TECHNO-GRAM
004-2023

SUBJECT: Pollutant Loading Calculations

PURPOSE: The purpose of this Techno-gram is to establish procedures for submitting pollutant loading for stormwater management best management practices (BMPs).

SCOPE: This Techno-gram establishes a new As-built Plan submittal requirement for BMPs.

Effective immediately, the Department of Permitting, Inspections and Enforcement (DPIE) will require submittal of pollutant loading calculation information for each BMP. This information shall be submitted with all As-built Plans. The attached form shall be filled out by the Design Engineer, one form for each BMP.

This information is required to enable Prince George's County to capture new and redevelopment BMP load reduction information required by the Maryland Department of the Environment (MDE). The first page of the form is intended to be filled out by the As-built Engineer of record.

The second page has two sections to be filled out by the County.

- DPIE (GIS) to confirm the data/BMP features have been digitized.
- The Department of the Environment (DoE) to adjust the loads for Land River Segments (edge of stream or edge of tide).

The remaining pages are for information only, to provide supporting methodology information and Pollutant Loading Reduction Calculator for calculating the BMP reduction loads using the MDE design manual.

APPROVED BY:

Dawit Abraham

Dawit Abraham,P.E. Acting Director

August 3, 2023

PRINCE GEORGE'S COUNTY
DEPARTMENT OF PERMITS, INSPECTION , AND ENFORCEMENT
Stormwater Pollutant Load Calculator

Note: *Blue Color Cells Need to be Filled* , green cells are calculated values. **Jan-23**

THIS SECTION IS TO BE COMPLETED BY THE DESIGN ENGINEER

DPIE Permit #:	123	**Project Name:**	123		
Site Address:	123	**City:**		**State/ZIP:**	123	**123**
BMP Type:	Enhanced Filters - RR	**Practice Type:**	Runoff Reduction	**BMP ID:**	12

CONTRIBUTING AREA DRAINING TO THE BMP

Drainage Area to BMP (A)	Impervious Cover Treated (I)		Maintenance Area Responsibility	
UNITS: Acres	**Percent Treated**	**Area Treated in Acres**	**Private or Public**	
0.45	77.8	0.3501	Private	

REQUIRED WATER QUALITY VOLUME (ESD_V)

Woods in Good Condition Target Rainfall PE (inches) based on Ref. 2	Runoff depth Co-eff. RV = 0.05 + 0.009 (I) Impervious (I) is in % (See Ref. 1)	Runoff Volume $ESD_{V(required)}$ (acre-feet) =(PE) x (RV) x (A) / 12 (See Ref. 1)
1.80	0.75	0.05

DESIGN RAINFALL CALCULATIONS (P_{design})

Provided Water Quality Volume $ESD_{V(design)}$ (acre-feet) based on Design Calculation*	Design Rainfall P_{design} (inches) = $ESD_{V(design)}$ x 12 / [(RV) x (A)]
0.040	1.42

RAINFALL DEPTH TREATED PER IMPERVIOUS ACRES

Runoff depth Q (inches) = (P_{design} / PE) x 2.6 (See Ref. 9)	Removal Efficiency (RE) TN (%) See Adjustor Curves Ref. 5	Removal Efficiency (RE) TP (%) See Adjustor Curves Ref. 5	Removal Efficiency (RE) TSS (%) See Adjustor Curves Ref. 5
2.05	67	78	84

