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Concerning "Efforts to Address Urban Stormwater Runoff"
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Good morning, Madame Chair. It is a pleasure to be back before you again on behalf of the Natural Resources Defense Council to discuss one of my favorite topics – the role of green infrastructure in revitalizing our waterways and our cities. I want to thank you for your leadership on these issues and the hard work of your staff in both the Economic Recovery legislation and reauthorization of the Clean Water State Revolving Fund already this year.

Interest in green infrastructure is skyrocketing among members of Congress, the sewage treatment industry, state and local governments, and the public. This is an opportune moment to discuss the barriers to full, effective implementation of green infrastructure as an integral part of water and wastewater resources management in communities across the country.

<u>Background</u>

Many communities, ranging from highly developed cities to newly developing towns, are looking for ways to assure that their rivers, streams, lakes, and estuaries are protected from the impacts of urbanization and climate change. Traditional development practices cover large areas of the ground with impervious surfaces such as roads, driveways, and rooftops. Once such development occurs, rainwater cannot infiltrate into the ground, but rather runs off site at levels that are much higher than would naturally occur. The collective force of all such rainwater scours streams, erodes stream banks, and causes large quantities of sediment and other pollutants to enter the waterbody each time it rains.

In addition to the problems caused by stormwater and nonpoint source runoff, 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. In the late 20th century, most cities that attempted to reduce sewer overflows did so by separating combined sewers, expanding treatment capacity or storage within the sewer system, or by replacing broken or decaying pipes. However, these traditional practices can be enormously expensive and take decades to implement. Moreover, piped stormwater and combined sewer overflows ("CSOs") may also in some cases have the adverse effects of upsetting the hydrological balance by moving water out of the watershed, thus bypassing local streams and ground water. Many of these events also have adverse impacts and costs on source water for municipal drinking water utilities.

Climate change is already stressing aquatic ecosystems, infrastructure, and water supplies. While impacts vary regionally, in much of the U.S., more frequent heavy rainfall events overload the capacity of sewer systems and water and wastewater treatment plants, as well as result in more stormwater runoff, exacerbating water pollution from sediments, nutrients, pathogens, pesticides, and other pollutants. In addition, decreased summer precipitation and other changes to the volume and timing of flows reduce stored water in reservoirs and reduce groundwater levels. Sea-level rise will adversely affect groundwater by causing an increase in the intrusion of salt water into coastal aquifers. All of these impacts will make less fresh water available for human use.

To ameliorate these problems, a set of techniques, approaches and practices can be used to eliminate or reduce the amount of water and pollutants that run off a site and ultimately are discharged into adjacent waterbodies. We refer to these collectively as "green infrastructure." As cities move towards sustainable infrastructure, green infrastructure can be a valuable approach.

"Green infrastructure" is a relatively new and flexible term, and it has been used differently in different contexts. Thus, to date, there is no universally established definition of the term. For example, some writers have defined it broadly as "an interconnected system of natural areas and other open spaces that conserve natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife."[1] The Green Infrastructure Statement of Intent signed by U.S. EPA, NRDC, the Low Impact Development Center, the National Association of Clean Water Agencies (NACWA) and the Association of State and Interstate Water Pollution Control Administrators (ASWIPCA) uses the term "green infrastructure" to generally refer to systems and practices that use or mimic natural processes to infiltrate, evapotranspirate (the return of water to the atmosphere either through evaporation or by plants), or reuse stormwater or runoff on the site where it is generated.[2]

<u>What is Green Infrastructure?</u>

Green infrastructure involves management approaches and technologies that utilize, enhance and/or mimic the natural hydrologic cycle processes of infiltration, evapotranspiration and reuse. Green infrastructure is the use of soil, trees, vegetation, and wetlands and open space (either preserved or created) in urban areas to capture rain while enhancing wastewater and stormwater treatment. Green infrastructure approaches currently in use include green roofs, trees and tree boxes, rain gardens, vegetated swales, pocket wetlands, infiltration planters, porous and permeable pavements, vegetated median strips, reforestation/revegetation, and protection and enhancement of riparian buffers and floodplains. Green infrastructure can be used almost anywhere soil and vegetation can be harnessed or worked into the urban or suburban landscape. Green infrastructure also includes decentralized rainwater harvesting approaches, such as the use of rain barrels and cisterns to capture and re-use rainfall for watering plants or flushing toilets. These approaches can be used to keep rainwater out of the sewer system so that it does not contribute to a sewer overflow and also to reduce the amount of untreated runoff discharging to

