reduction
1 pass/week	[Road Imp. Unit Load (lbs/acre/yr) × Imp. Area (acres) × Efficiency]	0%	0%	1%
2 passes/week	[Road Imp. Unit Load (lbs/acre/yr) × Imp. Area (acres) × Efficiency]	0%	0%	1%
Urban Soil Restoration - Impervious				
Level 1	[Aggregate Imp. Unit Reduction (lbs/acre/yr) × Imp. Area (acres)]	13.7 lbs/acre/yr	0.70 lbs/acre/yr	1,696 lbs/acre/yr
Level 2	[Aggregate Imp. Unit Reduction (lbs/acre/yr) × Imp. Area (acres)]	15 lbs/acre/yr	0.77 lbs/acre/yr	1,864 lbs/acre/yr
Urban Soil Restoration - Pervious				
Level 1	[Turf Unit Reduction (lbs/acre/yr) × Turf Area (acres)]	4.4 lbs/acre/yr	0.72 lbs/acre/yr	278 lbs/acre/yr
Level 2	[Turf Unit Reduction (lbs/acre/yr) × Turf Area (acres)]	8.9 lbs/acre/yr	1.44 lbs/acre/yr	557 lbs/acre/yr
Floating Treatment Wetlands				
10% Pond Surface Area Coverage	[Urban Unit Load (lbs/acre/yr) × Urban Area (acres) × Efficiency]	1%	2%	2%
11-20% Pond Surface Area Coverage	[Urban Unit Load (lbs/acre/yr) × Urban Area (acres) × Efficiency]	2%	3%	5%
21-30% Pond Surface Area Coverage	[Urban Unit Load (lbs/acre/yr) × Urban Area (acres) × Efficiency]	3%	5%	7%
31-40% Pond Surface Area Coverage	[Urban Unit Load (lbs/acre/yr) × Urban Area (acres) × Efficiency]	3%	7%	9%
41-50% Pond Surface Area Coverage	[Urban Unit Load (lbs/acre/yr) × Urban Area (acres) × Efficiency]	4%	8%	12%
Load Reduction BMPs				
Stream Restoration/Outfall Stabilization				
Planning Rate[1]	[Length of Stream Restored (ft) × Unit Load Reduction (lbs/ft)]	0.075 lbs/ft	0.068 lbs/ft	248 lbs/ft
Protocols	See expert panel report	N/A	N/A	N/A

[1] Planning rate cannot be used for determining final project credit.

BMP	Load Reduction Formula	TN Efficiency/Per Unit Load Reduction	TP Efficiency/Per Unit Load Reduction	TSS Efficiency/Per Unit Load Reduction
Shoreline Management				
Planning/Default Rate[2]	[Length of Shoreline Restored (ft) × Unit Load Reduction (lbs/ft)]	0.173 lbs/ft	0.122 lbs/ft	328 lbs/ft
Protocols	See expert panel report	N/A	N/A	N/A
[2] Planning/Default rate should only be used for planning purposes or for non-conforming projects.				
Storm Drain Cleaning				
Organic[3]	[Mass of Wet Solids Collected (tons/yr) × Conversion Factor (lbs/ton)]	4.44 lbs/ton	0.48 lbs/ton	400 lbs/ton
Inorganic[4]	[Mass of Wet Solids Collected (tons/yr) × Conversion Factor (lbs/ton)]	3.78 lbs/ton	0.84 lbs/ton	1,400 lbs/ton
[3] Wet weight to dry weight conversion is built into conversion factor. [4] Wet weight to dry weight conversion is built into conversion factor.				
Land Cover Conversion BMPs				
Non-Riparian				
Imp. Surface Reduction (Imp. to Turf)	[Imp. Unit Load (lbs/acre/yr) – Turf Unit Load (lbs/acre/yr)] × Area Converted (acres)]	6.96 lbs/acre/yr	0.45 lbs/acre/yr	5,241 lbs/acre/yr
Street Trees (Imp. to Tree Canopy over Imp.)	[[Road Imp. Unit Load (lbs/acre/yr) – Tree Canopy Over Imp. Unit Load (lbs/acre/yr)] × Area Converted (acres)]	3.10 lbs/acre/yr	0.76 lbs/acre/yr	1,404 lbs/acre/yr
Urban Tree Canopy Planting (Turf to Tree Canopy over Turf)	[[Turf Unit Load (lbs/acre/yr) – Tree Canopy Over Turf Unit Load (lbs/acre/yr)] × Area Converted (acres)]	3.20 lbs/acre/yr	0.50 lbs/acre/yr	206 lbs/acre/yr
Forest Planting (Turf to Forest)	[[Turf Unit Load (lbs/acre/yr) – True Forest Unit Load (lbs/acre/yr)] × Area Converted (acres)]	11.12 lbs/acre/yr	1.78 lbs/acre/yr	2,805 lbs/acre/yr
Forest Conservation (Urban to Forest)	[[Urban Unit Load (lbs/acre/yr) – True Forest Unit Load (lbs/acre/yr)] × Area Converted (acres)]	10.57 lbs/acre/yr	1.10 lbs/acre/yr	2,465 lbs/acre/yr
Conservation Landscaping (Turf to Mixed Open)	[[Turf Unit Load (lbs/acre/yr) – Mixed Open Unit Load (lbs/acre/yr)] × Area Converted (acres)]	5.24 lbs/acre/yr	0.53 lbs/acre/yr	0.00 lbs/acre/yr

BMP	Load Reduction Formula	TN Efficiency/Per Unit Load Reduction	TP Efficiency/Per Unit Load Reduction	TSS Efficiency/Per Unit Load Reduction
Riparian				
Forest Planting (Turf to Forest)	[[Turf Unit Load (lbs/acre/yr) – True Forest Unit Load (lbs/acre/yr)] × Area Converted (acres)] + [Urban Unit Load (lbs/acres/yr) × Area Converted (acres) × Efficiency]	14.34 lbs/acre/yr & 25%	2.50 lbs/acre/yr & 50%	4,411 lbs/acre/yr & 50%
Conservation Landscaping (Turf to Mixed Open)	[[Turf Unit Load (lbs/acre/yr) – Mixed Open Unit Load (lbs/acre/yr)] × Area Converted (acres)] + [Urban Unit Load (lbs/acre/yr) × Area Converted (acres) × Efficiency]	6.75 lbs/acre/yr & 12.5%	0.74 lbs/acre/yr & 25%	0.00 lbs/acre/yr & 25%
Septic BMPs				
Connections[5]	[Septic Unit Load (lbs/system) × Efficiency]	73%	N/A	N/A
Denitrification	[Septic Unit Load (lbs/system) × Efficiency]	50%	N/A	N/A
Pumping	[Septic Unit Load (lbs/system) × Efficiency]	5%	N/A	N/A

[5] Efficiency based on Phase III WIP values.

Appendix D: Methodology for Calculating Equivalent Impervious Acres

The Department is using the Phase 6 Model land cover pollutant unit loads and best management practice (BMP) load reduction rates to determine total nitrogen (TN), total phosphorus (TP), and total suspended sediment (TSS) reductions. These pollutant unit loads and reduction rates are also being used to determine the equivalent impervious acre (EIA) credits provided by alternative BMPs. The Phase 6 Model is more detailed in its calculation of pollutant loads than Phase 5. As a result, the discrepancy between the model phases must be accounted for to ensure consistent load reduction and equivalent impervious acre conversion factor (EIA_f) calculations.

Terrestrial vs. Stream Bed and Bank Loads

The Phase 6 Model significantly differs from the Phase 5 Model in how loads are attributed. In the Phase 5 Model, the total unit loads per land cover Load Source reflect inputs from both terrestrial loads (i.e. over land) and stream bed and bank loads (STB). However, the total unit loads per land cover Load Source in the Phase 6 Model only reflect terrestrial loads. To ensure consistency in the calculation of EIAs between the two models, the Department estimated a total unit load, which is the sum of the Load Source's terrestrial load and STB load attributed to that Load Source. The method for calculating the STB load attributed to each Load Source can be found in Appendix E.

Calculating Deltas

Calculating the EIA_f for each alternative BMP is a two-step process. First, the pollutant load reductions for TN, TP, and TSS are calculated for the alternative BMP. Next, these pollutant load reductions are divided by the delta between aggregate impervious and true forest unit loads for TN, TP, and TSS. The difference between true forest and aggregate impervious loads signifies maximum restoration potential. The Aggregate Impervious – True Forest deltas for TN, TP, and TSS are shown in Table 22 and are calculated by subtracting the Total Forest unit load from the Total Impervious unit load.

Table 22. Aggregate Impervious – True Forest Delta Calculation using Revised Phase 6 Model Pollutant Unit Loads

		TN (lbs/acre/yr)	TP (lbs/acre/yr)	TSS (lbs/acre/yr)
1.	Impervious STB	5.73	1.83	7,125
2.	Impervious Terrestrial	14.66	0.72	1,668
3.	**Total – Aggregate Impervious (1 + 2)**	**20.39**	**2.55**	**8,793**
4.	True Forest STB	0.88	0.27	719
5.	True Forest	1.43	0.05	28
6.	**Total – True Forest (4 + 5)**	**2.31**	**0.32**	**747**
7.	**Aggregate Impervious – True Forest Delta (3 – 6)**	**18.08**	**2.23**	**8,046**

All alternative BMPs except land use conversion practices use the Aggregate Impervious unit load – True Forest unit load deltas in their EIA_f calculation as shown in Equation 5 of this Guidance and repeated below.

$$EIA_f = \frac{\left(\frac{TN\ Load\ Red.}{I-F_{TN}}\right)+\left(\frac{TP\ Load\ Red.}{I-F_{TP}}\right)+\left(\frac{TSS\ Load\ Red.}{I-F_{TSS}}\right)}{3}$$

Where:

EIA_f = Equivalent impervious acre conversion factor
TN Load Red. = BMP load reduction for TN (lbs/unit/yr)
TP Load Red. = BMP load reduction for TP (lbs/unit/yr)
TSS Load Red. = BMP load reduction for TSS (lbs/unit/yr)
$I – F_{TN}$ = Aggregate impervious unit load minus true forest unit load for TN (lbs/acre/yr)
$I – F_{TP}$ = Aggregate impervious unit load minus true forest unit load for TP (lbs/acre/yr)
$I – F_{TSS}$ = Aggregate impervious unit load minus true forest unit load for TSS (lbs/acre/yr)

Land use conversion practices are calculated using the upland stormwater management practice method for determining an equivalent impervious acre. This method uses the stormwater treatment (ST) 1 inch performance delta instead of the Aggregate Impervious unit load – True Forest unit load for its EIA_f calculation (see Table 23). The ST 1 inch delta calculation is shown in Equation 16. This is the ST 1 inch treatment efficiency multiplied by the Total Impervious unit load.

