Milwaukee's Green Roofs: Sowing the Seeds of Prosperity for People and the Planet

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ABSTRACT

When most people think of Milwaukee, Wisconsin, they think of beer. But Milwaukee's history as the beer capital of the world is just one illustration of the water-rich history Milwaukee enjoys because of its proximity to Lake Michigan. Looking to its freshwater future without turning its back on the past, Milwaukee is also becoming known as a sustainability showcase. Milwaukee's showcase is not just about environmental sustainability though; it's also about economic and social sustainability.

While the seeds of sustainable green infrastructure were first sown here more than 10 years ago, they've spread nowhere faster than they have across the region's flat rooftops. In fact, the sustainable development model established by the Milwaukee Metropolitan Sewerage District (MMSD) and the Housing Authority of the City of Milwaukee (HACM) features green roofs at its nexus, where water resource enhancements meet not only energy benefits and cost savings, but also environmental justice.

The benefits of green roofs are easily demonstrated in Milwaukee where a small, central portion of the City's sewer system is a combined stormwater and wastewater system. The vast majority of the City is laced with separate sewer systems. Whether combined or separate, MMSD knows that green infrastructure can play a crucial role in supplementing sewers to manage water – a role that's likely to grow if storms continue to intensify as climate change models predict. In addition, HACM knows that green roofs contribute to economic development and good mental and physical health of residents who live in its buildings.

Recognizing this, MMSD has funded green infrastructure projects resulting in nearly two acres of green roofs and HACM has installed over one acre of green roofs. The collective benefit from these roofs that MMSD sees every time it rains is to hold over 55,000 gallons of rainwater that would otherwise pick up pollutants and could flow into area waterways or need to be treated at a water reclamation facility. Simultaneously, the collective benefit HACM provides through green roofs (together with other green amenities) is high-quality living that helps stimulate adjacent economic and social improvements in the City of Milwaukee. Water resource, energy, and quality-of-life benefits go hand-in-hand where Milwaukee's green roofs are concerned.

This paper showcases the benefits of green roofs in Milwaukee as they relate to MMSD and HACM. MMSD collects, conveys, stores and treats wastewater and also manages flooding. HACM provides decent/quality, safe and affordable housing with transition options. While both agencies have significantly different focuses, each has come to the independent conclusion that

green roofs are good for the City, the water systems it depends on, and the collective region as a whole!

KEYWORDS

Green roofs, sustainability, green infrastructure, stormwater, sustainable infrastructure.

INTRODUCTION AND METHODOLOGY

Figure 1. Highland Gardens, HACM, Milwaukee

The Housing Authority of the City of Milwaukee (HACM) is a national leader in building safe, affordable public housing. HACM has also received national recognition for the green infrastructure and energy conservation features it includes in its public housing. Amortized over time, HACM recognizes that green features easily repay initial up-front costs. The broader community immediately benefits from better stormwater management and reduced urban heat island effect. In addition, features such as green roofs help sustain people's psyches beyond their physical needs.

Where possible, HACM seeks to convert traditional urban renewal projects into facilities that are more integrated into the community. This helps develop community interaction and provides more travel options as well as pedestrian access.

HACM's initial interest in green roofs and sustainable features began with design and construction of their Highland Gardens building. HACM considered including a green roof as part of their strategy to reduce their building's impact on urban runoff and sewer overflows to waterways tributary to Lake Michigan. HACM owns significant roof space, and they understand that the only roof that doesn't leak is the one on the blueprints. The idea of adding a growing medium and plants to the top of a public housing roof made people many skeptical at first, so to learn more and address the skepticism HACM visited a modular system that had recently been installed at the Great Lakes WATER Institute in Milwaukee. They were pleased with the result and never looked back!

Today, HACM owns three buildings with green roofs. These green roofs total 51,332 square feet (1.2 acres), most of which are extensive green roofs (included in that total is 1,400 square feet of intensive green roof). Including green roofs in HACM's projects is consistent with Milwaukee Mayor Tom Barrett's vision for a Greener, Cleaner, Milwaukee. Together, HACM and the mayor's office set the tone for more green rooftops to follow.

