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STORMWATER

The regulatory landscape for stormwater management is in the midst of significant changes. As regulations and our understanding of stormwater continue to evolve, the sector is faced with considerable opportunities and challenges associated with how best to address the water quality and quantity impacts from stormwater runoff in a technically sound and cost-effective manner, the author writes. One approach the Environmental Protection Agency has tried is through the Total Maximum Daily Load program, but a federal court in Virginia rejected that approach in a recent decision. Some have argued that through this approach, EPA is effectively trying to regulate water itself. This view does not correctly reflect the nuances of the agency's approach or of this case. This article provides technical details to dispel misunderstandings of the nature of the ruling, explores the issues surrounding stormwater management, and offers suggestions for better approaches for addressing a growing source of water pollution nationwide.

Square Peg in a Round Hole: Are Flow-Based TMDLs the Wrong Approach to Manage Stormwater Runoff?

By Seth Brown

I. Introduction

The regulatory landscape for stormwater management is in the midst of significant changes. As regulations and our understanding of stormwater continue to evolve, the sector is faced with considerable opportunities and challenges associated with how best to address the water quality and quantity impacts from stormwater runoff in a technically sound and cost-effective manner. Attempting to fit this square peg of water pollution into the round hole of existing regulatory programs was the issue raised in the recent Accotink Creek Total Maximum Daily Load (TMDL) case, which focused on the use of stormwater runoff as a surrogate for legally recognized pollutants.[1] This case has spawned a wide range of opinions on the potential implications of the ruling, especially as it relates to the ability of EPA to regulate stormwater flow.

This article will review the technical, legal and regulatory details of this case as well as provide some historical context on how stormwater regulations have evolved, and lastly to discuss potential implications that

[1] *Virginia DOT v. EPA*, E.D. Va., No. 1:12-cv-775, 1/3/13.

this ruling may have on stormwater regulation in the future.

II. Background

A. Defining Stormwater

The term ‘‘stormwater’’, broadly refers to discharges of runoff from landscapes due to precipitation inputs, such as rainfall or snow melt. Some of this precipitation is intercepted by vegetation; however, most rainfall (in situations outside of dense forests) ends up in direct or indirect contact with the landscape. The land surface acts as a sponge by soaking up the initial volume of precipitation resulting in no or little runoff until the ground becomes saturated. This initially retained volume is referred to as ‘‘storage’’ by hydrologists, and after this amount is exceeded, water runoff is generated. As water washes across the landscape, constituents are transported to downstream areas. In pristine settings, a relatively small amount of runoff (or none at all) is generated from most storm events; however, land use changes can affect this. For instance, the removal of forested areas and the introduction of agricultural tilling practices will increase runoff. The amount of discharge will be further increased with the onset of impervious surfaces, such as rooftops and parking lots, associated with urbanization activities. This increase in runoff alters site hydrology and redistributes the balance of flows between runoff, vegetative capture and uptake and shallow/deep groundwater recharge. Not only does runoff volume increase, but so does the rate of runoff flowing through systems. Water conveyed across parking lots, into pipes and through concrete-lined channels travels at a higher velocity than in pristine conditions. The coupled effect of more runoff volume being delivered at a higher rate leads to significant flooding problems as well as severely eroded streams. Not only is the rate and volume of impacted stormwater runoff an issue, but so is the quality of that runoff. As runoff flows across these affected landscapes, they convey pollutants that are either embedded in the top layer of soil, such as nutrients used to fertilize agricultural fields, or that reside on the ground surface, such as oil and gas on parking lots released from automobiles or air-deposited brake dust containing heavy metals on roadsides.