Table 23. ST 1 Inch Delta Calculation using Revised Phase 6 Model Impervious Unit Loads

		TN (lbs/acre/yr)	TP (lbs/acre/yr)	TSS (lbs/acre/yr)
1.	**ST 1 Inch Pollutant Removal Efficiency**	**0.35**	**0.55**	**0.70**
2.	Impervious STB Unit Load	5.73	1.83	7,125
3.	Impervious Terrestrial Unit Load	14.66	0.72	1,668
4.	**Total Impervious Unit Load (2+3)**	**20.39**	**2.55**	**8,793**
5.	**ST 1 Inch Delta (1×4)**	**7.14**	**1.40**	**6,155**

Equation 16. EIA_f Calculation for Land Use Conversion Practices

$$EIA_f = \frac{\left(\frac{TN\ Load\ Red.}{ST\ 1"\ delta_{TN}}\right) + \left(\frac{TP\ Load\ Red.}{ST\ 1"delta_{TP}}\right) + \left(\frac{TSS\ Load\ Red.}{ST\ 1"delta_{TSS}}\right)}{3}$$

Where:

TN Load Red. = Land cover conversion load reduction for TN (lbs/unit/yr)
TP Load Red. = Land cover conversion load reduction for TP (lbs/unit/yr)
TSS Load Red. = Land cover conversion load reduction for TSS (lbs/unit/yr)
ST 1"delta TN = ST 1 inch pollutant efficiency applied to total impervious unit load for TN
ST 1"delta TP = ST 1 inch pollutant efficiency applied to total impervious unit load for TP
ST 1"delta TSS = ST 1 inch pollutant efficiency applied to total impervious unit load for TSS

Appendix E: Methodology for Calculating the Stream Bed and Bank Load

The method for calculating the stream bed and bank load (STB) attributed to each Load Source is performed outside of the Phase 6 Model but follows the same principles that are used in the Chesapeake Assessment Scenario Tool (CAST). This methodology was provided to the Department by the Chesapeake Bay Program (CBP) (Devereux 2019). For each pollutant, the Load Source-specific ratio was calculated between the CAST scenario edge-of-stream (EOS) load output not including STB and the calibration average EOS load not including STB. Next, the calculated ratio was multiplied by the STB base source-specific load. For the total suspended sediment (TSS) STB load only, an additional 4/3 of the CAST scenario EOS impervious TSS load was added, consistent with the Phase 6 Model methodology. These equations are summarized below:

Equation 17. Calculations for STB Loads for TN, TP, and TSS

$$TN\ STB\ Load = \left(\frac{Scenario\ EOS\ without\ STB\ TN}{CAL\ EOS\ without\ STB\ TN}\right) \times STB\ Base\ TN$$

$$TP\ STB\ Load = \left(\frac{Scenario\ EOS\ without\ STB\ TP}{CAL\ EOS\ without\ STB\ TP}\right) \times STB\ Base\ TP$$

$$TSS\ STB\ Load = \left\{\left(\frac{Scenario\ EOS\ without\ STB\ TSS}{CAL\ EOS\ without\ STB\ TSS}\right) \times STB\ Base\ TSS\right\} + \left(\frac{4}{3} \times Scenario\ Impervious\ TSS\right)$$

Where:

TN = Total nitrogen
TP = Total phosphorus
TSS = Total suspended sediment
STB = Stream bed and bank load source
EOS = Edge-of-stream
CAL = Calibration average

The STB base load used in each equation is a set load determined during the development and calibration of the Phase 6 Model. It is presented in terms of nitrate, organic nitrogen, and ammonia for TN, and phosphate and organic phosphorus for TP. However, the results are summed to TN and TP for convenience. The calibration average EOS load is the average of the annual calibration scenarios from 1984 to 2013. Both the STB base load and the calibration average EOS load are not CAST outputs and were provided by CBP. All calculations are performed at the land river modeling segment scale and include the agencies as defined in CAST. Counties and municipalities are implicitly included.

STB Load Normalization

Because a single STB base load exists for all Load Sources, the STB source-specific load calculated using Equation 17 is an overestimation. This overestimation was accounted for and corrected by the Department using the following steps:

1. Calculate the ratio of the CAST scenario EOS load output to the calibration average EOS load for the aggregate of all other Load Sources and sum the result with the Load Source-specific ratio calculated above.

2. To account for Load Source group breakouts, renormalize the Load Source-specific ratio by first dividing it by the sum of the ratios calculated in Step 1 and then multiplying the result by the CAST scenario EOS load output to the calibration average EOS load ratio for the aggregate of all Load Sources.

3. Disaggregate the final STB load by multiplying the Load Source-specific STB base load by the renormalized ratio. If calculating the TSS STB load, add in 4/3 of the CAST scenario impervious EOS load. The impervious load includes CAST MS4 and Non-Regulated Buildings and Other, and Roads.

Appendix F: Examples of Calculating Equivalent Impervious Acre Credits for Alternative Best Management Practices

The Department has developed individual BMP calculators to estimate EIA credit. Calculators are available for the following BMP types: stream restoration, shoreline management, street sweeping, storm drain cleaning, land use conversion, and floating treatment wetlands. Calculators to determine the load reduction and EIA credit achieved from stream restoration and shoreline management practices using the expert panel protocols are also available. These calculators are located at mde.maryland.gov/programs/Water/StormwaterManagementProgram/Pages/storm_gen_permit.aspx.

Street Sweeping

Equivalent Impervious Acre Conversion Factors (EIA_f) for Street Sweeping

BMP	EIA_f per Lane Mile Swept
Advanced Sweeping	
1 pass/12 weeks	0.027
1 pass/8 weeks	0.059
1 pass/4 weeks	0.087
Spring 1 pass/1-2 weeks else monthly	0.106
Spring & Fall 1 pass/1-2 weeks else monthly	0.148
1 pass/2 weeks	0.156
1 pass/week	0.235
2 passes/week	0.304
Mechanical Broom	
1 pass/4 weeks	0.001
1 pass/week	0.004
2 passes/week	0.008

1. Determine the number of lane miles swept and the street sweeping best management practice (BMP) type.

2. Find the corresponding EIA_f according to Table 1 (and repeated above).

3. Multiply that EIA_f by the number of lane miles swept.

   Note: Street sweeping is an annual BMP. Equivalent impervious acre (EIA) credit is based on the annual number of miles swept averaged over the span of the 5 year permit term.

$$Number\ of\ Lane\ Miles\ Swept \times EIA_f = Equivalent\ Impervious\ Acre\ Credit$$

Example:

1. An MS4 jurisdiction is using advanced sweeping technology and sweeping 100 lane miles once every 12 weeks.

2. The EIA_f for advanced sweeping – 1 pass/12 weeks is 0.027.

3. Multiply the EIA_f of 0.027 by the number of lane miles swept (i.e., 100 lane miles). The EIA credit for 100 lane miles of street sweeping is 2.7 acres.

$$100 \; Lane \; Miles \times 0.027 \; EIA_f = 2.7 \; Equivalent \; Impervious \; Acres \; Credit$$

Storm Drain Cleaning

EIA_f for Storm Drain Cleaning

Material Removed	EIA_f per Ton of Material Removed
Organic	0.17
Inorganic	0.25

1. Determine if material is organic or inorganic based on the majority content of solids.

2. Find the corresponding EIA_f according to Table 1 (and repeated above).

3. Measure the mass (tons) of solids/organic matter that are captured and properly disposed of by the storm drain cleaning practice on an annual basis.

4. Multiply the EIA_f by the mass collected.

Note: Storm drain cleaning is an annual BMP. EIA credit is based on the captured annual aggregate load averaged over the span of the 5 year permit term.

$$Mass \; Collected \; (tons) \times EIA_f = Equivalent \; Impervious \; Acre \; Credit$$

Example:

1. The MS4 jurisdiction has determined that the majority content of solids vacuumed from the storm drain are organic.

2. The EIA_f for removing 1 ton of organic material is 0.17.

3. The amount of solids removed is 2,000 lbs or 1 ton.

4. Multiply the EIA_f of 0.17 by the mass of material removed in tons (i.e., 1 ton). The EIA credit for removing 1 ton of organic material is 0.17 acres.

$$1\ Ton\ of\ Organic\ Materials\ Removed \times 0.17\ EIA_f = 0.17\ Equivalent\ Impervious\ Acre\ Credit$$

<u>Floating Treatment Wetland</u>

EIA_f for Floating Treatment Wetlands (FTW)

BMP	% of Pond Wet Surface Area Covered by FTW	EIA_f per Impervious Acre
FTW1	10%	0.008
FTW2	11-20%	0.017
FTW3	21-30%	0.026
FTW4	31-40%	0.034
FTW5	41-50%	0.042

1. Determine the number of impervious acres draining to the stormwater pond.

2. Determine the percent of the pond's wet surface area that is covered by the FTW and the corresponding EIA_f according to Table 1 (and repeated above).

3. Multiply that EIA_f by the impervious acres within the pond's drainage area.

$$Total\ Impervious\ Acres\ within\ the\ Pond's\ Drainage\ Area \times EIA_f = Equivalent\ Impervious\ Acre\ Credit$$

Example:

1. A stormwater pond receives drainage from 50 acres of impervious surfaces.

2. The FTW design covers 30% of the pond's wet surface area, so the corresponding EIA_f is 0.026.

3. Multiply the EIA_f of 0.026 by the total impervious acres in the pond's drainage area (i.e., 50 acres). The EIA credit for the FTW is 1.30 acres.

$$50\ Impervious\ Acres \times 0.026\ EIA_f = 1.30\ Equivalent\ Impervious\ Acres\ Credit$$

Non-Riparian Land Cover Conversion

EIA_f for Non-Riparian Land Cover Conversion BMPs

Land Cover Conversion BMP	EIA_f per Acre of Land Cover Converted
Forest Planting	1.10
Conservation Landscaping	0.37
Impervious Surface Reduction	0.71
Street Trees	0.40
Urban Tree Canopy Planting	0.28

1. Determine the number of acres to be converted and the type of land cover conversion.
2. Find the corresponding EIA_f according to Table 1 (and repeated above).
3. Multiply that EIA_f by the number of converted acres.

$$Acres\ of\ Land\ Converted\ \times EIA_f = Equivalent\ Impervious\ Acre\ Credit$$

Example:

1. An MS4 jurisdiction is planning to implement a forest planting BMP and convert 100 acres of turf to forest.
2. The EIA_f for forest planting without a riparian buffer is 1.10.
3. Multiply the EIA_f of 1.10 by the converted acres (i.e., 100 acres). The EIA credit for 100 acres of forest planting is 110 acres.

$$100\ Acres\ of\ Land\ Converted\ from\ Turf\ to\ Forest \times 1.10\ EIA_f = 110\ Equivalent\ Impervious\ Acres\ Credit$$

Riparian Land Cover Conversion

EIA_f for Riparian Land Cover Conversion BMPs

Land Cover Conversion BMP	EIA_f per Acre of Land Cover Converted
Riparian Forest Buffers	1.50
Riparian Conservation Landscaping	0.50

1. Determine the number of acres to be converted and the type of land cover conversion. (Note: The only land cover conversion BMPs that offer additional credit for a riparian buffer are forest planting and conservation landscaping.)
2. Find the corresponding EIA_f according to Table 1 (and repeated above).

3. Multiply that EIA_f by the number of converted acres.

$$Acres\ of\ Land\ Converted\ within\ a\ Riparian\ Buffer \times EIA_f = Equivalent\ Impervious\ Acre\ Credit$$

Example:

1. An MS4 jurisdiction is planning to implement a forest planting BMP as a riparian buffer and convert 100 acres of turf to forest.

2. The EIA_f for forest planting with a riparian buffer is 1.50.

3. Multiply EIA_f of 1.50 by the converted acres (i.e., 100 acres). The EIA of 100 acres of forest planting is 150 acres.

$$100\ Acres\ of\ Land\ Converted\ to\ Forest\ within\ a\ Riparian\ Buffer \times 1.50\ EIA_f = 150\ Equivalent\ Impervious\ Acres\ Credit$$

<u>Forest Conservation</u>

1. Determine the number of forest acres to be conserved.

2. Multiply the number of forest acres by the EIA_f, from Table 1 (i.e., 0.46).

$$Acres\ of\ Forest\ Preserved \times 0.46\ EIA_f = Equivalent\ Impervious\ Acre\ Credit$$

Example

1. An MS4 jurisdiction is planning to conserve 100 acres of forest.

2. Multiply the EIA_f of 0.46 by the conserved forest acres eligible for credit (i.e. 100 acres). The EIA credit for 100 acres of forest conservation is 46 acres.

$$100\ Acres\ of\ Forest\ Preserved \times 0.46\ EIA_f = 46\ Equivalent\ Impervious\ Acres\ Credit$$

Septic Practices

EIA_f for Alternative Septic BMPs

BMP	EIA_f per System
Septic Pumping	0.02
Septic Denitrification	0.16
Septic to WWTP Connection	0.23

1. Determine the number of septic systems pumped, septic systems converted to a wastewater treatment plant (WWTP) connection, or denitrification systems installed.

2. Find the corresponding EIA_f according to Table 1 (and repeated above).

3. Multiply that EIA_f by the number of septic systems as determined in Step 1.

$$Number\ of\ Septic\ Systems \times EIA_f = Equivalent\ Impervious\ Acre\ Credit$$

Example:

1. An MS4 jurisdiction has pumped 100 septic systems.

2. The EIA_f for septic pumping is 0.02.

3. Multiply 0.02 acres by the number of septic systems (i.e., 100). The EIA credit for 100 septic systems pumped out is 2 acres.

$$100\ Septic\ Systems\ Pumped \times 0.02\ EIA_f = 2\ Equivalent\ Impervious\ Acres\ Credit$$

(Note: Septic pumping is an annual BMP. EIA credit is based on the number of systems pumped averaged over the span of the 5 year permit term.)