Unveiled in 2004, Highland Gardens includes 20,000 square feet of modular green roof over 114 units. At the time it was installed it was the largest green roof on a residential property in the Nation! The facility transformed the property of two derelict high-rise apartment building towers

on 1.2 acres. The towers, which were built in 1967, were in poor condition, expensive to maintain, and densely crowded, among other problems. After assessing the property, HACM initiated the Highland Gardens project with the goal of replacing the old units in the high-rises. The now-four-story building is 120,000 square feet and includes some family units in addition to those for elderly and disabled residents.

Cherry Court, HACM's second green roof facility, is a 120-unit apartment complex for the elderly and people with disabilities. It includes a 20,000 square foot living roof that both aids stormwater management and lengthens the lifespan of the roof.

Convent Hill has five separate green roofs totaling nearly 12,000 square feet as well as 1,400 square feet of accessible green terrace for use by residents. The green roofs provide significant cooling and some heating cost reductions, less noise infiltration into the building, reduced stormwater runoff into the sewer system, and a potential doubling of the roof's functional lifespan.

Figure 2. Convent Hill, HACM, Milwaukee

The Milwaukee Metropolitan Sewerage District knows that when it rains hard too much unwanted stormwater gets into the sewer systems, either through stormwater runoff into the combined sewer system, or by inflow and infiltration of stormwater into sanitary sewer pipes. When this happens, resources are expended to convey and provide treatment to these additional inflows, and/or the system fills up, resulting in sanitary and combined sewer overflows. While overflows only occur an average of twice a year, MMSD and the region are striving to reduce these occurrences even more. One means of accomplishing this includes a greener, more sustainable approach to stormwater management. Green infrastructure helps restore some of the earth's natural hydrologic functions. While green infrastructure can't replace the capacity of the pipes and treatment technologies comprising grey infrastructure, it can store, convey, and use rainwater to great benefit while supplementing the capacity of grey infrastructure.

The majority of MMSD's service area, about 95 percent, has two separate sewer systems: one for stormwater and one for wastewater. The remaining five percent – the downtown core and adjacent neighborhoods – is served by one system that combines stormwater with sanitary wastewater. Because the man-made conveyance systems are different under the two plumbing scenarios, so too are the respective benefits of green roofs.

- *Separate sewer area benefits:* In the separate sewer area, the system's design goal was to keep rainwater out of the sanitary sewer system and carry it to receiving waters. Only the sanitary system was designed to carry water for treatment. Here, green roofs can help to improve receiving water quality (by filtering pollutants) and reduce the amount of water needing to be treated at water reclamation facilities by holding water and keeping it from leaking into the sanitary sewer system.

- *Combined sewer area benefits:* Green roofs in the combined sewer service area capture rainwater that might have otherwise contribute to a combined sewer overflow. Reducing the amount of water in the sewer system reduces the occurrences and volumes of combined

sewer overflows and reduces the need for rainwater to be treated at the water reclamation facilities. This results in less energy being used, fewer greenhouse gases produced and a subsequent cost savings.

MMSD recognizes that green roofs can infiltrate and evapotranspire stormwater that would otherwise run off an impervious roof. Through its Stormwater Best Management Practices (BMP) Partnership projects, MMSD has already sponsored the construction of nine green roofs including one on its headquarters building. From 2003 to 2009, the program was a competitive cost-share program designed to seed and demonstrate the benefits of green roofs, rain gardens, porous pavement, and other BMPs. Green roofs funded under the program are primarily extensive and total 75,614 square feet (1.7 acres). Taken together, these green roofs hold more than 33,000 gallons of stormwater. Projects include:

Great Lakes WATER Institute, Milwaukee (2003): This 7,600 square foot project is situated on Milwaukee's inner harbor and surrounded by paved roadways and cement docks and walkways. It offers a working model of an aesthetically-impressive stormwater mitigation strategy that is especially suited to dense urban development.

Urban Ecology Center, Milwaukee (2003): This 625 square foot project is on an accessible garage. It provides a sensory garden for native plants, and directs excess rainwater to a pond.