B. Technical Aspects of Stormwater Management

Most early stormwater programs targeted the first 0.5 inches of runoff, which is commonly referred to as the ‘‘first flush’’ because studies done in the early 1980s, most notably the National Urban Runoff Program (NURP) study (U.S. EPA, 1983), contended that this volume usually transports the majority of land-stored pollution through urban runoff. As mentioned above, the focus of prior efforts to manage stormwater runoff was on water quantity (flooding) concerns, which led to a design philosophy of removing the runoff from the landscape as quickly as possible and conveying this runoff through engineered (and impervious) flow paths. In areas with chronic flooding, the stormwater flows would be conveyed to detention basins designed to reduce peak discharges for a specific design storm, which in many instances was the 10-year storm (the statistically largest storm event that would occur within a 10-year period, or converse is that this event has a 10 percent chance of occurring in any year). The target of this flood control was often set to maintain pre-development (conditions prior to a specific project) discharge levels in urban areas. The NURP study highlighted that both the quantity and quality of runoff should be of concern, and helped to drive the need for the inclusion of stormwater runoff in the National Pollutant Discharge Elimination System program. The reliance on detention, most often by temporarily holding runoff in ponds to attenuate peak discharges, continued in many programs with thresholds for design storms reduced to smaller events, such as the 2-year storm. The rationale being that runoff detained in ponds not only reduced flooding, but also facilitated sedimentation to reduce the downstream transport of pollutants, many of which adsorb onto the surface of suspended sediment. This approach, while providing additional treatment of runoff, neglects the impacts of high-frequency events, such as the 2-year storm, on headwater streams.

Fluvial geomorphology is the study of river system processes focusing on formation of natural channels and the interaction between water flow and sediment transport. A fundamental element of this field is the concept of a ‘‘channel-forming’’ discharge (often referred to as the ‘‘effective’’ or ‘‘bankfull’’ discharge). Intuition tells us that this discharge must be associated with large-scale flooding events, such as the 100-year discharge. Science, however, shows us that this intuitive understanding is incorrect. The channel-forming discharge represents the erosive flow in a channel that occurs frequently enough to transport the most sediment over a long period of time (i.e., 100 years, etc.). Counter to intuition, outside of steep mountainous streams, this discharge is associated most commonly with the 1.5-year discharge (Biedenharn *et al.*, 2001; Dury, 1973; Hey, 1975; Leopold, 1994; Leopold and Wolman, 1957), and can be an even smaller discharge, such as that associated with the 1-year or even 6-month storm, for urbanized areas (Johnson and Heil, 1996). Considering this fact, it is not surprising that headwater streams (which comprise 80 percent of total stream miles in the world) downstream of detention ponds releasing 2-year flows continue to erode at high rates. This erosion generates high amounts of sediment within stream systems–often many times more than that delivered from the land surface (Simon and Klimetz, 2008; Trimble, 1997; Wilson et al., 2007) . Erosion rates are even higher when channels are exposed to artificially long durations of erosive flows that occur at the outfall of detention ponds. Bledsoe (2002), et al (MacRae, 1997; MacRae and Rowney, 1992) have done extensive work on the impacts of erosive flows for extended duration in urban streams. In fact, there has been so much damage done to urban streams from a lack of adequate runoff control that an entirely new field has arisen, stream restoration, which focuses on restoring severely impacted headwater and medium order streams.

Stormwater management has evolved, to some degree, beyond the detain-and-release approach. For instance, some programs have instituted the approach to design ‘‘extended detention’’ facilities, which hold runoff for a specific duration (24-48 hours in most cases) to provide enhanced pollutant removal. Practices incorporating vegetation, such as ‘‘wet’’ basins (ponds that hold water at all times) and constructed wetlands, provide even more treatment potential, especially for heavy metals and nutrients through vegetative uptake and processing. Other advancements have occurred, such as in the proprietary device field with the development of products such as hydrodynamic separators, sand filters, and underground treatment chambers to address stormwater management in ultra-urban settings. But perhaps the most significant advancement in stormwater management has been Low Impact Development (LID), which utilizes small, distributed and often vegetated systems that encourage retention of runoff from a site or an area. This approach is akin to pollution prevention, because reducing the amount of runoff generated from a developed site (through practices such as reduction of impervious cover, enhanced infiltration and rainwater harvesting) also addresses the mechanism that transports land-based pollution (runoff) from a site. This approach provides the additional benefit that it attempts to re-establish groundwater flows, which feed stream baseflow and improve aquatic habitat, and also reduces the volumes of runoff discharged to headwater streams, which are often severely impacted by the release of erosive flows from more traditional stormwater infrastructure. This approach, which reduces stormwater runoff volume, is currently being adopted by many large municipalities, such as Philadelphia, Seattle, and Chicago, who struggle with combined sewer overflows (CSOs). In this context, this approach is often referred to as Green Infrastructure (GI). While the use of LID and GI has been shown to provide effective runoff treatment and volume reduction, it is still a nascent approach that has not been widely accepted. Barriers to wider implementation of these practices include the perception of costliness and concerns over long-term performance and operations/maintenance issues.