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[1] Benedict and McMahon, *Green Infrastructure* (2006).
[2] http://cfpub.epa.gov/npdes/greeninfrastructure/gisupport.cfm.

surface waters. Green infrastructure also allows stormwater to be absorbed and cleansed by soil and vegetation and either re-used or allowed to flow back into groundwater or surface water resources.

Green Infrastructure Benefits[3]

Green infrastructure has a number of environmental and economic benefits in addition to reducing sewer overflows and stormwater discharges, including:

- *Cleaner Water* – Percolation of stormwater through soil, uptake by vegetation, and water reuse reduce the volumes of stormwater runoff and, in combined systems, the volume of combined sewer overflows, as well as reduce concentrations of pollutants in those discharges.

- *Enhanced Water Supplies* – Most green infiltration approaches involve allowing stormwater to percolate through the soil where it recharges the groundwater and the base flow for streams, thus ensuring adequate water supplies for humans and more stable aquatic ecosystems. In addition, capturing and using stormwater conserves water supplies.

- *Reduced flooding* – Green infrastructure both controls surface flooding and stabilizes the hydrology so that peak stream flows are reduced.

- *Cleaner Air* – Trees and vegetation improve air quality by filtering many airborne pollutants and can help reduce the amount of respiratory illness. Green infrastructure approaches that facilitate shorter commute distances and the ability to walk to destinations also reduce vehicle emissions.

- *Reduced Urban Temperatures* – Summer city temperatures can average 10ºF higher than nearby suburban temperatures. High temperatures are also linked to higher ground level ozone concentrations. Vegetation creates shade, reduces the amount of heat absorbing materials and emits water vapor – all of which cool hot air. Limiting impervious surface, using light colored impervious surfaces (e.g., porous concrete), and vegetating roofs also mitigate urban temperatures.

- *Moderated Impacts of Climate Change* – Climate change impacts and effects vary regionally, but green infrastructure techniques provide adaptation benefits for a wide array of circumstances, by conserving and reusing water, promoting groundwater recharge, reducing surface water discharges that could contribute to flooding. In addition, there are mitigation benefits such as reduced energy demands and carbon sequestration by vegetation.

- *Increased Energy Efficiency* – Green space helps lower ambient temperatures and, when incorporated on and around buildings, helps shade and insulate buildings from wide temperature swings, decreasing the energy needed for heating and cooling. Also energy use associated with pumping and treating is reduced as stormwater is diverted from wastewater

[3] http://www.nrdc.org/water/pollution/rooftops/contents.asp.

collection, conveyance and treatment systems. Energy efficiency not only reduces costs, but also reduces generation of greenhouse gases.

- *Source Water Protection* – Green infrastructure practices provide pollutant removal benefits, thereby providing some protection for both ground water and surface water sources of drinking water. In addition, green infrastructure provides groundwater recharge benefits by putting stormwater back into the ground and enhances surface water quality by redirecting the high volume and velocity flows that scour streams and muddy drinking water sources.

- *Wildlife Habitat* – Stream buffers, wetlands, parks, meadows, green roofs, and rain gardens increase biodiversity within the urban environment.

- *Community Benefits* – Trees and plants improve urban aesthetics and community livability by providing recreational and wildlife areas. Studies show that property values are higher, homes sells faster, and crime is reduced when trees and other vegetation are present.

- *Health Benefits* – Studies show that people who have access to green infrastructure in their communities get more exercise, live longer, and report better health in general. Exposure to green infrastructure (even through a window) improves mental functioning, reduces stress, and reduces recovery time from surgery.

- *Green Jobs* – Designing, installing, and maintaining green infrastructure creates new jobs for architects, designers, engineers, construction workers, maintenance workers, plumbers, landscapers, nurseries, etc.

