SEATTLE, WASHINGTON

A CASE STUDY OF HOW GREEN INFRASTRUCTURE IS HELPING MANAGE URBAN STORMWATER CHALLENGES

TYPES OF GREEN INFRASTRUCTURE USED: Green roofs, rain barrels/cisterns, permeable pavement, rain gardens, vegetated swales, street trees, green streets

Seattle has been working at green infrastructure for over a decade, and its commitment over many years has resulted in a serious overall program. The city does not yet have a comprehensive citywide green infrastructure plan; its Comprehensive Drainage Plan is generally supportive of green infrastructure (which it dubs "natural drainage strategies"), but does not spell out an overall vision of its implementation. On the other hand, Seattle contains broadly-applicable requirements to use green infrastructure "to the maximum extent feasible," for both new and redevelopment projects and the city requires certain projects to achieve specific numeric targets for peak runoff following development. Seattle has strong resources to assist private parties to implement green infrastructure and an equally major investment in implementing green infrastructure in practice to achieve stormwater and CSO reduction goals. Specifically, the city has stormwater and right-of-way improvement design manuals laying out stormwater design strategies for different kinds of projects, and it has demonstrated green infrastructure via numerous roadway improvement projects and green roofs. These initiatives now are accompanied by regulatory green infrastructure programs—Green Factor—which demands that development projects achieve minimum scores based on landscaping features that promote the use of green infrastructure, as well as the stormwater code, which requires for most projects the use of green stormwater infrastructure best management practices (BMPs) to mitigate stormwater where feasible. As a complement to these resources, Seattle also provides green infrastructure incentives—rebates for installing rain barrels and cisterns to capture stormwater in a particular basin served by the combined sewer system. Other incentives are integrated into the city's stormwater fees, which help pay for the implementation of stormwater control strategies; non-residential properties' fee is directly related to the amount of on-site impervious area, and all property owners in the city can receive a parcel credit for installing green infrastructure features as well as other flow control and treatment BMPs. Additionally, city officials report that the CSO reduction strategy is committing to using green infrastructure, which will be formalized through the Long Term Control Plan efforts currently underway.

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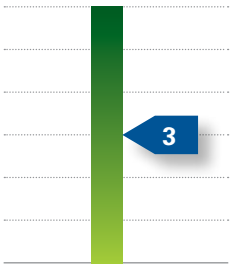

Total Criteria Score
Out of a possible 6

EMERALD CITY CRITERIA*

- ☐ Long-term Green Infrastructure (GI) Plan?
- ☐ Requirement to use GI to reduce some portion of the existing impervious surfaces?
- ☐ Retention Standard?
- ☑ Incentives for private-party actions?
- ☑ Guidance or other affirmative assistance to accomplish GI within City?
- ☑ Dedicated funding source for GI?

BACKGROUND

Located between Puget Sound and Lake Washington, Seattle is a highly urbanized area that retains a strong connection to its waterways, many of which serve as salmon spawning grounds. Seattle is primarily located within the Lake Washington and Puget Sound watersheds and receives its drinking water from the Cedar River, the South Fork of the Tolt River, and three groundwater wells. Stormwater runoff has long been identified as a threat to the aquatic habitat of Puget Sound and the sensitive salmon streams. However, controlling stormwater volumes and flow rates is a complicated task in a city where the majority of development predated stormwater regulations. Consequently, water quality in the region is impaired and the hydrology of rivers and creeks is altered.

Seattle's Green Factor Program, a landscape requirement designed to increase the quantity and quality of planted areas in parts of the city, was the first of its kind in the United States. While developers and designers have flexibility to meet the requirements, the program does encourage the use of large plants and green roofs in publicly visible areas. Its scoring system provides bonuses for food cultivation, native and drought-tolerant plants, and rainwater harvesting.

Seattle's network of sewer and drainage systems is the responsibility of Seattle Public Utilities (SPU). The system includes approximately 968 miles of combined sewers with 92 permitted CSO outfalls, 38 CSO control detention tanks/pipes, 448 miles of sanitary sewers, and 460 miles of storm drains with 170 storm drain outfalls.[1] During heavy rains, the combination of stormwater (about 90 percent of the volume) and sewage exceed the drainage system's capacity, causing annual overflows of approximately 100 million gallons per year (down from 30 billion gallons in 1970).[2] SPU's approach to green infrastructure as it relates to stormwater and CSO control involves the testing of technologies or projects as pilots and then rolling out programs with broader application. SPU's Green Stormwater Infrastructure (GSI) program also supports the use of GSI at the site level through full street right-of-way improvements with natural drainage systems and through larger development planning and design. Factors such as Seattle's hilly topography, soil conditions, and street widths limit the sites for which GSI solutions are appropriate.