C. Stormwater Regulations

1. NPDES MS4 Program

In 1990, stormwater was first federally regulated under the NPDES program, a Clean Water Act program designed to control point-source pollution. This regulatory change reflected the amendments to the act included in the Water Quality Act of 1987. Prior to this time, urban drainage design focused on addressing impacts to infrastructure and property damage as well as concerns with public safety associated with flooding events. The 1990 change to the NPDES program was the first time that water quality of stormwater runoff was addressed at the federal level.

The first wave of stormwater regulations, referred to as Phase I, included large municipal separate storm sewer systems (MS4s), industrial stormwater discharges in large urban areas, and construction sites greater than 5 acres. In 1999, Phase II regulations lowered the population threshold for inclusion of MS4s, increased requirements for industrial stormwater dischargers, and reduced the threshold for construction sites to 1 acre. EPA also introduced six minimum control measures for general permits, including public education and outreach requirements, public involvement and participation, illicit discharge detection and elimination, construction site runoff control, new development and redevelopment treatment requirements, and pollution prevention. In their permits, MS4s select best management practices (BMPs) to address pollutants of concern using technology-based treatment requirements that assume BMP efficacy based on technical literature or manufacturer information for proprietary devices.

However, despite the inclusion of urban runoff in the NPDES program as well as technical advancements in the stormwater sector, pollution associated with stormwater continues to increase as other point-source pollutants decrease in many major U.S. watersheds (U.S. EPA, 2004). To address the growing problem of stormwater pollution, the EPA requested that the National Research Council (NRC) review the existing stormwater regulatory program in 2009, and provide recommendations. These results were documented in a report titled *Urban Stormwater Management in the United States* (NRC, 2009). In this document, the NRC advises that stormwater volume or impervious cover serve as proxies for pollutant loading, and that municipalities address the full-distribution of flows, not just effluent peak flows. The report also called for improved monitoring methods and more BMP data. In 2010, EPA began a formal rulemaking to update and improve the stormwater program.

The proposed rule is slated for release in June of this year. An expected focal point for this regulatory change is the implementation of the first national stormwater performance standard, which is anticipated to be based upon on-site retention of stormwater runoff – in other words, a flow-based standard.

2. Stormwater and the Total Maximum Daily Load Program

a) Overview of TMDL Program

Another program within the Clean Water Act that addresses point and nonpoint pollution is the Total Maximum Daily Load (TMDL) program. Section 303(3) of the act requires states to develop lists of impaired waters (those not meeting assigned water quality standards) in order to develop remedies to address the sources of impairments by limiting the pollutant daily loads that will lead to the attainment of water quality standards within the water body. The premise of this program is that Waste Load Allocations (WLA, regulated pollutant sources) and Load Allocations (LA, unregulated pollutant sources) are determined within a watershed with the goal of quantifiably identifying pollution reductions needed to meet the impaired water body's assigned water quality standards. Traditionally, a water body has an identified impairment for specific pollutants, such as sediment, heavy metals or bacteria. EPA states that ''throughout the U.S., there are thousands of waters listed for impairments from stormwater sources . . . the most common pollutants. . .include sediment, pathogens, nutrients, and metals.'' (U.S. EPA, 2007a). Further, EPA explains that, ''when (a) TMDL is implemented, the stormwater wasteload allocation is implemented via the NPDES stormwater permitting system.'' In other words, a municipality with an MS4 permit is required to incorporate the required pollutant reductions as spelled out in a TMDL document for water bodies within its jurisdiction.