Shoreline Management (Default Rate)

1. Determine the number of feet of shoreline managed.

2. Multiply the EIA_f from Table 1 (i.e., 0.04 acres) by the number of shoreline feet.

$$Number\ of\ Feet\ of\ Shoreline\ Managed \times 0.04\ EIA_f = Equivalent\ Impervious\ Acre\ Credit$$

Example:

1. An MS4 jurisdiction is managing 100 feet of shoreline.

2. Multiply the EIA_f of 0.04 acres by the feet of shoreline managed (i.e., 100). The EIA credit for 100 feet of shoreline management is 4 acres.

$$100\ Feet\ of\ Shoreline\ Managed \times 0.04\ EIA_f = 4\ Equivalent\ Impervious\ Acres\ Credit$$

Stream Restoration (Planning Purposes Only)

1. Determine the number of stream feet to be restored.

2. Multiply the EIA_f from Table 1 (i.e., 0.02 acres) by the number of stream feet.

$$Length\ of\ Planned\ Stream\ Restoration\ in\ Feet \times 0.02\ EIA_f = Equivalent\ Impervious\ Acre\ Credit$$

Example:

1. An MS4 jurisdiction plans to restore 100 stream feet.

2. Multiply the EIA_f of 0.02 acres by the stream feet to be restored (i.e., 100 feet). The EIA planning credit for 100 feet of stream restoration is 2 acres.

$$Planned\ Stream\ Restoration\ of\ 100\ Feet \times 0.02\ EIA_f = 2\ Equivalent\ Impervious\ Acres\ Credit$$

Note that the 0.02 equivalent impervious acre is a stream restoration planning rate. Once stream restoration projects are completed, the project-specific measurements and pollutant load reductions calculated in accordance with the stream restoration protocols must be used to determine the EIA credit.

Stream Restoration/Shoreline Management Using Protocols

1. Determine under which protocols the stream restoration or shoreline management project is eligible for credit.

2. Sum load reductions from each protocol preformed on the project.

3. Using Equation 5, substitute load reductions determined in Step 2 to calculate the project's EIA credit.

Example:

1. An MS4 jurisdiction's stream restoration project is eligible for credit under Protocols 1 and 2.

2. Protocol 1 resulted in load reductions of 1,538 lbs TN, 708 lbs TP, and 122 tons TSS. Protocol 2 resulted in a load reduction of 73 lbs TN. The total nutrient and sediment credits for this project are:

   TN = 1,538 lbs + 73 lbs = 1,611 lbs
   TP = 708 lbs
   TSS = 122 tons = 244,000 lbs

3. Substituting the load reductions from Step 2 into Equation 5, the project's EIA credit is 146 acres.

$$EIA = \frac{\left(\frac{1{,}611}{18.08}\right) + \left(\frac{708}{2.23}\right) + \left(\frac{244{,}000}{8{,}046}\right)}{3} = 146\ Equivalent\ Impervious\ Acres\ Credit$$

Appendix G: Design Criteria for Urban Soil Restoration

Feasibility and Testing:

- Soil amendments must not be applied where:
  - The depth to the seasonal high water table, bedrock, hard pan, or other confining layer is less than two feet below the soil surface;
  - Average slope exceeds ten percent; or
  - Soils are saturated or seasonally wet.
- Soil testing must be conducted at two stages:
  - Prior to construction to a depth of 1 foot below the proposed application area to determine soil properties related to saturation, bulk density, pH, salts, and nutrients. This will determine what soil amendments may be needed; and
  - One week after amendment incorporation to determine if any additional nutrient requirements, and pH and/or organic adjustments, are needed to further plant growth.

Design Criteria:

- When used to restore compacted soils and improve soil porosity, the area must be excavated or ripped to the depth and soil amendments added according to the degree of compaction (i.e., Level 1, 2).
- Soil restoration to depths up to 15 inches requires removal of the existing soil and physical mixing of the soil with compost (excavation and mixing method, see below). Soil restoration to depths greater than 15 inches requires complete cultivation (see below).
- When used in conjunction with another best management practice (BMP):
  - Soil must be excavated to the design depth (e.g., for filtering practices, between 12 to 24 inches); and amendments added using an excavation and mixing method; and
  - For media depths greater than 15 inches, the complete cultivation method should be used.
- Once the soil restoration has been completed, the site should be planted and stabilized immediately.
- Excavation and Mixing Method:
  - Remove the compacted soils, working in strips perpendicular to the slope/flowpath and using multiple lifts if necessary;
  - Separate and remove a minimum of 25% of the densest subsoil for removal. Stockpile the remaining soil next to the excavated area;
  - Scarify the bottom of the excavated area;
  - Replace the soil in a minimum of two lifts. More lifts may be needed depending on the equipment used. For each lift:
    - Replace soil by loosening, aerating and mixing; and
    - Incorporate the required soil amendments uniformly throughout each lift.
  - Rake to level the amended area, removing woody debris and any rocks larger than 1 inch in diameter; and

    - The finished grade of the amended area must be a minimum of 4 inches above the existing grade to account for settlement. The finished grade must be adjusted to account for field conditions and soil texture; final grades should match original grade three months after installation.
- Complete Cultivation Method:
    - Remove the top layer of soil to a depth of 6 inches to 12 inches. Drop the removed material next to the excavated area. Removed soil that is in large lumps or is blocky may require further breaking up.
    - Cultivation of the second layer can be started after completing the removal of the upper layer. Cultivation is accomplished by lifting and raking the soil in place. Long teeth on the bucket can assist in this process. If the material is not easily crumbled (i.e., is friable) by lifting and raking, then scrape in soil in 6 inch to 12 inch layers. Lifting and dropping the material in place can also be used to break up blockier soils.
    - Mix any soil amendments into the stockpiled soil (see above). After soil amendments have been added, pull the top, stockpiled layer back into the excavation. Level the amended area as needed;
    - Incorporate soil amendments with a 6 inch rototiller;
    - Rake to level the amended area, removing woody debris and any rocks larger than 1 inch in diameter; and
    - The finished grade of the amended area must be a minimum of 4 inches above the existing grade to account for settlement. The finished grade must be adjusted to account for field conditions and soil texture; final grades should match original grade three months after installation.

Appendix H: Minimum Qualifying Conditions for Stream Restoration and Shoreline Management Projects

Stream Restoration

Not all stream restoration projects may qualify for sediment or nutrient reductions in the Phase 6 Chesapeake Bay Watershed Model (Phase 6 Model), and subsequently they may not be eligible for equivalent impervious acre (EIA) credits. The stream restoration expert panel reports, *Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects (January 2014), Consensus Recommendations for Improving the Application of the Prevented Sediment Protocol for Urban Stream Restoration Projects Built for Pollutant Removal Credit (February 2020)*, and *Consensus Recommendations to Improve Protocols 2 and 3 for Defining Stream Restoration Pollutant Removal Credits (October 2020),* outline the qualifying conditions for stream restoration projects that qualify for nutrient and sediment load reduction credits. In order for a project to qualify for EIA credits, it must meet the key criteria identified below, as well as all other criteria outlined within the expert panel reports.

1. Stream restoration projects that are primarily designed to protect public infrastructure by bank armoring or rip rap do not qualify for a credit. For further information regarding what does and does not constitute bank armoring, and specifically what is eligible for credit, please see the approved memo, *Consensus Recommendations for Improving the Application of the Prevented Sediment Protocol for Urban Stream Restoration Projects Built for Pollutant Removal Credit (February 2020)*, specifically Table 3 of the report.

2. The stream reach must be greater than 100 feet in length and be still actively enlarging or degrading in response to upstream development or adjustment to previous disturbances in the watershed (e.g., a road crossing and failing dams).

3. There may be certain project design conditions that must be satisfied in order to be eligible for credit under one or more of the specific protocols described in the stream restoration expert panel report.

4. A qualifying project must meet certain presumptive criteria to ensure that high functioning portions of the urban stream corridor are not used for in-stream stormwater treatment (i.e., where existing stream quality is still good). These may include one or more of the following:

    - Geomorphic evidence of active stream degradation, i.e., Bank Erosion Hazard Index (BEHI) score
    - An IBI (i.e., index of biological integrity) of fair or worse
    - Hydrologic evidence of floodplain disconnection
    - Evidence of significant depth of legacy sediment in the project reach

5. Before credits are granted, stream restoration projects will need to meet post-construction monitoring requirements, exhibit successful vegetative establishment, and have undergone initial project maintenance.

6. A qualifying project must demonstrate that it will maintain or expand existing riparian vegetation in the stream corridor, and compensate for any project related riparian losses in project work areas as determined by regulatory agencies.

7. All qualifying projects must have a designated authority responsible for development of a project maintenance program that includes routine maintenance and long-term repairs.

Shoreline Management

Not all shoreline management projects may qualify for sediment or nutrient reductions in the Phase 6 Model, and subsequently they may not be eligible for EIA credits. The Shoreline Management Expert Panel report, *Recommendations of the Expert Panel to Define Removal Rates for Shoreline Management Projects (June 2017),* outlines the qualifying conditions for shoreline management projects that qualify for nutrient and sediment load reduction credits. In order for a project to qualify for EIA credits, it must meet the criteria detailed in Table 24.

Table 24. Basic Qualifying Conditions for Pollutant Load Reductions and EIA Credit for Shoreline Management Practices

Shoreline Management Practice	Load Reduction Criteria[1]
Living Shoreline a) Nonstructural; b) Hybrid system including a sill; and c) Hybrid system including a breakwater	1. The site is currently experiencing shoreline erosion or is replacing existing armor. The site was graded, vegetated, and excess sediment was removed or used[2], and 2. When a marsh fringe habitat (a or b) or beach/dune habitat (c) is created, enhanced, or maintained.
Revetment and/or Breakwater System without a Living Shoreline	1. The site is currently experiencing shoreline erosion, and 2. A living shoreline is not technically feasible or practicable as determined by substrate, depth, or other site constraints, and 3. When the breakwater footprint would not cover submerged aquatic vegetation (SAV), shellfish beds, and/or wetlands.
Bulkhead/Seawalls	1. The site is currently experiencing shoreline erosion, and 2. The site consists of port facilities, marine industrial facilities, or other marine commercial areas where immediate offshore depth (e.g., depths deeper than 10 feet 35 feet from shore) precludes living shoreline stabilization or the use of a breakwater or revetment.

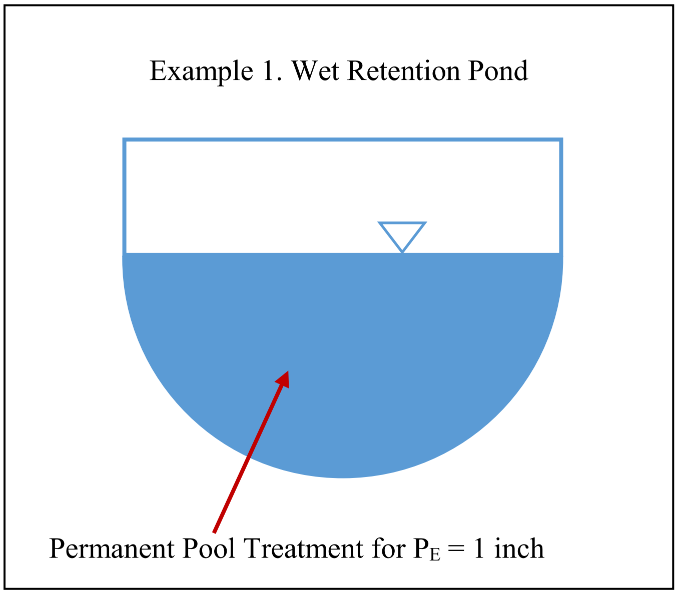
Notes:
[1] Projects that impact the Chesapeake Bay Preservation Act protected vegetation without mitigation receive no pollutant load reduction toward the Chesapeake Bay total maximum daily load or EIA credit. The Department may, on a case-by-case basis, determine a practice is ineligible for credit when the unintended consequences of negative impacts to wetlands and SAVs caused by these shoreline management techniques outweigh the benefits.
[2] Bank analysis that demonstrates the site has bank stability and does not have erosion can serve to meet this qualifying condition. This should be coordinated through the regulatory approval process to ensure proper methods, reporting, and requirements are done and are accepted so that the project meets this basic qualifying condition.

Appendix I: Example Impervious Acre Calculations for the Water Quality Treatment, Watershed Management, and Green Stormwater Infrastructure Credits

Water Quality Treatment (WQ_T) and Watershed Management (WM) Credits

Example 1:

Wet retention pond with a permanent pool water quality treatment volume for rainfall depth of 1 inch. Impervious area in the drainage area to the pond is 10 acres.



