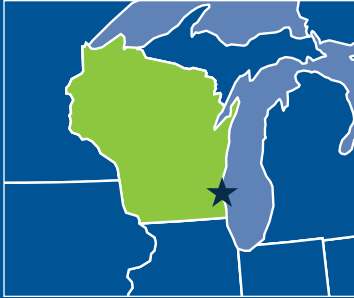


MILWAUKEE, WISCONSIN

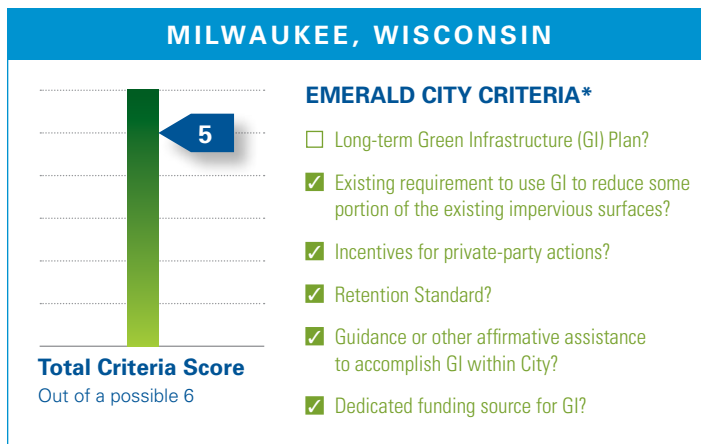
A CASE STUDY OF HOW GREEN INFRASTRUCTURE IS HELPING MANAGE URBAN STORMWATER CHALLENGES

TYPES OF GREEN INFRASTRUCTURE USED: Green roofs, blue roofs, rain barrels/cisterns, permeable pavement, rain gardens, infiltration trenches or vaults, vegetated swales, street trees, planter boxes, downspout disconnection, stream buffer



The Milwaukee Metropolitan Sewerage District (MMSD) is a regional and national wastewater utility leader in its integration of green infrastructure into its combined sewer overflow reduction strategy. While MMSD has numerous green infrastructure planning projects under way, including specific targets within its 2035 plan to reduce the number of CSOs to zero and a triple-bottom-line analysis modeled on Philadelphia's, it does not have a regional plan. In 2008 MMSD undertook a code and ordinance review for the communities in its service area and cataloged the efforts to date over the summer of 2011. It has dedicated

capital funds to support green roof grants (\$5 million in 2010–2011), rain barrels, and rain gardens, as well as resident education and an online cost-benefit tool. MMSD recognizes the value of partnering with local and national organizations and agencies to accomplish its goals, including a program to purchase and restore land upstream of Milwaukee to prevent flooding and overflow problems from occurring in the first place.



BACKGROUND

Like other cities with combined sewer systems, Milwaukee has a history of overflows. As a result, from 1977 to late 1993, the regional wastewater treatment agency, Milwaukee Metropolitan Sewerage District (MMSD), invested approximately \$1 billion to build a deep tunnel storage system to eliminate sanitary sewer overflows and limit combined sewer overflows to an average of 1.4 per year. While the tunnel reduced both the number and the volume of sanitary sewer outflows by more than 80 percent (from 8–9 billion gallons to about 1 billion gallons annually), the district still experiences an average of 4.1 sanitary sewer overflows and 2.6 CSOs each year.¹

As noted in the first *Rooftops to Rivers* report, MMSD serves a combined population of approximately 1.1 million people. The agency manages wastewater from 28 municipalities, each with its own sewer system that drains into MMSD's 300 miles of regional sewers. On a dry day, the district's two wastewater treatment plants each process about 50 million to 80 million gallons of wastewater.² The treated wastewater is discharged into Lake Michigan, which is also the city's drinking water supply.³ About 5 percent of MMSD's service area, including parts of Milwaukee and the village of



Installation of porous pavers at the Energy Exchange (November 2009).

Shorewood, utilizes a combined sewer system, with overflow points located along rivers that flow into Lake Michigan. This area, which measures 14,338 acres, is about 30 percent impervious.⁴ The rest of MMSD's service area has separate sewer systems for stormwater and wastewater.

