# Green Infrastructure Toolkit for Wisconsin Municipalities

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# Acknowledgements

The development of this toolkit was led by Zoë Goodrow – principal author and project manager of the toolkit, and Green Infrastructure Policy Specialist at Clean Wisconsin. Nancy Retana, Resilient Communities Program Director, and David Tipson, Vice President at Clean Wisconsin co-managed and co-edited the toolkit.

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The toolkit is an extension of the years of Clean Wisconsin's community engagement and green infrastructure work in Milwaukee and other regions across the state. **This work would not be possible without the organizations and individuals who have supported us and welcomed us into their communities.**

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# Green Infrastructure Toolkit for Wisconsin Municipalities

**Clean Wisconsin's Green Infrastructure Toolkit for Wisconsin Municipalities** empowers local governments to realize the benefits of green infrastructure as a stormwater management solution and community enhancement strategy. Local governments are typically the first to experience the impacts of floods and are on the front lines of developing infrastructure, regulations, and emergency responses. Fortunately, municipalities are uniquely positioned to implement green infrastructure. They often have the flexibility to enact change quickly and to tailor their responses while still serving as models for surrounding communities.

Wisconsin is a mosaic of communities – urban, suburban, and rural – each facing a unique set of issues. We at Clean Wisconsin designed the toolkit with the diversity of Wisconsin's local governments in mind. We want to help local officials preserve the rural landscape, increase urban vitality, and improve the quality of life for their residents. With community engagement and technical support, local governments can develop dynamic green infrastructure projects as creative solutions to flooding while also benefiting public health, the economy, and the environment.

Through meta-analysis of case studies and hosting focus groups of municipal leaders, Clean Wisconsin identified the most common challenges faced by local government agencies when it comes using green infrastructure to help manage stormwater:

- Perception that green infrastructure performance is unknown
- Perception of higher costs when compared to conventional or "gray" infrastructure
- Unfamiliarity with maintenance requirements and cost
- Conflicting codes and ordinances
- Lack of government capacity and disconnect from other departments and sectors

This toolkit provides examples on how to enable and authorize green infrastructure through policy changes, quantifies costs and benefits of green infrastructure, addresses the above barriers faced by municipalities when it comes to implementation, and provides examples of successful efforts across the state.

## A warmer and wetter Wisconsin calls for greener solutions

Weather patterns across Wisconsin are changing—our state is 3 degrees warmer on average than it was in the 1950s, and we get about 5 more inches of annual rainfall. The last three years have been the wettest ever recorded in our state.[1]

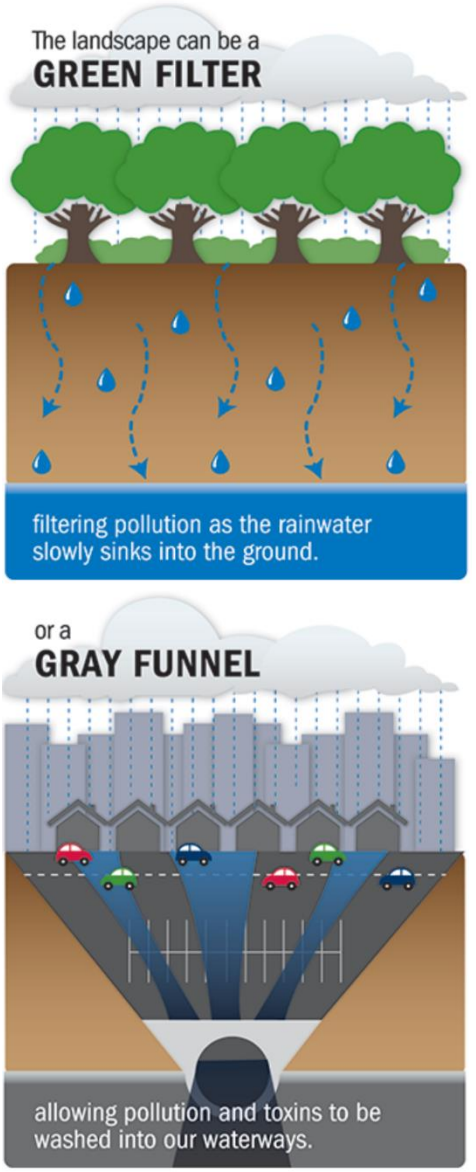
That means Wisconsin communities are enduring an increasing number of severe storms that damage property and claim lives. Monroe County alone has been slammed by more than 20 flash floods in just the last 15 years. The county's flood-damage expenses between 2010 and 2019 topped $33 million, more than one thousand times greater than each of the previous two decades.[2]

And it's not just Monroe County. Communities across Wisconsin are finding out that the way they've managed stormwater for decades is no longer working. Relying on conventional stormwater infrastructure is no longer viable for most communities. Reacting to floods and relying on conventional stormwater systems is too expensive .

Conventional stormwater systems, or "gray" infrastructure, include gutters, drains, pipes, and retention basins. Gray infrastructure uses impermeable surfaces like concrete and asphalt to direct stormwater to a built system that eventually drains into bodies of water, along with the pollutants the stormwater runoff picks up along the way.

These stormwater-management systems were not designed for Wisconsin's new norm of increased rainfall and more intense storm events. In fact, by preventing rainfall from infiltrating into the soil, gray infrastructure can at times make flooding more severe. A continued reactive stance to these disasters is proving to be far more costly than active prevention and adaptation. Rebuilding after flood events must incorporate proactive designs that do not replicate the inadequacies of traditional gray infrastructure but include **green stormwater infrastructure**.

*Outdated "gray" infrastructure was often not designed with our current climate in mind- sometimes exacerbating flooding across the state as precipitation increases.* [1]



## What is green stormwater infrastructure?

Green stormwater infrastructure is a stormwater management approach that mimics the water cycle and **manages rain where it falls**, allowing it to filter into the ground. In this toolkit, green infrastructure refers to both natural and engineered ecological systems, including rain gardens, rain barrels, green roofs, permeable pavements, street trees, vegetative barriers and infiltration basins. Green infrastructure practices reduce runoff and treat stormwater at its source while providing other environmental, social, economic, aesthetic, educational and public-health benefits. Designs that incorporate both gray and green infrastructure are becoming more widely used in planning to accommodate changing weather impacts.