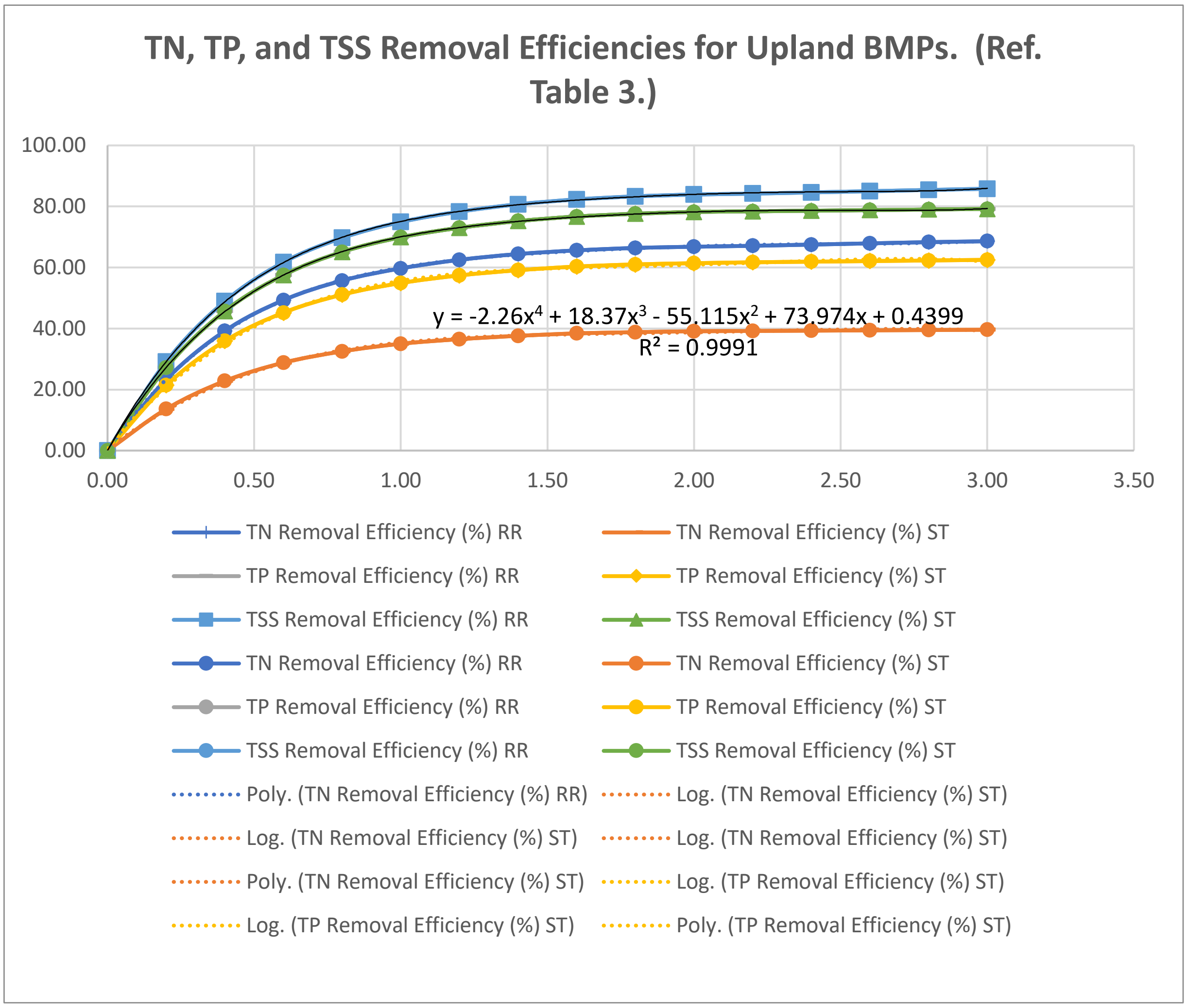
POLLUTANT LOAD REDUCTION CALCULATION

Load Type	Statewide Urban Unit Load (UUL) lbs/acre/year (see Ref. 6)	Load Reduction Achieved by ESD_V (lbs) = (UUL) x (I) x (RE) (See Ref. 8)
Total Nitrogen (TN)	20.39	4.79
Total Phosphorus (TP)	2.55	0.70
Total Suspended Solids (TSS)	8,793.00	2,589.08

* $ESD_{V\ design}$ should be as close as possible to the $ESD_{V\ required}$, if less then the untreated volume should be managed downtream by the next BMP.

I hereby certify to the best of my knowledge that the stormwater management facility (BMP) as referenced in the permit number shown above, has been constructed in accordance with the plans and specifications approved by Prince George's County, and provides the impervious area treatment stated in this certification.

COMPANY NAME:		**DATE:**	
LICENSED ENGINEER:		**Signature PE Seal:**	
LICENSE #:			



TN, TP, and TSS Removal Efficiencies for Upland BMPs. (Ref. Table 3.)
100.00
80.00
60.00
40.00
20.00
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
y = -2.26x4 + 18.37x3 - 55.115x2 + 73.974x + 0.4399
R2 = 0.9991
TN Removal Efficiency (%) RR
TN Removal Efficiency (%) ST
TP Removal Efficiency (%) RR
TP Removal Efficiency (%) ST
TSS Removal Efficiency (%) RR
TSS Removal Efficiency (%) ST
TN Removal Efficiency (%) RR
TN Removal Efficiency (%) ST
TP Removal Efficiency (%) RR
TP Removal Efficiency (%) ST
TSS Removal Efficiency (%) RR
TSS Removal Efficiency (%) ST
Poly. (TN Removal Efficiency (%) RR)
Log. (TN Removal Efficiency (%) ST)
Log. (TN Removal Efficiency (%) ST)
Log. (TN Removal Efficiency (%) ST)
Poly. (TN Removal Efficiency (%) ST)
Log. (TP Removal Efficiency (%) ST)
Log. (TP Removal Efficiency (%) ST)
Poly. (TP Removal Efficiency (%) ST)

Angela D. Alsobrooks
County Executive

NPDES New Development BMP Report Form

PRINCE GEORGE'S COUNTY
DEPARTMENT OF THE ENVIRONMENT
(New Development Only)

DPIE
DEPARTMENT OF PERMITTING, INSPECTIONS AND ENFORCEMENT

THIS SECTION IS TO BE COMPLETED BY THE DESIGN ENGINEER				
DPIE Permit #:	Project Name:			
Address:	City:		State:	Zip:
BMP Type: Shallow Marsh	Purpose of BMP Construction: New Development			
Drainage Area to BMP (A)	Impervious Cover Treated (I)		BMP Maintenance Responsibility	
Acres	%	Acres	Private	Public
			☐	☐

REQUIRED WATER QUALITY VOLUME CALCULATION (ESD_V)		
Woods in Good Condition Target Rainfall $\mathbf{P_E}$ (inches) based on Ref. 2	Runoff Co-eff. $\mathbf{R_V}$ = 0.05 + 0.009 (I) Impervious (I) is in % (See Ref. 1)	Runoff Volume $\mathbf{ESD_V}$ (acre-feet) =(P_E) x (R_V) x (A) / 12 (See Ref. 1)

DESIGN RAINFALL CALCULATION (P_{design})	
Provided Water Quality Volume $\mathbf{ESD_{V(design)}}$ (acre-feet) based on Design Calculation	Design Rainfall $\mathbf{P_{design}}$ (inches) = $ESD_{V(design)}$ x 12 / [(R_V) x (A)]

RAINFALL DEPTH TREATED PER IMPERVIOUS ACRE TO ACCOUNT FOR ESD TO THE MEP			
Runoff depth Q (inches) = (P_{design} / P_E) x 2.6 (See Ref. 9)	Removal Efficiency **(RE) TN** (%) See Adjustor Curves Ref. 5	Removal Efficiency **(RE) TP** (%) See Adjustor Curves Ref. 5	Removal Efficiency **(RE) TSS** (%) See Adjustor Curves Ref. 5

POLLUTANT LOAD REDUCTION CALCULATION		
Load Type	Statewide Urban Unit Load (**UUL**) lbs/acre/year (See Ref. 6)	**Load Reduction** Achieved by ESDv (lbs) = (UUL) x (I) x (RE) (See Ref. 8)
Total Nitrogen (TN)	20.39	
Total Phosphorus (TP)	2.55	
Total Suspended Solids (TSS)	8,793	

I hereby certify to the best of my knowledge that the stormwater management facility (BMP) as referenced in the permit number shown above, has been constructed in accordance with the plans and specifications approved by Prince George's County, and provides the impervious area treatment stated in this certification.