Solution:

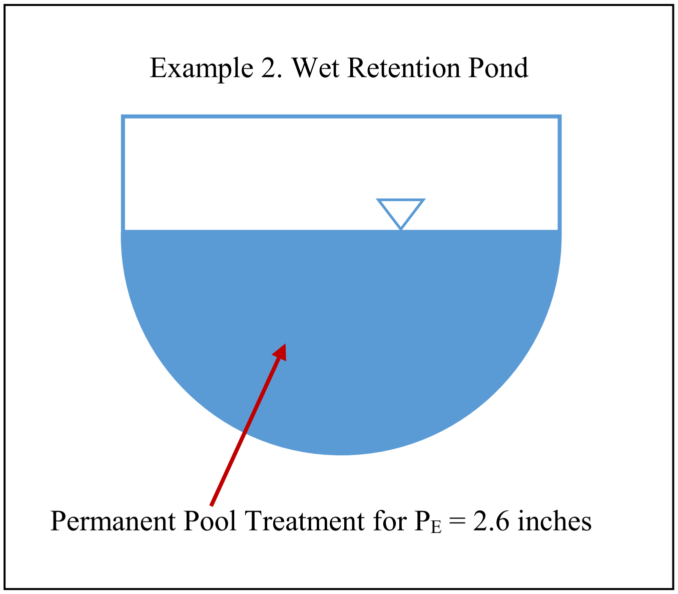
Since the rainfall depth treated (P_E) = 1 inch, the WQ_T credit is:

$$WQ_T\ Credit = \left(\frac{P_E}{1\ inch}\right) \times Impervious\ Acres\ in\ Drainage\ Area$$

$$WQ_T\ Credit = \left(\frac{1\ inch}{1\ inch}\right) \times 10\ acres\ = \mathbf{10\ acres}$$

Example 2:

Wet retention pond with a permanent pool water quality treatment volume for rainfall depth of 2.6 inches. Impervious area in the drainage area to the pond is 10 acres.



Solution:

Since the rainfall depth treated (P_E) is > 1 inch, the WQ_T credit is:

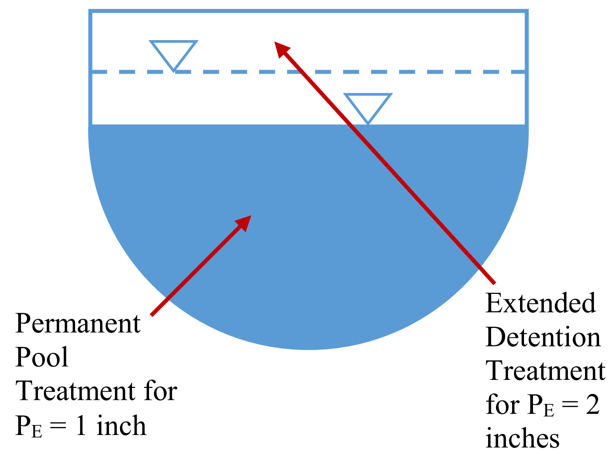
$$WQ_T\ Credit = \left[\frac{1\ inch + [(P_E - 1\ inch) \times 0.25]}{1\ inch}\right] \times Impervious\ Acres\ in\ Drainage\ Area$$

$$WQ_T\ Credit = \left[\frac{1\ inch + [(2.6\ inches - 1\ inch) \times 0.25]}{1\ inch}\right] \times 10\ acres = \mathbf{14\ acres}$$

Example 3:

Wet extended detention pond with a permanent pool treatment volume for rainfall depth of 1 inch and extended detention volume for an additional rainfall depth of 2 inches. The total rainfall depth managed is 3 inches. Impervious area in the drainage area to the pond is 10 acres.

Example 3. Wet Extended Detention Pond



Solution:

Since the rainfall depth treated (P_E) in the permanent pool = 1 inch, the WQ_T credit is:

$$WQ_T\ Credit = \left(\frac{P_E}{1\ inch}\right) \times Impervious\ Acres\ in\ Drainage\ Area$$

$$WQ_T\ Credit = \left(\frac{1\ inch}{1\ inch}\right) \times 10\ acres\ = \mathbf{10\ acres}$$

WM credit is available for extended detention volume above the permanent pool volume for up to a total rainfall depth treated of 3 inches:

$$WM\ Credit = \left[\frac{(P_E - Rainfall\ Depth\ Treated\ for\ WQ_T) \times 0.25}{1\ inch}\right] \times Impervious\ Acres\ in\ Drainage\ Area$$

$$WM\ Credit = \left[\frac{(3\ inches - 1\ inch) \times 0.25}{1\ inch}\right] \times 10\ acres = \mathbf{5\ acres}$$

$$Total\ Credit = WQ_T\ Credit + WM\ Credit = 10\ acres + 5\ acres = \mathbf{15\ acres}$$

Alternative Solution:

Alternatively, a portion of the extended detention volume equal to the permanent pool volume is eligible for WQ_T credit. The remaining extended detention volume is then eligible for WM credit:

P_E treated by permanent pool = 1 inch (use toward WQ_T)
P_E treated by extended detention used toward water quality treatment = 1 inch (use toward WQ_T)
Remaining P_E treated by extended detention = 1 inch (use for WM credit)

$$WQ_T\ Credit = \left[\frac{1\ inch + [(P_E - 1\ inch) \times 0.25]}{1\ inch}\right] \times Impervious\ Acres\ in\ Drainage\ Area$$

$$WQ_T\ Credit = \left[\frac{1\ inch + [(2\ inches - 1\ inch) \times 0.25]}{1\ inch}\right] \times 10\ acres = \mathbf{12.5\ acres}$$

$$WM\ Credit = \left[\frac{(P_E - Rainfall\ Depth\ Treated\ for\ WQ_T)\times 0.25}{1\ inch}\right] \times Impervious\ Acres\ in\ Drainage\ Area$$

$$WM\ Credit = \left[\frac{(3\ inches - 2\ inches)\times 0.25}{1\ inch}\right] \times 10\ acres = \mathbf{2.5\ acres}$$

$$Total\ Credit = WQ_T\ Credit + WM\ Credit = 12.5\ acres + 2.5\ acres = \mathbf{15\ acres}$$

Note: While these two solutions result in the same total credit, the difference will become important when applying green infrastructure credits to the project.

<u>Adding Green Stormwater Infrastructure (GSI) Credits</u>

Using the same examples (1-3) above and adding green infrastructure features:

Example 4:

Wet retention pond with a permanent pool water quality treatment volume for a rainfall depth of 1 inch. The impervious area in the drainage area to the pond is 10 acres. Green infrastructure features are added to meet GSI credit requirements.

Solution:

Since the rainfall depth treated in the permanent pool = 1 inch, the WQ_T credit is:

$$WQ_T\ Credit = \left(\frac{P_E}{1\ inch}\right) \times Impervious\ Acres\ in\ Drainage\ Area$$

$$WQ_T\ Credit = \left(\frac{1\ inch}{1\ inch}\right) \times 10\ acres = \mathbf{10\ acres}$$

$GSI\ Credit = 1.35 \times\ 10\ Impervious\ Acres\ Credit\ from\ WQ_T = \mathbf{13.5\ acres}$ (This is the total credit for the project)

Example 5:

Wet retention pond with a permanent pool treatment volume for a rainfall depth of 2.6 inches. The impervious area in the drainage area to the pond is 10 acres. Green infrastructure features are added to meet GSI credit requirements.

Solution:

Since the rainfall depth treated in the permanent pool is > 1 inch, the WQ_T credit is:

$$WQ_T\ Credit = \left[\frac{1\ inch + [(P_E - 1\ inch)\times 0.25]}{1\ inch}\right] \times Impervious\ Acres\ in\ Drainage\ Area$$

$$WQ_T\ Credit = \left[\frac{1\ inch + [(2.6\ inches - 1\ inch)\times 0.25]}{1\ inch}\right] \times 10\ acres = \mathbf{14\ acres}$$

$GSI\ Credit = 1.35 \times [14\ Impervious\ Acres\ Credit\ from\ WQ_T] = \mathbf{18.9\ acres}$ (This is the total credit for the project)

Example 6:

Wet extended detention pond with a permanent pool treatment volume for rainfall depth of 1 inch and extended detention volume for an additional rainfall depth of 2 inches. Total rainfall depth treated is 3 inches. Impervious area in drainage area to pond is 10 acres. Green infrastructure features are added as required to meet GSI credit requirements.

Solution:

Since the rainfall depth treated (P_E) in the permanent pool = 1 inch, the WQ_T credit is:

$$WQ_T\ Credit = \left(\frac{P_E}{1\ inch}\right) \times Impervious\ Acres\ in\ Drainage\ Area$$

$$WQ_T\ Credit = \left(\frac{1\ inch}{1\ inch}\right) \times 10\ acres = \mathbf{10\ acres}$$

WM credit is available for extended detention volume above the permanent pool volume for up to a total rainfall depth treated of 3 inches:

$$WM\ Credit = \left[\frac{(P_E - Rainfall\ Depth\ Treated\ for\ WQ_T) \times 0.25}{1\ inch}\right] \times Impervious\ Acres\ in\ Drainage\ Area$$

$$WM\ Credit = \left[\frac{(3\ inches - 1\ inch) \times 0.25}{1\ inch}\right] \times 10\ acres = \mathbf{5\ acres}$$

$GSI\ Credit = 1.35 \times 10\ Impervious\ Acres\ Credit\ from\ WQ_T = \mathbf{13.5\ acres}$ (This credit replaces the impervious acre credit)

$$Total\ Credit = GSI\ Credit + WM\ Credit = 13.5\ acres + 5\ acres = \mathbf{18.5\ acres}$$

Alternative Solution:

Alternatively, a portion of the extended detention volume equal to the permanent pool volume is eligible for WQ_T credit. Only the remaining extended detention volume is then eligible for WM credit:

P_E treated by permanent pool = 1 inch (use toward WQ_T)
P_E treated by extended detention used toward impervious acre credit = 1 inch (use toward WQ_T)
Remaining P_E treated by extended detention = 1 inch (use for WM credit)

$$WQ_T\ Credit = \left[\frac{1\ inch + [(P_E - 1\ inch) \times 0.25]}{1\ inch}\right] \times Impervious\ Acres\ in\ Drainage\ Area$$

$$WQ_T\ Credit = \left[\frac{1\ inch + [(2\ inches - 1\ inch) \times 0.25]}{1\ inch}\right] \times 10\ acres = \mathbf{12.5\ acres}$$

$$WM\ Credit = \left[\frac{(P_E - Rainfall\ Depth\ Treated\ for\ WQ_T) \times 0.25}{1\ inch}\right] \times Impervious\ Acres\ in\ Drainage\ Area$$

$$WM\ Credit = \left[\frac{(3\ inches - 2\ inches) \times 0.25}{1\ inch}\right] \times 10\ acres = \mathbf{2.5\ acres}$$

$GSI\ Credit = 1.35 \times 12.5\ Impervious\ Acres\ Credit\ from\ WQ_T = \mathbf{16.88\ acres}$ (This credit replaces the WQ_T)

$$Total\ Credit = GSI\ Credit + WM\ Credit = 16.88\ acres + 2.5\ acres = \mathbf{19.38\ acres}$$

Appendix J: Data Reporting, Verification, and Inspection Frequencies

Municipal separate storm sewer system (MS4) permits require that the MS4 Geodatabase include data for all best management practices (BMPs) implemented for new development, redevelopment, and MS4 restoration. In addition, the impervious acres credit must be calculated from the approved plans for each restoration or redevelopment project and recorded in the MS4 Geodatabase. MS4 jurisdictions can refer to the Department's User's Guide for specific instructions on the reporting and use of the MS4 Geodatabase. The below reporting structure (Table 25, Table 26, and Table 27) provides BMP classification codes that must be used for reporting.