Green infrastructure practices ***reduce*** runoff by capturing rain where it falls and allowing it to filter through the ground. Practices such as rain gardens and bioswales capture stormwater and allows it to recharge groundwater supplies. Rain barrels and cisterns capture and store water for reuse, reducing the amount of water that flows from the property. Lower discharge volumes translate into reduced combined sewer overflows and lower pollutant loads.

Permeable surfaces and vegetation ***slow*** runoff and filter pollutants, reducing strain on stormwater infrastructure and improving water quality. Street trees and vegetated curb areas reduce the flow of water to impervious surfaces that drain into storm drains or water bodies. This reduces the burden on gray infrastructure and mitigates the risk of flooding. This is especially important in communities that have combined sewer systems as high stormwater flows can send untreated sewage into our waters.

Green infrastructure practices ***filter*** stormwater where it falls. Stormwater runoff meets whatever pollutant resides on the impervious surface including road salt, trash, sediment, pesticides, and other contaminants. Many green infrastructure practices such as soil and plants help capture and remove pollutants from stormwater in a variety of ways including adsorption, filtration, plant uptake and the decomposition of organic matter.


*Rain gardens, like all types of green infrastructure, mimic the water cycle and manage rain where it falls.* [2]

***Green infrastructure can be used in…***

- Communities of any size (urban, rural, suburban, etc.)
- Communities that experience flooding and water quality issues
- Residential areas, business districts, and public spaces
- Small to large scale initiatives or projects
- Local governments interested in saving stormwater management costs
- Municipalities that have Municipal Separate Storm Sewer System (MS4) or other permits
- Communities interested in enhancing quality of life

## Types of Green Stormwater Infrastructure

**Bioretention and infiltration practices** such as **rain gardens** are a type of water capture feature in landscaping that slows the flow of runoff and absorbs it during storm events. These shallow depressions are filled with deep-rooted native plants and perennial wildflowers that collect water from roofs, driveways, and other hard surfaces and naturally absorb water into the ground. These plants also provide habitat for native pollinators, increase biodiversity, and help sequester carbon. Rain gardens range from 100 to 300 square feet, are three to eight inches deep, and are often strategically placed near downspouts on homes or by storm drains on right-of-ways.

**Bioswales** are long, channeled drainage ways for stormwater with vegetation and large stones that capture, slow, and infiltrate runoff. They often incorporate thicker and heavier grasses, making them better able to filter pollutants compared to rain gardens. Bioswales are designed to manage much more runoff from a large impervious area like streets and parking lots. They also have more complicated design features such as layers of engineered soil and gravel, perforated pipe underdrains, and overflow structures to help handle runoff from bigger storms.

**Infiltration basins** capture stormwater and infiltrates it into the ground through highly permeable soil and vegetation. These shallow, artificial ponds can be installed in conjunction with bioswales that will channel stormwater to the infiltration basin where it is stored until it infiltrates into the groundwater supply. Infiltration basins are highly effective at providing water quality treatment and groundwater recharge.

*The photo above features several green infrastructure practices on the grounds of Maryland Avenue Montessori School in Milwaukee, including a rain garden, bioswale, and infiltration basin.* [3]

**Constructed wetlands** are designed to contain water at all times and mimic the functions of natural wetlands to capture stormwater, reduce nutrient loads, and create diverse wildlife habitat. They fulfill critical ecosystem functions such as providing habitat, serving as ecological buffers, and reducing nutrient load into waterways. Studies show that healthy constructed wetlands can remove up to 70 percent of total nitrogen, 70 percent of total phosphorous, and 95 percent of total suspended solids from stormwater runoff and reduce erosion and storm impacts.[3–5]

**Wetland restoration** plays an important role in ecosystem health and stormwater management. Wetlands reduce peak flows and flood damage, store water, protect shorelines from erosion, and provide community aesthetics and recreational opportunities. Wetlands collect, slow, and filter runoff and provides habitat for fish and wildlife. These features are being integrated into community plans as a flood and hazard mitigation tool. Restoring existing wetlands is more affordable than constructing new ones.

**Rain barrels and cisterns** are containers that attach to downspouts and capture stormwater runoff from the roof and gutter system of a building. Collecting roof runoff in rain barrels reduces the amount of water for use on property landscape and significantly prevents flooding and water pollution when implemented at a larger scale. A typical rain barrel holds 55 gallons of stormwater. Cisterns are partially or fully buried tanks with a secure cover and a discharge pump that provides more storage than barrels.

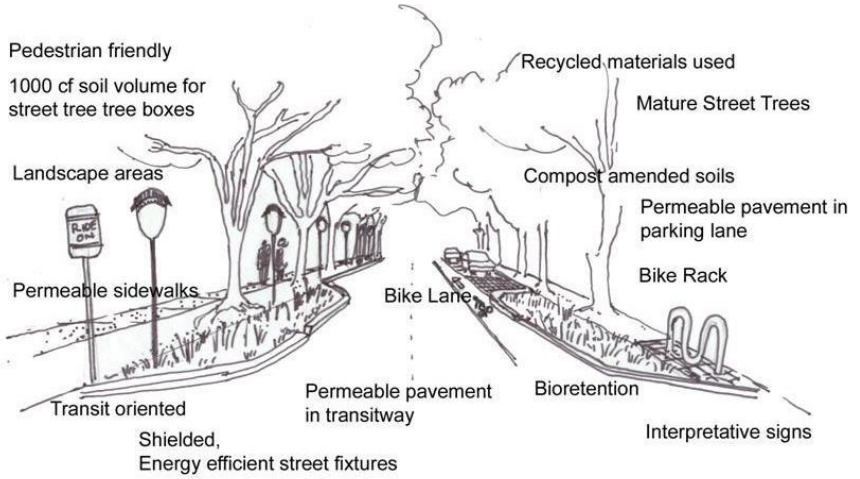
**Green roofs** are roofs covered partially or completely with vegetation and a growing medium planted over a waterproofing membrane and may also include a drainage system. They absorb rainwater, insulates buildings, provides a habitat for wildlife, reduces water pollution, and sequesters carbon. Green roofs offer significant economic benefits including longer roof life, heating and cooling energy savings, and reduced infrastructure costs from maintenance or repair of traditional roofs.