Company Name: ______________________________ Date: ______________________________

Licensed Engineer: ______________________________ Signature/ PE Seal: __________________________

License Number: ______________________________

NPDES New Development BMP Report Form

THIS SECTION IS TO BE COMPLETED BY DPIE			
Case No:		BMP Site ID#	Structure ID#
Built Date:	Digitized By:	Approval Date:	Approved By:

THIS SECTION IS TO BE COMPLETED BY DoE					
TMDL Watershed (MDE 8): Patuxent River Lower			BMP Class: E	Local TMDL: ☐	Bay TMDL: ☐
Phase 6 Model Segment Delivery Factor (Ref. 7)			Ultimate TN Reduction Achieved by ESDv (lbs) = (TGL) x (RE) x (DF)	Ultimate TP Reduction Achieved by ESDv (lbs) = (TGL) x (RE) x (DF)	Ultimate TSS Reduction Achieved by ESDv (lbs) = (TGL) x (RE) x (DF)
TN	TP	TSS			

Loads Calculated By: Date:

Example Calculations for Target Rainfall

Compute Woods in Good Condition Target Rainfall P_E

(Source: Section 5.2.3 of Maryland Stormwater Design Manual, Volume I and Volume II, Maryland Department of the Environment, 2000):

5.2.5 Design Examples: Computing ESD Stormwater Criteria

Design examples are provided only to illustrate how ESD stormwater sizing criteria are computed for hypothetical development projects. These design examples are also utilized elsewhere in the manual to illustrate design concepts.

Design Example No. 5.1: Residential Development – Reker Meadows

The layout of the Reker Meadows subdivision is shown in Figure 2.6.

Site Data:

Location:	Frederick County, MD
Site Area:	38.0 acres
Drainage Area:	38.0 acres
Soils:	60% B, 40% C
Impervious Area:	13.8 acres

Step 1: Determine ESD Implementation Goals

The following basic steps should be followed during the planning phase to develop initial targets for ESD implementation.

A. Determine Pre-Developed Conditions:

The goal for implementing ESD on all new development projects is to mimic forested runoff characteristics. The first step in this process is to calculate the RCN for "woods in good condition" for the project:

- Determine Soil Conditions and RCNs for "woods in good condition"

Soil Conditions

HSG	RCN†	Area	Percent
A	38‡	0	0%
B	55	22.8 acres	60%
C	70	15.2 acres	40%
D	77	0	0%

† RCN for "woods in good condition" (Table 2-2, TR-55)
‡ Actual RCN is less than 30, use RCN = 38

- Determine composite RCN for "woods in good condition"

$$RCN_{woods} = \frac{(55 \times 22.8 \text{ acres}) + (70 \times 15.2 \text{ acres})}{38 \text{ acres}} = 61$$

The target RCN for "woods in good condition" is 61.

B. Determine Target P_E Using Table 5.3:

P_E = Rainfall used to size ESD practices

During project planning and preliminary design, site soils and proposed imperviousness are used to determine the target P_E for sizing ESD practices to mimic wooded conditions.

- Determine Proposed Imperviousness (%I)

Proposed Impervious Area (as measured from site plans): 13.8 acres
%I = Impervious Area / Drainage Area
= 13.8 acres / 38 acres
= 36.3%;

Because %I is between 35% and 40%, both values should be checked and the more conservative result used to determine target P_E.

For this example, assume imperviousness is distributed proportionately (60/40) in B and C soils.

- Determine P_E from Table

Using %I = 35% & 40% and B Soils:

		Hydrologic Soil Group B					
%I	RCN*	P_E = 1"	1.2"	1.4"	1.6"	1.8"	2.(
15%	67	**55**					
20%	68	60	**55**	**55**			
25%	70	64	61	58			
30%	72	65	62	59	**55**		
35%	74	[illegible]	[illegible]	[illegible]	[illegible]		
40%	75	[illegible]	[illegible]	[illegible]	[illegible]		
45%	78	68	66	62	58		

$P_E \geq$ 1.8 inches will reduce the RCN to reflect "woods in good condition" for %I = 35% & 40%

Using %I = 35% & 40% and C Soils:

		Hydrologic Soil Group C					
%I	RCN*	P_E = 1"	1.2"	1.4"	1.6"	1.8"	:
15%	78	**70**					
20%	79	**70**					
25%	80	72	**70**	**70**			
30%	81	73	72	71			
35%	82	74	73	72	**70**		
40%	84	77	75	73	71		
45%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

For %I = 35%, $P_E \geq$ 1.6 inches will reduce the RCN to reflect "woods in good condition"
For %I = 40%, $P_E \geq$ 1.8" to achieve the same goal.

For this project, P_E happens to be the same for both soil groups, therefore use P_E = 1.8 inches of rainfall as the target for ESD implementation.

C. Compute Q_E :

Q_E = Runoff depth used to size ESD practices
Q_E = P_E x Rv, where
P_E = 1.8 inches
R_v = 0.05 + (0.009)(I); I = 36.3
= 0.05 + (0.009 x 36.3) = 0.38

Q_E = 1.8 inches x 0.38
= 0.68 inches

ESD targets for the Reker Meadows project:

P_E = 1.8 inches
Q_E = 0.68 inches

By using ESD practices that meet these targets, Re_v, WQ_v, and Cp_v requirements will be satisfied. Potential practices could include swales or micro-bioretention to capture and treat runoff from the roads. Likewise, raingardens and disconnection of rooftop runoff could be used to capture and treat runoff from the houses.

