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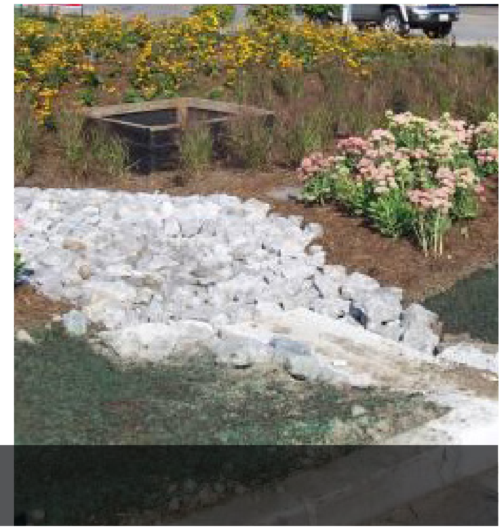

Assessing Green Infrastructure Performance and Cost

STORMWATER CONTROL IN THE WESTERN LAKE ERIE BASIN

Green infrastructure (GI) is part of the infrastructure system in built environments, installed in strategic locations to capture stormwater runoff after a rain event. GI projects are placed in locations to slow stormwater flows to streams, reduce flooding or fast currents that erode stream banks, or filter pollutants from parking lots or roadways. GI remains a small, but growing, piece of the stormwater management puzzle. For GI projects such as rain gardens, permeable pavement, and tree filters to become an integral part of the stormwater runoff toolkit, local decision-makers need a clear idea of their cost, effectiveness, and best use.

COLLABORATING THROUGHOUT THE WESTERN LAKE ERIE BASIN

Researchers from the University of Toledo partnered with the Storm Water Action Group (SWAG) of Lake Erie's Western Basin, a group comprised of municipalities, agencies, and non-profit organizations, to collect data on GI cost and performance. Many SWAG participants received funding in 2012 through the Great Lakes Restoration Initiative Surface Water Improvement Fund to install GI in Lucas County, Ohio. The group used this opportunity to share how well each of their GI projects perform in Northwest Ohio's poorly drained soils and how much they cost to install and maintain over time – key barriers to implementing GI at a larger scale in this and many geographies. The group met quarterly to guide the performance assessment process, shared lessons learned, and advanced understanding of GI projects throughout the region (see sidebar for list of participants).

ASSESSING GI COST AND PERFORMANCE

Researchers worked with SWAG to develop methods for assessing GI performance and created an online platform for sharing project specifications and costs. The team analyzed ten projects in total, including rain garden, bioretention, biofiltration, permeable pavement, tree filter, and wetland restoration projects. They compared design, installation, and on-going management costs for each GI site (e.g., capital, operations, and maintenance). They also determined how effectively certain GI projects captured rainwater and filtered soil and heavy metals found in the stormwater runoff. For a subset of sites, monitoring data informed storm water management models used to gauge project performance under varying conditions, see sidebar for GI monitoring details and results.

FACULTY & PARTNERS

- Cyndee Gruden, Department of Civil Engineering, University of Toledo
- Keri Gerwin, Water Quality Planner, Toledo Metropolitan Council of Governments

A diverse group of end users helped to co-produce the science that served to strengthen their own low impact development projects. The Toledo Metropolitan Area Council of Governments hosted meetings, which included the City of Toledo, City of Oregon, Lucas County, Boy Scouts of America, Toledo Botanical Gardens, Toledo Metroparks, University of Toledo, and Toledo Homeowners. Several members of this group are continuing to engage in conversations about advancing GI in the Western Lake Erie Basin and are bringing new partners into these efforts.

SHARING RESULTS

The research team facilitated sharing of GI cost, on-going operations and maintenance plans, and preliminary performance data among members of the SWAG (see table below). Longer-term performance assessments will unfold as responsible parties continue to collect and analyze data. The GI case studies developed throughout this project create a useful resource for decision-making about what type of GI project could fit budgets and best address stormwater needs for decision-makers throughout the Western Lake Erie Basin and beyond.