- *Cost Savings* – Green infrastructure saves capital costs associated with paving, curb and gutter, building large collection and conveyance systems, and digging big tunnels and centralized stormwater ponds; operations and maintenance expenses for treatment plants, pumping stations, pipes, and other hard infrastructure; energy costs for pumping water around; cost of treatment during wet weather; and costs of repairing the damage caused by stormwater, such as streambank restoration.

New Strategies, and Benefits, for Wet Weather Management

The last few decades of wet weather management have resulted in the current convention of control and treatment strategies that are largely hard infrastructure: engineered, end-of-pipe, and site-focused practices concerned primarily with peak flow rate and suspended solids concentrations and other pollutant control. Conventional practices, however, fail to address the widespread and cumulative hydrologic modifications within the watershed, including increased stormwater volumes and runoff rates, excessive erosion and stream channel degradation, and decreased groundwater recharge.

While conventional practices work to drain each site, continued expansion of dispersed, low-density developments over the past years means that too much water, carrying too much pollution, is flowing into waterways. The results are poor water quality, especially at drain outlets, and a dramatic drop in the refill rate of aquifers and streams. The 20 regions in the country that developed the most land over the period 1982 to 1997 now lose between 300 and 690 billion gallons of water annually that would otherwise have filtered through the earth and been captured as groundwater.[4]

The loss, or waste, of this water is particularly relevant as prolonged drought and the incipient effects of climate change impact wide regions of the United States. Areas as diverse as the states along the Colorado River Corridor and the urban southeast have experienced (or are currently experiencing) moderate to severe water shortages in the past two years. As recently as 2003 the U.S. General Accounting Office predicted that 36 states were anticipating localized, if not statewide, water shortages within the next decade.[5] But through implementing green infrastructure practices that emphasize rainfall harvesting – infiltrating rainfall to recharge groundwater sources and capturing rooftop runoff for onsite reuse – cities and states can dramatically increase their available water supplies. This benefit occurs in addition to the benefits green infrastructure provides with respect to reducing the problems of pollution and erosion generated by urban runoff.

NRDC, in cooperation with leading academics, has recently conducted a study in California incorporating analyses of land use, water supply patterns, and the energy consumption of water systems. The study examined the potential for use of green infrastructure practices that emphasize water harvesting to augment water supplies in urbanized Southern California and limited portions of the San Francisco Bay Area. Based upon this analysis, we found that through implementing green infrastructure practices at new and redeveloped residential and commercial properties alone in these areas, the potential exists for saving as much as 400,000 acre-feet (af), more than 130 billion gallons of water, each year by 2030. The amount of water savings available increases considerably if green infrastructure practices are implemented at other types of land use and development. This critical benefit is available in urban areas across the country, and could be used on a wide scale to address water supply issues brought on by population growth, drought, and climate change in any number of settings.

Furthermore, in areas such as Southern California that are dependant on distant or energy-intensive sources of water, practices that augment local water sources such as groundwater or captured rainwater can be used as a means of reducing the amount of energy used to supply water, and its attendant greenhouse gas emissions. Each gallon of water used to recharge groundwater locally represents one gallon of water that no longer needs to be supplied, at great energy costs, through the California State Water Project or through ocean water desalination. Our study found that the 400,000 af of increased local water supplies potentially available in California corresponds to a potential savings of over 1,100,000 megawatt hours of electricity, avoiding the release of over 340,000 metric tons of carbon dioxide per year.

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[4] American Rivers, NRDC, and Smart Growth America, *Paving Our Way to Water Shortages: How Sprawl Aggravates The Effects of Drought (*Smart Growth America: 2002).

[5] U.S. General Accounting Office, Freshwater Supply: States' Views of How Federal Agencies Could Help Them Meet the Challenges of Expected Shortages (July 2003).

Barriers to Green Infrastructure Implementation

Given all those benefits, lots of communities are interested in investing in green infrastructure, and an increasing number are doing so despite the barriers, but there are several major reasons why others have not yet done so. I will identify a number of the barriers and my recommendations for overcoming them below:

(1) Lack of familiarity with green infrastructure techniques by wastewater professionals

Green infrastructure techniques have been in use for many years (and in some cases, for centuries), but have not been the dominant paradigm for water and wastewater management that most those professionals currently working in the field have studied. This could be addressed by setting up regional centers of excellence on green infrastructure that could collaborate with universities and private and public organizations on research and technical assistance projects, assist universities and technical training centers to develop green infrastructure curriculum, and provide university and professional program trainings on green infrastructure methods.