Example: Calculations for Load Reductions achieved by an ESD Facility (New Development)

Compute Runoff Volume ESD_V

It is assumed that a site area [Drainage Area (A) = 0.45 acres, Impervious Area (I) = 0.35 acres, Percent Impervious = 0.35x100/0.45 = 77.8%, Target Rainfall P_E = 1.8 inches] has been treated by a Runoff Reduction (RR) BMP such as Micro-bioretention. The total load reductions achieved by the Micro-bioretention facility is calculated in the following steps,

$$Target\ Rainfall\ P_E = 1.8\ inches$$

$$Runoff\ Coefficient\ R_V = 0.05 + 0.009 \times (77.8) = 0.75$$

Therefore, Target Runoff Volume (ESD_V) to be treated by the Micro-bioretention facility will be

$$Runoff\ Volume\ ESD_V = \frac{P_E \times R_V \times\ A}{12} = \frac{1.8\ \times 0.75\ \times 0.45}{12} = 0.05\ acre - feet$$

Compute Design Rainfall P_{design} Volume ESD_V:

Assume the actual or provided ESD_V based on design calculation is 0.04 acre-feet. Therefore, calculated design rainfall P_{design} is

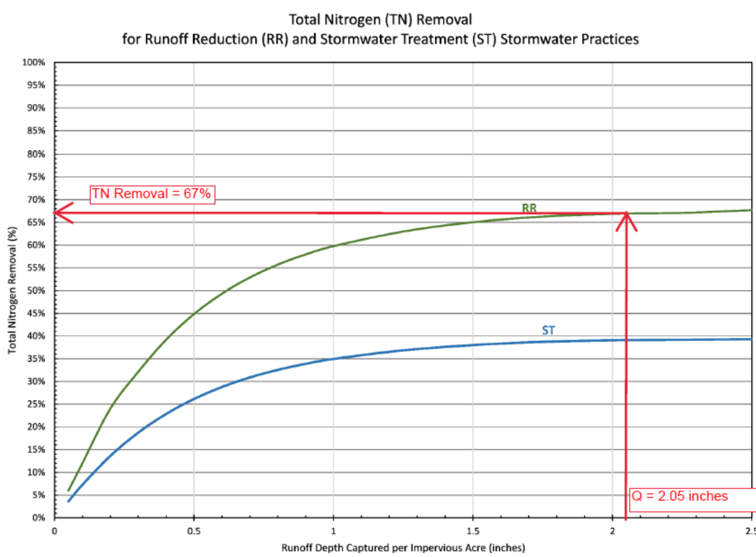
$$Design\ Rainfall\ P_{design} = \frac{ESD_V \times 12}{R_V \times A} = \frac{0.04\ \times 12}{0.75\ \times 0.45} = 1.42\ inches$$

Compute Rainfall Depth Treated Per Impervious Acre to Account for ESD To The MEP:

$$Runoff\ Depth\ Q = \frac{P_{design} \times 2.6}{P_E} = \frac{1.42 \times 2.6}{1.8} = 2.05\ inches$$

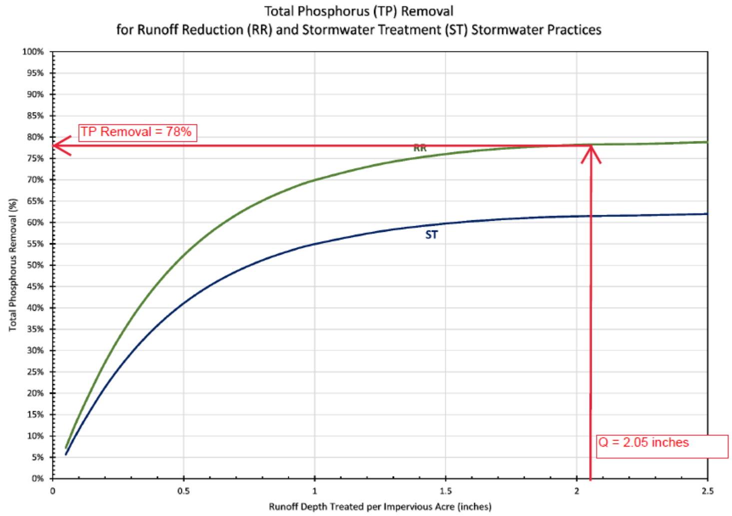
Compute Load Reduction achieved by an ESD Facility:

Removal Efficiency (RE) for Total Nitrogen (TN) from Adjustor Curves for an RR facility with Runoff Depth 2.05 inches is 67%

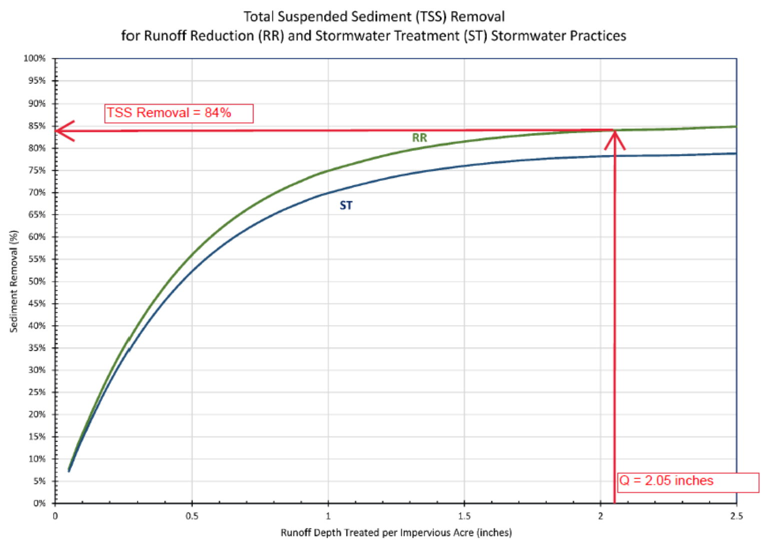


Removal Efficiency (RE) for Total Phosphorous (TP) from Adjustor Curves for an RR facility is 78%

NPDES New Development BMP Report Form



Removal Efficiency (RE) for Total Suspended Solids (TSS) from Adjustor Curves for an RR facility is 84%



From Reference 6, Statewide Urban Unit Load (UUL) in lbs/acre/year for TN, TP, and TSS are:

$$UUL \text{ for TN} = 20.39\ lbs/acre/year$$

$$UUL \text{ for TP} = 2.55\ lbs/\text{acre/year}$$

$$UUL \text{ for TSS} = 8{,}793\ lbs/\text{acre/year}$$

Total Load Reduction Achieved by RR facilities are

$$TN\ Reduction\ = (UUL\ for\ TN) \times (I) \times RE$$

$$= 20.39 \times 0.35 \times 0.67 = 4.78\ lbs$$

$$TP\ Reduction\ = (UUL\ for\ TP) \times (I) \times RE$$

$$= 2.55 \times 0.35 \times 0.78 = 0.70\ lbs$$

$$TSS\ Reduction\ = (UUL\ for\ TSS) \times (I) \times RE$$

$$= 8{,}793 \times 0.35 \times 0.84 = 2{,}585.14\ lbs$$

Removal Efficiency (RE) for Total Nitrogen (TN) from Adjustor Curves for an RR facility with Runoff Depth 2.05 inches is 67%

Reference 1

Table 2, Page 5.18, Maryland Stormwater Design Manual, Volume I and Volume II, Maryland Department of the Environment, 2000.