MMSD'S GREEN INFRASTRUCTURE APPROACH

To complement the deep tunnel system and reduce overflows and stormwater runoff even further, MMSD began to explore the potential of utilizing green infrastructure practices in 2002. It is notable that MMSD undertook its green infrastructure investments absent federal or state action. One of its first initiatives was a downspout disconnection program to redirect building downspouts to rain barrels. A second effort was a cooperative partnership with public entities and private businesses in the Village of Shorewood (which is adjacent to Milwaukee) to install 60 rain gardens. The combined cost of the two projects was approximately \$170,000.⁵

Nearly 10 years later, MMSD's downspout disconnection, rain barrel, and rain garden programs are still going strong. In addition, since the first *Rooftops to Rivers* publication, MMSD's stormwater management manual has been revised to include volume control, impervious surface reduction, and standard operating and maintenance requirements that encourage the use and long-term maintenance of green infrastructure practices. This manual is a guide to meet MMSD's stormwater management rules, which are applicable to both new construction and redevelopment throughout the watersheds upstream of the estuary that drains into Lake Michigan.^{6,7} Between MMSD and the Housing Authority of the City of Milwaukee (HACM), 5.6 acres of green roofs have been installed as of May 2011; 1.2 acres were installed by HACM.⁸ Also, MMSD partners with The Conservation Fund on a land acquisition program called Greenseams™, further described below.

The Water Quality Initiative,⁹ a joint effort of MMSD and the Southeastern Wisconsin Regional Planning Commission, identified the reduction of non-point sources of water pollution as the most important action, and green infrastructure as a tool to reduce peak stormwater flows from

the 100-year and smaller storm events. In 2009, MMSD's vision for integrated watershed management set forth the laudable goal of becoming a model of sustainability, with a healthier Milwaukee region and a cleaner Lake Michigan accomplished through the agency's leadership in attaining zero overflows, zero basement backups, and improved stormwater management. MMSD further noted that, to deal with stormwater issues during large storm events, a regional approach to planning was needed, with a shift in focus from political boundaries to watershed boundaries. Also in 2009, MMSD prepared a publication, *Fresh Coast Green Solutions*, to provide a triple-bottom-line assessment of green infrastructure's benefits.¹⁰

PROMOTING RAIN BARRELS, RAIN GARDENS, AND GREEN ROOFS

Public education and outreach programs, such as MMSD's downspout disconnection and rain garden installation programs are considered cost-effective approaches for managing stormwater and improving water quality. Along with the city of Milwaukee and 27 other communities, MMSD encourages businesses, municipalities, and homeowners to manage stormwater on site through the installation of green roofs and the redirection of downspouts into rain barrels and rain gardens. To do so, MMSD funds community workshops and pilot programs and provides cost-share partnership funding to support the costs of green roofs. From 2003 to 2009, 1.7 acres of green roofs were installed through a partnership program.¹¹ For 2010 and 2011, MMSD provided a matching-fund program to maximize resources and encourage engagement in shared stormwater outcomes. In 2010, 2.6 acres of green roofs were installed through MMSD's Regional Green Roof Initiative, and another 1.7 acres are pending completion in 2011.¹² MMSD budgeted \$5 million as a matching-fund program to retrofit building rooftops with green roof technology. As part of the program, MMSD will gather quantitative data on the impact of green roofs and qualitative data on the feasibility of green roofs in its service area.¹³

As part of its public education and outreach efforts, MMSD recently launched H2OCapture.com to educate the region about green infrastructure and engage area residents and businesses to help reach a goal of capturing 500 million gallons of rain—a quantity nearly equal to the storage capacity of its deep tunnels—during storm events. Besides information on performance and cost, the site includes a calculator, developed by NRDC, that individuals can use to determine how much rain is captured by different types of green infrastructure. The site also allows MMSD to highlight “signature projects” like the one in the Walnut Way

community, where 38 downspout disconnections, 38 rain gardens priced at \$1,200 each, and 4 cisterns were installed to divert about 552,000 gallons each year from the sewer system to natural infiltration.¹⁴ The site provides up-to-date news on events and incentives and is a cost-effective way for the district to engage the public.¹⁵

WATERSHED-SCALE INNOVATIONS: PROTECTING LANDS THROUGH GREENSEAMS™

Greenseams™ is a program that began in 2002 to provide nonstructural flood and stormwater management protection. Through it, MMSD partners with The Conservation Fund to acquire conservation easements on land along riparian corridors, wetlands, and floodplains to protect their natural functions. Since its inception, the program has acquired, restored as necessary, and placed development restrictions on 75 properties totaling more than 2,254 acres. Management of these properties is handled by either a local municipality or a land trust, subject to a conservation easement held by MMSD.¹⁶ For 2011, MMSD's approved budget includes approximately \$1.5 million for the Greenseams™ project to cover the acquisition of 6 properties totaling 225 acres.¹⁷

MILWAUKEE'S FIRST “GREEN CORRIDOR”

MMSD's green infrastructure commitment has also helped reinvent portions of the city. MMSD is working with the city of Milwaukee, American Rivers, Gateway to Milwaukee, and the Energy Exchange to transform a three-mile stretch of 6th Street, on Milwaukee's south side, into the city's first “green corridor.” A combination of bioswales (the city installed 15 during the summer of 2011), planters, and porous pavement will help combat flooding and control stormwater in the neighborhood, and solar-powered bus stops and LED lighting will reduce energy use and greenhouse gas emissions.