(2) Lack of integration and coordination of water and wastewater management at the watershed level

In most communities, drinking water provision, wastewater treatment, and stormwater management are all managed by separate utilities, which may or may not coordinate their activities. Stormwater management itself is also very complex because multiple agencies are involved in activities related to stormwater pollution, such as street cleaning, road building, trash collection, snow removal, and park maintenance. While there is no perfect solution, communities that adopt watershed protection or environmental services agencies are better able to identify and seize upon the synergies provided by the use of green infrastructure to yield multiple environmental and economic benefits. Incentives for such multi-function local entities would encourage such integrated thinking.

(3) Lack of aggregated monitoring data showing environmental benefits on a watershed or sewershed scale

There are a number of excellent sources of data on the performance of green infrastructure techniques, including universities, federal and state agencies, industry research arms, local government monitoring, and citizen monitoring. However, such information is rarely available to demonstrate the aggregated effect of a series of site level or neighborhood level practices on a watershed, subwatershed, or sewershed. For example, while there are models that predict the reductions in combined sewer overflow volume into the Anacostia and Potomac Rivers and Rock Creek from intensive use of green infrastructure in the District of Columbia,[6] those models have not been validated through on-the-ground implementation of controls with appropriate monitoring. Congress should expand research and development efforts into green infrastructure technology, management approaches, and the associated environmental, social, and economic benefits, including demonstration projects here in D.C. and across the nation to evaluate the

[6] http://cfpub.epa.gov/npdes/greeninfrastructure/modelsandcalculators.cfm.

benefits of intensive green infrastructure implementation on a watershed, sewershed, or combined sewer system.

(4) Local building codes, road codes, or other ordinances that prohibit the use of green infrastructure techniques

In many communities across the U.S., there are a host of regulations on the books that prohibit such safe, sensible green infrastructure practices, such as using permeable pavement for driveways, disconnecting downspouts so that the rain percolates through the soil instead of flowing into the streets, capturing rainwater to use for watering plants and flushing toilets, and narrowing side streets and putting vegetated swales alongside them to capture runoff. In 2002, NRDC issued *Out of the Gutter*,[7] which included a checklist of legal impediments to the use of green infrastructure from such codes and ordinances, which is attached to this testimony. Clean Water Act municipal stormwater permits should require permit holders to remove local ordinance impediments to the use of green infrastructure.

(5) The single source, single media regulatory scheme

Effective green infrastructure implementation requires having sewer authorities, stormwater utilities, planning and zoning authorities, and private entities, including developers, builders, and property owners contribute to a watershed-wide effort. To do this effectively, a community needs a comprehensive green infrastructure strategy, which requires getting a lot of people to work together who don't normally do so. The current regulatory system is not structured to facilitate cross-media, watershed-wide solutions. Every water pollution source has its own permit requirements to meet, and many entities are not required even to reduce their own stormwater pollution discharges, much less contribute to a larger sustainability strategy. In addition, most of the requirements are based on pollutant loadings, not maintaining hydrology, which is the guiding principle for green infrastructure. As a result, many permit holders are focused too narrowly to see the benefits that green infrastructure can provide. My recommendation for this would be to pilot water resource permits for urban water, wastewater, and stormwater that apply to all sources within a political boundary (i.e., city, county) or that apply to multiple political entities covering an entire watershed, subwatershed, or sewershed. If successful, such pilots could demonstrate ways to enhance water resources more cost effectively and with more non-water resource benefits as well.