Milwaukee County Zoo, Milwaukee (2004): This 2,356 square foot project includes 640 square feet of eco-ballast. Temperature data is collected on the roof, and a live webcam keeps green roof enthusiasts informed of its progress: http://www.zoosociety.org/Education/FunStuff/Webcam/index.php?cam=greenroof .

Figure 3. MMSD, Milwaukee Co. Zoo

Milwaukee Metropolitan Sewerage District, Milwaukee (2004): This 3,400 square foot project is on the MMSD's four-story headquarters building. It includes 435 four-inch modules and 75 pavers for walkways. The initial planting included grasses and forbs native to Wisconsin's dry prairies, and was later supplemented with sedum better suited to the harsh rooftop conditions.

Figure 4. MMSD, Headquarters Building

City of Milwaukee Offices, Milwaukee (2006): This 17,700 square foot project is on a city-owned administration building. Its base layer is a vapor barrier with five inches of rigid insulation on top. The roof membrane is a single-ply (EPDM) rubber that's 90 mils thick and glued to the insulation. A protective fabric is next to protect the rubber from puncture, overtopped with a root barrier and drainage board. Over the drainage board, there is a moisture retention mat. Soil includes a 3- to 4-inch layer of 70% kiln expanded shale with 30% organic compost, and the plant mix is a variety of sedum.

Mequon Nature Preserve, Mequon (2007): This 4,233 square foot project is planted with sedum. The building also includes a geothermal power system and photovoltaic panels.

Figure 5. MMSD, Mequon Nature Preserve

MillerCoors, Milwaukee (2009): This 8,200 square foot project is on building #35 at the brewery. It reduces the volume of rainfall that flows off the property, and can be seen from various vantage points around the brewery campus.

Figure 6. MMSD, MillerCoors

United Community Center, Milwaukee (2009): This 1,500 square foot project is on a building on the City's near south side that offers a number of programs for clients of all ages.

Milwaukee Public Library Annex, Milwaukee (2009): This 30,000 square foot green roof is to be installed on the annex of the central library to reduce runoff into the combined sewer system.

Figure 7. MMSD, Milwaukee's Green Lakefront

RESULTS & DISCUSSION

HACM continues to use green roofs on its new projects as a standard practice to support their ongoing sustainability goals, increase roof life, and add additional insulation to their buildings. Building residents have had limited exposure to the green roofs so far as two of the three buildings that have this feature do not provide resident accessibility. In fact, the Highland and Cherry buildings have working green roofs that are not accessible by code. A handicap-

accessible, intensive green terrace was incorporated into the Convent Hill building beside the community room for resident use, thus providing an important aesthetic benefit to residents. Upper roofs at Convent Hill are extensive systems and are not accessible to residents.

HACM has partnered with the United Community Center to construct a 35-unit apartment building on the UCC Campus. The bid plans include working green roofs on all roof surfaces. They are also preparing plans for a renovation of HACM's Lapham Park building where they're also exploring the integration of solar hot water panels on the roof along with green roof systems in between the arrays. A 4,000 square foot green roof will be installed this summer at the Hillside Family Resource Center following a roof replacement.

In 2010, MMSD launched a stand-alone, $5 million green roof implementation program. This effort is the next step towards building a sustainable infrastructure for the future. MMSD launched the 2010 Regional Green Roof Initiative with funding secured through its own budgetary process. This is a $5 million matching funds program aimed at forming mutually beneficial partnerships to expand green roof coverage in the MMSD service area and further promote the benefits of green roof technology. The 2010 program is open to all interested sectors and to proposers incorporating monolithic/integrated roofs as well as the modular technology. The Request for Proposal (RFP) was released in December of 2009.

The program seeks proposers that will:

- Further promote green roof technology in the region through education programs and/or exposure to the public.

- Provide matching funds that may include in-kind contributions.

- Commit to the long-term success and maintenance of the projects.

MMSD assumes a base cost of $20 per square foot for green roofs for estimating purposes. The 2010 program stands to add well over 230,000 square feet of additional green roof area to the region, for a total of over 305,600 square feet (7.0 acres). Together, existing and 2010 MMSD-sponsored green roofs could hold over 134,000 gallons of stormwater every time it rains one inch!