Table 25. BMP Classification Codes for RR and ST Practices

Manual	Description	Class	Code
Ponds			
P-1	Micro-Pool Extended Detention (ED)	S	PMED
P-2	Wet Pond	S	PWET
P-3	Wet ED Pond	S	PWED
P-4	Multiple Pond	S	PMPS
P-5	Pocket Pond	S	PPKT
Wetlands			
W-1	Shallow Wetland	S	WSHW
W-2	ED Shallow Wetland	S	WEDW
W-3	Pond/Wetland System	S	WPWS
W-4	Pocket Wetland	S	WPKT
Infiltration			
I-1	Infiltration Trench	S	ITRN
I-2	Infiltration Basin	S	IBAS
M-3	Landscape Infiltration	E	MILS
M-4	Infiltration Berm	E	MIBR
M-5	Dry Well	E	MIDW
Filtering Systems			
F-1	Surface Sand Filter	S	FSND
F-2	Underground Filter	S	FUND
F-3	Perimeter Filter	S	FPER
F-4	Organic Filter	S	FORG
F-5	Pocket Filter	S	FPKT
F-6	Bioretention[1]	S	FBIO
M-2	Submerged Gravel Wetland	E	MSGW
M-6	Micro-Bioretention[1]	E	MMBR
M-7	Rain Garden[1]	E	MRNG
M-9	Enhanced Filter[2]	E	MENF
Open Channel Systems			
O-1	Dry Swale	S	ODSW
O-2	Wet Swale	S	OWSW
M-8	Grass Swale	E	MSWG
M-8	Bio-Swale	E	MSWB

Manual	Description	Class	Code
M-8	Wet Swale	E	MSWW
Alternative Surfaces			
A-1	Green Roof, Extensive[3]	E	AGRE
A-1	Green Roof, Intensive[3]	E	AGRI
A-2	Permeable Pavement[3]	E	APRP
A-3	Reinforced Turf[3]	E	ARTF
Nonstructural Techniques			
N-1	Rooftop Disconnect	E	NDRR
N-2	Non-Rooftop Disconnect	E	NDNR
N-3	Sheetflow to Conservation Area	E	NSCA
Other Systems			
M-1	Rainwater Harvesting	E	MRWH
Notes: [1] Can be an infiltration practice [2] Not a standalone practice [3] Typically a proprietary system			

Table 26. BMP Classification Codes for Alternative Practices

Alternative BMP (Class A)	Code
Mechanical Street Sweeping	MSS
Regenerative/Vacuum Street Sweeping (i.e., Advanced Street Sweeping)	VSS
Impervious Surface Reduction (i.e., impervious to pervious)	IMPP
Impervious Surface to Forest (i.e., IMPP + FPU)	IMPF
Forestation on Pervious Urban (i.e., Forest Planting)	FPU
Catch Basin Cleaning (i.e., Storm Drain Cleaning)	CBC
Storm Drain Vacuuming (i.e., Storm Drain Cleaning)	SDV
Stream Restoration	STRE
Outfall Stabilization	OUT
Shoreline Management	SHST
Septic Pumping	SEPP
Septic Denitrification	SEPD
Septic Connections to WWTP	SEPC

There are several new alternative BMPs (see Table 27 below) where the classification codes are not recognized by the MS4 Geodatabase. For these practices, please enter the corresponding class code (i.e., “A”) in the *BMP_CLASS* field, the code “OTH” in the *BMP_TYPE* or *ALTBMP_TYPE* field, and the code from Table 27 in the *GEN_COMMENTS* field. This will allow for the reporting of these practices until the MS4 Geodatabase is updated.

Table 27. BMP Classification Codes for New Alternative Practices

Alternative BMP (Class A)	Code
Conservation Landscaping	CLTM
Elimination of Discovered Nutrient Discharges from Grey Infrastructure	DGI
Floating Treatment Wetlands	XFTW
Forest Conservation	FCO
Riparian Conservation Landscaping	RCL
Riparian Forest Planting	RFP
Street Trees	STCI
Urban Soil Restoration (Compacted Pervious Surfaces)	USRP
Urban Soil Restoration (Removed Impervious Surfaces)	USRI
Urban Tree Canopy (i.e., Pervious Turf to Tree Canopy over Turf)	UTC
Dry Channel Regenerative Step Pool Stormwater Conveyance System[1]	SPSD
Note: [1] SPSD is considered a stormwater retrofit by the CBP Stream Restoration Expert Panel. This practice may use the same pollutant load reductions as a filtering practice.	

The MS4 Geodatabase also contains information regarding inspection and maintenance. Successful restoration requires that BMPs function properly to ensure that the expected water quality improvements are achieved. Therefore, BMP inspection and routine maintenance need to be conducted in order for MS4 jurisdictions to claim credit. Otherwise, the credits will be removed until proper performance is verified. All runoff reduction (RR) and stormwater treatment (ST) BMPs must be regularly maintained and inspected a minimum of every three years. Alternative BMPs must follow inspection frequencies as specified by the Chesapeake Bay Program (CBP) expert panels, except for land cover conversion BMPs, which must be inspected triennially. See Table 28 for inspection frequencies. The BMP data must include the last inspection date and whether the facility has been properly maintained. A “failed” designation assigned to any BMP indicates that the facility is not functioning as designed.

Table 28. BMP Inspection Frequencies

BMP	Inspection Frequency
Efficiency BMPs	
Stormwater Treatment (ST)	Triennial
Runoff Reduction (RR)	
Urban Soil Restoration	
Street Sweeping	Annual
Floating Treatment Wetlands	Credit valid 3 years; inspections extend credit
Load Reduction BMPs	
Stream Restoration/Outfall Stabilization	Credit valid 5 years; inspections extend credit
Shoreline Management	
Storm Drain Cleaning	Annual
Land Cover Conversion BMPs	
Non-Riparian	Triennial
Riparian	
Septic BMPs	
Connections	N/A
Denitrification	Annual
Pumping	

Appendix K: Reporting New Development

Best management practices (BMPs) implemented to meet new development requirements may not be used for credit toward stormwater wasteload allocations (SW-WLAs) or impervious acre restoration. However, local governments are required to report data for new development, redevelopment, and restoration projects in the Department's MS4 Geodatabase so that net pollutant loads will be calculated in the Chesapeake Bay Watershed Model. The discussion below will provide guidance on the proper reporting of urban BMP data.

Current Maryland regulations require that environmental site design (ESD) be used to the maximum extent practicable (MEP) to reduce the runoff from new development and replicate the hydrologic characteristics of forested conditions. To meet this requirement on a new development project, ESD practices must be used either exclusively or, where necessary, in combination with structural practices to provide sufficient treatment and reduce the volume of runoff from the 1 year, 24 hour design storm. For new development projects, this standard is based on the median value of the 1 year storm for Maryland, or 2.7 inches of rainfall.

Pollutant removal rates for upland stormwater practices are determined using the Adjustor Curves from the Chesapeake Bay Program (CBP) publication *Recommendations of the Expert Panel for New State Stormwater Performance Standards* (Schueler and Lane, 2012 and 2015) that are found in Appendix A. These curves are a function of the type of practices used and the rainfall depth treated per impervious acre. On these curves, BMPs are classified as either runoff reduction (RR) or stormwater treatment (ST) practices as outlined in Table 2 (see Section IV).

Maryland's ESD sizing criteria (see Chapter 5, pp 5.18-19 of the 2000 Stormwater Design Manual, i.e. the Manual) mandates that ESD practices be used to treat the runoff from 1 inch of rainfall (i.e., P_E = 1 inch) on all new developments where stormwater management is required. After all reasonable opportunities for using ESD practices are exhausted, structural practices (i.e., those found in Chapter 3 of the Manual) may be used to address any remaining requirements. As discussed in Section IV, the ESD practices listed in the Manual are considered RR practices when using the adjustor curves. Likewise, the structural practices found in Chapter 3 of the Manual are considered ST practices.

When using the adjustor curves to determine removal efficiency for each pollutant (i.e., TN, TP, and TSS), the runoff depth (in inches) per impervious acre treated is used to determine the RR and ST pollutant removal efficiencies. Also, the most significant difference between the RR and ST curves for each pollutant is from 0 to 1 inch of runoff depth. For runoff depths greater than 1 inch, there is little difference in the slopes of the two RR and ST curves.

The ESD sizing criteria are based on capturing and treating the runoff from 2.7 inches of rainfall. For an impervious surface, the runoff depth from 2.7 inches of rainfall is approximately 2.6 inches. Therefore, new development projects that fully meet the ESD to the MEP mandate should use 2.6 inches for the runoff depth treated per impervious acre.

Because ESD practices must be used to treat at least 1 inch of rainfall, the RR curves are used to determine pollutant removal rates up to a runoff depth of 1 inch. However, and as noted above, there is little to no difference between the RR and ST slopes/curves beyond 1 inch. Therefore, the RR curves may be used to determine pollutant removal efficiencies where ESD and structural practices are used to address new development stormwater management requirements. Where the ESD to the MEP requirements are fully addressed (i.e., the P_E is fully addressed), the runoff depth of 2.6 inches is used in conjunction with the curves. Equation 18 may be used to determine the runoff depth treated where the ESD requirements are not fully addressed.

Equation 18. Calculation of Rainfall Depth Treated per Impervious Acre to Account for ESD to the MEP

$$Q = \left(\frac{P_{design}}{P_E}\right) \times 2.6\ inches$$

Where:

Q = Runoff depth treated per impervious acre (inches) to be used with the adjustor curves
P_{design} = The rainfall treated by stormwater management practices (inches)
P_E = The rainfall target used to size ESD practices

Table 29 provides the pollutant removal rates for stormwater management meeting ESD to the MEP.

Table 29. Pollutant Removal Rates for ESD to the MEP

Sediment	85%
Total Phosphorus	78.8%
Total Nitrogen	67.9%

Appendix L: Phase III Watershed Implementation Plan - Maryland Delivery Factor Summary Table (Edge-of-Stream to Edge-of-Tide Conversion Factors)

Land River Segment	TN	TP	TSS
Allegany County			
N24001PU0_3871_3690	0.59	0.18	0.14
N24001PU1_3100_3690	0.63	0.46	0.30
N24001PU1_3580_3780	0.64	0.47	0.47
N24001PU1_3850_4190	0.81	0.64	0.11
N24001PU1_3940_3970	0.55	0.52	0.55
N24001PU2_3140_3680	0.94	0.36	0.33
N24001PU2_3180_3370	0.56	0.28	0.26
N24001PU2_3370_4020	0.66	0.33	0.28
N24001PU3_3680_3890	0.75	0.44	0.48
N24001PU4_3780_3930	0.78	0.45	0.39
N24001PU4_3890_3990	0.92	0.74	0.72
N24001PU4_3970_3890	0.78	0.70	0.38
N24001PU4_3990_3780	0.94	0.85	0.69
N24001PU4_4440_3970	0.87	0.85	0.84
N24001PU5_3930_4170	0.69	0.27	0.22
N24001PU5_4170_4020	0.78	0.39	0.11
N24001PU6_3870_3690	0.83	0.38	0.27
N24001PU6_4020_3870	0.70	0.26	0.15
Anne Arundel County			
N24003WL0_4390_0000	0.94	0.98	1.00
N24003WL0_4391_0000	1.00	1.00	1.00
N24003WL0_4392_0000	1.00	1.00	1.00
N24003WL0_4393_0000	1.00	1.00	1.00
N24003WL0_4394_0000	1.00	1.00	1.00
N24003WL0_4420_0000	0.78	0.44	0.19
N24003WL0_4421_0000	0.95	1.00	1.00
N24003WL0_4422_0000	1.00	1.00	1.00
N24003WL0_4423_0000	1.00	1.00	1.00
N24003WL0_4424_0000	1.00	1.00	1.00
N24003WL0_4425_0000	1.00	1.00	1.00
N24003WL0_4600_0000	0.86	0.85	0.78
N24003WL0_4601_0000	1.00	1.00	1.00
N24003WL0_4602_0000	0.96	1.00	1.00
N24003WL0_4603_0000	1.00	1.00	1.00
N24003WL0_4770_0000	1.00	1.00	1.00
N24003WL0_4771_0000	0.81	0.82	0.78

Land River Segment	TN	TP	TSS
N24003WL0_4772_0000	0.92	1.00	1.00
N24003WM0_3961_0000	0.92	0.82	0.36
N24003WM0_3962_0000	1.00	1.00	1.00
N24003WM0_3963_0000	1.00	1.00	1.00
N24003WM0_3966_0000	1.00	1.00	1.00
N24003WM3_4060_0001	0.66	0.35	0.18
N24003XL3_4710_0000	0.83	0.67	0.41
N24003XL3_4711_0000	0.84	0.72	0.49
N24003XL3_4712_0000	0.86	0.68	0.39
N24003XL3_4713_0000	0.78	0.69	0.45
N24003XL3_4950_0000	0.72	0.62	0.42
N24003XU2_4270_4650	0.76	0.81	0.22
N24003XU2_4480_4650	0.74	0.77	0.16
N24003XU3_4650_0001	0.80	0.57	0.16
Baltimore City			
N24510WM0_3650_0001	0.76	0.71	0.43
N24510WM0_3740_0001	0.41	0.65	0.44
N24510WM0_3741_0000	0.85	0.81	0.60
N24510WM0_3960_0000	1.00	1.00	1.00
N24510WM0_3961_0000	1.00	1.00	1.00
N24510WM0_3962_0000	1.00	1.00	1.00
N24510WM0_3964_0000	1.00	1.00	1.00
N24510WM1_3910_0001	0.60	0.67	0.43
N24510WM3_4060_0001	0.67	0.52	0.42
Baltimore County			
N24005SL2_2910_3060	0.95	0.68	0.37
N24005WM0_3650_0001	0.72	0.58	0.38
N24005WM0_3740_0001	0.39	0.62	0.41
N24005WM0_3741_0000	0.82	0.71	0.44
N24005WM0_3742_0000	1.00	1.00	1.00
N24005WM0_3743_0000	1.00	1.00	1.00
N24005WM0_3744_0000	1.00	1.00	1.00
N24005WM0_3745_0000	0.80	0.93	1.00
N24005WM0_3881_3880	0.00	0.00	0.00
N24005WM0_3964_0000	1.00	1.00	1.00
N24005WM0_3965_0000	1.00	1.00	1.00
N24005WM1_3660_3910	0.46	0.55	0.38
N24005WM1_3910_0001	0.54	0.54	0.32
N24005WM3_3880_4060	0.54	0.37	0.22
N24005WM3_4060_0001	0.63	0.40	0.21

