Scoring System for Watershed Retrofits

Category 1: Phosphorus Removal

Phosphorus removal for each retrofit was calculated using two methodologies: initially using the Virginia Runoff Reduction Method[1] and subsequently, using the methodology developed for the Chesapeake Bay Program's Urban Stormwater Workgroup[2]. The data presented in this plan and its appendices relies on the Chesapeake Bay Program's methodology unless otherwise indicated.

For both methods, phosphorous removal is calculated by relating the volume of stormwater treated to the water quality volume, the volume generated within the target drainage area during the first 1 inch of each storm, for each retrofit project.

To apply the Virginia Runoff Reduction Method, the pollutant load generated by the target drainage area is calculated using an average annual rainfall of 43 inches, and an event mean pollutant concentration of 0.26 mg/L for phosphorous. Percent pollutant removal values for each retrofit type derived using the Runoff Reduction Method are applied to calculate the expected annual phosphorous removal for the identified retrofits.

For projects that do not treat the entire water quality volume, rainfall data is used to determine the anticipated percent pollutant removal based on the relationship between the rainfall depth treated by the retrofit and annual rainfall. A retrofit that treats the entire water quality volume, or 1 inch of rainfall, will treat 90% of the rain events in a given year. However, a retrofit that treats 0.6 inch of rainfall will treat the stormwater generated by only 67.7% of the rain events in that year. For the latter retrofit, pollutant removal will be reduced. **Table 1** illustrates the relationship between the rainfall depth treated and the percent pollutant removal.

Table 1. Weighting Factor based on Rainfall Depth Treated

Rainfall Depth Treated (in)	%Annual Rainfall	% Pollutant Removal = %Annual Rainfall/90%
1.0	90%	100
0.8	79.2%	88
0.6	67.7%	75
0.4	50.9%	57
0.2	22.4%	25

To calculate pollutant removal using the methodology developed by the Chesapeake Bay Program's Urban Stormwater Workgroup, the treatment volume is related to each project's impervious drainage area to determine the runoff depth treated in inches. Retrofit types are categorized as either runoff reduction or stormwater treatment best management practices. The pollutant loading rates from the Chesapeake Bay Program (CBP) Model, shown in **Table 2**, are used to calculate the pollutant load for total phosphorus (TP). (Pollutant loads for total nitrogen (TN) and total suspended sediment (TSS) can also be calculated using this method.)

[1] Hirschman, D, Collins, K., and T., Schueler, 2008. *Technical Memorandum: The Runoff Reduction Method. Center for Watershed Protection, Ellicott City, MD.*

[2] Bahr, R., Brown, T., Hansen, L.J., Kelly, J., Papacosma, J., Snead, V., Stack., B., Stack, R. and S. Stewart, 2012. *Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects. Chesapeake Stormwater Network, Ellicott City, MD.*

Table 2. CBP Annual Urban Runoff Loads per Acres		
Parameter	**Urban Impervious**	**Urban Pervious**
TN (lbs)	16.86	10.07
TP (lbs)	1.62	0.41
TSS (lbs)	1,171.32	175.80

The Chesapeake Stormwater Network (CSN) National Rainfall Frequency Analysis runoff reduction equation is then used to determine the percentage of the pollutant load removed by each retrofit (see Equation 1 below).

Equation 1 TP Removal Percentage for Runoff Reduction

$$TP\ Removal\ \% = 0.0304x^5 + 0.2619x^4 + 0.9161x^3 - 1.6837x^2 + 1.7072x - 0.0091$$

$$x = runoff\ depth\ captured\ per\ impervious\ acre\ in\ the\ contributing\ drainage\ area\ for\ each\ proposed\ retrofit$$

A score of 10 points per pound of phosphorous removed is given to each retrofit, and the score is given a weight of 2.5.

Category 2: Impervious Area Acreage

The size of the contributing drainage area is credited at 5 points per acre. The score for the contributing drainage area is given a weight of 2.0.

Category 3: Potential Utility or Site Constraints

Site constraints that can create significant conflicts for implementation of retrofits include water or gas mains, steep slopes, and the need for substantive excavation. Retrofits identified as having these site constraints are a score of 0, those with possible site constraints or less severe site constraints, such as existing trees or gas and water services (but not mains), are given a score of 5, and sites without any identifiable constraints are given a score of 10. For utility constraints, the criteria in **Table 3** are applied to score the retrofit.

Table 3. Potential Utility or Site Constraints Scoring Scheme			
Utility	**Low = 10 pts**	**Medium = 5 pts**	**High = 0 pts**
Water	Verified free of conflicts	Possible conflict or project limits adjusted due to location of line	Verified conflict
Sanitary		Possible or verified conflict	
Gas		Possible conflict or project limits adjusted due to location of line	Verified conflict
Electric (to street lights)		Possible or verified conflict	

The score for the utility or site constraint factor is given a weight of 1.5.

Category 4: Property Ownership

Stormwater retrofits located on public land are easier to install and maintain. Therefore, retrofits proposed for public land are given a higher score than private land. A retrofit that will be located on private land is given a score of 0; on a school property a score of 4; in the road right-of-way a score of 7; and on park or government lands a score of 10. The score for property ownership is given a weight of 1.5.

Category 5: Potential for Quick Implementation

Retrofits that have the potential for quick implementation are given a higher score because they can lead to more immediate water quality results or, in some cases, are time-dependent, and construction plans must be completed quickly. Two types of projects were considered to have potential for quick implementation: 1) Projects that coincide with planned construction in the area, and 2) Projects that have no road cuts, new curbing, or other road changes; include no major structural work (beyond curb cuts, underdrains, and overflows), and are located on public property. These projects are given a score of 10. Projects that do not fit either category are given a score of 0 for this factor. The score for quick implementation potential is given a weight of 1.0.

Category 6: Treatment of an Existing Drainage Problem or Identified Hotspot

Occasionally, potential retrofit sites are located where a drainage problem or pollution hotspot already exists, and the retrofit will help solve the problem. Projects that will address an existing drainage problem or pollution hotspot receive a score of 10, while projects that do not receive a score of 0. This factor is given a weight of 0.5.

Category 7: County Maintenance Burden

Potential retrofits that are expected to have a high maintenance burden are given a lower score for this factor. For the most part, the level of maintenance required is based upon the type of retrofit implemented (**Table 4**). High maintenance burden projects are given a score of 0, medium maintenance burden projects are given a score of 5, and low maintenance burden projects are given a score of 10, as shown in the table below.

Table 4. Maintenance Burden Scoring Scheme	
High = 0 pts	Street Bioretention, Permeable Pavement
Medium = 5 pts	Bioretention, Dry Swale*,Filtering Practices, Rain Garden, Rainwater Harvesting, Tree Pits, Underground Detention Retrofit, Wet Swale
Low = 10 pts	Bioswale*, Constructed Wetland, Downspout Disconnection, Grass Channel*, Impervious Cover Removal, Sheetflow to a Conservation Area, Stormwater Planters
*If located along a street, practice is to be treated as a Street Bioretention	

The score for County maintenance burden is given a weight of 0.5.

Category 8: Educational Opportunity

Potential retrofits that represent good educational opportunities are given a higher score for this factor. Retrofits that can include educational signage, including residential streets with sidewalks, receive a score of 5, retrofits in parks receive a score of 8, and retrofits at schools receive a score of 10. This factor is given a weight of 0.5.