**Permeable pavements** are surfaces that infiltrate stormwater and melting snow into the ground in contrast to impervious surfaces that generate runoff. Permeable pavements are designed to allow stormwater to infiltrate through the pavement to an underground storage system or infiltrate into the ground as it passes through layers of stone or other filtering media. These structures can be used within parking lots, streets, sidewalks, driveways, and patios. Vegetation can be incorporated into permeable pavement allowing the absorption of carbon dioxide, increasing aesthetics, enabling carbon sequestration, and creating pollinator habitat.

**Street trees** are trees planted along roadsides. Once mature, these trees provide significant benefits to watersheds as they absorb stormwater and slow stormwater runoff. A single mature oak tree can absorb over 40,000 gallons of water in one year. Street trees also improve air quality and provide shade and cooling effects through evapotranspiration, reducing the temperature of pavement, buildings, and surrounding air. Another green infrastructure practice with trees **agroforestry**, or the intentional integration of trees and/or shrubs with agriculture (e.g., crops and livestock).

**Green streets** integrate several green infrastructure features to increase infiltration of runoff from streets and sidewalks, reduce flows, enhance water quality, increase neighborhood aesthetics, and more.

*Green streets demonstrate creative ways to use natural solutions to enhance community quality of life.* [4]



# Getting Started: Permit Requirements and Demonstration Projects

## Demonstration projects

Many local governments begin experimenting with green infrastructure through demonstration or pilot projects. Common demonstration projects include green streets, green roofs, and rain gardens. These projects are a great way to meet many of the requirements of MS4 and other stormwater permits. Demonstration projects also allow municipalities to test out different green infrastructure practices and strategies before committing to long-term investments and initiatives.

Demonstration projects can be risky when done in highly visible areas, yet a benefit of these projects is to garner community buy-in and serve as an educational opportunity. For example, a green infrastructure project in the Green Bay area was viewed negatively by the public when native plants became overgrown and unsightly – resulting in the public to view green infrastructure negatively overall. To avoid this, recurring advice from municipal leaders in Wisconsin with green infrastructure experience is:

*Demonstration projects like rain gardens with signage offer opportunities for outreach, education, and social cohesion. The garden above features native plants, promoting habitat for pollinators and other wildlife.* [5]

- **Plan for maintenance:** Maintenance must be thought of prior to the implementation stage and must be accounted for during the planning process. Understanding the benefits of green infrastructure can help make the case for maintenance in budgets. Maintenance requirements are generally *less* extensive compared to conventional stormwater infrastructure, but they require *different* techniques.
- **Engage the community during the planning process:** This will ensure that projects are context-specific and include community priorities. This also helps garner community buy-in and provides opportunities to communicate the benefits of green infrastructure.
- **Communicate the benefits and cost saving aspects to the community:** Expressing the importance of green infrastructure beyond stormwater management and flood control is essential to get community support. Quantification of the benefits of these practices will prove valuable for outreach. If a municipality is installing a green street as a demonstration project, local government leaders must be prepared to explain the long-term benefits of its installation. Various outreach mediums may be used to communicate the benefits of these projects and include presentations, workshops, media campaigns, written materials, and other community events.

## Stormwater regulations in Wisconsin & how green infrastructure can help

There are several regulations and permitting processes related to waste and stormwater management that municipalities must comply with. While the state government doesn't require green infrastructure in all municipalities, such projects can help municipalities comply with state and federal regulations and permit requirements.

Around 240 municipalities in Wisconsin with separate waste and stormwater systems are required to have **Municipal Separate Storm Sewer System (MS4) permits**. These permits are effective for up to five years, at which point they are updated and re-issued. MS4 permits require municipalities to reduce polluted stormwater runoff by implementing stormwater management programs that must contain an array of activities. They also require municipalities to meet Total Maximum Daily Load (TMDL) water pollutant limits required by the Clean Water Act.

Municipalities across the state struggle to meet their TMDL limits and MS4 requirements because of increased precipitation, flooding, and outdated gray infrastructure. ***Green infrastructure can help meet these requirements*** – in fact, the Wisconsin Department of Natural Resources (DNR) recently required several municipalities to enable green infrastructure provisions in their codes and ordinances to comply with their MS4 permits.

Municipalities with combined sewer systems must apply for **Combined Sewer Overflow (CSO) permits** through the National Pollutant Discharge Elimination System (NPDES) in the event of sewer overflow events. CSOs are expensive and are becoming more frequent. Green infrastructure projects reduce flood severity and frequency, lessening the need for municipalities to apply for CSO permits, saving municipalities money and hardship.

*How can green infrastructure mitigate permitting issues and help municipalities meet MS4 requirements and TMDL limits?*

| Stormwater Management Program Requirements from MS4 Permit | Ways to Use Green Infrastructure to Help Meet Requirement |
|---|---|
| **Public education and outreach-** Programs must encourage the public and business to adopt behaviors and procedures to reduce stormwater pollution. | **Install a demonstration project** to educate the community on the importance of green infrastructure and stormwater management. |
| **Public involvement and participation-** Programs must encourage participation from individuals to prevent stormwater pollution. | **Implement projects that encourage community participation** like rain garden installations or street tree planting days. |
| **Illicit discharge detection and elimination-** Programs must identify, prevent, and eliminate illicit (non-rainwater) pollutants and discharges to storm sewer systems. | **Install a stormwater infiltration basin** paired with a bioswale to prevent polluted water from getting into waterways. |
| **Construction site pollutant control-** Municipalities must develop a soil erosion control ordinance and enforce it on construction sites | **Add green infrastructure requirements** (e.g., vegetation buffers) to slow runoff and trap sediments before entering the waterways. |
| **Post-construction stormwater management-** Municipalities must develop a post-construction ordinance and enforce it to ensure areas of new and redevelopment include measures to mediate issues from stormwater runoff | **Add green infrastructure requirements** (e.g., permeable pavements, rain gardens, bioswales) to control pollutants and water flow, maintain infiltration, and protect waterways and wetlands near post-construction areas. |
| **Pollution prevention practices by the municipality-** Programs must include practices to prevent pollutants from municipally owned sources | **Install green infrastructure** along city roads, medians, or other municipal properties like waste transfer stations to prevent pollutants from entering their storm sewer system. |

