International Municipal Lawyers Association
2014 Annual Conference
Baltimore, Maryland

September 11, 2014

Stormwater Management:
A Chesapeake Bay Watershed Context

Lee R. Epstein
Chesapeake Bay Foundation
Annapolis, Maryland, USA

©2014 International Municipal Lawyers Association. This is an informational and educational report distributed by the International Municipal Lawyers Association during its 2014 Annual Conference, held September 10-14, 2014 in Baltimore, MD. IMLA assumes no responsibility for the policies or positions presented in the report or for the presentation of its contents.

Introduction and Context

The Chesapeake Bay is a national treasure, but it has been suffering for decades from excess nitrogen, phosphorus and sediment pollution. Today, the states of Maryland, Virginia, Pennsylvania, Delaware, West Virginia, and New York, the District of Columbia, and the Federal government are working together to reduce these pollutants to a healthy level. These reductions are making a difference in improved water quality and better habitat conditions. But the Bay and many of its tributary streams and rivers constitute an ecosystem still dangerously out of balance.

Polluted urban and suburban ("stormwater") runoff is a water quality problem of increasing magnitude across the United States. By the latter part of the last decade, such authorities as the National Academy of Sciences' National Research Council,[1] the U.S. Environmental Protection Agency ("EPA"),[2] and Chesapeake Bay Program scientists,[3] all concluded that urban runoff poses an insidious and uniquely growing threat to waters of the Unites States, and particularly to the tidal Chesapeake Bay estuary and its upland rivers and streams. Among all other major sources, polluted runoff has been the source from which it is most difficult to obtain steady reductions.

In the Chesapeake Bay watershed, almost 4.9 million acres of land are developed, which is about 12 percent of the land that drains into the estuary's 64,000 square mile (166,000 square km or 16.6 million hectare) watershed. A little more than a quarter of this developed land, 1.3 million acres (526,000 hectares), is covered in pavement, roofs, and other surfaces that rain cannot penetrate.[4] Lawns and turf, some of which provide inadequate infiltration of runoff, cover up to 3.8 million acres (1.5 million hectares) (9.5 percent of the Bay watershed).[5] Increasingly, spread-out development, known as urban sprawl, is the pattern of development found across the watershed, which adds an estimated 38,000 acres of land development each year.[6] In Maryland, between 1973 and 2010, the population grew by 39 percent while the amount of developed land multiplied by 154%.[7]

---

[1] National Academy of Sciences, National Research Council, *Urban Stormwater Management in the United States* (2008), vii, available at http://www.epa.gov/npdes/pubs/nrc_stormwaterreport.pdf [hereinafter "Urban Stormwater"]. Indeed, according to that report, "Stormwater runoff from the built environment remains one of the great challenges of modern water pollution control, as this source of contamination is a principal contributor to water quality impairment of waterbodies nationwide." Urban Stormwater at vii.

[2] U.S. Environmental Protection Agency, Office of the Inspector General, *Development Growth Outpacing Progress in Watershed Efforts to Restore the Chesapeake Bay*, Evaluation Report No.2007-P-00031, September 10, 2007, Summary Recommendations.

[3] Chesapeake Bay Program, *Bay Barometer*, CBP/TRS 293-09, EPA-903-R-09-001 (March 2009), 8.

[4] Claggett, P., U.S. Geological Survey [USGS], Personal Communication, January 9, 2014.

[5] Schueler, T. and Claggett P., "The Clipping Point: Turf Cover Estimates for the Chesapeake Bay Watershed and Management Implications," *CSN Technical Bulletin No.8*, Chesapeake Stormwater Network (April 1, 2010), 5.

[6] Claggett, P., USGS, Personal Communication, June 25, 2012; Claggett, P.R. et al, "Estimating the Extent of Impervious Surfaces and Turf Grass Across Large Regions," *Journal of the American Water Resources Association*, 49(5) (2013).

[7] Maryland Department of Natural Resources, Fisheries Habitat and Ecosystem Program, "Land Conservation is Fish Conservation," http://www.dnr.state.md.us/fisheries/fhep/ (last viewed in November, 2013).