b) Technical Basis for Stormwater Surrogates

To address stormwater source impairments, some states have developed ''flow-based TMDLs'', which use stormwater runoff (flow) or impervious cover as a surrogate or proxy for impairments such as sediment and biological condition. Examples of this approach include Eagleville Brook (Conn.), Barberry Creek (Maine) and Potash Brook (Vt.), all located in EPA Region 1 (Northeast), and Hinkson Creek, Columbia, (Mo.) along with Pearson and Wilson/Jordan Creeks in Springfield (Mo.). The Eagleville Brook TMDL is an example of the application of the Impervious Cover (IC) method, which has been used in a number of other cases, primarily in EPA Region 1, which identified this method as ''potentially useful, innovative TMDL approach for water bodies impaired by stormwater'' (ENSR, 2005). This method is targeted for watersheds with 9 percent or greater total impervious cover and most commonly addresses aquatic biota/benthic and sediment impairments. The 9 percent impervious cover threshold is tied to the commonly held view that watersheds with 10 percent impervious cover or more are generally considered impaired, while watersheds with 25 percent impervious cover are often severely impaired (Schueler, 1994). More recent studies, such as the U.S. Geological Survey study titled, *Effects of Urban Development on Stream Ecosystems in Nine Metropolitan Study Areas Across the United States*, show that watersheds can become affected at even lower levels of imperviousness, such as 2-5 percent as a lower threshold (Coles et al, 2012). Another surrogate approach is the use of Load Duration Curves (LDC) to associate stormwater runoff with sediment generated. This method is described in detail in the EPA document, *An Approach for Using Load Duration Curves in the Development of TMDLs*, (EPA, 2007b):

> The duration curve is more appropriate in cases where flow is a primary driver in pollutant delivery mechanisms, and other processes are a relatively insignificant part of the total loading. Flow, in many cases, is the principal force behind habitat modification, stream bank erosion, and other concerns preventing attainment of designated uses.

The approach analyzes the cumulative frequency of stream flows over a specific period to express the relationship between flows and associated water quality loadings. The development of LDCs is related to Flow Duration Curves (FDCs) in a system. Typically, FDCs utilize daily average flows which are sorted high to low and plotted using a semi-log plot (see Figure 1). In this example, taken from the 2007 (b) EPA document, the discharge of 440 cubic feet per second is highlighted. In this context, the highlighted flow has a value of 60, which means that 60 percent of daily average flows equal or exceed this amount. To develop an LDC, simply multiply the FDC by the targeted numeric water quality goal (water quality standard) and apply required unit conversion. An example is shown in Figure 2.

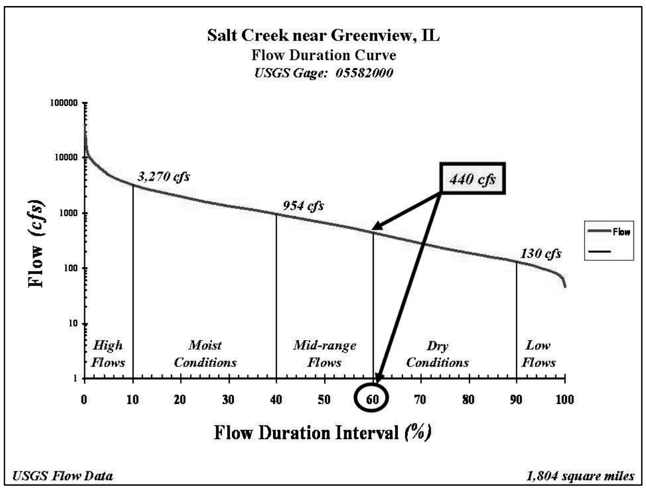

Figure 1: Example of a Flow Duration Curve (EPA, 2007b)

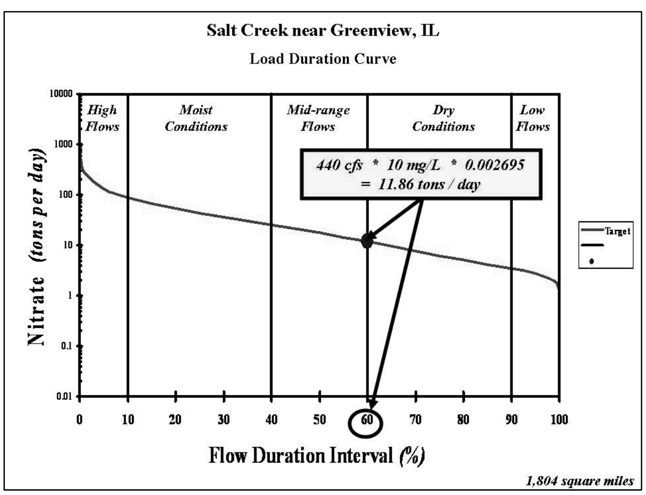

Figure 2: Example of a Load Duration Curve (EPA, 2007b)

