Green Infrastructure/CSOs

QUESTION:

The following question was sent to NACWA CSO communities via email on October 19, 2006:

"We are reaching out to you as one of NACWA's CSO community members with two requests for information.

1) We are beginning to study how green infrastructure is used by our member agencies in the context of CSO control projects. Many of our member cities' efforts were profiled by the Natural Resources Defense Council (NRDC) in its recent report Rooftops to Rivers: Green Strategies for Controlling Stormwater and Combined Sewer Overflows (2006) (available at http://www.nrdc.org/water/pollution/rooftops/contents.asp). We now are exploring a joint effort with NRDC, the U.S. Environmental Protection Agency (EPA), and other groups on green infrastructure (e.g., a memorandum endorsing green infrastructure in the context of enforcement consent decrees, etc.).

A) Is your city using, or planning to use, green infrastructure for direct CSO control or for stormwater control?
B) If yes, what types of projects have you initiated (e.g., downspout disconnections, municipal programs and public funding, green rooms, rain gardens/vegetated swales & landscapes; permeable pavement; wetlands/riparian protection/urban forests, other)?
C) What barriers (regulatory, political, or otherwise) do you find exist to implementation of green solutions in the CSO context?

2) Second, a member agency has asked if we are aware of situations where a municipality *without its own treatment plant* has been named as a CSO co-permittee with the treating municipality. In this case, the non-treating municipality is the *sole source of flows* to the CSO structure, but the treating municipality owns the structure."

RESPONSES/ANSWERS:

NACWA received a number of responses to this question. The answers are summarized below, organized by metropolitan jurisdiction:

Seattle, WA: There is a great deal underway in the Seattle along the lines of Green Infrastructure:

Storm Control
The 'Rooftops to Rivers: Green Strategies for Controlling Stormwater and Combined Sewer Overflows (2006)' provides a good general description of Seattle's Natural Drainage System approaches which have focused on stormwater control in creek watersheds. In addition to the projects presented in that document, Seattle has completed construction of the Pinehurst Green Grid and is in preliminary engineering for the Venema Green Grid. Both of these projects use a modification of the SEA Street design concept for right-of-way redevelopment to retain runoff from smaller storm events (up to 2-year storm event), and convey large storm events. The Pinehurst project address stormwater from 49-acres of

the Thornton Creek watershed in northeast Seattle, and the Venema Green Grid will address approximately 70-acres of the Pipers Creek watershed in northwest Seattle. In addition to the street design concept, the Venema project may include working with the residents to implement LID strategies on private property.

CSO control

Seattle has constructed one pilot project, and is in the planning stage for a second pilot project focusing on cistern and raingarden use for CSO reduction. The first project is the Fremont RainCatcher project to disconnect downspouts from the combined sewer system and to evaluate on-site methods of residential site stormwater control at 10 sites in Fremont. Monitoring at an individual parcel scale is underway and will continue for a total of two wet seasons; monitoring includes continuous flow monitoring and water quality grab samples.

The second project is the Lakewood RainCatchers where Seattle is performing a detailed evaluation of the cost and benefits of encouraging customer-based stormwater control strategies on residential sites to meet combined sewer overflow reduction business area goals in a partially separated basin. As part the project Seattle will also assess the water quality impacts of adding new roof area to receiving water bodies and how to best mitigate the potential pollutant loading from the roofs. This is a 75-acre basin consisting of approximately 390 single-family residential parcels. Part of the project is establishing what level of participation can be expected from single-family residents. For monitoring and evaluation purposes the project will focus one subbasin for use of cisterns, and another subbasin with the use of raingardens. Each subbasin and the full project basin will be monitored pre and post project for changes to the sewer system flow.