# Funding and Financing for Green Infrastructure

The time to invest in green stormwater infrastructure is now. The **Inflation Reduction Act of 2022** invests $386 billion in climate resiliency through incentives, tax credits, and other spending - signaling a green light to everyone (*e.g.,* consumers, companies, local governments) to start doing green projects. Just prior to that legislation, the federal government enacted the **Infrastructure Investment and Jobs Act** - the largest water investment in our nation's history - including $55 billion for clean drinking water infrastructure, $50 billion for climate resiliency, and $21 billion for pollution removal. These monies are allocated to various programs like the **Clean Water State Revolving Fund** or the **Sewer Overflow and Stormwater Reuse Municipal Grant Program** in the EPA - both of which can fund green infrastructure projects.

In focus groups and interviews we conducted to inform this toolkit, municipal staff identified the following as the most effective strategies for successful green infrastructure financing:

- Make the business case – demonstrate how being *proactive* with green infrastructure instead of *reactive* with conventional approaches will save your municipality money.
- Integrate green infrastructure into existing government processes.
- Collaborate with a network of partners – this is attractive to funders, helps finance green infrastructure through multiple funding streams, and ensures sustainability of initiatives.
- Leverage multiple financing mechanisms (e.g., utility fees, grant funding, writing green infrastructure into other government processes).
- Incentivize participation from the private sector.
- Plan for green infrastructure maintenance from the beginning.
- Be thoughtful with communications, messaging, and outreach.

### Making the business case – lower costs for towns and cities

Investing in green infrastructure can minimize a community's dependence on gray infrastructure and save the community money from associated costs. In general, green infrastructure practices that have traditional alternatives (e.g., permeable vs. concrete sidewalks, green vs. traditional roofs) are more affordable than their traditional alternatives. In cases where initial installation of green infrastructure is more costly, when considering the life cycle and maintenance costs of certain practices, green infrastructure is **consistently the more affordable option**. For example, a green roof installation cost is about $100 per month less than that of a conventional roof, considering their lifespans of 50 and 20 years respectively.[6] Also, when considering the additional benefits of a green roof, the profitability of the investment is much higher. Permeable pavements are generally cheaper to install and always more affordable to maintain over time when compared to traditional impervious surfaces like concrete sidewalks, roads, and driveways.

**Treating water costs less in communities that invest in green infrastructure**, as these practices both filter water and reduce the volume of polluted water entering waterways. An EPA study of drinking water source protection concluded that every $1 spent on source-water protection efforts saved $27 in water treatment costs.[7]

Communities also **spend less on flood damages** when they have invested in green infrastructure, as these practices significantly reduce the impact of floods on homes, bridges, and other infrastructure. Other reduced costs include road and sidewalk salt applications and associated costs from damages. Dane County[6] reported that **permeable pavement decreases 77 percent of annual road salt usage**, and $800 to $3,300 per ton of rock salt will be saved without infrastructure damages from salt application. See Avoided and Reduced Costs" in the "Quantified Benefits" section of this toolkit for more statistics like this.

## Local financing - Stormwater Utility Fees

Financial incentives make the initial investment in green infrastructure more palatable, but they do require that municipalities have the available funds to implement. In addition to grants and loan programs, **municipalities can implement stormwater utility fees to finance green infrastructure**. The benefits of this fee are two-fold as it incentivizes green infrastructure while funding the incentive. Stormwater fees are often included in property taxes but can be separated. Like with most utility fees, stormwater fees are often viewed as a fair, equitable method for users who benefit from the utility.

Fees could be determined in several ways, depending on the goals of the community. For example, the total area of impervious surfaces on a property could determine the fee if the goal is to increase permeable surfaces in that area. Property owners that implement green infrastructure could also receive a one-time credit to their stormwater utility fees, receive a percent fee reduction, or a fee reduction based on how much water is prevented from entering the stormwater system or waterbodies. Fees should be directed at those that produce the most runoff, and municipalities could provide discounts, vouchers, or zero interest loans for low-income neighborhoods – finding the right balance of collecting enough funds to pay for green infrastructure without being overburdensome on the community.

***Example from Madison, WI - Stormwater Utility Credit Policy***[8]

In 2022, the City Engineer of Madison determined it necessary to update the city's rate adjustment and credit policy goals to:

1) support the city's compliance with their MS4 requirements,
2) create a more equitable distribution of the city's stormwater management costs, and
3) reward actions that reduce the city's cost of stormwater management (i.e., green infrastructure practices).

Customers that implement and maintain a green infrastructure practice from a provided list are rewarded with a credit towards their stormwater utility fees. The credit consists of two components – a pollution reduction component (based on the total suspended solid (TSS) reduction) and the conveyance system component (based on storm discharge volume reduction) – each prorated based on the percent of stormwater reduction achieved. Overall, this policy reduces the city's stormwater management costs.

## Funding from state and federal programs

There are funding opportunities at the state and federal level, including grant and low-interest or interest free loan programs. An advantage of green infrastructure projects is that they are eligible for a variety of funding programs as these projects typically have numerous and diverse benefits. The table on the next few pages summarizes the most common programs that could fund green infrastructure projects at the municipal level. It indicates which phase(s) of the project (planning and design, construction, operations and maintenance, or monitoring) could be funded through the program.