Land River Segment	TN	TP	TSS
N24005WU0_3021_3020	0.14	0.15	0.00
N24005WU0_3540_0000	1.00	1.00	1.00
N24005WU0_3541_0000	1.00	1.00	1.00
N24005WU0_3542_0000	1.00	1.00	1.00
N24005WU0_3670_0001	0.28	0.49	0.34
N24005WU0_3671_0000	0.91	0.80	0.48
N24005WU0_3820_0000	1.00	1.00	1.00
N24005WU0_3821_0000	1.00	1.00	1.00
N24005WU1_3350_3490	0.31	0.38	0.06
N24005WU1_3482_0001	0.70	0.51	0.35
N24005WU1_3490_3480	0.31	0.37	0.06
N24005WU2_3020_3320	0.39	0.34	0.06
N24005WU2_3320_3480	0.41	0.41	0.07
N24005WU3_3480_3481	0.44	0.39	0.06
N24005WU3_3481_0001	0.81	0.59	0.22
Calvert County			
N24009WL0_4772_0000	0.90	1.00	1.00
N24009WL0_4920_0000	1.00	1.00	1.00
N24009WL0_4921_0000	1.00	1.00	1.00
N24009WL0_4922_0000	1.00	1.00	1.00
N24009WL0_4923_0000	1.00	1.00	1.00
N24009WL0_4925_0000	1.00	1.00	1.00
N24009XL0_4954_0000	0.82	0.93	1.00
N24009XL0_5320_0001	0.76	0.51	0.31
N24009XL0_5341_0000	0.87	0.73	0.31
N24009XL0_5342_0000	0.80	0.52	0.37
N24009XL0_5343_0000	1.00	1.00	1.00
N24009XL0_5345_0000	1.00	1.00	1.00
N24009XL0_5346_0000	1.00	1.00	1.00
N24009XL0_5348_0000	1.00	1.00	1.00
N24009XL0_5350_0000	0.80	0.61	0.37
N24009XL3_4713_0000	0.84	0.70	0.43
N24009XL3_4950_0000	0.78	0.67	0.43
N24009XL3_4951_0000	0.79	0.63	0.37
N24009XL3_4952_0000	0.88	0.80	0.36
Caroline County			
N24011EL0_4591_0000	0.90	0.78	0.18
N24011EL2_4590_0001	0.47	0.80	0.08
N24011EL2_4630_0000	0.83	0.78	0.22
N24011EM0_4322_0000	0.92	0.88	0.36

Land River Segment	TN	TP	TSS
N24011EM0_4323_0000	0.85	0.76	0.31
N24011EM0_4324_0000	0.90	0.74	0.15
N24011EM0_4327_0000	0.82	0.68	0.15
N24011EM2_3980_0001	0.43	0.65	0.11
N24011EM2_4100_0001	0.48	0.79	0.15
N24011EM2_4101_0000	0.91	0.80	0.29
N24011EM3_4320_0000	0.88	0.73	0.18
N24011EM3_4321_0000	0.92	0.76	0.24
N24011EM3_4325_0000	0.91	0.79	0.22
N24011EM4_4740_0000	1.00	1.00	1.00
Carroll County			
N24013PM1_3120_3400	0.73	0.61	0.61
N24013PM1_3450_3400	0.74	0.66	0.64
N24013PM1_3711_3710	0.55	0.28	0.22
N24013PM2_2860_3040	0.74	0.70	0.52
N24013PM2_3400_3340	0.86	0.85	1.00
N24013PM3_3040_3340	0.66	0.61	0.47
N24013SL0_2831_2830	0.18	0.45	0.13
N24013SL3_2460_2430	0.33	0.17	0.14
N24013WM0_3881_3880	0.00	0.00	0.00
N24013WM1_3882_3880	0.46	0.38	0.23
N24013WM3_3880_4060	0.62	0.58	0.47
N24013WU0_3021_3020	0.14	0.17	0.00
N24013WU1_3350_3490	0.32	0.52	0.09
Cecil County			
N24015EU0_2940_0000	0.89	1.00	1.00
N24015EU0_2941_0000	0.87	0.73	0.84
N24015EU0_2985_0000	0.79	0.46	0.22
N24015EU0_3010_0000	0.94	1.00	1.00
N24015EU0_3050_0000	1.00	1.00	1.00
N24015EU0_3130_0000	1.00	1.00	1.00
N24015EU0_3131_0000	1.00	1.00	1.00
N24015EU0_3200_0000	0.90	0.82	0.48
N24015EU0_3201_0000	0.92	0.81	0.39
N24015EU0_3202_0000	1.00	1.00	1.00
N24015EU0_3203_0000	1.00	1.00	1.00
N24015EU0_3300_0000	0.80	1.00	1.00
N24015EU0_3301_0000	1.00	1.00	1.00
N24015EU0_3302_0000	1.00	1.00	1.00
N24015EU0_3360_0000	1.00	1.00	1.00

Land River Segment	TN	TP	TSS
N24015EU0_3361_0000	0.90	0.79	0.35
N24015EU0_3362_0000	1.00	1.00	1.00
N24015EU0_3363_0000	1.00	1.00	1.00
N24015EU0_3364_0000	1.00	1.00	1.00
N24015EU1_2650_0001	1.00	0.97	0.77
N24015EU1_2810_0001	0.86	1.00	0.56
N24015EU1_2980_0000	0.79	0.61	0.36
N24015EU1_2981_0000	0.80	0.59	0.35
N24015EU1_2982_0000	0.91	0.84	0.35
N24015EU1_2983_0000	0.88	0.72	0.34
N24015EU1_2984_0000	1.00	1.00	1.00
N24015SL2_2480_0001	0.86	0.71	0.43
N24015SL9_2720_0001	0.79	0.45	0.26
N24015SL9_2970_0000	1.00	1.00	1.00
N24015SL9_2971_0000	0.93	0.69	0.46
Charles County			
N24017PL0_5290_0000	1.00	1.00	1.00
N24017PL0_5390_0000	1.00	1.00	1.00
N24017PL0_5391_0000	1.00	1.00	1.00
N24017PL0_5392_0000	1.00	1.00	1.00
N24017PL0_5440_0000	0.75	0.58	0.24
N24017PL0_5450_0000	0.67	0.42	0.15
N24017PL0_5510_0001	0.47	0.49	0.25
N24017PL0_5530_5710	0.77	0.63	0.30
N24017PL0_5580_0000	1.00	1.00	1.00
N24017PL0_5581_0000	1.00	1.00	1.00
N24017PL0_5582_0000	0.66	0.43	0.16
N24017PL0_5583_0000	0.73	0.50	0.21
N24017PL0_5584_0000	1.00	1.00	1.00
N24017PL0_5585_0000	0.90	1.00	1.00
N24017PL0_5670_0000	1.00	1.00	1.00
N24017PL0_5671_0000	1.00	1.00	1.00
N24017PL0_5710_0001	0.81	0.61	0.18
N24017PL0_5720_0001	0.46	0.35	0.10
N24017PL0_5790_0000	1.00	1.00	1.00
N24017PL0_5791_0000	1.00	1.00	1.00
N24017PL0_5860_0000	1.00	1.00	1.00
N24017PL0_5930_0000	1.00	1.00	1.00
N24017PL1_5230_0001	0.50	0.70	0.63
N24017PL2_5300_5630	0.57	0.59	0.60

Land River Segment	TN	TP	TSS
N24017PL2_5630_0001	0.67	0.43	0.37
N24017PL2_5800_0000	0.80	0.57	0.25
N24017XL0_5340_0000	0.78	0.58	0.34
Dorchester County			
N24019EL0_4591_0000	0.92	0.77	0.17
N24019EL0_4592_0000	0.82	0.65	0.14
N24019EL0_4593_0000	0.91	0.86	0.32
N24019EL0_4598_0000	1.00	1.00	1.00
N24019EL0_4892_0000	1.00	1.00	1.00
N24019EL0_5151_0000	0.62	0.52	0.11
N24019EL0_5262_0000	1.00	1.00	0.83
N24019EL0_5280_0000	0.84	0.81	0.47
N24019EL0_5281_0000	0.96	1.00	1.00
N24019EL0_5282_0000	1.00	1.00	1.00
N24019EL0_5283_0000	1.00	1.00	1.00
N24019EL0_5284_0000	1.00	1.00	1.00
N24019EL0_5285_0000	1.00	1.00	1.00
N24019EL0_5590_0000	1.00	1.00	1.00
N24019EL0_5766_0000	1.00	1.00	1.00
N24019EL0_5890_0000	1.00	1.00	1.00
N24019EL1_5150_0001	0.58	0.84	0.26
N24019EL2_4630_0000	0.87	0.83	0.39
N24019EL2_4634_0000	0.84	0.62	0.09
N24019EM0_4322_0000	0.93	0.89	0.54
N24019EM0_4880_0000	1.00	1.00	1.00
N24019EM0_4881_0000	1.00	1.00	1.00
N24019EM0_4883_0000	1.00	1.00	1.00
N24019EM0_4884_0000	1.00	1.00	1.00
N24019EM0_4885_0000	1.00	1.00	1.00
N24019EM0_4886_0000	0.74	0.55	0.05
N24019EM0_4887_0000	1.00	1.00	1.00
N24019EM0_4888_0000	1.00	1.00	1.00
N24019EM0_4889_0000	1.00	1.00	1.00
N24019EM0_4890_0000	0.98	1.00	1.00
N24019EM0_4891_0000	1.00	1.00	1.00
N24019EM0_5260_0000	1.00	1.00	1.00
N24019EM0_5261_0000	1.00	1.00	1.00
N24019EM0_5263_0000	1.00	1.00	1.00
Frederick County			
H24021PM1_3510_4000	0.65	0.57	0.51

Land River Segment	TN	TP	TSS
H24021PM3_3040_3340	0.55	0.50	0.49
H24021PM4_3340_3341	0.55	0.36	0.31
N24021PM1_3450_3400	0.72	0.60	0.65
N24021PM1_3510_4000	0.66	0.62	0.56
N24021PM1_3710_4040	0.77	0.55	0.47
N24021PM1_3711_3710	0.63	0.31	0.24
N24021PM1_4000_4290	0.77	0.66	0.54
N24021PM2_2860_3040	0.81	0.85	1.00
N24021PM2_3400_3340	0.86	0.85	1.00
N24021PM3_3040_3340	0.68	0.63	0.46
N24021PM4_3340_3341	0.73	0.62	0.44
N24021PM4_3341_4040	0.76	0.68	0.49
N24021PM4_4040_4410	0.75	0.54	0.48
N24021PM7_4150_4290	0.86	0.62	0.45
N24021PM7_4200_4410	0.80	0.59	0.43
N24021PM7_4290_4200	0.92	0.69	0.67
N24021PM7_4410_4620	0.74	0.52	0.45
Garrett County			
H24023PU2_4720_4750	0.80	0.56	0.08
H24023PU3_4451_4450	0.77	0.61	0.08
N24023PU1_3850_4190	0.67	0.32	0.04
N24023PU1_3940_3970	0.53	0.47	0.57
N24023PU1_4190_4300	0.69	0.27	0.03
N24023PU1_4300_4440	0.77	0.54	0.68
N24023PU2_4720_4750	0.84	0.65	0.08
N24023PU2_4750_4451	0.87	0.69	0.10
N24023PU3_4450_4440	0.78	0.51	0.61
N24023PU3_4451_4450	0.77	0.51	0.08
Harford County			
N24025SL0_2721_2720	0.73	0.43	0.37
N24025SL2_2750_2720	0.77	0.57	0.48
N24025SL2_2910_3060	0.93	0.67	0.32
N24025SL2_3060_0001	0.94	0.76	0.34
N24025SL9_2720_0001	0.79	0.48	0.31
N24025SL9_2970_0000	1.00	1.00	1.00
N24025SL9_2971_0000	1.00	0.99	0.83
N24025WU0_3160_0000	0.72	0.58	0.12
N24025WU0_3161_0000	0.94	1.00	1.00
N24025WU0_3162_0000	1.00	1.00	1.00
N24025WU0_3163_0000	0.88	1.00	1.00