MEASURING THE EFFECTIVENESS OF MILWAUKEE'S GREEN INFRASTRUCTURE

MMSD has done an excellent job of monitoring the success of its green infrastructure pilot projects, both in terms of tracking distribution of rain barrels and implementation of practices such as rain gardens and permeable pavements, and in evaluating the large-scale impact of such projects. Of particular interest since the 2006 *Rooftops to Rivers* report is a study conducted to determine whether infiltration from green infrastructure practices might negatively affect leaky sanitary pipes. In 2005 and 2006, MMSD studies detected



Bio-retention swales for stormwater treatment along Grange Avenue in the Village of Greendale.

no inflow and infiltration for large-scale stormwater ponds placed 60 feet or more from pipes. As for smaller-scale practices, the studies recommended that these be placed at least 10 feet from pipes but found that shorter distances were possible. MMSD determined that future research is needed to evaluate the impact of soil type on the ability of green infrastructure to complement inflow and infiltration reductions.¹⁸

In addition to monitoring, MMSD has utilized modeling to evaluate the effectiveness of green infrastructure practices on a wider scale. In 2007, for example, the district evaluated the ability of select green infrastructure practices, implemented at varying densities, to reduce CSOs in a typical 6-acre section of Milwaukee that included both residential and commercial lots. It was found that, for residential areas, practices such as porous pavement, downspout disconnections, rain barrels, rain gardens, trees, and compost amendments could reduce CSO volume by 12 to 38 percent and could lessen peak flows by 5 to 36 percent. At 50 percent implementation, CSO volume effectiveness from baseline would drop to 20 percent, and at 12.5 percent implementation, it would diminish to 5 percent from baseline. The conclusion was that, to produce the greatest benefit, widespread implementation is necessary.¹⁹

FINANCE STRATEGY

MMSD's capital budget is financed primarily through a tax on district properties based on their value, and a similar charge placed on 10 nonmember communities outside Milwaukee County that are also serviced by MMSD. The tax also funds acquisitions and improvements that enhance MMSD's sewerage service.²⁰ For 2011, tax revenue and nonmember billings are estimated to be \$111 million. MMSD's operating expenses are funded primarily through sewer service charges, which are an estimated \$66.7 million for 2011. Revenue also comes from the sale of fertilizer manufactured from

sewage sludge, with estimated net income of \$7.8 million for 2011. MMSD actively reviews ways to reduce expenses by implementing programs such as Greenseams™, described earlier, by providing incentives to achieve compliance, by public outreach and awareness programs, and by maximizing funding from private and government-sector grants and subsidies.²¹

2010 was a particularly challenging year for MMSD. After a catastrophic storm in July, MMSD delayed its regular budget cycle as it evaluated options and strategies “to address what seem to be more frequent and expansive issues in wet weather management.”²² As a result, the district's 2011 budget expanded its “Private Property Infiltration and Inflow Reduction” program to address issues of aging or deteriorating infrastructure and improved stormwater management to make it more resilient in the future. In particular, the program is addressing issues related to clear water entering the system through infiltrating leaky pipes, which has been identified as one of the primary causes of system capacity problems.²³

To incentivize participation, MMSD places an emphasis on leading by example, offering public outreach and technical assistance, and developing grant and cost-sharing opportunities, as discussed above. In addition, MMSD's 2011 capital budget includes \$1 million in funding for the 28 communities it serves to help them implement various green infrastructure projects. The district allocates funding among all 28 communities, and in the two communities with combined sewer systems, at least 25 percent of the funding must be expended in the combined area.²⁴

The district has very few regulatory requirements for green infrastructure. For development or redevelopment projects that include an increase of one-half acre or more of impervious surface, porous pavement, or vegetated roof, or where the disturbed area is greater than 2 acres, the area is subject to runoff requirements.²⁵ In reality, however, relatively few development or redevelopment projects exceed this

threshold.²⁶ One other potentially applicable requirement is Chapter NR 216 of the Wisconsin Administrative Code, which may require communities to reduce the total suspended solids in runoff from the developed urban area by 40 percent.²⁷

*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.