MMSD knows that both the traditional grey and green infrastructure approaches to stormwater and CSO management can be very expensive to retrofit within older urban areas. Both approaches can also generate important environmental, social, and other benefits to local watersheds and urban-area communities according to the City of Philadelphia's Water Department. However, green infrastructure approaches may generate a broader and more valuable array of environmental, public health, and social benefits than do traditional CSO control strategies.

For this reason, MMSD recognizes that further analysis of the true benefits of sustainable infrastructure in the MMSD service area is needed. There are several reasons for this, including:

Potential interest in considering the full spectrum of sustainable infrastructure benefits: We all understand the need to foster partnerships that result in a full range of environmental, economic, and social benefits. To encourage partnerships and robustly report the full benefits of sustainable infrastructure like green roofs, additional benefits to consider may include reducing CSO/SSO/blending volumes, reducing energy usage, reducing greenhouse gas emissions,

keeping beaches open, enhancing aesthetics that result in higher property values, and reducing polluted stormwater runoff. Acknowledging these full benefits is often referred to as Triple Bottom Line accounting.

Uniquely developed system: The Milwaukee region's system has mostly solved the problem of combined sewer overflows through grey infrastructure, reducing the number of combined sewer overflows from an average of 50 (until the mid-1990s) to about two per year and reducing the average volume of overflow from over eight billion gallons to just under one billion gallons per year. Modeling the benefits of green roofs relative to the existing MMSD system will help target areas where they can be most effective.

The need to consider life-cycle and avoided treatment costs: This will allow a better long-term cost-benefit comparison ultimately more useful to alternatives analysis and long-term planning to eliminate CSOs.

Widely variable data from across the country: While there is good literature on the costs and benefits of sustainable infrastructure, experiences around the country vary greatly depending on climate, energy costs, and a host of other factors. Cost and benefit information related to the Midwest would provide the Milwaukee regional with a greater degree of accuracy in achieving the benefits claimed of green roofs.

CONCLUSIONS

MMSD has funded green infrastructure projects resulting in nearly two acres of green roofs and HACM has installed over one acre of green roofs. The benefits of reduced stormwater runoff into the sewer system and surface waters, reduced heating/cooling costs, and benefits to resident and regional psyche are unmatched, although have not been fully quantified. While quantifying those benefits is certainly in order, MMSD and HACM know that the benefits will be tremendous and have elected to not wait for further study. As a result, green roofs and quality of life improvements go hand in hand in Milwaukee.

ACKNOWLEDGMENTS

Special thanks go to the many people working tirelessly to blanket the Greater Milwaukee Watersheds in green infrastructure. These include many people at all levels of government and private life who, one-by-one, are stepping up to the environmental, social, and economic challenges that increasingly confront us.

REFERENCES

Apex Green Roofs, "Add Financial Value: Green Roof Directly Save You Money," [Internet]; available from http://www.apexgreenroofs.com/green-roof-benefits.html#6

City of Philadelphia Water Department, "Green City, Clean Waters: The City of Philadelphia's Program for Combined Sewer Overflow Control," (2009).

Deneen, S, "Green Roof," (2009). [Internet]; available from http://www.the-dailygreen.com/living-green/definitions/green-roof

Housing Authority of the City of Milwaukee, "Convent Hill," (2009).

Milwaukee Metropolitan Sewerage District, "Fresh Coast Green Solutions: Weaving

Milwaukee's Green & Grey Infrastructure into a Sustainable Future," (2010).
Milwaukee Metropolitan Sewerage District, "Stormwater Best Management Practices and the GLWI Green Roof," (2005). Contract M03015E15, University of Wisconsin-Milwaukee.
Sierra Club, "Building Better: A Guide to America's Best New Development Projects," (2005).
Southeastern Wisconsin Watersheds Trust, "Greater Milwaukee Water Quality Connections," (2009).
Tom Barrett, Mayor of Milwaukee, Press Release: "Mayor Barrett Launches Milwaukee Green Team to Build a "Greener, Cleaner Milwaukee," February 22, 2005.
Wisconsin Builder, "Cherry Hill on Top: Milwaukee Takes Housing to the Next Level," (2006).
Wisconsin Builder, "Simple Pleasures: Highland Gardens Caters to its Residents," (2004).