In addition to the following table, municipalities can utilize the **EPA's Water Finance Clearinghouse –** an online portal that searches a database with over $10 billion in water funding sources and over 550 additional resources like reports, webinars, etc. to support local water infrastructure projects, including green infrastructure. It is regularly updated and free to use. Users can search by funder, region, eligibility, and environmental sector.

https://www.epa.gov/waterfinancecenter

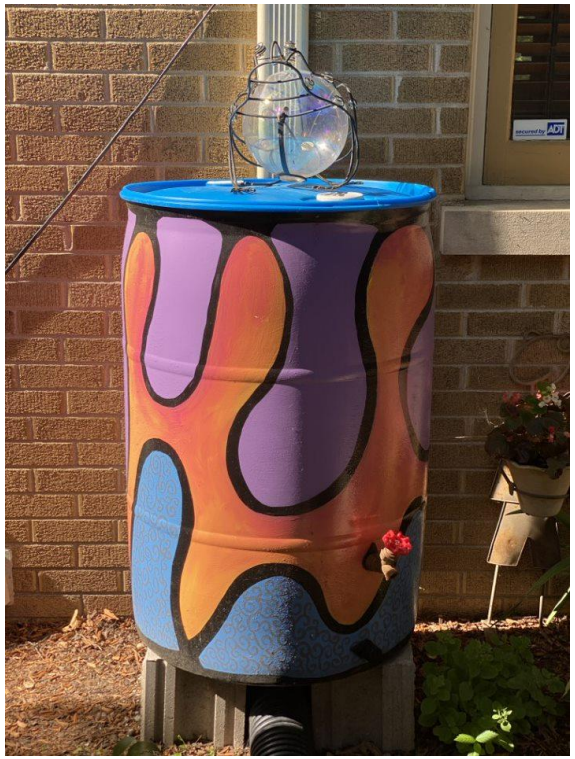
| Agency | Program | Description | Planning & Design | Construction | Operations & Maintenance | Monitoring |
|---|---|---|---|---|---|---|
| WI DNR | Clean Water Fund Program (CWFP) | Reduced interest-rate loans for publicly owned wastewater and water-quality-related stormwater infrastructure projects (some municipalities eligible for principal loan forgiveness) | X | X | | |
| WI DNR | Pilot Projects Program | Sub-program of CWFP, specifically for non-traditional projects and generally used to reduce nutrient outputs into watersheds | X | X | | X |
| WI DNR | Safe Drinking Water Loan Program | Reduced interest-rate loans for publicly owned drinking water infrastructure projects that are needed to protect public health and achieve or maintain compliance with federal and state regulations relating to water supply | X | X | | |
| WI DNR | DNR Surface Water Grant | Various cost-sharing grants for surface water protection and restoration - can support ordinance development, planning and education projects, and surface water restoration and management projects | X | X | X | X |
| WI DNR | Municipal Flood Control Grant Program | Funds riparian restoration projects and flood mapping projects | X | X | | |
| WI DNR | Urban Nonpoint Source & Stormwater Management (UNPS&SW) Grant Program | Includes planning and construction grants that fund evaluation and planning processes, construction of BMPs, local stormwater management funding programs, local ordinance preparation and updates, etc. | X | X | | |
| WI DNR | Targeted Runoff Management (TRM) Grant Program | Funds urban and agricultural nonpoint source control projects designed to meet EPA-approved TMDL goals | | X | | |
| WI DOA | Community Development Block Grant Planning (CDBG-PLNG) Program | Funds planning efforts to improve community opportunities and vitality. Eligible projects include community development plans, comprehensive plans, small area and neighborhood plans, and redevelopment plans. | X | | | |
| WI DOA | Community Development Block Grant - Public Facilities (CDBF-PF) Program | Funds infrastructure and facility projects in low- to medium-income communities. Eligible projects include improvements, repairs, or expansions of streets, drainage systems, water and sewer systems, sidewalks, and community centers | | X | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| WI DOA | Wisconsin Coastal Management Grant Program | Funds coastal resource and community planning, policy and ordinance development and improvement, wetland protection and restoration projects, nonpoint source pollution projects | X | X | | |
| WI BCPL | BCPL State Trust Fund Loan Program | Provides loans for local infrastructure projects including stormwater management projects | X | X | X | X |
| Great Lakes Comm-ission | Great Lakes Green Infrastructure Champions Program | Grants support community projects that focus on developing strategies to overcome key barriers to GI. Projects can include code and ordinance review and revision, development of sustainable funding streams, operation and maintenance training, and workforce development | X | X | X | X |
| EPA | Water Infrastructure Finance and Innovation Act (WIFIA) | Funds development and implementation activities for Clean Water SRF and Drinking Water SRF projects and drought prevention, mitigation, and reduction projects | X | X | | |
| USDA | Water & Waste Disposal Loan & Grant Program in Wisconsin | Funds may be used to finance the acquisition, construction or improvement of stormwater collection, transmission and disposal in rural areas | | X | X | |
| USDA | Water & Waste Disposal Predevelopment Planning Grants in Wisconsin | Funds initial planning and development of applications for USDA Rural Development Water and Waste Disposal direct loan/grant and loan guarantee programs | X | | | |
| USDA | SEARCH - Special Evaluation Assistance for Rural Communities and Households in Wisconsin | Funds pre-development planning costs for feasibility studies to support applications for funding stormwater projects or preliminary designs for projects that construct or improve rural stormwater infrastructure | X | | | |
| USDA | Community Facilities Direct Loan & Grant Program in Wisconsin | Funds essential community facilities projects including street improvements through grants or loans | | X | | |
| USDA | Great Lakes Sediment and Nutrient Reduction Program | Funds sediment and nutrient reduction activities associated with agricultural nonpoint pollution, stormwater, or Great Lakes shorelines | X | X | X | X |
| USDA | Tree planting and forest health improvement in the Great Lakes Basin | Funds green infrastructure projects that reduce runoff from degraded sites by planting trees and other vegetation | X | X | X | X |

