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BEFORE THE
SUBCOMMITTEE ON WATER RESOURCES AND ENVIRONMENT OF THE
COMMITTTEE ON TRANSPORTATION AND INFRASTRUCTURE
UNITED STATES HOUSE OF REPRESENTATIVES

March 19, 2009

Madam Chair and members of the Subcommittee, I am Michael H. Shapiro, Acting Assistant Administrator for Water at the United States Environmental Protection Agency (EPA). I appreciate the opportunity to provide EPA's perspectives on the important issues associated with urban stormwater and green infrastructure.

Introduction

Stormwater pollution from point sources and nonpoint sources is one of our nation's most challenging water quality problems and is a significant contributor to the impairment of the country's streams, rivers, and watersheds.

Unlike pollution from industry or sewage treatment facilities, which is caused by a discrete number of specific sources, stormwater pollution derives from a very large number and variety of sources. Rainwater and snowmelt run off lawns, parking lots, streets, farms, and construction and industrial sites. It picks up fertilizers, soil and sediments, pesticides, oil and grease, heavy metals and many other pollutants on the way to our rivers, lakes, and coastal waters. The impermeable surfaces of our traditional urban and suburban landscapes also result in increased stormwater volume and rates.

Smaller tributaries and even larger streams cannot accommodate the increased water volume and flow that occur immediately following rainfall and snowmelt events, leading to eroded streambanks, incised channels, streams choked with sediment, destroyed aquatic life and aquatic habitat, and increased flooding and property damage.

In September 2007, the EPA Inspector General concluded that stormwater discharges in the Chesapeake Bay associated with increased impervious surface area, which was attributable to development were far outstripping gains made from addressing other sources of degradation. Addressing the actual volume and rates of stormwater discharges into the Bay watershed, as in many other watersheds, is the primary challenge for protecting and restoring the integrity of this system.

Stormwater also transports excess nutrients to our surface waters. Nutrient pollution, or excess nitrogen and phosphorus in the natural system, is also responsible for a large proportion of water quality impairments in the U.S. It threatens water quality, human health, and habitats across the nation. Nutrient pollution is a national issue of widespread and growing environmental urgency. Across the nation, nitrogen levels in water are climbing and phosphorus pollution is spreading.[1] Further, EPA has seen little progress in removing waters impaired by nutrients from the impaired waters lists. Without changes, data indicate that the U.S. may lose ground on the environmental progress in responding to the pollution of the nation's waters achieved over the past four decades.

In addition to these problems, many older cities (including many of the largest cities in the United States), have combined sewage and stormwater pipes which periodically—and in some cases frequently—overflow due to precipitation events. Moreover, piped stormwater and combined sewer overflows ("CSOs") may also, in some locations, have the adverse effects of upsetting the hydrological balance by moving water out of the watershed, thus bypassing local streams and ground water. Because stormwater pollution is caused by so many different activities, green infrastructure is a promising approach for reducing stormwater pollution and improving our nation's water quality.

[1] Information obtained from a comparison of the national summary tables and charts for available water quality data reported by the States to EPA under Section 305(b) and 303(d) of the Clean Water Act.
http://www.epa.gov/waters/ir/index.html

The Advantages of Green Infrastructure

Green infrastructure represents an effective response to a variety of environmental challenges that is cost-effective, sustainable, and provides multiple desirable environmental outcomes. EPA's Office of Water initially endorsed green infrastructure because of the benefits for managing wet weather and wet weather-related events, including stormwater, combined sewer overflows (CSOs) and nonpoint source discharges. However, as will be emphasized here today, green infrastructure provides a variety of other benefits as well.

In October 2008, the National Research Council released the study: *Urban Stormwater Management in the United States*. Among other findings, the study concluded that stormwater is a serious source of impairment to the waters of the U.S., and that the National Pollutant Discharge Elimination System (NPDES) program can take a number of actions to reduce those impairments and improve water quality. As land surfaces are paved and stormwater discharges are carried directly to waterways via pipes and other conveyance systems, the natural hydrologic cycle is preempted. The National Research Council study highlighted the importance of managing stormwater rates, and recommended a focus on the use of technologies that capture, infiltrate and evapotranspire stormwater.

With respect to wet weather management, green infrastructure techniques use exactly those mechanisms of stormwater collection, infiltration and evapotranspiration by utilizing natural systems, or engineered systems that mimic natural landscapes, to capture, cleanse and reduce stormwater discharges using plants, soils and microbes. Green infrastructure can also support reuse of rainfall, thus also reducing the volume and impacts of stormwater discharges to water quality.

On the regional scale, green infrastructure consists of an interconnected network of open spaces and natural areas (such as forested areas, floodplains and wetlands) that improve water quality while providing recreational opportunities and wildlife habitat. When discussing green infrastructure at large geographic scales, it is also important to consider the value of open space preservation and natural resource protection for purposes of wildlife habitat and other ecological functions. On the local scale, green infrastructure consists of site-specific management practices (such as rain gardens, porous pavements, green roofs and cisterns) that are designed to maintain natural hydrologic functions by absorbing and infiltrating precipitation where it falls, and by returning it to the atmosphere via plants.