Stormwater Runoff as a Source of Pollution to the Bay

According to recent US EPA modeling, stormwater runoff accounts for 17 percent of the nitrogen pollution, 16 percent of the phosphorus pollution, and 25 percent of the sediment pollution in the overall Chesapeake Bay system; in some of the Chesapeake's tributary rivers, those numbers can reach much higher.[8] For example, model estimates indicate that Maryland stormwater delivers almost a third of that state's total nitrogen, phosphorus, and sediment pollution sent to the Bay[9].

By 2012, nearly 2,500 miles of rivers and streams in Pennsylvania, and more than 2,500 miles in Maryland, had been legally designated as "impaired" by polluted urban runoff under the federal Clean Water Act.[10] In the last nationwide expert assessment, stormwater runoff was reported to be responsible for more than 38,000 miles of impaired rivers and streams, almost a million acres of impaired lakes, and nearly 3,000 miles of impaired bays.[11]

Pollutants in Stormwater Runoff, and Environmental Effects

Polluted urban runoff comes from rainwater or snowmelt flowing off of hardened or "impervious" surfaces (rooftops, driveways, parking lots, roads and highways, and even compacted lawns) which prevent the water and pollutants from filtering slowly into the ground or being taken up by plants. Just an inch of rain running off an acre of hardened surface such as a road or parking lot produces 27,000 gallons (102,000 liters) of polluted runoff.[12] Environmental effects from this source of pollution are serious and long-lasting. Rainwater running off of pavement carries with it nutrients such as phosphorus and nitrogen, and pesticides and herbicides from nearby planted areas. Also running off pavement are toxic metals such as copper and zinc, oil and toxic petroleum products, animal feces, and dirt or sediment.[13]

Sediment is also produced in-stream, as the force and speed of water running off hardened surfaces carves deeply into stream-banks and stream-beds, creating incised streams with badly

---

[8] Chesapeake Bay Program, *Chesapeake Bay Watershed Model Version 5.3.2 2012-2013 Progress Runs* (March, 2014) [hereinafter "Progress Runs"].
[9] U.S. Environmental Protection Agency, *Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorus and Sediment* (December 29, 2010), §4.3, at 4-5, 4-6 [hereinafter "Bay TMDL"].
[10] Chesapeake Bay Foundation, *Polluted Runoff: How Investing in Runoff Pollution Control Systems Improves the Chesapeake Bay Region's Ecology, Economy, and Health* (January 2014), 7 [hereinafter "Polluted Runoff"].
[11] Urban Stormwater, 25.
[12] Water Education Foundation, "Aquapedia," http://www.aquapedia.com/?s=one+inch+of+rain&x=25&y=23 , last viewed on March 28, 2014.
[13] U.S. Environmental Protection Agency, *Protecting Water Quality from Urban Runoff* , EPA 841-F-03-003 (2003), http://www.epa.gov/npdes/pubs/nps_urban-facts_final.pdf , last viewed March 28, 2014; Maryland Department of the Environment, Water Management Administration, "Maryland's National Pollutant Discharge Elimination System Municipal Stormwater Monitoring (1997), 10.

eroding banks (what biologists call "urban stream syndrome"[14]). Sediment then clouds the water, clogs fish gills, and covers stream bottoms, making survival difficult or impossible for many species of macro-invertebrates, fish, and amphibians. Phosphorus (which attaches to sediment particles) and nitrogen over-enrich water-bodies, leading to algal growth and die-off, which in turn produce low oxygen/no oxygen conditions ("hypoxia/anoxia") where fish and other aquatic animals quite literally cannot "breathe." In the Bay during the summer of 2013, 22% of the water volume "went dead" (a bit more than the annual average), seriously reducing habitat for both fish and crabs.[15] In addition, the oxygen depletion killed benthic (bottom-dwelling) communities of worms and small shellfish that form critical elements in the Bay's food webs.