c) Policy Basis for Stormwater Surrogates

The basis for including regulated stormwater discharges in Waste Load Allocations (WLAs) are found in a 2002 U.S. EPA memo, which clarifies that discharges from MS4s fall under the NPDES regulatory program, and therefore, are considered to be regulated point sources. This point source designation for both Phase I and Phase II communities allows flows from these entities to be included in WLAs and that the results of a completed TMDL must be incorporated in MS4 permits. As highlighted previously, since 2002, there have been several examples where WLAs in stormwater TMDLs have been based upon surrogates. The basis for this use is likely the term ''other appropriate measure'' in 40 C.F.R. 130.2(i), as is noted in the Hinkson Creek TMDL document. This phrase comes from a section of code that describes the various ways that TMDLs can be expressed (''in terms of either mass per time, toxicity, or other appropriate measure''). The employment of surrogates is further reinforced by an EPA memo released in November 2010 that was intended to be a revision of the 2002 memo. The 2010 memo states: ''Since the stormwater-source impairment is usually the result of a cumulative impact of multiple pollutants and physical effects, it may be difficult to identify a specific pollutant causing the impairment. Using a surrogate parameter in developing wasteload allocations for water impaired by stormwater sources may, at times, be the appropriate approach for restoring waterbodies.'' The memo then cites many of the same flow-based TMDLs discussed in this article as examples of this accepted approach. The reaction to the 2010 memo from the water quality sector was immediate and strong. The Water Environment Federation and other groups in the sector provided comments to EPA questioning this policy change to support the use of surrogates and noted that the change was made with little or no input from the sector. Due to the strong reaction, EPA pulled the memo back and submitted this document to the White House Office of Management and Budget for review, where it remains today.

III. The Accotink Creek TMDL

A. Background and the Ruling

Accotink Creek is a 25-mile long tributary of the Potomac River located in the Northern Virginia suburbs in the Washington, D.C. metro area. Two segments of Accotink Creek were listed on the state of Virginia's 2008 303(d) list of impaired waters for failing to attain the Commonwealth's aquatic life designated use. The lower segment of Accotink Creek was first listed for this impairment in 1996 and has remained on all subsequent lists while the upper segment was added in 2008. Both segments were identified as not meeting aquatic life use due to poor health in the benthic biological community. Potential pollutant stressors impacting the benthic community identified include nutrients, toxicity, metals, stormwater runoff and sediment. The most probable stressor was identified as sediment caused by excessive stormwater runoff. What makes this TMDL unique is that EPA Region 3, not the commonwealth of Virginia, led the study and developed the document. This was due to a consent decree among EPA, the American Canoe Association Inc., and the Littoral Society requiring the development of TMDLs for all impaired waters identified on Virginia's 1998 303(d) list. This agreement stated that Virginia was to complete these TMDLs (Accotink Creek was included in this list) by May 2010. When the Commonwealth failed to meet this deadline, EPA was required to finalize the TMDL by May 2011 in accordance with the terms of the consent decree. On April 18, 2011, EPA established a TMDL for Accotink Creek based on stormwater flow in order to reduce sedimentation in the creek. In July 2012, the Virginia Department of Transportation and the Fairfax County Board of Supervisors (collectively Virginia DOT) filed a lawsuit in U.S. District Court for the Eastern District of Virginia based on the following question: Does the Clean Water Act authorize EPA to regulate the level of a pollutant in Accotink Creek by establishing a TMDL for the flow of a nonpollutant into the creek? The court reviewed EPA's decision pursuant to the two-step analysis set forth in *Chevron U.S.A. Inc. v. NRDC* 467 U.S. 837, 21 ERC 1049 (1984): the first step is to determine whether Congress addressed the precise question at issue and, the second step is to determine if EPA's interpretation of the Clean Water Act was permissible. Based upon this analysis, on Jan. 3, 2013, the court ruled that stormwater runoff could not be used as a surrogate for other pollutants to meet a TMDL (*Virginia DOT v. EPA*, E.D. Va., No. 1:12-CV-775, 2013 BL 2384). The ruling went further by specifying that other ''nonpollutants'' could also not be used as proxies for legally recognized pollutants. With regard to the first Chevron test, the court cited U.S.C. 1313(d)(1)(C), which states that, ''the total maximum daily load, for those pollutants which the Administrator identifies,'' and that '''pollutants'' is statutorily defined by 33 U.S.C. 1362(6), which is not ambiguous in the eyes of the court and does not include stormwater runoff.'' The court held ''EPA may not regulate something over which it has no statutorily granted power – annual loads or nonpollutants – as a proxy for something over which it *is* granted power – daily loads or pollutants.'' Furthermore, the court held that even if step one of Chevron were met, the case could not meet the second step of Chevron, which is the determination of EPA's interpretation of the statute as being ''permissible.'' The court stated:

> EPA has approved 3,700 TMDLs for sediment nationwide, and in Virginia has addressed 111 benthic impairments with TMDLs. None of them regulated the flow rate of stormwater. By comparison, EPA has tried . . . regulating sediment via flow in four instances nationwide, and all four attempts were challenged in court. One has settled, the other three are still pending.

Regarding the use of surrogates in TMDLs, the judge refers to this practice as, ″mere bootstrapping″, and highlights the fact that the recent ruling of Friends of the Earth v. EPA (446 F.3d 140, 62 ERC 1161 (D.C. Cir. 2006)), which denied the use of defining loads in TMDLs in terms of seasonal or annual loads, illustrates another example of a ″similar attempt by EPA to take liberties with the way Congress intended to express its TMDLs.″ EPA had until March 3 to appeal the decision, but declined to do so, meaning the ruling will stand. The lack of appeal may signal that EPA is not confident in the success of an appeal based upon technical merits of the case. Also, if EPA viewed this ruling as a potential threat to its ability to regulate flow under the NPDES program, we would likely expect an appeal. The lack of an appeal may illustrate that EPA does not perceive a legal leakage of this case outside of the TMDL context and into the NPDES program.

B. Technical Information on the Development of the TMDL

The Accotink Creek watershed is located within Fairfax County, the City of Fairfax and the Town of Vienna, Virginia. The watershed is a typical urbanized watershed in the Mid-Atlantic region–a high amount of medium-to-high density residential development (35 percent), a significant amount of roadway (15 percent), and some institutional and commercial areas (11 percent) resulting in a 25 percent impervious cover across the watershed. Most significant of all, there is very little stormwater management throughout the watershed. Over 70 percent of the soils in the watershed are D type soils with an additional 10 percent in the C-type category, which illustrates the poor draining nature of the shed under natural conditions. The watershed is 47.9 square miles in size and exhibits a fair amount of relief as it drains from an elevation of 492 feet to 7 feet above mean sea level. The combination of significant urbanization, high relief, and poor-draining soils leads to a situation where streambanks and beds throughout the system experience high amounts of stress–and this is exacerbated by the lack of stormwater management in the system.

The goal of addressing stormwater runoff during the window when a majority of the land development activity occurred in the watershed, between the 1950's and 70's, was to drain runoff from parking areas and roadways as efficiently as possible. As previously discussed, little thought was given to managing peak flows from development, and the treatment that was provided in this era targeted primarily large, infrequent events, not the events associated with channel-forming discharge (1-1.5 year events). Also, the focus of stormwater management at that time did not address stormwater runoff quality, let alone the impacts of increased stormwater runoff volume on headwater streams. The result—as the Fairfax County Accotink Creek Watershed Management Plan report states—is a situation in which 91 percent of the channels are unstable and experience severe stream bank erosion. (Fairfax County, 2011)

In making the case for the relationship between flow and sediment loads in the TMDL, EPA refers to a metric termed the ''logarithmic ratio of bed stability'' (LRBS), which is a normalized number that relates stream power (in a technical sense) to predicted or expected sediment size distribution. An LRBS near zero indicates a physically stable stream, while positive numbers indicate the accumulation of sediment within the stream, and negative terms indicate channel-eroding conditions. Values for LRBS have been collected across Virginia to develop distributions and the values found within Accotink Creek, as mentioned in the TMDL document, ''are some of the most positive LRBS numbers recorded statewide.'' This finding translates to severely eroding streams, even beyond the type of erosion one would expect to see in mountainous streams in the region.

The results arrived at in the Accotink Creek TMDL were based upon LDCs focusing on sediment, which express the relationship between stream flow stream sediment loadings, as well as FDCs. The TMDL allocations were established using the one-year, 24-hour discharge, as this rate approximate the channel-forming discharge in urban settings, as previously discussed, and therefore generates significant amounts of in-stream sourced sediment. Similarly, this discharge can adversely impact benthic communities, and it also it coincides with proposed standards for Virginia's stormwater program, which would make the implementation of the load reductions more easily integrated into MS4 programs.