5.2.2 Environmental Site Design Sizing Criteria

The criteria for sizing ESD practices are based on capturing and retaining enough rainfall so that the runoff leaving a site is reduced to a level equivalent to a wooded site in good condition as determined using United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) methods (e.g., TR-55). The basic principle is that a reduced runoff curve number (RCN) may be applied to post-development conditions when ESD practices are used. The goal is to provide enough treatment using ESD practices to address Cp_v requirements by replicating an RCN for woods in good condition for the 1-year rainfall event. This eliminates the need for structural practices from Chapter 3. If the design rainfall captured and treated using ESD is short of the target rainfall, a reduced RCN may be applied to post-development conditions when addressing stormwater management requirements. The reduced RCN from Table 5.3 is calculated by subtracting the runoff treated by ESD practices from the total 1-year 24-hour design storm runoff.

Table 5.3 was developed using the "Change in Runoff Curve Number Method" (McCuen, R., MDE, 1983) to determine goals for sizing ESD practices and reducing RCNs if those goals are not met. During the planning process, site imperviousness and soil conditions are used with Table 5.3 to determine a target rainfall for sizing ESD practices. Table 5.3 is also used to determine the reduced RCNs for calculating additional stormwater management requirements if the targeted rainfall cannot be met using ESD practices.

<u>ESD Sizing Requirements:</u>
P_E = Rainfall Target from Table 5.3 used to determine ESD goals and size practices

Q_E = Runoff depth in inches that must be treated using ESD practices
= $P_E \times R_v$; R_v = the dimensionless volumetric runoff coefficient
= 0.05 + 0.009(I) where I is percent impervious cover

ESD_v = Runoff volume (in cubic feet or acre-feet) used in the design of specific ESD practices

$$= \frac{(P_E)(R_v)(A)}{12}$$ where A is the drainage area (in square feet or acres)

Reference 2

Table 5.3, Page 5.21 to 5.22, Maryland Stormwater Design Manual, Volume I and Volume II, Maryland Department of the Environment, 2000.

Table 5.3 Rainfall Targets/Runoff Curve Number Reductions used for ESD

Hydrologic Soil Group A										
%I	RCN*	P_E = 1"	1.2"	1.4"	1.6"	1.8"	2.0"	2.2"	2.4"	2.6"
0%	40									
5%	43									
10%	46									
15%	48	**38**								
20%	51	40	**38**	**38**						
25%	54	41	40	39						
30%	57	42	41	39	**38**					
35%	60	44	42	40	39					
40%	61	44	42	40	39					
45%	66	48	46	41	40					
50%	69	51	48	42	41	**38**				
55%	72	54	50	42	41	39				
60%	74	57	52	44	42	40	**38**			
65%	77	61	55	47	44	42	40			
70%	80	66	61	55	50	45	40			
75%	84	71	67	62	56	48	40	**38**		
80%	86	73	70	65	60	52	44	40		
85%	89	77	74	70	65	58	49	42	**38**	
90%	92	81	78	74	70	65	58	48	42	**38**
95%	95	85	82	78	75	70	65	57	50	39
100%	98	89	86	83	80	76	72	66	59	40

Hydrologic Soil Group B										
%I	RCN*	P_E = 1"	1.2"	1.4"	1.6"	1.8"	2.0"	2.2"	2.4"	2.6"
0%	61									
5%	63									
10%	65									
15%	67	**55**								
20%	68	60	**55**	**55**						
25%	70	64	61	58						
30%	72	65	62	59	**55**					
35%	74	66	63	60	56					
40%	75	66	63	60	56					
45%	78	68	66	62	58					
50%	80	70	67	64	60					
55%	81	71	68	65	61	**55**				
60%	83	73	70	67	63	58				
65%	85	75	72	69	65	60	**55**			
70%	87	77	74	71	67	62	57			
75%	89	79	76	73	69	65	59			
80%	91	81	78	75	71	66	61			
85%	92	82	79	76	72	67	62	**55**		
90%	94	84	81	78	74	70	65	59	**55**	
95%	96	87	84	81	77	73	69	63	57	
100%	98	89	86	83	80	76	72	66	59	**55**

(green) Cp_v Addressed (RCN = Woods in Good Condition)

(yellow) RCN Applied to Cp_v Calculations

Table 5.3 Runoff Curve Number Reductions used for Environmental Site Design (continued)

Hydrologic Soil Group C										
%I	RCN*	P_E = 1"	1.2"	1.4"	1.6"	1.8"	2.0"	2.2"	2.4"	2.6"
0%	74									
5%	75									
10%	76									
15%	78									
20%	79	**70**								
25%	80	72	**70**	**70**						
30%	81	73	72	71						
35%	82	74	73	72	**70**					
40%	84	77	75	73	71					
45%	85	78	76	74	71					
50%	86	78	76	74	71					
55%	86	78	76	74	71	**70**				
60%	88	80	78	76	73	71				
65%	90	82	80	77	75	72				
70%	91	82	80	78	75	72				
75%	92	83	81	79	75	72				
80%	93	84	82	79	76	72				
85%	94	85	82	79	76	72				
90%	95	86	83	80	77	73	**70**			
95%	97	88	85	82	79	75	71			
100%	98	89	86	83	80	76	72	**70**		