Seattle also performed a cursory study of green infrastructure in comparison to a centralized storage approach for CSO reduction in the Windermere Basin, another partially separated basin. Specifically, Seattle studied roof leader disconnects into rain gardens followed by an overflow system to discharge large storm events to the street. Unfortunately, this approach ended up being too costly, largely because of the following factors: (1) the costs for the centralized facility were on the low side due to availability of land at a good location; (2) the hilly terrain of the Windermere basin was not conducive to rerouting rain water from roofs, resulting in a substantial costs for piping, (3) the percent participation of the property owners within the basin needed to disconnect their roof leaders to achieve CSO control using all decentralized strategies was so high (100% of the roof area on 70% of the lots) that it would require a mandatory program, not voluntary. The decentralized costs were scaled to represent this scenario, including the requirement to purchase easements so that the city could enforce maintenance in the future. The cost of the roof leader disconnect approach to achieve the necessary CSO reduction was more than 3x's as high as the cost of a storage facility.

Seattle is in the early stages of a research effort to further enhance understanding of the effectiveness and appropriateness of "distributed" strategies so that they can be more fully evaluated and utilized to facilitate the achievement of drainage and wastewater goals. This project is called Demand Management, Phase I of which will include: an identification of possible demand management techniques, an evaluation of the performance and cost-effectiveness of the techniques, identification of performance gaps and research and/or pilot projects necessary to fill those gaps, program recommendations for deploying the techniques and ancillary benefits of deploying the techniques. As part of this work the city will focus modeling scenarios on four downtown CSO basins. This area is

characterized primarily by zero lot line development and commercial or multi-family buildings. This project has the potential to be a good partnering opportunity with the Low Impact Development Center who is also planning similar work.

General
Seattle is rewriting its Stormwater Code and will include guidance on LID facilities (bioretention, porous pavement, greenroofs, etc), as well as guidance on roof downspout disconnections and proper means of surface conveyance of roofwater.

Barriers
One major barrier is the lack of good technical guidance and standards, which Seattle is trying to address through its Stormwater Code revisions.

A second major barrier is the uncertainty around the long term performance of decentralized controls. Any method selected for CSO reduction needs to still be functional into the future. Projects such as rain gardens, cisterns, etc. on private property are a challenge, because the city cannot force people to build and then maintain "green infrastructure" that is on their property. Through the Lakewood pilot project the city will evaluate the long term performance of systems installed by property owners volunteering to participate in the program.

A third major barrier is the ability to provide a detailed cost benefit analysis of the LID alternative compared to the traditional vault alternatives. Increasing the ability to accurately model LID facility performance (with continuous modeling, calibrated with high quality monitoring data) and a larger data set on the true costs of LID approaches can greatly help.

King County, WA: There are some good things going on in King County; however, by the nature of the systems being separate from the City of Seattle, most of the green infrastructure activity is happening on the City side. Even in areas where King County is responsible for the CSOs, if any downspout connection or other approaches are taken, they have to be taken property by property and that area of the system is in the City's jurisdiction.

Milwaukee, WI: The Milwaukee Metropolitan Sewerage District (MMSD is actively implementing Green Infrastructure for both CSO and storm water management. MMSD has active projects with:

1. Purchasing river buffers to protect waterway. By January 2007 we will be over 1,000 acres purchased. MMSD is currently expanding this program to also include reforestation of some of these properties.
   http://www.mmsd.com/floodmanagement/greenseams.cfm
2. Selling rain barrels locally on MMSD website. MMSD has sold over 4,240 rain barrels since June 2003. MMSD converts pickle barrels that hold about 55 gallons each into rain barrels. http://www.mmsd.com/rainbarrel/index.cfm
3. Fostering rain garden construction throughout the Milwaukee region. MMSD recently partnered with a local foundation and had a rain garden day where officials educated people on the benefits and construction needs of a rain garden and also offered ½ price plants. MMSD also built a few around the region as part of some BMP demonstration projects financed by the District.
   http://www.mmsd.com/programs/rain_garden.cfm

4. Financed a variety of best management practices as demonstration projects. http://www.mmsd.com/docs/procurement/rfp/rfp_20060628112320.pdf These include:
    a. Green Roofs
    b. Porous pavements
    c. "green" parking lots
    d. Cisterns
    e. Downspout disconnections
5. Construction of a "river-edge" wetland that will convert an impervious area to a wetland to treat storm water. Currently in planning/design.
6. Construction of a wetland to treat parking lot runoff.
7. Conversion of a historic pump house to a coffee house/public education facility for green infrastructure

MMSD sees the biggest barriers existing to implementation of green solutions as lack of public understanding, lack of financing, lack of regulatory integration with "structural" control mechanisms, and lack of metrics (or science) on what benefits might be derived.