| | | | | | | |
|---|---|---|---|---|---|---|
| FEMA | Building Resilient Infrastructure and Communities (BRIC) | Funds proactive investment in resilience for communities to be better prepared and remain resilient prior to a flood or other natural disaster | X | X | X | |
| FEMA | Hazard Mitigation Grant Program (HMGP) | Funds green infrastructure methods to reduce the impacts of flood and drought, development of hazard mitigation plans, and utility and infrastructure retrofits | X | X | | |
| FEMA | Flood Mitigation Assistance (FMA) Grant | Funds community flood mitigation green infrastructure projects, planning activities, and technical assistance | X | X | | |
| HUD | Community Development Block Grant (CDBG) Entitlement Program | Funds improvements and construction of public facilities and activities relating to energy conservation | X | X | | |
| NOAA | NOAA Great Lakes Habitat Restoration Regional Partnerships Grant | Funds wetland restoration and community engagement projects | X | X | | X |
| NOAA | National Coastal Resilience Fund | Funds planning and implementation of projects that focus on nature-based solutions and enhancing community resilience | X | X | | |
| NOAA | Coastal Habitat Restoration and Resilience Grants for Underserved Communities | Funds habitat restoration activities that promote resilient ecosystems and communities in underserved coastal areas | X | X | X | X |
| USACE | Corps Water Infrastructure Financing Program | Provides long-term, low-cost loans for local investment in infrastructure projects that address community water resource needs, enhance resilience to flooding, promote economic prosperity, and improve environmental quality | | X | | |
| USACE | Planning Assistance to States | Funds comprehensive planning processes for activities that address water quality, supply, and conservation; wetland restoration; and flood damage reduction | X | | | |
| USFWS | Sustain Our Great Lakes (SOGL) | Funds projects that expand green stormwater infrastructure in Great Lakes communities | X | X | X | X |

## Tips for grant planning and writing

**Green infrastructure projects require funding and staff capacity – but so does the process of applying for funds. It is important to remember the that administrative costs related to the development of the proposal can be recouped through funded proposals.**



*A hand-painted rain barrel from Milwaukee* [6]

**Understand eligibility.** Some programs have specific requirements to prioritize lower income areas or certain community sizes (i.e., rural or urban communities).

**Review key application dates and requirements.** There are often many important dates for the application process, like pre-proposal or letter of intent deadlines. Most programs require letters of support or other supplementary materials from partners, meaning municipalities will need to acquire documents from collaborators or other stakeholders.

**Look into previously funded projects.** A lot of funding program websites will have information on past projects. This is a good resource to understand what competitive proposals look like. If this information is not available on program websites, a quick internet search should find results, as awardees are often required to credit funders when communicating about their projects.

**Develop partnerships.** Partnerships are key when applying for grants. This shares the burden of writing a proposal and makes the proposal more competitive. Funders like to see collaborations and partnerships as they usually indicate a more lasting impact and sustainable project.

**Contact the program officer or local office of the agency.** Contact information should be present on the website of each program. Doing this before writing a proposal or after, to solicit feedback before submitting, can be helpful. This allows you to directly hear from the funders what they are looking for, let's them become familiar with you and your project, and provides an opportunity for constructive feedback before submitting your proposal.

**Use planning tools.** Complete a logic model and develop a timeline to help plan your project. It is important to have a clear need and an actionable plan to achieve your anticipated outcomes.

**Consider hiring a grant writing consultant.** If possible, hiring a consultant to take on the bulk of the writing could save a lot of admin staff resources. Keep in mind that if the proposal gets funded, the cost for a consultant could be recouped.

**University of Wisconsin-Madison has a more thorough guide for grant writing at https://writing.wisc.edu/handbook/assignments/grants-2/.**

# Integrating Green Infrastructure into Municipal Processes

Municipalities across Wisconsin have increased green infrastructure in their communities by means of several tools and government processes. Many local governments have audited their codes and ordinances, looking for policies that influence (negatively or positively) green infrastructure implementation. Local governments then identify where they can amend policies to encourage or even *require* green infrastructure. See below for an explanation of the municipal tools that exist and examples of how communities have used them.

## Regulatory tools

While demonstration projects are good tools to engage the community, showcase the flexibility and adaptability of green infrastructure practices, and demonstrate the feasibility of such projects to gain community buy-in – implementation at a larger scale must be more systematic to have a substantial impact. It's essential for municipalities to integrate green infrastructure practices into existing laws, policies, plans, and processes. One way municipalities have successfully done this is through **updating their zoning or building codes and stormwater ordinances** to enable or require green infrastructure practices. This sets the stage for greater use of green infrastructure – once enabled, developers, contractors, and communities will consider green infrastructure as a potential (or required) component of their projects.

**Zoning and building codes** can require green infrastructure in new construction or substantial renovation projects. They can either (1) set stormwater retention requirements (e.g., every parking facility is required to capture, filtrate, infiltrate, or store the first 1.25 inches of stormwater) that property owners can meet by their own choice of green infrastructure or (2) enumerate specific green stormwater practices that qualify to meet the regulatory requirement. **Stormwater ordinances** can encourage or directly require green infrastructure to meet stormwater retention requirements. Stormwater ordinances can be included in many sources like zoning and building codes, erosion control ordinances, and subdivision regulations. They can simply require green infrastructure or connect the practices to stormwater fees (see incentive tools). These ordinances best reach new construction projects but can also impact substantial renovations.