Hydrologic Soil Group D										
%I	RCN*	P_E = 1"	1.2"	1.4"	1.6"	1.8"	2.0"	2.2"	2.4"	2.6"
0%	80									
5%	81									
10%	82									
15%	83									
20%	84	**77**								
25%	85	78								
30%	85	78	**77**	**77**						
35%	86	79	78	78						
40%	87	82	81	79	**77**					
45%	88	82	81	79	78					
50%	89	83	82	80	78					
55%	90	84	82	80	78					
60%	91	85	83	81	78					
65%	92	85	83	81	78					
70%	93	86	84	81	78					
75%	94	86	84	81	78					
80%	94	86	84	82	79					
85%	95	86	84	82	79					
90%	96	87	84	82	79	**77**				
95%	97	88	85	82	80	78				
100%	98	89	86	83	80	78	**77**			

Cp_v Addressed (RCN = Woods in Good Condition)

RCN Applied to Cp_v Calculations

Reference 3

Table 2, Page 7, Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated Guidance for National Pollutant Discharge Elimination System Stormwater Permits, Maryland Department of the Environment, June 2020.

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.

Reference 4

Table 3, Page 8, Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated Guidance for National Pollutant Discharge Elimination System Stormwater Permits, Maryland Department of the Environment, June 2020.

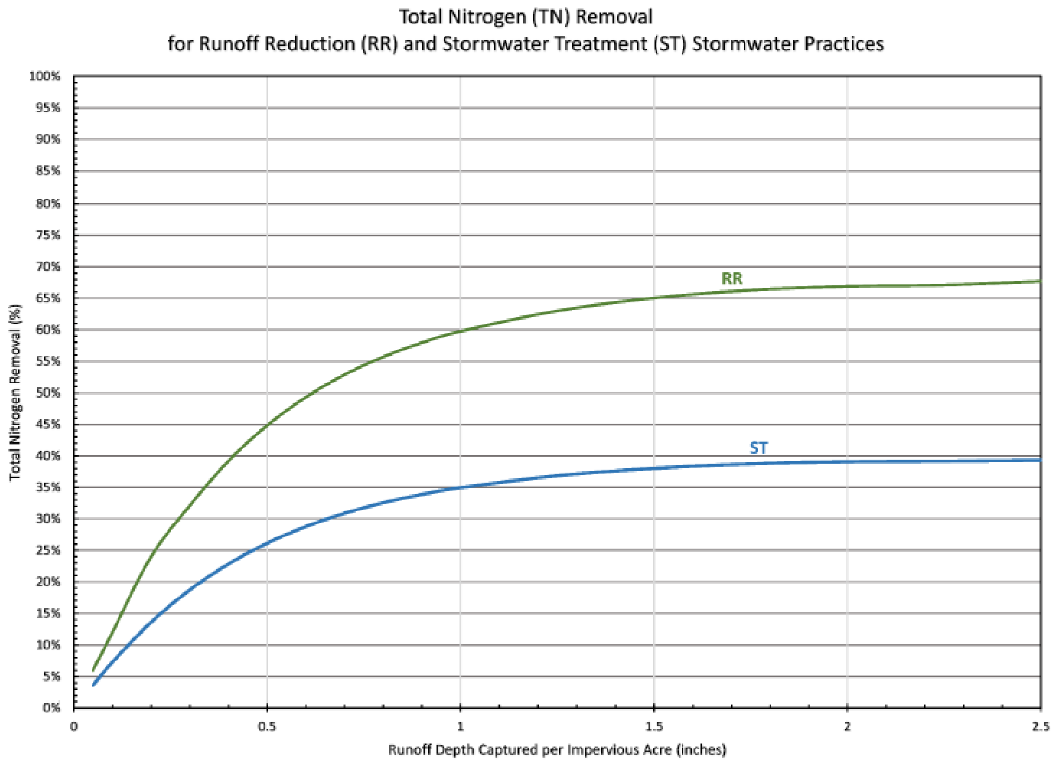
Table 3. TN, TP, and TSS Removal Efficiencies for Upland BMPs

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.

Reference 5

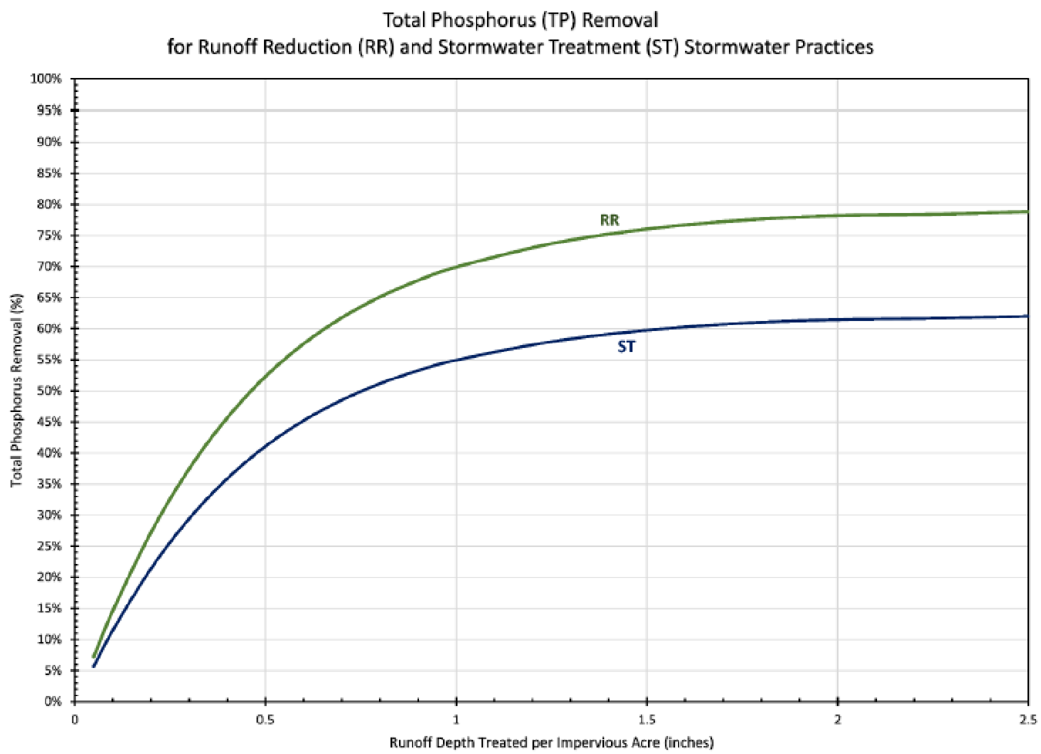
Appendix A, Adjustor Curves, Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated Guidance for National Pollutant Discharge Elimination System Stormwater Permits, Maryland Department of the Environment, June 2020.