Portland, OR: The City of Portland, Oregon has used, is using and plans to use green infrastructure extensively to directly control CSO and separated stormwater. Approximately 40 % of Portland's total CSO control requirements will be met by use of green infrastructure. Approximately 50% of the City's separated stormwater runoff will be managed using green infrastructure. CSO controls include what are called the Cornerstone Projects, which consist of:

- A downspout disconnection program (primarily a residential incentive program funded by the City)
- Infiltration of stormwater from residential streets into sumps (most of which are regulated as UICs)
- Directing separated stormwater to water quality / green treatment facilities such as ponds and constructed wetlands

Although Portland will complete its CSO capital construction projects in 2011, it will require additional CSO controls well into the future to keep up with growth and infill development. This future flow will be managed by what are called Sustainable Stormwater Projects consisting of:

- Green Streets, which are rain gardens in the street, or an infiltration/treatment/storage area constructed by cutting out a portion of the street pavement and cutting the curbs and installing appropriate soils and plants.
- Planters installed along commercial streets.
- Rain gardens for parking lots and green roofs installed by the City on schools and other public facilities.
- Permeable Pavement(depending on the results of several pilot projects currently on the ground).
- Encouraging and occasionally cost-sharing with private development to install green roofs, rain gardens, and landscaping.

The Separated Stormwater system is currently managed through a variety of controls:

- Stormwater infiltration from residential streets via sumps.

- Storage and treatment facilities such as landscaped areas/ rain gardens/ponds and infiltration basins.

Future stormwater management of the separated area of the City will be aided by the new Clean River Rewards Program. This is a program to provide financial incentives to residential and commercial customers to control stormwater on site. This is scheduled to begin in November of 2006.

In implementing green solutions in the CSO context, Portland has concerns about the implementation of federal rules on Underground Injection Control (UIC) devices that work against putting stormwater into the ground where nature intended.

Lowell, MA: Lowell is not using any green infrastructure for direct CSO or stormwater control at this time, but may consider it in the future.

Superior, WI: The City of Superior is engaged in a number of CSO control projects, including rain gardens, rain barrels, and a large stormwater detention basis. Additionally, the City is planning a roof-top garden as part of the roof replacement of its wastewater pumping station. The City hopes to provide educational tours of the garden once it has been constructed.

Narragansett Bay Commission, RI: The Narragansett Bay Commission (NBC) is not planning to utilize green infrastructure for direct CSO or stormwater control. However, it has significantly reduced stormwater discharges into its sewerage system by requiring developers to prepare a Stormwater Management Plan as an element of the Sewer Connection Permit process. This plan requires the developer to investigate options for stormwater management and to study and/or evaluate the use of Best Management Practices in their approach to stormwater management on the project site before allowing storm flow from such project sites to enter into the combined sewer system. The utilization of green Low Impact Design technologies is encouraged and has reduced stormwater flow affecting CSO discharges. The Narragansett Bay Commission Rules and Regulations, Article 4.4, Stormwater Connections state the following:

> *No person(s) shall make direct or indirect connections or shed stormwater from roof down spouts, foundation drains, areaway drains, or other sources of stormwater which in turn are connected to any public sewer unless the NBC determines that a combined sewer is the only reasonable means available for disposal and such connection receives NBC approval. It shall be the responsibility of the user to execute, and bear the cost of, a Storm Water Mitigation Plan if required by the NBC in this regard. The Storm Water Mitigation Plan, may include, but not limited to, the following studies and/or evaluations:*
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> A. *Investigation of mitigating measures to eliminate or reduce storm flow from the project;*
> B. *The use of Low Impact Development and Design methods to eliminate or reduce storm flow from the project;*
> C. *Best Management Practices approach to stormwater management to eliminate or reduce storm flow from the project;*
> D. *Investigation of alternative options available to direct discharges into natural waterways;*

