

CALCULATING LOAD REDUCTIONS FROM NONPOINT SOURCE PROJECTS

The following “Sample Calculations” are provided by MDE as illustrative examples of how to calculate load reductions for total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS).

- Before calculating, select a BMP practice to be used.
 - MDE recommends BMP removal efficiency rates for certain practices (see Table 1)
- Note: For BMP practices not listed in Table 1, MDE recommends applicants visit the Center for Watershed Protection at: www.cwp.org to obtain reasonable estimates.

Table 1.

BMP Practice	Removal Efficiency Rate (%)		
	TN	TP	TSS
Detention Facilities	5	10	10
ED Facilities w/micro pool	30	40	80
Wet Ponds/Wetland Systems	30	40	80
Infiltration Practices	30	40	80
Filtration Practices	30	40	80
Open Channel Systems	30	40	80

- Use the Simple Method (Schueler, 1987) equation to calculate the load:

$$L = 0.226 * R * C * A \quad \text{where, the following variables apply:}$$

L = Load (lbs/yr)

A= Area Treated (acres)

C= Pollutant Concentration (mg/l)

R= Runoff

0.226 = a unit conversion factor

Where runoff is calculated using the following,

$$R = P * P_j * R_v \quad \text{where,}$$

P = Annual Rainfall (inches)

Ia = Impervious Fraction (%)

Pj = Fraction of events that produce runoff (usually 0.9)

Rv = $0.05 + (.9 * Ia)$

Sample Calculation # 1 - NEW SWM PRACTICES

Event Mean Concentration Method				A	B	C	D	E	F	G	H	I
Treated Area (acres)	TN Concentration (mg/l)	TP Concentration (mg/l)	TSS Concentration (mg/l)	TN Load (lbs/yr)	TP Load (lbs/yr)	TSS Load (tons/yr)	TN Load After Reduction (lbs/yr)	TP Load After Reduction (lbs/yr)	TSS Load After Reduction (tons/yr)	TN Difference (lbs/yr)	TP Difference (lbs/yr)	TSS Difference (tons/yr)
300	2	0.30	80	1,548	232	31	1,471	209	28	77	23	3
300	2	0.30	80	1,548	232	31	1,084	139	6	464	93	25
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Rainfall Average in Maryland = 42 inches

Imperviousness = 28% equivalent to Medium Density Residential [based on work by Cappiella, K. and K. Brown, "Impervious Cover and Land Use in the Chesapeake Bay Watershed," Center for Watershed Protection. Ellicott City, MD, 2001]

Average Urban Pollution Concentrations for TN, TP and TSS were cited from the Maryland Stormwater Design Manual, see pp 1.6.

Columns G, H and I represent the reduced load associated with each one of the BMP practices shown in Table 1 above when the recommended efficiency removal rates are used. See Sample Calculation #3 for Stream Restorations.

BMP Practice	Expected Pollutant Removal		
	TN (lbs/yr)	TP (lbs/yr)	TSS (tons/yr)
Detention Facilities	77	23	3
ED Facilities w/micro pool	464	93	25
Wet Ponds/Wetland Systems	464	93	25
Infiltration Practices	464	93	25
Filtration Practices	464	93	25
Open Channel Systems	464	93	25

Sample Calculation # 2 - SWM RETROFIT

If the volume of water or land area to be treated is less than 100%, as in this presented case only 75% of water volume can be treated, the following calculation can be made to quantify the anticipated load removal:

Event Mean Concentration Method

BMP Efficiency

Reduced

A B C D E F G H I

Reduced Efficiency for retrofits not able to perform at 100%, Reduction occurs in Load After Reduction Cell

Treated Area (acres)	TN Concentration (mg/l)	TP Concentration (mg/l)	TSS Concentration (mg/l)	TN Load (lbs/yr)	TP Load (lbs/yr)	TSS Load (tons/yr)	TN Load After Reduction (lbs/yr)	TP Load After Reduction (lbs/yr)	TSS Load After Reduction (tons/yr)	Total Nitrogen Difference (lbs/yr)	Total Phosphorus Difference (lbs/yr)	Total Sediment Difference (tons/yr)
300	2	0.30	80	1,548	232	31	1,490	215	29	58	17	2
300	2	0.30	80	1,548	232	31	1,200	163	12	348	70	19
300	2	0.30	80	1,548	232	31	1,200	163	12	348	70	19
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300	2	0.30	80	1,548	232	31	1,200	163	12	348	70	19

Rainfall Average in Maryland = 42 inches; imperviousness = 28% equivalent to Medium Density Residential

Columns G, H and I represent the reduced load associated with each one of the BMP practices shown in Table 1 when the recommended efficiency removal rates are reduced to be only 75% effective. See Sample Calculation #3 for Stream Restorations.

BMP Practice with Reduced Efficiency	Expected Pollutant Removal		
	TN (lbs/yr)	TP (lbs/yr)	TSS (tons/yr)
Detention Facilities	58	17	2
ED Facilities w/micro pool	348	70	19
Wet Ponds/Wetland Systems	348	70	19
Infiltration Practices	348	70	19
Filtration Practices	348	70	19
Open Channel Systems	348	70	19

Sample Calculation # 3 – STREAM RESTORATION

For stream restoration projects, the following reduction efficiency rates are advised

TN Reduction Efficiency Rate	TP Reduction Efficiency Rate	TSS Reduction Efficiency Rate
(lbs per linear foot)	(lbs per linear foot)	(lbs per linear foot)
0.202	0.0107	3.58

In the Sample Pre-Application, a stream restoration project for Little Red Creek is proposed to treat a 2000 linear foot stream reach. The result is found by multiplying 2000 times each of the recommended efficiency reduction rates above.

Therefore, the reduced load associated with the restoration would be:

BMP Practice	Expected Pollutant Reduction		
	TN (lbs/yr)	TP (lbs/yr)	TSS (tons/yr)
Stream Restoration	400	21.4	3.58

Note: TSS in tons is obtained by dividing the result in lbs/yr by 2000.

Sample Calculation FAQs

Q1: Are the Removal Efficiency Rates in the Design Manual consistent with those developed by the Chesapeake Bay Program (CBP)?

A1: There may be different values recommended by CBP than those recommended by the Department. The Department suggests using removal rates based upon those found in the Maryland Stormwater Design Manual. CBP is currently reevaluating efficiency rates for specific BMPs. Information can be found at <http://www.chesapeakebay.net/tribtools.htm>

Q2: Can I use alternative efficiency removal rates in my calculations?

A2: Yes, but you must document the sources of the removal rates and describe why you have used them. The Department acknowledges that removal rates vary considerably based on many factors, such as implementation and site characteristics. There are other valid methods to calculate loading rate reductions for these parameters and applicants proposing projects may provide alternative calculation methods and variables that are generally accepted and reasonable.

Q3: The Design Manual addresses new development, but my project is a retrofit. Are these standards still applicable?

A3: Yes. The Design Manual is directed toward new development and in most cases retrofits will not be able to perform at 100% of the removal rate recommended. Therefore, applicants should adjust the removal efficiency to a rate which is proportional to the water volume or land area that the BMP practice will be able to treat. Refer to Sample Calculation #2 for an example, which uses a reduced efficiency of 75%, i.e., a twenty five percent reduction from the BMP efficiency rates provided in Table 1.

Q4: What are other typical pollution concentrations from the Design Manual?

A4: The Design Manual contains a table of Typical Pollutant Concentrations Found in Urban Stormwater available on the web at: http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.asp