(6) Ineffective integration of green infrastructure into the NPDES permitting program

Stormwater permits under the National Pollutant Discharge Elimination System (NPDES) program are often vague and largely unenforceable. The NPDES program as a whole relies on two types of effluent limitations –technology-based standards and water quality based standards. Most stormwater permits currently contain neither. EPA has still not set technology based standards for the construction and development industry, and has indicated that it does not propose to set any such standards for post-construction stormwater discharges from development despite the fact that green infrastructure techniques have been demonstrated to be effective, and the most cost effective way in which to implement those controls is to integrated them into new

[7] http://www.nrdc.org/water/pollution/gutter/gutter.pdf.

and redevelopment rather than retrofit existing buildings and streets.[8] EPA needs to set such standards, and they need to be based on maintaining predevelopment hydrology, which is the widely recognized first principle of green infrastructure approaches.[9] NPDES permits for stormwater are also ineffective because they usually do not require controls to reduce pollutant loadings into streams by any specified amount even when stormwater has been identified as the source of water quality impairment downstream. So, they often do not even contain basic Clean Water Act requirements, much less provisions reflective of broader water resource goals, such as groundwater recharge, minimum stream flow, streambank protection, and aquatic habitat protection, which green infrastructure can help a community to achieve. There have been significant improvements in some jurisdictions over the past several years to require environmental results from stormwater programs, not just program development, but there is a long way to go. Technology-based standards focused on hydrology would be one next logical step. Minimum requirements linked to water quality standards compliance and total maximum daily loads would be another.

Green infrastructure can also be used to reduce combined sewer overflows, but, to date, very few communities have been allowed to use this approach as a significant component of their combined sewer overflow long term control plans in part due to the lack of watershed-wide or sewershed-wide monitoring results as discussed above. Congress should provide funding targeted to communities that want to use a green infrastructure approach for CSO control and commit to monitoring their results and sharing that data widely. In addition, proposals by communities to use green infrastructure to reduce CSOs should be evaluated by regulatory authorities at least as favorably as those relying solely on hard infrastructure. Some regulators now discourage communities from using green infrastructure approaches. Exactly the opposite should be the case.

(7) Lack of coordination between land use planning and permitting and stormwater management

Decisions about stormwater management are usually made after development projects have been fully platted and the design has been approved by multiple entities. It is too late at that point to do effective environmental site design to, for example, reduce impervious surfaces, preserve tree canopy, enhance stream buffers, or employ many of the other green infrastructure techniques. Stormwater, wastewater, and drinking water planning should be coordinated and integrated with land use and transportation planning through all available permitting mechanisms.

(8) Lack of public awareness of stormwater pollution and green infrastructure techniques

To most people stormwater pollution does not sound like a big problem. Since the pipes that carry trash, road runoff, pesticides, fertilizers, pet waste, and other stormwater contaminants into waterways are underground, most people never think about them at all, or, perhaps worse, think the pipes lead to a treatment plant somewhere, even though most dump directly into waterways. Since most people don't even understand that there is a problem and that they contribute to it, they don't feel obliged to contribute to the solution. In addition, people are often concerned

[8] http://www.epa.gov/owow/nps/lid/costs07/.
[9] http://cfpub.epa.gov/npdes/greeninfrastructure/technology.cfm.

about potential adverse impacts of green infrastructure solutions, such as mosquito breeding and basement flooding, which do not occur in well designed and maintained systems. Education needs to occur at multiple levels with multiple audiences to address these obstacles, including landscapers, builders, property owners, land care professionals, engineers, plumbers, architects, business owners, regulators – the list goes on and on. This type of education needs to occur at the retail level, by state and local governments, schools, community groups, and so forth, but the trainers need training and materials, and those can and should be developed along with identification of best practices for training each target audience at centralized locations, such as regional green infrastructure centers of excellence.

(9) Lack of investment in water and wastewater infrastructure and in research and development to improve techniques for managing water and wastewater

Finally, green infrastructure suffers from some of the maladies shared by hard infrastructure, including lack of sufficient funding at the federal, state, or local levels. Water is our most precious resource, yet we do not invest in ensuring its availability and safety for future generations. Communities need to invest in green infrastructure and other cost effective solutions; they need to establish incentives to leverage private investment in green infrastructure; and they need to be supported by robust federal and state green infrastructure programs that provide technical support, grant funding for pilot projects, training, research and development, compliance assistance, and model development and application.

Conclusion

Communities across the U.S. are poised to use green infrastructure to revive their waterways, revitalize their neighborhoods, and create green jobs, but there are significant barriers that they face in adopting green infrastructure solutions. Thank you for holding this hearing today to explore those barriers and Congress' role in removing them. I appreciate the opportunity to appear before you to address these issues and look forward to your questions.