Green infrastructure has a number of other environmental and economic benefits in addition to improving water quality, including: recharge of ground water and surface water supplies; cleaner air; reduced urban temperatures; reduced energy demand; carbon sequestration; reduced flooding; community benefits, such as improved aesthetics; improved human health; additional recreational and wildlife areas; and potential cost savings associated with lower capital costs for paving, curb and gutter, and building large stormwater collection and conveyance systems.

EPA is reaping many of the benefits of green infrastructure less than one mile away at our Headquarters Federal Triangle complex. As part of a larger effort to beautify our Headquarters and demonstrate more environmentally sound building and landscaping techniques, in June 2007, we unveiled a green project in our Ariel Rios South building's courtyard. It showcases green infrastructure techniques including rain gardens, bioretention cells, permeable concrete and pavers, and a cistern, which reduce runoff from storms and can lessen sewer overflows. In addition to the courtyard, we have added four additional rain gardens on the perimeter of our buildings. Stormwater runoff is also being diverted from the EPA West building roof into six 1000 gallon cisterns located in the below grade parking garage. In an excellent example of water reuse, the cistern water is being used to irrigate planting beds and grassy areas. Working with our partners at GSA, these projects have helped showcase how building design can minimize the impact to our natural environment.

There is an ever growing interest and excitement by communities across the country in green infrastructure approaches. Cities such as New York City, Louisville, Cincinnati, Kansas City, Philadelphia, Seattle and Portland are making, or are planning to make, significant investments in green infrastructure to help manage their wet weather challenges, including CSOs and stormwater. Their interest in these approaches is based on analyses that green infrastructure offers cost savings when used with more traditional "grey infrastructure" approaches. They also see that these approaches provide multiple benefits to their communities.

Cincinnati, Kansas City and Philadelphia have undertaken similar analyses of how green infrastructure can supplement grey infrastructure within the context of their CSO long-term control planning and have concluded that green infrastructure elements can help provide the necessary water quality outcomes for less money in a number of watersheds or sewersheds. While green infrastructure approaches are not a complete substitute for grey infrastructure, they can limit the frequency of sewer overflow events, delay stormwater discharges, and reduce the amount and rate of CSO discharge to receiving waters.

Barriers, Accomplishments and Recommendations

Two years ago, EPA embarked on an enhanced effort to promote green infrastructure through all of our water programs in conjunction with several partners including American Rivers, the National Association of Clean Water Agencies, the Natural Resources Defense Council, the Low Impact Development Center, and the Association of State and Interstate Water Pollution Control Administrators. One of our initial releases, in January of 2008, was the *Green Infrastructure Action Strategy*. The Strategy is an action plan of several dozen activities and initiatives to overcome barriers to green infrastructure implementation, moving these sets of technologies from supplemental components of wet weather management to mainstream approaches. A variety of challenges to successful and wide-spread implementation were identified and EPA and its partners are meeting many of the challenges identified in the *Strategy*. However, we still have much to accomplish. I would like to discuss some of the most notable challenges.

One of the most significant barriers to green infrastructure is one that is typical to all novel approaches requiring significant change to existing institutional, technical and administrative frameworks: it's new! Design engineers, utilities, public works departments, transportation agencies and others are not only familiar with traditional grey infrastructure approaches, but their institutions are built around those paradigms. They understand pipe diameters and basin sizing, but often are not familiar with soil engineering and plants.

To address this needed shift in industry culture, we are engaged in a wide variety of outreach and training activities, including workshops, webcasts, publication of many documents on a variety of critical topics, working partnerships with a variety of sectors such as Federal highways, and modification and development of models and calculators to make design work and life cycle costing analyses easier. However, we also know that the most effective outreach can be done by state regulatory agencies in their one-on-one interactions related to permit and enforcement order implementation. These interactions can provide permitees and others assurance that such approaches are both beneficial and legal. The National Research Council stormwater study discussed funding for state stormwater programs.

EPA has heard concerns that green infrastructure approaches would not be effectively “credited” by EPA in permitting and enforcement processes. We have taken several steps to partially address this concern:

> 1) In August 2007, EPA’s water permits and water enforcement programs issued a joint memo indicating that green infrastructure approaches are consistent with National Pollutant Discharge Elimination System (NPDES) requirements, and should be encouraged in CSO and stormwater programs; and
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> 2) We have increased our emphasis on outreach to State and EPA Regional regulatory programs to assist them in specific permitting and enforcement cases and also to provide general guidance on incorporating green infrastructure into regulatory programs.

I am encouraged by the success of these efforts as increasing numbers of state regulators and permittees are making use of green infrastructure options.