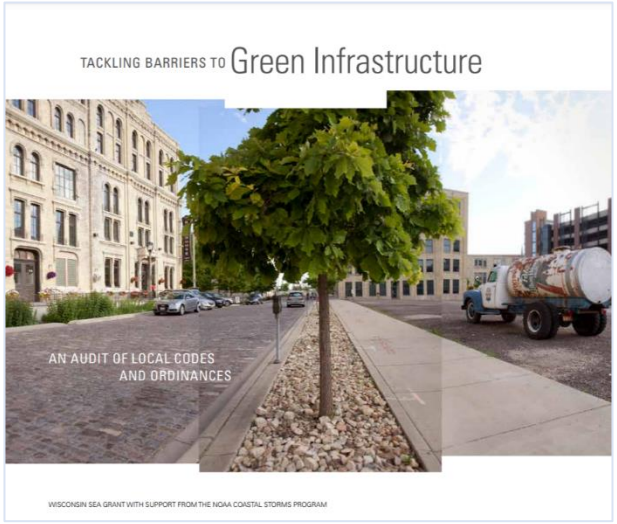
***Example from Milwaukee Metropolitan Sewerage District (MMSD) Stormwater Regulations***[8]

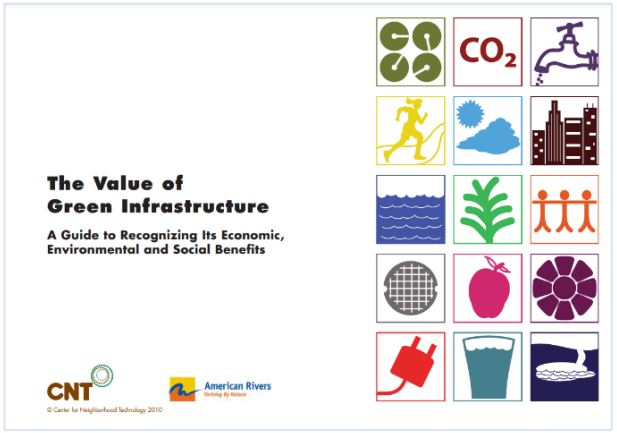
Construction projects that add 5,000+ square feet of impervious area must have a green infrastructure plan. The plan must include green infrastructure with a detention volume equal to one-half inch multiplied by the area of the new impervious surface. It also must include a project description with dimensions and impervious surface dimensions, including location of green infrastructure practice, calculations, and maintenance plan. If a construction project adds 0.5 acres of new impervious or disturbs more than 1 acre of land, they must have a stormwater management plan. MMSD provided materials that (1) support the development of these plans, (2) demonstrate green infrastructure is important, (3) articulate how being proactive with stormwater management is more cost effective than reacting to increasingly severe flooding events, and (4) listed acceptable green infrastructure practices for the plans. These requirements are from MMSD's Chapter 13 regulations and apply to of all 28 municipalities regulated by MMSD.

***Example from Superior, WI - Codes & Ordinances Audit***[9]

In 2017, the City of Superior was awarded an Urban Nonpoint Source and Stormwater Planning Grant through the Wisconsin DNR to audit and update their codes and ordinances to implement more green infrastructure in their city. They used the **Wisconsin Sea Grant workbook "Tackling Barriers to Green Infrastructure: An Audit of Municipal Codes and Ordinances"**[10] to guide their auditing process. They also updated their stormwater permitting application to require permittees to include green infrastructure features in their plans. Ordinances that were successfully updated through the project include:

- **Sump Pump and Rain Barrel Ordinance (#O20-4199, Sec. 104-252) -** Rain barrels are allowed to collect roof stormwater runoff and sump pump discharge. The City also finances several activities related to installing a sump pump (inspection, materials, installation, etc.) to reduce residential flooding.
- **Native Lawn Ordinance (#O19-4172, Sec. 104-260(2)e) -** Native plants (grasses and wildflowers) are an exception to the grass and invasive species requirements for residential or commercial properties. The ordinance explicitly encourages the cultivation and maintenance of native plants.
- **Compost Ordinance (#O19-4172, Sec. 104-266) -** A new ordinance to encourage composting yard waste and food scraps to reduce nutrient runoff into stormwater conveyance system. The ordinance states general regulations for residential composting.
- **Water Quality - Stream and Bluff Set-back Ordinance (#O19-4168, Sec. 122-670) -** This ordinance establishes a buffer area of a certain size around wetlands, streams, and bluffs to protect the watershed.
- **Buffers and Parking Lot Landscaping (#O19-4146, Sec. 122-723 and Sec. 122-725 through 726) -** Requirements for parking lots were redefined to improve natural aesthetics and stormwater retention. The ordinances contain planting requirements (e.g., deep-rooted, native) and require landscape plans be submitted for all new lots.
- **Erosion Control Ordinance (#O19-4138, Sec. 34-191 through 224) -** Construction projects must have an approved erosion and sediment control plan and a stormwater management permit. Permits require certain green infrastructure practices at construction sites. The City names green infrastructure in the ordinance and lists the issues green infrastructure can mitigate.




*Many municipalities across Wisconsin have used the above resources from Wisconsin Sea Grant and the Center for Neighborhood Technology to support their green infrastructure initiatives. See "Additional Resources" section for more information.*

***Example from Green Bay, WI - Code and Ordinance Update Process***[11]

The City of Green Bay used Wisconsin Sea Grant's workbook and the **Center for Neighborhood Technology's "The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental, and Social Benefits"**[12] to help guide their process. They graded their areas of policy on how "green infrastructure friendly" they were, and then amended codes and ordinances accordingly. This process cost $24,730 and was supported by $15,000 in grant funds from Great Lakes Commission's Great Lakes Green Infrastructure Champions program. The funds were used to hire a consultant to conduct the audit. Once the consultant completed the audit, steps for codifying the suggested amendments were:

1. Present results from audit internally to municipal staff
2. Gather and incorporate feedback on drafts of proposed code changes (2-year process)
3. Share with law department for legal review
4. Make draft codes available for public comment through stakeholder outreach and committee meetings
5. Share draft code amendments with relevant committees for approval
6. Put final codes before city council to be codified

The City of Green Bay reported the following as the **lessons they learned** from their code audit:[11]

- Be proactive and spend time educating elected officials, especially when new officials are elected.
- Offer staff training across departments to help create internal buy-in.
- Be consistent and persistent with outreach efforts for each project phase.
- Base outreach on facts and data.
- Provide many opportunities for feedback through each project phase.
- Utilize the expertise of the City's staff.
- Word choice and phrasing are important – take the time to understand what terminology means to your stakeholders.