An ''attainment watershed'' or ''attainment stream'' approach was used in the TMDL development for Accotink Creek. This approach focuses on determining the flow regime associated with watersheds attaining water quality standards and are of a similar nature and within the region of the study watershed in order to provide a baseline or a reference for attainment goals. Using this approach, Flow Duration Curves and Sediment Rating Curves developed for Accotink Creek and two other attainment watersheds (Buffalo Creek and Catoctin Creek) in the region that are currently meeting water quality standards consistent with Accotink Creek. These watersheds are dominated by forested and agricultural land coverage. The values for Accotink Creek were compared with the attainment watersheds to determine the flow could be generated within the Accotink Creek watershed while still meeting water quality standards. From this analysis, it was found that the existing unit-area flow rate of 1,321.7 ft^3/acre-day has to be reduced down to 681.8 ft^3/acre-day in order to meet water quality standards—a 48.4 percent reduction in flow.

IV. Analysis

A. Technical Considerations

The attainment watershed approach is used in situations where the basis of the impairment or the pollutant of concern is directly related to the flows generated in the study watershed. For Accotink Creek watershed, the relationship between sediment and flow is the basis for the TMDL and compared with two watersheds that are attaining aquatic life use for benthic macroinvertabrate community water quality standard. With this in mind, it is critical that the hydrologic nature of study and attainment watersheds be comparable in key aspects; however, there is a significant difference between the Accotink Creek watershed and the attainment watersheds. As previously noted, the soils in the study watershed are dominated (70 percent) by poorly-draining Hydrologic Soil Group (HSG) D-type soils. The Natural Resources Conservation Service (NRCS) states that, ''soils in this group have high runoff potential . . . water movement through the soil is restricted or very restricted'' (USDA, 2007). To contrast, the soils in both attainment watersheds are dominated by B- and C-type soils – 53 and 35 percent for Buffalo Creek and 70 and 21 percent for Catoctin Creek, respectively. The NRCS describes these soils as those that ''have moderately low runoff potential . . . water transmission through the soil is unimpeded'' for B-type, and, ''have moderately high runoff potential . . . water transmission through the soil is somewhat restricted,'' for C-type soils. Considering this significant difference in dominant soil types, the flows generated by similar inputs (i.e., storms) would differ regardless of the land cover within the watershed.

B. Policy Considerations

If the ruling on the Accotink Creek case had been different, Fairfax County and other impacted MS4s would be required to reduce their 1-year, 24-hour discharges by nearly 50 percent. The practical ability to meet this target is nearly impossible using current technologies and considering other constraints. The Accotink Creek watershed is 87 percent developed (Fairfax County, 2011), leaving little opportunity to reduce flows through new development, therefore, flow reduction would occur either through active retrofitting of existing developments or when redevelopment occurs. The ability to provide significant flow-reduction is limited for either option when compared to new development. Also, if the Accotink Creek watershed was less developed, the D-type soils would greatly limit the ability to use infiltration-based practices to obtain flow reduction. The use of attainment watersheds dominated by better draining soils (compared with Accotink Creek watershed) provide a load reduction that is unrealistic for the study watershed.

Interestingly, the Accotink Creek watershed TMDL report mentions a number of funding sources within the watershed and highlights stream restoration projects that have been completed by the City of Fairfax as well as Fairfax County's watershed plan program, which proposes numerous stream restoration projects within the watershed. While there are sources to fund stormwater projects within the watershed, there is no discussion on the magnitude of funding required to address the level of flow reduction proposed, and there is also no discussion on the practical ability to do so considering the poorly-draining soils within the watershed. The plan to reduce sediment delivery within the watershed through restoration of headwater streams, as performed by the City of Fairfax and as planned by Fairfax County, seems to be a more reasonable manner of addressing sediment loads in the watershed. These projects; however, will not reduce flow volumes, so it is curious that the TMDL report highlights this type of work.