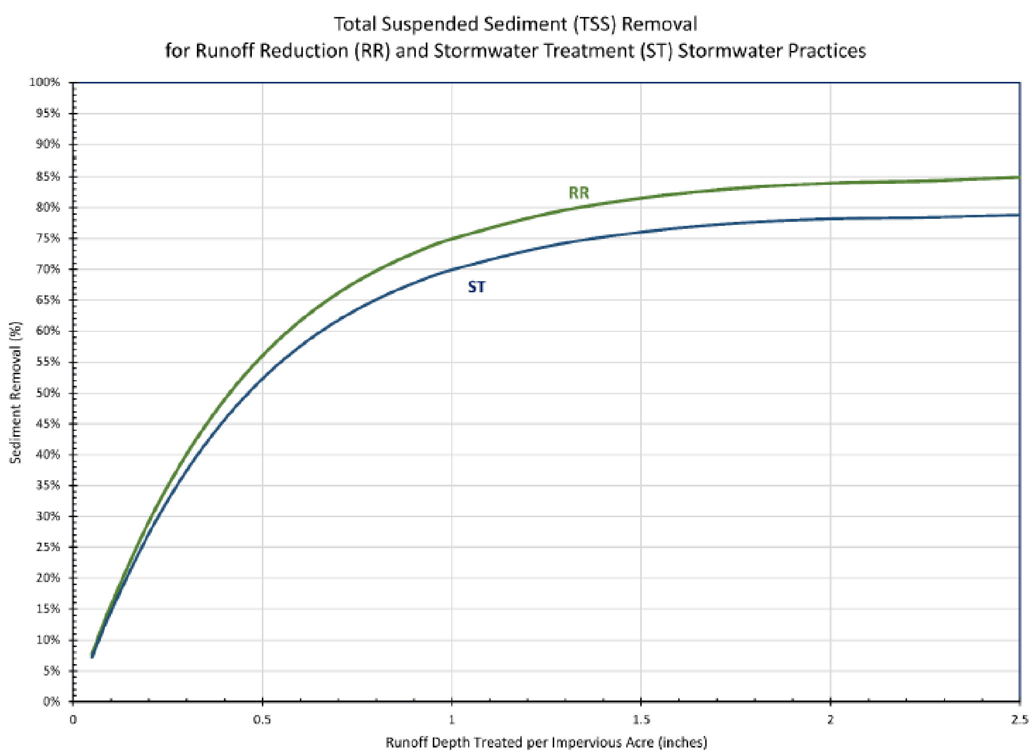
44

NPDES New Development BMP Report Form

Reference 5 (Contd.)



45



46

Reference 6

Table 4, Page 9, Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated Guidance for National Pollutant Discharge Elimination System Stormwater Permits, Maryland Department of the Environment, June 2020.

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

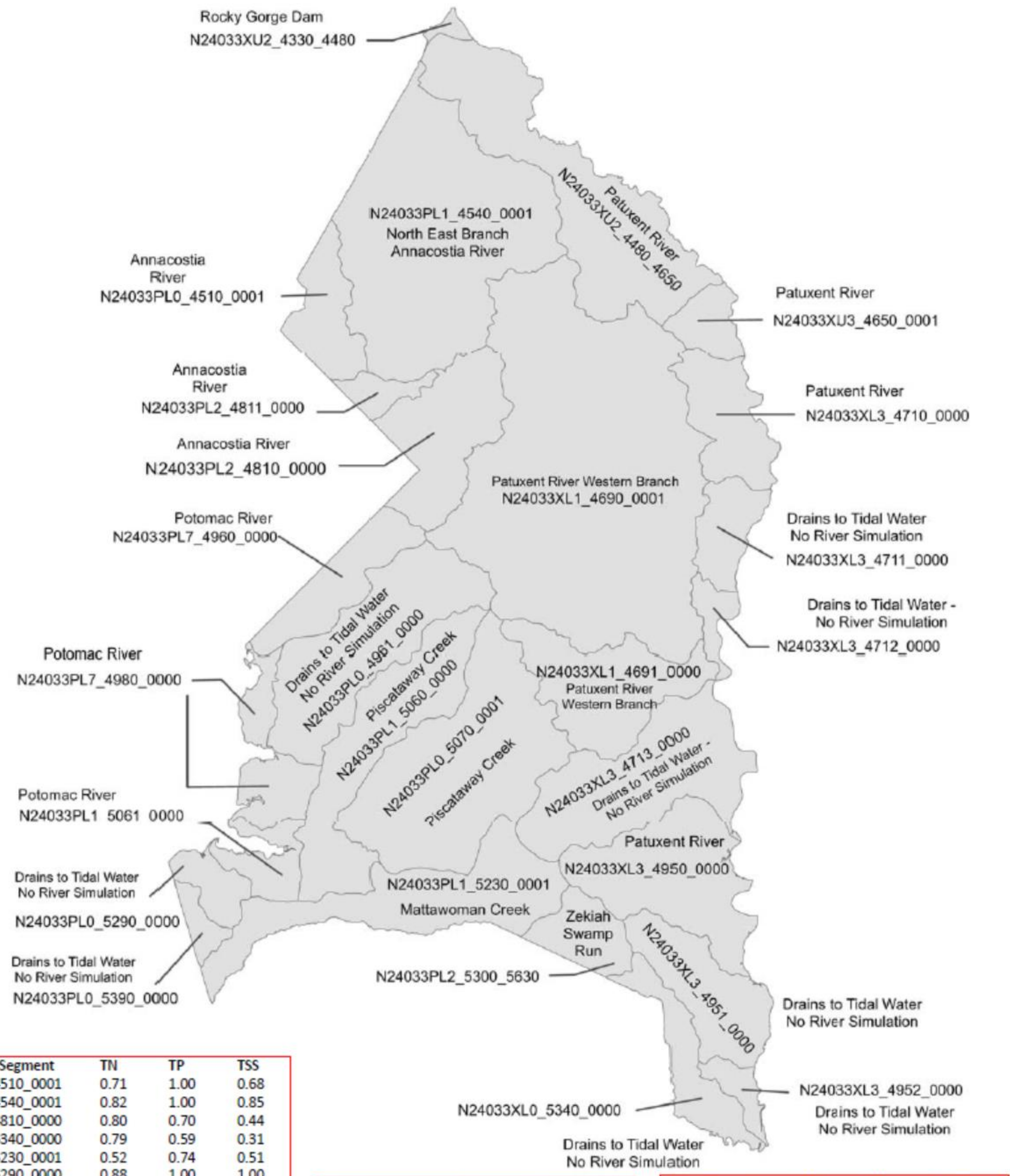
Load Source[1]	Statewide EOS Urban Unit Load (lbs/acre/yr)		
	TN	TP	TSS
Aggregate Impervious	20.39	2.55	8,793
Impervious Road	36.43	6.89	20,055
Mixed Open	8.19	1.58	3,552
Septic	16.83	0.00	0.00
Tree Canopy over Impervious	33.33	6.13	18,651
Turf	13.43	2.10	3,552
Tree Canopy over Turf	10.23	1.60	3,346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