Other Impacts of Stormwater Runoff

There are direct impacts from stormwater runoff for humans as well. Stormwater running off urban and suburban areas can pollute public drinking water supplies, since many of our rivers and streams are either directly used for this purpose (after treatment) or feed reservoirs that are so utilized. Stormwater pollution increases the cost of treatment and filtration. For example, in the Washington, D.C. metropolitan area, "[t]he Washington Suburban Sanitary Commission is spending about $28 million to extend drinking water intake pipes farther into the Potomac River to avoid sediment and other runoff pollution near shore."[16] Polluted stormwater runoff also makes it unsafe for the public to use many streams, rivers, parts of the Chesapeake Bay, and other bodies of water around the country for contact recreation for at least 48 hours after a rainstorm. This is because bacteria in the runoff can cause illness in those who might come into contact with the water.[17] Fishing (especially for shellfish) can also be restricted at such times.

Inadequately managed runoff from impervious surfaces also causes local flooding. This is a nationwide problem. In 2008, flooding was estimated to cause $3 billion in property damages. The Federal Emergency Management Agency (FEMA) has estimated that up to 25% of economic losses from flooding occur in areas that are not technically designated as "floodplain" (i.e. not in areas immediately adjacent to a stream or river). This means that, in 2008 alone, up to $750 million in flood damages was likely the result of poorly managed stormwater runoff.[18] Climate change effects on weather patterns may in some parts of the country already be increasing the frequency or severity of storms that produce heavy rains, which can make these existing problems even worse.

---

[14] Walsh, Christopher J. et al., "The urban stream syndrome: current knowledge and search for a cure," *Journal of the North American Benthological Society*, 24(3):706-723 (2005).
[15] U.S. Environmental Protection Agency, Chesapeake Bay Program, at http://www.chesapeakebay.net/blog/keyword/dead_zone (last viewed May 15, 2014).
[16] Polluted Runoff, 9.
[17] Urban Stormwater, 26.
[18] James M. Wright, P.E., Federal Emergency Management Agency Training: *Floodplain Management-Principles and Current Practices* (2007-2008), Available online at: http://training.fema.gov/EMIWeb/edu/docs/fmpcp/Chapter%202%20-%20Types%20of%20Floods%20adn%20Floodplains.pdf , 1-4, 2-14.

Conclusions

Urban and suburban runoff pose real water pollution problems for the nation, and for the Chesapeake Bay watershed in particular. While remediation of already urban areas where stormwater management has been absent, or is inadequate or outdated, may sometimes be difficult and expensive, it is not impossible: modifying older practices that are already in the ground can be very cost-efficient. Promoting modern management practices to be employed during redevelopment, and combining the rehabilitation of streets, parking lots, and municipal facilities with up-to-date practices, can go a long way. State-of-the-art designs for both old and new development attempt to capture, treat or harvest runoff where it falls -- if possible, facilitating runoff's infiltration into the ground, using plants and trees that take up or evapo-transpire pollutants, and/or collecting and reusing water on-site for non-potable purposes. Many of such projects can fulfill so-called "triple bottom line" objectives for a community: social, economic, and environmental.[19] As a less desirable but still moderately useful alternative in ultra-urban areas, the use of below-ground cisterns to slow outflow and settle sediments and some pollutants can be encouraged.

Finally, there are innovative mechanisms being used in the Chesapeake Bay watershed to increase the cost-efficiency of urban and suburban stormwater management, and to obtain the financing necessary for sometimes costly retrofit projects. The former can be seen in the District of Columbia's new offset policies which allow a portion of the on-site volume management requirement (1.2 inches) to be performed off-site by the developer or via the developer's acquisition of offsite credits. The latter can be seen in Prince George's County, Maryland's coming experiment with innovative public-private partnership financing.

The bottom line is there are viable solutions out there for many of the real or perceived problems with managing this pollution source -- but nothing, of course, is free.

[19] Philadelphia Water Department, *Green City, Clean Waters: The City of Philadelphia's Program for Combined Sewer Overflow Control, Summary Report* (Sept.1, 2009), 17.