Appendix D. Water Quality Volume Peak Discharge

The peak rate of discharge for individual design storms may be required for several different components of water quality BMP design. While the primary design and sizing factor for most stormwater runoff reduction BMPs is the design Water Quality Volume (WQV), several design elements will require a peak rate of discharge for specified design storms. The design and sizing of pretreatment cells, level spreaders, by-pass diversion structures, overflow riser structures, grass swales, and filters all require a peak rate of discharge in order to ensure non-erosive conditions and flow capacity.

The peak rate of discharge from a drainage area can be calculated from any one of several calculation methods. The NRCS TR-55 Curve Number (CN) methods (NRCS TR-55, 1986) are very useful for characterizing complex sub-watersheds and drainage areas and estimating the peak discharge from large storms (greater than two inches), but can significantly underestimate the discharge from small storm events (Claytor and Schueler, 1996). Since the WQV is based on a half-inch or one-inch rainfall, depending upon the best management practice (BMP), this underestimation of peak discharge can lead to undersized diversion and overflow structures, potentially bypassing a significant volume of the design WQV around the BMP. Undersized overflow structures and outlet channels can cause erosion of the BMP conveyance features which can lead to costly and frequent maintenance.

Rather than the CN Method, the method recommended here is based on the approach used by the South Carolina Department of Transportation (SC DOT) for determining peak flow designs for Manufactured Treatment Devices (MTDs). SC DOT specifies that the 1.8-inch, 1-year, 24-hour storm event be used to size water quality devices (as pollutant removal effectiveness for this storm event equates roughly to annual performance). 1.8-inch, 1-year, 24-hour storm event is known as the Water Quality Event (WQE). The following provides a step by step procedure for calculating the WQE peak rate of discharge (Q_{pWQE}):

Step 1: Estimate peak rainfall intensity using South Carolina Department of Transportation (SC-DOT) Designation SC-M-815-13 (8/11) using:

$$i = \frac{a}{(b + t_c)^c}$$

where

i = the rainfall intensity (inches per hour)

t_c = the time of concentration (minutes)

a = water quality event coefficient = 135.65

b = water quality event coefficient = 40.2

c = water quality event coefficient = 1.0863

Step 2: Use the resulting rainfall intensity from Step 1 in the Rational Formula.

$$Q_{pWQE} = C \times i \times A$$

where

Q_{pWQE} = the WQE peak rate of discharge (ft^3/s),

C = the rational method runoff coefficient (not to be confused with the c value from Step 1)

i = the rainfall intensity from Step 1 (in/hr)

A = the contributing drainage area (acres)

The resulting Q from the Rational Formula represents the peak discharge for the WQE, and should be used when a peak rate of discharge is needed instead of a volume for sizing water quality practices and components.

Water Quality Volume and Peak Discharge References and Additional Resources

1. Claytor, R. and T. Schueler. 1996. *Design of Stormwater Filtering Systems*. Chesapeake Research Consortium and the Center for Watershed Protection. Ellicott City, MD. http://www.sciencetime.org/ConstructedClimates/wp-content/uploads/2013/01/ClaytorSchueler1996.pdf
2. Pitt, R., 1994, Small Storm Hydrology. University of Alabama - Birmingham. Unpublished manuscript. Presented at design of stormwater quality management practices. Madison, WI, May 17-19 1994.
3. SCDOT, 2011. Supplemental Technical Specification for Stormwater Manufactured Treatment Devices (MTDs). SCDOT Designation: SC-M-815-13 (8/11).
4. United States Department of Agriculture Natural Resources Conservation Service *Urban Hydrology for Small* Watersheds *TR-55.* June 1986.