The NBC shall consider the following factors with regard to making the determination as to permit the discharge of stormwater to the sanitary sewer system: (not in any order of priority)

A. *The present condition of areaway basin at the point of the proposed storm connection;*
B. *The potential impact of the proposed connection on the existing downstream connection;*
C. *The economic impact of the proposed connection on the NBC and the applicant; and*
D. *Any measures taken by the applicant to separate present and future flows, and to mitigate storm flows from the project*

Additionally, the NBC conducted a downspout disconnection project in one neighborhood where sewer users were provided with rain barrels. This study revealed that it was not a cost effective option for CSO control primarily because participation was voluntary. Even with NBC paying for the cost of the disconnection and rain barrel participation was a small percentage of those eligible. In NBC's efforts to reduce stormwater entering into the combined sewer lines, the Commission has seen many construction projects (new buildings and major renovations to existing buildings and sites) implement many different types of green infrastructure and technologies to reduce or eliminate stormwater discharges from their site. These include installation of green roofs, rain gardens, swales, rain barrels, cisterns with recycle to toilets, process or irrigation, porous parking areas, Cul-tech groundwater recharge systems, etc.

The NBC service area is in a highly urbanized, fully developed area, and as such there is very limited space to implement LID technologies on the wide scale basis that would be necessary to eliminate or significantly reduce CSO discharges.

Washington, DC: In the process of developing the District's combined sewer system (CSS) Long Term Control Plan (LTCP), DC Water and Sewer Authority (DC WASA) evaluated various LID's for potential use to reduce CSOs and meet the requirements of the federal Clean Water Act, and especially EPA's CSO Policy (which is now a regulatory requirement). Since the District is all but built-out, the emphasis was on evaluation of opportunities for retrofit of LIDs.

DC WASA came to several conclusions. Present generation of LIDs and other BMPs do not produce a consistent effluent, either in volume or in water quality. It is in part a result of the variability of the rainfall that LIDs are supposed to control. There are no accepted performance standards, either of quantity or of quality of the effluents generated by the available LID techniques. Most importantly, given the rigorous, numerical performance requirements of the LTCP delineated in the CSO Policy, and stringent numerical limits placed in the NPDES permit for CSO, there is simply no way to meet the regulatory requirements employing LIDs for the treatment and control of CSO. Furthermore, for LIDs to be effective means of CSO control, the retrofit would have to be wide spread, requiring significant portion of the property owners to implement LIDs on their properties, voluntarily if possible, otherwise under some kind of regulatory regime.

However, recognizing their benefits, even though not what's needed at this time for CSO control, DC WASA committed to work with EPA and others to develop performance standards for LIDs. (EPA declined the participate in the development of these standards).

DC WASA is also committed to spend $3 million for installing LIDs on WASA's own facilities as opportunities arise during rehabilitation, and collect performance data from these installations. That work is on going. DC WASA has also funded construction of several green roofs in DC, and these facilities are also being monitored to determine their performance.

DC WASA is therefore very supportive of LIDs in general, and are aware of their potential multifaceted benefits. However, DC WASA is of the opinion that for the LIDs to be accepted as alternative means of treatment and control of CSO, regulatory acceptance of these is a must. It simply would not be of any benefit to the CSO communities to spend ratepayers' money on projects that are not accepted by the state and federal regulatory agencies as compliant of the local and federal CSO laws and regulations. And given the variable nature of the performance of the LIDs, there is no reason to anticipate that the rigid numerical limits that are required of CSS LTCPs and set in the related NPDES permits can be met with these, as is presently required by law.

In view of the above, while DC WASA supports development of models to quantify LID performance, monitoring, measurement of economic and environmental benefits, increased federal funding and preparation of guidance documents, etc., NACWA can be most helpful by thoroughly investigating the regulatory changes that would be required for incorporating LIDs in CSS LTCPs, and how flexible the laws and regulations would have to be to account for the variability of the LIDs, if they are incorporated in the CSS LTCP. It is therefore critical that EPA becomes a partner in this endeavor from the outset.