Land River Segment	TN	TP	TSS
N24025WU0_3164_0000	1.00	1.00	1.00
N24025WU0_3250_0001	0.55	0.59	0.40
N24025WU0_3251_0000	1.00	1.00	1.00
N24025WU0_3252_0000	1.00	1.00	1.00
N24025WU0_3253_0000	0.84	0.69	0.45
N24025WU0_3254_0000	0.92	0.88	0.69
N24025WU0_3255_0000	1.00	1.00	1.00
N24025WU0_3540_0000	1.00	1.00	1.00
N24025WU1_3240_3331	0.76	0.47	0.24
N24025WU1_3330_0001	0.81	0.44	0.18
N24025WU1_3331_3330	0.82	0.47	0.22
N24025WU1_3482_0001	0.71	0.57	0.32
N24025WU2_3020_3320	0.39	0.40	0.07
Howard County			
N24027WM1_3882_3880	0.51	0.35	0.23
N24027WM3_3880_4060	0.55	0.39	0.26
N24027WM3_4060_0001	0.60	0.35	0.22
N24027XU0_4090_4270	0.73	0.69	0.35
N24027XU0_4091_4270	0.71	0.72	0.39
N24027XU0_4092_4090	0.19	0.59	0.10
N24027XU0_4130_4070	0.12	0.14	0.01
N24027XU2_4070_4330	0.14	0.15	0.01
N24027XU2_4270_4650	0.75	0.91	0.40
N24027XU2_4330_4480	0.30	0.29	0.05
N24027XU2_4480_4650	0.77	0.80	0.43
Kent County			
N24029EU0_3360_0000	1.00	1.00	1.00
N24029EU0_3361_0000	0.86	0.70	0.24
N24029EU0_3362_0000	0.92	0.95	0.79
N24029EU0_3363_0000	1.00	1.00	1.00
N24029EU0_3570_0000	1.00	1.00	1.00
N24029EU0_3571_0000	1.00	1.00	1.00
N24029EU0_3572_0000	0.86	0.75	0.36
N24029EU0_3573_0000	1.00	1.00	1.00
N24029EU0_3700_0000	1.00	1.00	1.00
N24029EU0_3720_0000	0.90	0.83	0.47
N24029EU0_3724_0000	0.86	0.77	0.41
N24029EU0_3725_0000	0.87	0.78	0.40
N24029EU0_3726_0001	0.42	0.56	0.22
N24029EU0_4010_0000	0.88	0.83	0.40

Land River Segment	TN	TP	TSS
N24029EU0_4011_0000	1.00	1.00	1.00
N24029EU0_4012_0000	0.92	0.83	0.45
N24029EU0_4013_0000	1.00	1.00	1.00
N24029EU0_4014_0000	1.00	1.00	1.00
N24029EU0_4015_0000	1.00	1.00	1.00
N24029EU0_4016_0000	1.00	1.00	1.00
N24029EU0_4120_0000	1.00	1.00	1.00
N24029EU0_4122_0000	1.00	1.00	1.00
N24029EU0_4123_0000	1.00	1.00	1.00
N24029EU0_4125_0000	1.00	1.00	1.00
N24029EU2_3520_0001	0.52	0.79	0.25
Montgomery County			
N24031PL0_4510_0001	0.68	0.89	0.67
N24031PL1_4460_4780	0.66	0.62	0.36
N24031PL1_4540_0001	0.84	0.92	1.00
N24031PL1_4780_0001	0.91	0.92	0.82
N24031PM0_4640_4820	0.17	0.58	0.51
N24031PM1_4250_4500	0.75	0.59	0.47
N24031PM1_4251_4250	0.68	0.12	0.13
N24031PM1_4252_4250	0.67	0.17	0.11
N24031PM1_4500_4580	0.75	0.60	0.44
N24031PM4_4040_4410	0.65	0.36	0.44
N24031PM7_4410_4620	0.79	0.60	0.44
N24031PM7_4580_4820	0.77	0.50	0.47
N24031PM7_4620_4580	0.74	0.53	0.23
N24031PM7_4820_0001	0.87	0.70	0.53
N24031XU0_4130_4070	0.12	0.14	0.01
N24031XU2_4070_4330	0.15	0.16	0.01
N24031XU2_4330_4480	0.27	0.24	0.04
Prince George's County			
N24033PL0_4510_0001	0.71	1.00	0.68
N24033PL0_4961_0000	0.80	0.69	0.47
N24033PL0_5070_0001	0.67	0.58	0.27
N24033PL0_5290_0000	0.88	1.00	1.00
N24033PL0_5390_0000	0.88	0.70	0.14
N24033PL1_4540_0001	0.82	1.00	0.85
N24033PL1_5060_0000	0.74	0.58	0.33
N24033PL1_5061_0000	1.00	1.00	1.00
N24033PL1_5230_0001	0.52	0.74	0.51
N24033PL2_4810_0000	0.80	0.70	0.44

Land River Segment	TN	TP	TSS
N24033PL2_4811_0000	0.93	0.83	0.55
N24033PL2_5300_5630	0.55	0.53	0.32
N24033PL7_4960_0000	0.89	0.84	0.46
N24033PL7_4980_0000	1.00	1.00	1.00
N24033XL0_5340_0000	0.79	0.59	0.31
N24033XL1_4690_0001	0.40	0.70	0.39
N24033XL1_4691_0000	0.83	0.80	0.36
N24033XL3_4710_0000	0.83	0.67	0.41
N24033XL3_4711_0000	0.90	0.77	0.43
N24033XL3_4712_0000	0.87	0.62	0.40
N24033XL3_4713_0000	0.76	0.58	0.33
N24033XL3_4950_0000	0.81	0.64	0.38
N24033XL3_4951_0000	0.79	0.56	0.32
N24033XL3_4952_0000	0.91	0.71	0.53
N24033XU2_4330_4480	0.32	0.38	0.07
N24033XU2_4480_4650	0.74	0.84	0.28
N24033XU3_4650_0001	0.84	0.79	0.35
Queen Anne’s County			
N24035EM2_3980_0001	0.41	0.60	0.11
N24035EM2_4100_0001	0.45	0.69	0.15
N24035EM2_4101_0000	0.87	0.74	0.32
N24035EU0_3700_0000	1.00	1.00	1.00
N24035EU0_3720_0000	0.93	0.73	0.23
N24035EU0_3721_0000	0.80	0.68	0.26
N24035EU0_3722_0000	0.83	0.68	0.22
N24035EU0_3830_0001	0.69	0.89	0.51
N24035EU0_4030_0000	0.89	0.88	0.56
N24035EU0_4120_0000	1.00	1.00	1.00
N24035EU0_4121_0000	1.00	1.00	1.00
N24035EU0_4122_0000	1.00	1.00	1.00
N24035EU0_4124_0000	1.00	1.00	1.00
N24035EU0_4260_0000	0.88	0.78	0.32
N24035EU0_4470_0000	0.84	0.72	0.30
N24035EU0_4471_0000	1.00	1.00	1.00
N24035EU0_4472_0000	0.89	0.78	0.34
N24035EU0_4473_0000	1.00	1.00	1.00
N24035EU0_4474_0000	1.00	1.00	1.00
N24035EU0_4475_0000	0.85	0.84	0.66
N24035EU0_4490_0000	1.00	1.00	1.00
N24035EU0_4491_0000	1.00	1.00	1.00

Land River Segment	TN	TP	TSS
N24035EU0_4610_0000	1.00	1.00	1.00
N24035EU0_4872_0000	1.00	1.00	1.00
N24035EU2_3520_0001	0.55	0.74	0.13
Somerset County			
N24039EL0_5761_0000	1.00	1.00	1.00
N24039EL0_5762_0000	0.85	0.68	0.15
N24039EL0_5763_0000	0.90	0.92	0.77
N24039EL0_5765_0000	1.00	1.00	1.00
N24039EL0_5890_0000	1.00	1.00	1.00
N24039EL0_5891_0000	1.00	1.00	1.00
N24039EL0_5892_0000	1.00	1.00	1.00
N24039EL0_5893_0000	1.00	1.00	1.00
N24039EL0_5894_0000	1.00	1.00	1.00
N24039EL0_6001_0000	0.79	0.70	0.23
N24039EL0_6002_0000	0.80	0.76	0.41
N24039EL0_6003_0000	0.98	1.00	1.00
N24039EL0_6004_0000	1.00	0.97	1.00
N24039EL0_6010_0000	0.93	0.97	1.00
N24039EL0_6011_0000	1.00	1.00	1.00
N24039EL1_5570_0001	0.50	0.85	0.36
N24039EL1_6000_0001	0.46	0.68	0.12
N24039EL3_5970_0000	0.91	0.83	0.34
N24039EL3_5971_0000	0.90	0.91	0.76
N24039EL3_5974_0000	0.94	1.00	1.00
St. Mary's County			
N24037PL0_5510_0001	0.44	0.55	0.33
N24037PL0_5670_0000	1.00	1.00	1.00
N24037PL0_5671_0000	0.77	0.50	0.33
N24037PL0_5672_0000	0.78	0.58	0.33
N24037PL0_5750_0001	0.56	0.57	0.39
N24037PL0_5830_0001	0.52	0.47	0.28
N24037PL0_5950_0000	0.97	1.00	1.00
N24037PL0_5951_0000	1.00	1.00	1.00
N24037PL0_5952_0000	0.80	0.59	0.23
N24037PL0_5960_0000	1.00	1.00	1.00
N24037PL0_5961_0000	0.79	0.54	0.28
N24037PL0_5962_0000	0.83	0.61	0.36
N24037PL0_5980_0000	1.00	1.00	1.00
N24037PL0_5981_0000	0.81	0.58	0.29
N24037PL0_5982_0000	1.00	1.00	1.00

Land River Segment	TN	TP	TSS
N24037PL0_5983_0000	1.00	1.00	1.00
N24037PL0_6020_0000	1.00	1.00	1.00
N24037PL0_6060_0000	1.00	1.00	1.00
N24037PL0_6110_0000	1.00	1.00	1.00
N24037PL1_5910_0001	0.69	1.00	0.82
N24037WL0_4924_0000	1.00	1.00	1.00
N24037WL0_5880_0000	1.00	1.00	1.00
N24037WL0_5881_0000	1.00	1.00	1.00
N24037XL0_4953_0000	0.86	0.68	0.40
N24037XL0_4955_0000	0.94	1.00	1.00
N24037XL0_4956_0000	1.00	1.00	1.00
N24037XL0_5340_0000	0.84	0.78	0.69
N24037XL0_5344_0000	1.00	1.00	1.00
N24037XL0_5347_0000	1.00	1.00	1.00
N24037XL0_5349_0000	1.00	1.00	1.00
Talbot County			
N24041EM0_4324_0000	0.81	0.70	0.33
N24041EM0_4551_0000	1.00	1.00	1.00
N24041EM0_4870_0000	1.00	1.00	1.00
N24041EM0_4871_0000	1.00	1.00	1.00
N24041EM0_4874_0000	1.00	1.00	1.00
N24041EM0_4875_0000	1.00	1.00	1.00
N24041EM0_4876_0000	1.00	1.00	1.00
N24041EM0_4882_0000	1.00	1.00	1.00
N24041EM2_4101_0000	0.90	0.78	0.33
N24041EM4_4740_0000	1.00	1.00	1.00
N24041EU0_4470_0000	0.92	0.81	0.44
N24041EU0_4474_0000	1.00	1.00	1.00
N24041EU0_4475_0000	0.90	0.75	0.31
N24041EU0_4550_0000	1.00	1.00	1.00
N24041EU0_4700_0000	0.93	0.98	0.70
N24041EU0_4873_0000	1.00	1.00	1.00
Washington County			
N24043PM7_4150_4290	0.87	0.59	0.64
N24043PU0_3000_3090	0.83	0.69	0.67
N24043PU0_3601_3602	0.92	0.62	0.51
N24043PU0_3611_3530	0.84	0.42	0.46
N24043PU0_3751_3752	0.83	0.65	0.59
N24043PU1_3030_3440	1.00	0.85	1.00
N24043PU1_3100_3690	0.64	0.39	0.42