REFERENCES

- 1 Sands, K.; S. Anthony; B. Graffin; T. Chapman; T. Petri; B. Sander; M. Pearsall, personal communication, May 20, 2011.
- 2 K. Sands and B. Graffin, personal communication, May 12, 2011.
- 3 Kloss, C., and C. Calarusse (2006). *Rooftops to Rivers: Green Strategies for Controlling Stormwater and Combined Sewer Overflows*, Natural Resources Defense Council, accessed at <http://www.nrdc.org/water/pollution/rooftops/contents.asp>.
- 4 Sands, K (March 8, 2011). "Weaving Milwaukee's Green and Grey Infrastructure Into a Sustainable Future," Powerpoint presentation prepared for the Urban Water Sustainability Leadership Conference, accessed at <http://www.wisconsinplanners.org/attachments/ConferencePresentations2011/Milw%20Green%20and%20Grey%20infrastructure%20into%20a%20sustainable%20future.pdf>.
- 5 Kloss, C., and C. Calarusse. (2006). *Rooftops to Rivers: Green Strategies for Controlling Stormwater and Combined Sewer Overflows*, Natural Resources Defense Council.
- 6 Sands, K.; T. Chapman; B. McDonald; H. Mason (2010). "MMSD's Fresh Coast Green Solutions: Weaving Milwaukee's Green and Grey Infrastructure Into a Sustainable Future," p. 11, accessed at <http://v3.mmsd.com/assetsclient/documents/sustainability/SustainBookletweb1209.pdf>.
- 7 K. Sands, personal communication, June 14, 2011.
- 8 K. Sands and C. Schultz, personal communication, May 12, 2011.
- 9 MMSD's 2020 Facilities Plan (issued in 2007) and the Southeastern Wisconsin Regional Planning Commission's Regional Water Quality Management Plan update were written under a program known as the Water Quality Initiative.
- 10 Sands, K.; T. Chapman; B. McDonald; H. Mason (2010). "MMSD's Fresh Coast Green Solutions: Weaving Milwaukee's Green and Grey Infrastructure Into a Sustainable Future," ch.13, accessed at <http://v3.mmsd.com/assetsclient/documents/sustainability/SustainBookletweb1209.pdf>.
- 11 K. Sands and C. Schultz, personal communication, May 12, 2011.
- 12 K. Sands and C. Schultz, personal communication, May 12, 2011.
- 13 MMSD (2010). "2011 Operations & Maintenance and Capital Budgets", accessed at <http://v3.mmsd.com/AssetsClient/Documents/Budgets/2011%20Adopted%20Budget.pdf>.
- 14 MMSD (2011). "Signature Projects Milwaukee: Walnut Way Neighborhood," accessed at <http://www.h2ocapture.com/~media/H2OCapture/PDF/Signature%20Project%20Files/BMPWalnutWay.ashx>.
- 15 K. Sands, personal communication, May 11, 2011.
- 16 The Conservation Fund (2010). "Greenseams: Flood Management in Milwaukee," accessed at www.conservationfund.org/project/greenseams_program.
- 17 MMSD (2010). 2011 Operations & Maintenance and Capital Budgets, p. 1.
- 18 Sands, K., and T. Chapman (2011). "Why Green Infrastructure and I/I Control Go Hand In Hand," *Waterworld*, February 2, 2011, accessed at www.waterworld.com/index/display/article-display/3836371838/articles/waterworld/volume-27/issue-2/urban-water-management/why-green-infrastructure-and-ii-control-go-hand-in-hand.html.
- 19 The Civic Federation (2007). "Managing Urban Stormwater with Green Infrastructure: Case Studies of Five U.S. Local Governments", prepared for the Center for Neighborhood Technology, accessed at <http://www.cnt.org/repository/GreenInfrastructureReportCivicFederation%2010-07.pdf>.
- 20 A stormwater management fee is assessed by the city of Milwaukee, and as part of its program, businesses that reduce imperviousness can receive credits. However, the scope of this case study is limited to MMSD.
- 21 MMSD (2010). 2011 Operations & Maintenance and Capital Budgets, p. 1.
- 22 MMSD. (2010). 2011 Operations & Maintenance and Capital Budgets, p. 1.
- 23 MMSD. (2010). 2011 Operations & Maintenance and Capital Budgets, p. 1.
- 24 MMSD. (2010). 2011 Operations & Maintenance and Capital Budgets.
- 25 Sands, K.; T. Chapman; B. McDonald; H. Mason (2010). "MMSD's Fresh Coast Green Solutions: Weaving Milwaukee's Green and Grey Infrastructure Into a Sustainable Future."
- 26 K. Sands, personal communication, May 11, 2011.
- 27 Detailed information on Wisconsin's runoff management program may be accessed at runoffinfo.uwex.edu.