So while we know that increased flow rates and volumes ultimately lead to entrenched and incised headwater streams, it may be too challenging to put a defined number on just how much is ''too much'' with enough certainty to make the results meaningful in any pragmatic way. Yet that is the exact goal of a TMDL. The TMDL program, unlike the NPDES program, works from resulting impacts (water quality standards in receiving streams) and works backwards, or upstream, to determine the allocated loads allowed to avoid these impacts, and it does so with no or little consideration of pragmatic and financial dimensions. The NPDES MS4 program, by contrast, is iterative and uses more flexible goals to address the impacts of stormwater runoff. Unlike wastewater discharges, the loads generated from runoff cannot be addressed by updating a process in a plant or building an underground storage facility. Stormwater, on the other hand, is located ''outside of the fence''–on private property and on public lands owned and operated by numerous agencies. The practical ability to address the loads associated with stormwater is tied to land use policies, land development activities, and intergovernmental coordination. The MS4 program has been established to work within this framework and to respect the challenges of addressing stormwater impacts while still moving forward to improve water quality. The plantiffs most likely entered into this case not because they are against progressive stormwater management, but because they recognized that the ability to meet the target reduction was unrealistic within their financial and technical frameworks. Also, these groups are already addressing stormwater impacts through innovative programs that work within pragmatic constraints. The Accotink Creek ruling may have highlighted that stormwater, as a complex and variable pollutant source, would be best regulated the under the NPDES program, and not through TMDLs. In the case of Accotink Creek, the affected regulated stormwater communities are already working on addressing stormwater impacts through the MS4 program, and seem to be doing so in a more practical and sensible manner.

Beyond this is the question of the ability to regulate flow (as a surrogate) in the TMDL program as well as in other regulatory programs, such as the NPDES MS4 program. It is hard to see how the Accotink Creek ruling will not impact other flow-based TMDLs, both those which are finalized and those that are currently being developed. EPA Region 7 has developed three other TMDLs for flow in Missouri, all of which have been legally challenged. Last year, EPA settled one case by agreeing to drop the flow-based surrogate for the Hinkson Creek TMDL. The others are still pending. EPA will likely move away from the use of surrogates such as flow or impervious cover in TMDLs, and tie them to pollutants such as sediment, which provides a clearer relationship between co-pollutant loadings. As previously presented, EPA is currently engaged in rulemaking to update the stormwater program, and it is expected that this will result in the first national performance standard for stormwater management–and it is anticipated that it will be flow-based. One interpretation of Section 402(P)6 of the Clean Water Act is that stormwater discharges are ''to be regulated to protect water quality,'' therefore, the downstream impacts of uncontrolled stormwater can be addressed through a variety of methods, including limiting the generation of runoff volume through a retention standard. Another interpretation is that the NPDES program was established to reduce pollutants that are discharged from a point source, such as an MS4. This view hinges upon the fact that runoff is not a pollutant, and that the ability to regulate discharge ends at the pipe, regardless of downstream impacts from excessive runoff.

V. Conclusion

Considering the questions in this case it is evident that the vehicle that has led to so much improvement of our water environment, the Clean Water Act, needs to be re-tooled to meet the water quality challenges of today and the future. A significant change for the better could include the development of a regulatory program for stormwater runoff that respects the unique nature of this growing source of water pollution. This may include clarifying that excessive stormwater runoff, while not being a pollutant, does generate significant amounts of pollution, and should therefore be controlled and managed like a pollutant.

Housing the MS4 program in EPA's Office of Wastewater Management is a relic of a regulatory approach that views stormwater as a sub-topic of wastewater. This reflects a fundamental misunderstanding and mischaracterization of the nature of stormwater runoff and the scale that this pollution source plays in impacting the nation's waters. William Ruckelshaus, the highly respected first EPA administrator, recently pointed out that while 85 percent of water quality impairments across the country at the time of the creation of the Clean Water Act were point source in nature (industrial and wastewater effluent, etc.), the exact converse is now true—85 percent of impairments are caused by nonpoint sources. (*Wall Street Journal*, April 17, 2010) Managing nonpoint pollution fully requires us to address the elephant in the room—agricultural runoff—as well as urban stormwater sources. In the article mentioned above, Mr. Ruckelshaus concludes that there is hard work to be done to bring together various stakeholders, often with competing interests, to effectively address agricultural and urban stormwater pollution. In citing the fact that we have done this before, Mr. Ruckelshaus provide us with the inspiration to know we can do the hard work necessary to continue to improve our water environment again.

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