Reference 7

Phase III Watershed Implementation Plan - Maryland Delivery Factor (Edge-of-Stream to Edge-of-Tide Conversion Factors)

Source: Appendix L, Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated Guidance for National Pollutant Discharge Elimination System Stormwater Permits, Maryland Department of the Environment, June 2020.



River Segment	TN	TP	TSS
PL0_4510_0001	0.71	1.00	0.68
PL1_4540_0001	0.82	1.00	0.85
PL2_4810_0000	0.80	0.70	0.44
XL0_5340_0000	0.79	0.59	0.31
PL1_5230_0001	0.52	0.74	0.51
PL0_5290_0000	0.88	1.00	1.00
PL2_5300_5630	0.55	0.53	0.32
PL0_4961_0000	0.80	0.69	0.47
PL1_5060_0000	0.74	0.58	0.33
PL1_5061_0000	1.00	1.00	1.00
PL0_5070_0001	0.67	0.58	0.27
XL1_4690_0001	0.40	0.70	0.39
XL1_4691_0000	0.83	0.80	0.36

River Segment	TN	TP	TSS
XL3_4710_0000	0.83	0.67	0.41
XL3_4711_0000	0.90	0.77	0.43
XL3_4712_0000	0.87	0.62	0.40
XL3_4713_0000	0.76	0.58	0.33
XL3_4950_0000	0.81	0.64	0.38
XL3_4951_0000	0.79	0.56	0.32
XL3_4952_0000	0.91	0.71	0.53

River Segment	TN	TP	TSS
XU2_4330_4480	0.32	0.38	0.07
XU2_4480_4650	0.74	0.84	0.28
XU3_4650_0001	0.84	0.79	0.35
PL0_5390_0000	0.88	0.70	0.14
PL7_4980_0000	1.00	1.00	1.00
PL7_4960_0000	0.89	0.84	0.46
PL2_4811_0000	0.93	0.83	0.55

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Reference 8

Steps for calculating loads reduced by BMPs, (See example at Page 49), Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated Guidance for National Pollutant Discharge Elimination System Stormwater Permits, Maryland Department of the Environment, June 2020.

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 a retrofit, determine the pre-restoration stormwater BMP type, inches of rainfall depth treated, and the corresponding upland BMP efficiency. Otherwise, use the drainage area to calculate the TN load without a BMP efficiency.
4. Calculate the pre-restoration TN load reduction using Equation 4 of this Guidance, and repeated below.

$$Load\ Reduction\ \left(\frac{lbs}{yr}\right)$$

$$= Urban\ \text{Unit}\ Load\ \left(\frac{lbs}{\frac{acre}{yr}}\right)\ x\ Imperv.Surf.in\ BMP\ Drainage\ Area\ (acres)\ x\ \frac{BMP\ Efficiency}{100}\ x\ Phase\ 6\ Model\ Segment\ Delibery\ Factor$$

5. Determine the post-restoration stormwater BMP type, inches of rainfall depth treated, and the corresponding upland BMP TN efficiency.
6. Calculate the post-restoration TN load reduction using Equation 4.
7. Subtract the result from the pre-restoration TN load to determine the TN credit obtained from the stormwater BMP:

$$TN\ Credit\ \left(\frac{lb}{yr}\right) = Pre\ Restoration\ TN\ Load\ Reduction\ \left(\frac{lb}{yr}\right) - \ Post\ Restoration\ TN\ Load\ Reduction\ \left(\frac{lb}{yr}\right)$$

$$TP\ Credit\ \left(\frac{lb}{yr}\right) = Pre\ Restoration\ TP\ Load\ Reduction\ \left(\frac{lb}{yr}\right) - \ Post\ Restoration\ TP\ Load\ Reduction\ \left(\frac{lb}{yr}\right)$$

$$TSS\ Credit\ \left(\frac{lb}{yr}\right) = Pre\ Restoration\ TSS\ Load\ Reduction\ \left(\frac{lb}{yr}\right) - \ Post\ Restoration\ TSS\ Load\ Reduction\ \left(\frac{lb}{yr}\right)$$

Reference 9

Appendix K: Reporting New Development, Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated Guidance for National Pollutant Discharge Elimination System Stormwater Permits, Maryland Department of the Environment, June 2020.

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 on 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 20 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 MEP.

Table 29. Pollutant Removal Rates for ESD to the MEP

Sediment	85%
Total Phosphorus	78.8%
Total Nitrogen	67.9%