Land River Segment	TN	TP	TSS
N24043PU2_2840_3080	0.87	0.50	0.46
N24043PU2_3080_3640	0.87	0.46	0.42
N24043PU2_3090_4050	0.86	0.68	0.60
N24043PU2_4050_4180	0.94	0.62	0.58
N24043PU3_2510_3290	0.57	0.09	0.33
N24043PU3_3290_3390	1.00	0.82	0.93
N24043PU3_3390_3730	0.92	0.66	0.55
N24043PU6_3440_3590	0.88	0.50	0.42
N24043PU6_3530_3440	0.84	0.44	0.46
N24043PU6_3590_3640	0.91	0.51	0.47
N24043PU6_3600_3602	0.94	0.62	0.49
N24043PU6_3602_3730	1.00	0.76	0.76
N24043PU6_3610_3530	0.95	0.66	0.76
N24043PU6_3640_3600	0.95	0.62	0.48
N24043PU6_3690_3610	0.75	0.27	0.24
N24043PU6_3730_3750	1.00	0.80	0.68
N24043PU6_3750_3752	1.00	0.79	0.82
N24043PU6_3752_4080	1.00	0.79	0.84
N24043PU6_4080_4180	1.00	0.78	0.79
N24043PU6_4180_4150	0.95	0.57	0.51
Wicomico County			
N24045EL0_4593_0000	0.88	0.67	0.08
N24045EL0_4594_0000	0.76	0.68	0.20
N24045EL0_4595_0000	0.86	0.76	0.24
N24045EL0_4596_0000	0.97	1.00	1.00
N24045EL0_4597_0000	0.90	0.68	0.10
N24045EL0_4598_0000	1.00	1.00	1.00
N24045EL0_4633_0000	0.62	0.49	0.09
N24045EL0_5040_0000	0.82	0.73	0.20
N24045EL0_5400_0001	0.38	0.59	0.10
N24045EL0_5760_0000	0.91	0.87	0.30
N24045EL0_5761_0000	0.99	1.00	1.00
N24045EL0_5762_0000	0.85	0.74	0.19
N24045EL0_5764_0000	1.00	1.00	1.00
N24045EL0_5767_0001	0.61	0.69	0.29
N24045EL1_5430_0001	0.50	0.93	0.27
N24045EL1_5570_0001	0.47	0.85	0.16
N24045EL2_4630_0000	0.97	0.97	0.96
N24045EL2_4634_0000	1.00	1.00	1.00
N24045EL2_5110_5270	0.28	0.71	0.13

Land River Segment	TN	TP	TSS
N24045EL2_5270_0001	0.45	0.75	0.16
N24045EL2_5272_5270	0.30	0.65	0.08
Worcester County			
N24047EL0_5271_0000	0.97	0.94	0.59
N24047EL1_5430_0001	0.53	0.84	0.17
N24047EL1_5570_0001	0.47	0.72	0.21
N24047EL1_5660_0000	0.88	0.70	0.20
N24047EL2_5110_5270	0.31	0.83	0.22
N24047EL2_5270_0001	0.47	0.75	0.16
N24047EL3_5870_0000	0.88	0.73	0.23
N24047EL3_5970_0000	0.95	0.94	0.44
N24047EL3_5971_0000	0.98	0.96	0.59
N24047EL3_5972_0000	0.70	0.59	0.15

Appendix M: Definitions

Advanced Street Sweeping	Either Regenerative-Air Sweepers (i.e., equipped with a sweeping head which creates suction and uses forced air to transfer street debris into the hopper) or Vacuum Assisted Sweepers (i.e., equipped with a high power vacuum to suction debris from street surface) (Source: 2016 Street Sweeping Report)
Agencies	Classification scheme used to further refine Load Sources in the Phase 6 Chesapeake Bay Watershed Model (Phase 6 Model) that generally correspond to source ownership.
Aggregate Impervious Land Cover	Phase 6 Model land cover consisting of impervious road and impervious non-road
Conservation Landscaping	Land cover conversion from pervious to a meadow condition
Edge-of-Tide (EOT) Loads	Pollutant loads to the tidal Chesapeake Bay
Edge-of-Stream (EOS) Loads	Phase 6 Model pollutant loads to smaller, headwater streams, as defined by the National Hydrography Plus Dataset
Equivalent Impervious Acre (EIA) Credit	Credit associated with alternative practices that result in pollutant load reductions but are not directly associated with impervious area draining to them (e.g., street sweeping, stream restoration). The credit is based on the amount of total nitrogen, total phosphorus, and total suspended sediment reductions achieved
Floating Treatment Wetlands	Buoyant rafts of wetland vegetation that are planted in growing media and whose roots extend below the water's surface of a stormwater management pond
Forest Planting	The conversion of pervious (turf) to a forested land cover greater than 0.5 acre (a survival rate of 100 trees planted per acre; at least 50% of trees have 2 inch diameter or greater 4.5 feet above ground)
Green Stormwater Infrastructure Credit	Additional impervious acre treatment credit for a best management practice (BMP) that provides water quality treatment and incorporates natural processes using vegetation and soils
Grey Infrastructure	Infrastructure designed to move urban stormwater away from the built environment and includes curbs, gutters, drains, piping, and collection systems (Source: EPA)
Illicit Discharge	Any non-stormwater discharge of pollutants to a municipal separate storm sewer system (MS4), except for discharges resulting from firefighting activities and other authorized non-stormwater discharges specified in the NPDES permits (Source: Chesapeake Bay Program)

Land Cover	Subset of Phase 6 Model Load Sources representative of ground cover conditions
Load Source	Unique sources of nitrogen, phosphorus, and sediment loads to the Chesapeake Bay that are explicitly simulated by the Phase 6 Model. Example sources include impervious roads, turf, and forest
Mechanical Street Sweeping	Mechanical Broom Sweepers that are equipped with water tanks, sprayers, brooms, and a vacuum system pump that gathers street debris (Source: 2016 Street Sweeping Report)
No Action Scenario	Phase 6 Model scenario that does not include the simulated effects of best management practices
Pollutant Removal Efficiencies	The effectiveness of a BMP at reducing nitrogen, phosphorus, and sediment loads, generally represented as a percentage
Riparian Conservation Landscaping	Grassland buffers that help filter nutrients, sediments, and other pollutants from runoff as well as remove nutrients from groundwater. These are buffers converted from managed turf land cover to a meadow use
Riparian Forest Buffers	Linear wooded areas that help filter nutrients, sediments, and other pollutants from runoff as well as remove nutrients from groundwater
Riparian Land Cover Conversion	Forest planting and conservation landscaping practices that occur within 100 feet of a perennial stream.
Runoff Reduction (RR) Adjustor Curve	Nitrogen, phosphorus, and sediment removal rates for BMPs in Chapter 5 of the Design Manual based on the amount of runoff they treat and the degree of runoff reduction they provide
Segment Delivery Factor	The proportion of sediment transported from an upland area or headwater stream to a mainstem segment
Soil Restoration	The process of enhancing the porosity of soils compacted by human activity in urban areas by excavating or tilling compacted soils and amending the tilled soils, typically with compost
Stormwater Treatment (ST) Adjustor Curve	Nitrogen, phosphorus, and sediment removal rates for BMPs in Chapter 3 of the Design Manual based on the amount of runoff they treat and the degree of runoff reduction they provide
Stream	A channel with perennial flow
Stream Bed and Bank Load	A linear Phase 6 Model Load Source. This Load Source provides an estimate of the nitrogen, phosphorus, and sediment loads from the bed and banks of a channel with perennial flow

Street Trees	Any tree planting that occurs over an impervious surface (e.g., trees planted in sidewalk boxes on a roadside curb)
Terrestrial Load	Pollutant load associated with actual watershed area draining to a given waterbody and does not include any in-stream contributions
Total Urban Load	The summation of impervious and turf loads in the Phase 6 Model
True Forest Land Cover	Statewide average forest cover
Upland Best Management Practice	Stormwater BMPs that meet the water quality criteria and design standards in the 2000 Stormwater Design Manual. Upland BMPs include structural practices, nonstructural practices, and alternative surfaces
Urban Tree Canopy	The conversion of turf to tree canopy over turf
Water Quality Treatment Volume (WQ_T)	Rainfall depth treated in restoration practices
Watershed Management Credit	Additional impervious acre treatment credit for providing greater storage volume for a rainfall depth between 1.0 inch and 3.0 inches to address resiliency from changing weather patterns

Appendix N: Revisions Made Since June 2020

The following changes have been made since the June 2020 version of the Accounting Guidance.

Reference	Revision
pgs. 2, 12, 59	Street Sweeping: Corrected frequency to align with expert panel: Revised "Fall 1 pass/1-2 weeks else monthly" to "Spring and Fall 1 pass/1-2 weeks else monthly" in Table 1, Table 6 and Appendix F
pg. 2	Land Cover Conversion: corrected EIA_f unit to "converted" for consistency in Table 1
pgs. 7-9	Section IV language was revised to focus on the general load reduction formula instead of what is required for Chesapeake Bay TMDL accounting. Reference to technical resources for stormwater WLA implementation plans on the Maryland TMDL Data Center website was added. Information related to pollutant reduction calculators associated with the Water Quality Trading Program was moved to Section VII
pg. 11	Street Sweeping: Removed language restricting credit for sweeping impervious area without curb and gutter to be consistent with credit eligibility defined by the expert panel report
pg. 12	Street Sweeping: Added footnote defining the spring and fall seasons in Table 6
pgs. 14, 97	Forest Planting: Revised minimum acre requirement from 1 to 0.5 acre
pgs. 14-15, 97-98	Conservation Landscaping (including riparian): Deleted unmanaged, unfertilized, and unmowed to clarify that a minimal level of management may be necessary to maintain a meadow condition
pg. 20	Septic Connections: Corrected sentence that explains the basis of the septic connection EIA credit: "The EIA credit for septic connection to an Enhanced Nutrient Removal (ENR) WWTP is based on the ratio between the septic denitrification and septic connection load reductions determined in the Maryland Phase III WIP."
pg. 21	Shoreline Management: Corrected the reference to the most recently revised expert panel report (2019)
pg. 22	Stream Restoration: Revised references reflecting the final approval of *Consensus Recommendations for Improving the Application of the Prevented Sediment Protocol for Urban Stream Restoration Projects Built for Pollutant Removal Credit* and *Consensus Recommendations to Improve Protocols 2 and 3 for Defining Stream Restoration Pollutant Removal Credits* approved by the Chesapeake Bay Program in 2020
pgs. 23-26	Elimination of Discovered Nutrient Discharges from Grey Infrastructure: Corrected the methodology to calculate the maximum EIA credit to reflect an annual load (Table 18, Equation 7, and Equation 8) and revised language to reflect this correction; added language to clarify that the maximum EIA credit is the maximum sum total EIA that can be claimed at any given time regardless of year or permit term; corrected calculated values in Table 18; made minor revision to reporting requirements
pg. 34	Water Quality Trading: Added reference to online technical resources available to estimate pollutant load reductions for urban stormwater management practices intended for sale on the nutrient trading market. Updated "county boundaries" to "jurisdictional boundaries"
pgs. 39-42	References: Added web links to referenced documents, corrected some author citations, updated references of documents that were revised and/or approved since June 2020, and added references
pg. 49	Appendix B: Corrected "load" to "load reduction" in step 7 of the EOT TN load reduction calculation and steps 5 and 8 of the wet pond example

pg. 53	Appendix C: Corrected septic connection efficiency from 50% to 73% and revised footnote to state that the efficiency is based on the Phase III WIP values
pg. 59	Appendix F: Added reference to BMP calculators available online to estimate EIAs; updated “Mile Swept” to “Lane Mile Swept”
pg. 60	Appendix F: Revised note to clarify that storm drain cleaning EIA credit is the average amount of material collected over the 5 year permit term
pg. 69	Appendix H: Added citations for *Consensus Recommendations for Improving the Application of the Prevented Sediment Protocol for Urban Stream Restoration Projects Built for Pollutant Removal Credit* and *Consensus Recommendations to Improve Protocols 2 and 3 for Defining Stream Restoration Pollutant Removal Credits* to the minimum qualifying conditions for stream restorations. Removed specific criteria for Protocol 3 under bullet 3 to generally refer to the expert panel reports for additional protocol-specific criteria
pg. 78	Appendix J: Deleted BMP Code SPSC. Stormwater Step Pool Conveyance System is a design type used for stream restorations; these practices will use the code STRE. Updated Catch Basin Cleaning description to note that it is credited as Storm Drain Cleaning