In September 2004, Seattle Mayor Greg Nickels introduced his "Restore Our Waters" (ROW) Strategy, a framework for coordinating and concentrating the city's efforts to rehabilitate local waterways. The strategy requires updating the city's stormwater code to include options for GSI alternatives to stormwater control. In response, SPU drafted a new Comprehensive Drainage Plan, broadening the scope to include infrastructure, public safety, and aquatic resource protection, and developed an SPU Urban Watershed Strategy to develop clear goals, indicators, and performance measures.

USING NATURAL DRAINAGE SYSTEMS TO MANAGE STORMWATER RUNOFF

In the late 1990s, the city began to install green stormwater infrastructure to mitigate urban stormwater runoff, and SPU developed pilot projects using the purpose of natural drainage system (NDS) strategies. The concept of NDS is to provide improved stormwater management by mimicking the natural hydrologic functions typically lost in an urban setting. NDS uses alternative street designs and vegetated BMPs to reduce the volume and rate of stormwater runoff, striving to replicate pre-development hydrologic function. In order to expedite the achievement of its water quality and flood mitigation goals, Seattle takes a proactive approach, retrofitting existing city streets using these green infrastructure techniques. NDS projects involve community members in all stages of implementation, from planning and construction to public education meetings on its importance and benefits. At one point, the program faced challenges from the city's emergency and transportation departments, which questioned the system's safety, integrity, and applicability. SPU worked with these departments to establish new road designs that met both the goals of the NDS program and the needs of emergency vehicles. The outcome has been innovative neighborhood and stormwater system designs with results exceeding expectations. Information obtained from NDS pilots has been used to develop the Seattle Right-of-Way Improvement Manual and the Stormwater Flow Control and Water Quality Treatment Technical Requirement Manual.

Descriptions of the Viewlands Cascade, Second Avenue Street Edge Alternative (SEA), 110th Street Cascade, Broadview Green Grid, and Pinehurst Green Grid NSD pilots were included in the 2006 *Rooftops to Rivers* publication. More recent work includes the Swale on Yale, scheduled to be constructed in the fall of 2011 – 2013, and the Ballard Roadside Raingardens, which began in June 2010. When complete, the $10 million Swale on Yale will consist of four extra-wide planting areas, 270 feet long by 10.5 to 16.5 feet wide, between the sidewalk and roadway. This area

will treat an average of 190 million gallons of stormwater annually, greatly reducing the amount of pollution flowing into Lake Union. A diversion vault under Yale Avenue North will divert stormwater into the biofiltration swales; it will also spin the stormwater to create a vortex so that large solids and trash can be separated and collected by a sump, which will be regularly cleaned by SPU crews. The project will require approximately 2,000 feet of new storm drain to convey untreated stormwater into the diversion vault, swirl concentration, and biofiltration swales. Treated stormwater will then go back into the storm drain to be discharged into the lake.[3]

Recently, Seattle was reminded of the necessity of careful planning, design, construction, and community engagement when designing and installing GSI in a dense urban setting. Sewage and drainage from Seattle's Ballard neighborhood flows into a combined sewer system that overflows into the Salmon Bay waterway approximately 70 to 80 times per year. To reduce the frequency of these overflows, SPU set out to install a series of rain gardens across 10 city blocks in the public right-of-way to treat 50,000 gallons of stormwater annually while providing attractive landscaping.[4,5] The project, known as the Ballard Roadside Rain Gardens pilot project, was implemented on an expedited schedule in 2010 when SPU received $1.4 million in federal stimulus money to initiate the $1.9 million project.

Due to the fast-tracked schedule, technical risks such as the adequacy of infiltration rates and the presence of underground springs were not fully considered during the design phase of the project. As a result, several of the rain gardens did not drain properly after construction. Further, due to the expedited process, SPU conducted only limited community outreach activities during the project's planning process, allowing insufficient time or opportunity to develop community acceptance, and leaving residents dissatisfied and concerned with the resulting standing water. SPU has recently been forced to spend another $500,000 to address the drainage issues.