Local regulations are often another challenge. Whether deliberate or inadvertent, local codes and ordinances frequently pose barriers to green infrastructure. Sometimes these are direct prohibitions on practices such as green roofs or permeable pavements. Indirect barriers often reside in plumbing codes that restrict water harvesting, fire codes that limit certain green streets approaches, or parking ordinances that require oversized parking lots.

Most of these barriers can be overcome without compromising the original intent of those policies. Cities with successful green infrastructure programs have had to thoroughly review their codes and ordinances, usually resulting in valuable modifications to these policies. To assist communities with this process, we have developed a helpful guidebook entitled *Aligning Local Codes and Ordinances with Water Quality Goals*. This document outlines a process for evaluating local policies and provides multiple options in a variety of different areas for modifying those policies to meet community objectives. The guide identifies the advantages for communities who conduct comprehensive reviews of their local policies, and revise them as necessary. Such reviews would do a great deal to institutionalize green infrastructure approaches at the local level.

Long-term maintenance and performance issues pose a challenge with decentralized approaches. Many green infrastructure elements are located on private property. Municipal entities are reticent to rely on long-term performance of practices outside of their immediate control, especially when they must achieve specific regulatory endpoints. Communities, such as Portland, have opted to implement a significant portion of their green infrastructure within public rights-of-way. Ordinances and maintenance agreements are also an important part of a program designed to achieve long-term effectiveness over wet weather controls.

As this is still a relatively new area, some questions remain. With respect to water quality and quantity, we understand performance of green infrastructure practices very well in some cases and reasonably well in others. However, we need better tools for estimating collective performance at regional scales, and there are still questions about long-term performance of some practices under various maintenance regimes. In addition, we need better quantification of those other benefits we have discussed, such as urban heat island reduction and removal of particulates from the air. A comparison of the economics and performance of green infrastructure and how it can supplement grey infrastructure for the entire life cycle will be extremely useful in establishing the utility of green infrastructure.

Moving research to practice is also an important need. There are many green technologies that can help protect water quality, and no single set of practices can be identified as the best for all circumstances. For example, in a very heavily developed downtown area, where space is at a premium, the placement of green roofs on the top of office buildings and residential high rises may be the most economical way to retain stormwater on site. The cities of Chicago, Philadelphia; Seattle and Portland are excellent models of successful green infrastructure and green roof programs.

A study of green roofs in Portland, Oregon demonstrated that, over a period of 18 months that included the wettest month on record, 5 different configurations of green roof type and thickness reduced the volume of runoff leaving the site 65 to 94 percent. On the other hand, in a suburban setting characterized by many single-family homes, rain gardens might provide a more cost-effective means to obtain similar results. Similarly, the problems presented and the solutions to be prescribed will differ greatly between Washington, D.C., and the arid Southwest. Thus, the determination of the most appropriate technologies will depend on a number of site-specific factors, such as available space, soil characteristics, depth of the water table, and climatic factors.

The Chesapeake Bay, the nation’s largest estuary, suffers from excessive nutrient and sediment loads resulting from a range of human activities. Runoff from developed and developing lands is the only source of nutrients and sediments that is actually increasing. Between 1990 and 2000, the watershed’s population increased by 8% while impervious cover increased by 40%. In addition, population now grows by 130,000 people annually and 100 acres of watershed forest lands are lost each day. Growth projections through 2030 show continued explosive growth is many areas.

While the States and EPA are making good progress to improve the effectiveness of our Clean Water Act regulatory program to address stormwater, the Chesapeake Bay Program is working with partners to identify situations where progressive developers, builders and homeowners realize very low levels of runoff through a full suite of green infrastructure practices that capture and reuse, infiltrate and evapotranspirate runoff from the site.

EPA's Bay Program is issuing grant money and developing incentive campaigns to support projects and sites that pursue and achieve "low runoff," even under extreme rain events. This is just one of the innovative approaches that EPA is pursuing to address the Inspector General's recommendations. The Bay Program's efforts, in coordination with its state and local partners, is a good example of the progress being made in moving design and technology research to implementation.

Financing frameworks are another challenge. These technologies are considered new, and perhaps 'riskier,' so States, municipalities and their financial institutions tend towards technologies that they understand. Financial incentives can generally offset the reticence to adopt new technologies. The American Recovery and Reinvestment Act set-aside for green projects, via the Clean Water State Revolving Fund, is a great first step. It is helping communities with green infrastructure plans initiate actions sooner, and has created interest in places where previously there was none. This set-aside provision will greatly facilitate the evolution of green infrastructure from a boutique approach to a mainstream technology.

Conclusion

EPA has made significant progress since April 2007 when the Agency and four national groups signed an agreement to promote green infrastructure. With our national and local partners, we are helping to change the way our nation views and manages stormwater.

We look forward to working with this Committee, our Federal and state colleagues, and the many partners, stakeholders, and citizens who want to promote green infrastructure to achieve our mutual water quality goals as well as to promote more livable communities.

Thank you again for inviting me to testify and I would be happy to respond to any questions you may have.