IMPACT

The results from this project have been communicated at multiple scales. Local and regional partners received regular updates at quarterly Storm Water Action Group meetings and the team also shared methods and key findings with other interested partners in the Western Lake Erie region via an online interactive mapping tool. Regional and national conferences and peer-reviewed publications provided opportunities to communicate results to practitioners and researchers in the water resources community around the country. The research team also added GI projects to the International Best Management Practices (BMP) Database, with maps of stormwater projects and the high quality monitoring data necessary to create a broad list of case studies and comparative performance data for decision-makers around the globe.

PILOTING COMPREHENSIVE STORMWATER PROJECT MONITORING

For select sites, the research team performed in depth and comprehensive water quality and quantity monitoring. The team used a variety of techniques to sample for water presence, flow, and quality and model project performance under different conditions, including:

- Water Flow – Water level logger
- Water Quality – Nutrients (Hach colorimetric assays), Solids (EPA method 160.2), Metals (EPA method 1638), Bacteria (Petrifilm), and Oil and Grease (EPA method 1664A)
- Water Presence – Rain event (Weather Station) and Water presence at project site (Soil Moisture Sensors)
- Hydrologic Modeling – Stormwater Management Model (SWMM)

ABOUT THE WATER CENTER

The U-M Water Center addresses critical and emerging water resource challenges through collaborative research projects. We believe that diversity is key to individual empowerment, and the advancement of sustainability knowledge, learning and leadership. The Center is part of the Graham Sustainability Institute, which integrates faculty and student talent across U-M, and partners with external stakeholders to foster collaborative sustainability solutions at all scales.

See: www.graham.umich.edu/water

This level of analysis gives a complete picture of the practice's performance under local conditions. Researchers found that a tree filter at the University of Toledo campus was effective at filtering rainfall events up to 0.10 inches for a capacity of 1100 gallons. The size of the rain event that can be contained depends on the rainfall intensity as well as the condition of the tree filter. The tree filter significantly reduced sediment runoff and filtered zinc but no other heavy metals consistently. Nutrient and bacterial levels before and after tree filter construction were below detection. Monitoring at this level of detail can be costly. To keep costs lower, each technique can be implemented individually or in a group.

Green Infrastructure Project Features

Site Name	Significant Features	Cost	O&M Assignment and Funding	Monitoring Plans
South Erie Street	2,900 ft.^{2} rain garden collecting street runoff	$8,000	City of Toledo Env. Staff; Staff time	Visual Monitoring
Conrad Street	30 bioretention areas on uncurbed residential streets	$180,000	Homeowners	Visual Monitoring
University of Toledo (UT)	1,500 ft.^{2} biofiltration of parking lot runoff	$25,000	UT Facilities, Faculty, & Students; Facilities budget & volunteers	Automated Quality and Flow Monitoring
University of Toledo	Tree filters collecting drainage from 37,460 ft.^{2}	$30,000	UT Facilities; Facilities budget & volunteers	Automated Quality and Flow Monitoring
Lucas County Engineer Building	1,800 ft.^{2} rain garden and 2,900 ft.^{2} permeable pavement	$43,900	Lucas County Engineers Office; LCE budget	Visual Monitoring
Larc Lane	2,900 ft.^{2} permeable pavement surrounding catch basins	$39,600	Lucas County Engineers Office; LCE budget	Visual Monitoring
Blue Creek Conservation Area	260,000 ft.^{2} wetland restoration and 1,000 ft. two-stage ditch	$171,000	Toledo Metroparks	Automated Quality and Flow Monitoring
Oregon Bioretention Facility	9 biorentention cells totalling 13,850 ft.^{2}	$104,600	City of Oregon; Grounds budget	Automated Quality and Flow Monitoring
Camp Miakonda	Pavers and 1,500 ft.^{2} rain garden	$48,000	Boy Scouts of America; BSE budget	Visual Monitoring

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