The knowledge gained through this pilot project highlighted the need to allow adequate time to review data and technical assumptions and specifications, and the importance of community outreach and engagement. However, SPU emphasizes that bioretention is an effective technology for reducing flows when applied where conditions are appropriate. As a strategy, SPU will continue to value bioretention as a tool for reducing CSO volumes, as well as to provide flow control in creek basins, and expects to continue to construct roadside rain gardens for both purposes.

GREEN FACTOR PROGRAM AND GREEN ROOFS

Seattle's Green Factor Program, the first of its kind in the United States, was instituted in 2006 and provides a flexible approach to GSI through development regulations. The Green Factor is a landscaping requirement for development intended to encourage design features such as large plants, green roofs, and vegetated walls to be installed in publicly visible areas. Developments are rated using a Green Factor Scorecard in order to ensure that a certain percentage of green (based on the development's underlying zoning) is included in the design. Minimum required scores range from 30 percent of a parcel in a commercial zone to 50 percent coverage in multifamily residential zones. Aesthetically, the scoring system promotes the implementation of GSI techniques in areas visible to the public, with bonuses provided for food cultivation, native and drought-tolerant plants, and rainwater harvesting. Besides reducing stormwater runoff and associated public infrastructure costs, such elements are intended to provide air quality benefits, create wildlife habitat, and alleviate the urban heat island effect.[6]

The landscaping requirements of the Seattle Green Factor can be met in part through the use of green roofs, and the program is expected to increase the number of green roofs within the city. At the end of 2009, there were 62 known green roofs in the city, with a total area of 359,375 square feet. An additional four buildings have designated 3,631 square feet of area for food production in planter boxes, and eight large at-grade green "lids" make up an additional 1,445,347 square feet of vegetated area. In all, 8.5 acres of the city's total roof surface area of 13,150 acres was covered with a green roof or rooftop garden.[7]

Besides the Green Factor Program, green roofs are encouraged by the 2009 Stormwater Code, which requires projects to implement GSI, including green roofs, to the maximum extent feasible, and through the LEED® green building certification program, which awards a point for a green roof.[8] Seattle also currently provides an impervious surface reduction credit that lists green roofs and roof gardens as acceptable strategies.[9]

Additionally, SPU is actively monitoring four green roof test projects to determine the extent to which the green roofs can absorb and delay stormwater flow. Starting in 2005, SPU began collecting information from green roofs at the Woodland Park Zoo's Zoomazium, the Ballard Library, Fire Station 10, and the Ross Park Shelterhouse.[10] With support from the King Conservation District, SPU and its partners have collected three years' worth of data for each of the green

roofs and are now completing a data set that will eventually be used to calibrate local hydrological models for green roof stormwater flow performance.[11]

FINANCE STRATEGY

For 2010–2015, Seattle has identified several GSI projects as part of its CSO control program. The overall CSO program for 2010–2015 is expected to reduce stormwater by a total of 7,924,000 gallons at a cost of $88 million to $255 million.[12] Historically, combined sewer overflow funding through Seattle's Drainage and Wastewater Fund (DWF) capital improvements project (CIP) has come primarily from the sale of revenue bonds. In 2003, DWF adopted a financial policy to gradually increase cash contributions from Seattle Public Utility to fund the CIP. Today, 25 percent of total CIP costs are funded by a cash contribution from SPU's capital and operating budget, with the remaining capital needs debt financed.[13]

The city of Seattle charges property owners a fee for stormwater management services based on each property's estimated impact on the city's drainage system. Instead of appearing on utility bills, these fees are billed as a separate line item on King County property tax statements. Prior to 2008, all property owners were charged a flat fee. Starting in 2008, Seattle changed the rate structure that underlies the calculation of drainage fees, in order to more closely tie such fees to customers' actual impacts on the drainage system. Residential properties are now charged on the basis of parcel size, and nonresidential properties on the basis of the amount of impervious surface.[13] In 2011, residential drainage bills ranged from $134.06 to $298.32 per year, regardless of the amount of impervious surface, and annual nonresidential bills ranged from $19.72 to $66.90 per 1,000 square feet, depending on the amount of impervious surface. In total, expected revenues from drainage fees were approximately $59 million for 2010 and $67.2 million for 2011,[14] up from $31.6 million in 2005.[15]

To incentivize GSI, Seattle Public Utilities has a Stormwater Facility Credit Program (SFCP) for property owners who have installed a fully functioning, well-maintained stormwater system—with such features as vaults, rain gardens, green roofs, rooftop gardens, permeable pavements, and filtration systems—that provides water quality treatment and/or slows down stormwater runoff from impervious surfaces such as rooftops, driveways, and walkways. Systems that are in compliance with the city's stormwater code standards[16] can qualify for the program, which, while open to anyone, is most beneficial to parcels with large amounts of impervious surface being managed by a stormwater system.[17] The maximum allowable parcel credit is 50 percent; the average awarded credit in 2008 was 9 percent.[18]

In addition to this program, the city provides RainWise Rebates for cisterns and rain gardens in a target CSO basin in the Ballard neighborhood. There, the city pays for most of the costs of installing rain gardens and cisterns, depending on how many square feet of roof runoff is controlled.[19] If successful, the city plans to extend the pilot project to other CSO target basins. While not currently active, Seattle Public Utilities has also provided Aquatic Habitat Matching Grants to individuals, business owners, nonprofits, and community groups wanting to protect or restore Seattle's aquatic habitat. This project was cut, however, as a cost-saving measure.

*EMERALD CITY RATING SYSTEM

Each of the cities profiled in *Rooftops to Rivers II* is a leader in green infrastructure investment—rethinking the design of municipal services and infrastructure. These cities leverage funding in creative ways. They provide tools to residential and commercial land owners to retrofit private properties and realize the multiple benefits provided by green infrastructure. In short, they are changing how cities look and function.

NRDC's Emerald City Rating System identifies six actions cities should undertake to maximize their green infrastructure investment. Our metric does not directly compare one city to another, due to geographical, population, budgetary and other differences. Instead, it identifies the presence or absence of common factors of success that NRDC believes are essential elements of a robust green infrastructure commitment. Only one city profiled, Philadelphia, is undertaking each of the actions identified, although each city is undertaking at least one.

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1 Seattle Dept. of Finance (Sept. 25, 2009). "2010-2015 Proposed Capital Improvement Program," accessed at http://www.seattle.gov/financedepartment/1015proposedcip/2010_PROPOSED_CIP_BOOK.pdf.

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4 "Meeting Notes: Ballard Roadside Raingarden Task Force (March 8, 2011)," accessed at www.seattle.gov/util/groups/public/@spu/@usm/documents/webcontent/01_012001.pdf.

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10 McIntosh, A. (2010). "Green Roofs in Seattle: A Survey of Vegetated Roofs and Rooftop Gardens," prepared for the city of Seattle and the University of Washington Green Futures Lab.

11 Joel Banslaben, personal communication, September 9, 2011.

12 Seattle Dept. of Finance (Sept. 25, 2009). "2010-2015 Proposed Capital Improvement Program," accessed at http://www.seattle.gov/financedepartment/1015proposedcip/2010_PROPOSED_CIP_BOOK.pdf.

13 Seattle Public Utilities. "New Drainage Rate Structure FAQ," accessed at www.ci.seattle.wa.us/util/Services/Drainage_&_Sewer/Rates/DrainageRates/NewRateStructureFAQ/index.htm.

14 Seattle Public Utilities. "Drainage Rate Increase FAQ," accessed at www.seattle.gov/UTIL/Services/Drainage_&_Sewer/Rates/DrainageRates/RateIncreaseFAQ/index.htm.

15 Seattle Office of City Auditor (2007). "Seattle Public Utilities Billing and Accounts Receivable – Drainage Fees: Internal Controls Review," accessed at www.seattle.gov/audit/docs/FinalReport020807.pdf.

16 Among other things, Seattle's stormwater code requires that properties be designed to reduce the introduction of pollutants into stormwater runoff as close to the source as possible; the code also sets minimum requirements for stormwater pollution prevention during construction and grading as well as for flow control and stormwater treatment facilities.

17 Seattle Public Utilities. "Stormwater Facility Credit Program," accessed at www.seattle.gov/util/groups/public/@spu/@ssw/documents/webcontent/spu01_006686.pdf.

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