## Planning tools

In addition to using regulatory tools, municipal governments in Wisconsin are increasingly planning for more green infrastructure in their communities by **incorporating those goals and practices into their planning documents**; from general comprehensive plans to more focused resiliency plans.

Writing green infrastructure into plans in this way is beneficial in many ways. First, it establishes strategic intervention instead of adopting green infrastructure in a more ad-hoc way. This proactive approach to stormwater management saves time, money, and energy for local governments when compared to the status quo – reacting to floods and other stormwater disasters. Secondly, budgets and funding proposals are often created from such plans, so including green infrastructure in planning efforts can be leveraged to include green stormwater infrastructure projects in future budgets.

Ideas for including green infrastructure into these plans include establishing an interagency task force, either within a municipality or across multiple local governments, community engagement activities such as focus groups, town halls, or open forums related to green infrastructure, and pilot installations or demonstration projects. Other communities in the state have created city resiliency plans and climate task forces to implement more green infrastructure and address stormwater management issues. While regulatory tools can be effective in increasing green infrastructure, zoning, and building codes may limit application of these plans.

## Incentive tools

While mandates are a more certain way to implement change, incentives are important tools municipalities can use to build more green infrastructure in their communities. Financial and development incentives may be implemented to enforce zoning codes or stand alone, which may be especially useful for properties or projects that are not subject to zoning or building code requirements. Municipal financial incentives may be enforced in the form of **subsidies, grants, or rebates for homeowners and/or contractors** to design and install green infrastructure practices. Although effective, municipal incentives require intensive decision making around the prioritization of subsidies (e.g., subsidizing many properties with small funds or a few properties with larger funds).

Municipalities can prioritize areas of greater stormwater management concern or lower income neighborhoods. Development incentives include expedited permitting for projects that include a certain amount of green infrastructure practices or practices that collect a set volume of stormwater. Some municipalities may find success with recognition programs that could include monetary awards where residents or businesses are publicly recognized for their exemplary green infrastructure projects. Programs like this provide marketing opportunities, public outreach and education, and could help municipalities meet their MS4 permit requirements.

## Incorporating green infrastructure into other municipal processes

Integrating green infrastructure practices into current municipal operations is another opportunity for local governments to take advantage of. Processes and plans that govern public lands like streets, right-of-ways along roadways, green spaces outside public buildings, and parks or recreational areas are opportunities to achieve multiple goals simultaneously, including green infrastructure.

For example, incorporating green infrastructure guidance into street design standards or guidelines for public construction projects would allow local governments to direct the installation of green infrastructure and account for long-term maintenance requirements/protocols and community priorities (e.g., speed limits). These types of tools are most successful when it coincides with community involvement and prior experience with green infrastructure, such as a successful pilot or demonstration project that has garnered public interest and buy-in.

***Example from Verona, WI - Water Sustainability Program***[13]

The City of Verona implemented a series of incentives for businesses and residential property owners for implementing green infrastructure practices.

The City provides a $10 rebate for each rain barrel (up to 4) for businesses and residential properties and will rebate 50% of native plant costs (up to $150) that are used in rain gardens. They also began a free, online program that allows residents to monitor their water usage to help them adjust their water use practices.

The City will also provide homeowners a contour map of their property to help them locate and plan a rain garden. They recommend using the **Wisconsin DNR's manual – Rain Gardens: A Guide for Homeowners and Landscapers.** [14]

# Quantified Benefits of Green Stormwater Infrastructure

The most commonly considered benefits of green infrastructure are related to stormwater runoff such as flood reduction and water quality improvement; however, the benefits of green infrastructure extend well beyond stormwater management. Municipal staff and stormwater engineers must consider the added value of co-benefits when considering investing in green infrastructure. The table below summarizes benefits of different green infrastructure practices, sourced from the Center for Neighborhood Technology.[7]

## Water quality benefits

Reducing stormwater runoff reduces the amount of pollutants entering local waterways. Vegetative green infrastructure practices filter pollutants from stormwater as the water seeps back into the ground. A meta-analysis of 66 studies of water quality and green infrastructure showed a range of **59 to 78 percent total suspended solids concentration reduction**, on average at sites that used green infrastructure.[15] Water quality benefits can reduce costs associated with purification and treatment by over 25 percent in some municipalities.[16]

| Benefit | Reduces Stormwater Runoff | | | | Increases Available Water Supply | Increases Groundwater Recharge | Reduces Salt Use | Reduces Energy Use | Improves Air Quality | Reduces Atmospheric $CO_2$ | Reduces Urban Heat Island | Improves Community Livability | | | | | Improves Habitat | Cultivates Public Education Opportunities |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Reduces Water Treatment Needs | Improves Water Quality | Reduces Grey Infrastructure Needs | Reduces Flooding | | | | | | | | Improves Aesthetics | Increases Recreational Opportunity | Reduces Noise Pollution | Improves Community Cohesion | Urban Agriculture | | |
| Practice | | | | | | | | | | $CO_2$ | | | | | | | | |
| Green Roofs | ● | ● | ● | ● | ○ | ○ | ○ | ● | ● | ● | ● | ● | ◒ | ● | ◒ | ◒ | ● | ● |
| Tree Planting | ● | ● | ● | ● | ○ | ◒ | ○ | ● | ● | ● | ● | ● | ● | ● | ● | ◒ | ● | ● |
| Bioretention & Infiltration | ● | ● | ● | ● | ◒ | ◒ | ○ | ○ | ● | ● | ● | ● | ● | ◒ | ◒ | ○ | ● | ● |
| Permeable Pavement | ● | ● | ● | ● | ○ | ◒ | ● | ◒ | ● | ● | ● | ○ | ○ | ● | ○ | ○ | ○ | ● |
| Water Harvesting | ● | ● | ● | ● | ● | ◒ | ○ | ◒ | ◒ | ◒ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ● |

● Yes ◒ Maybe ○ No

**Stormwater volume reduction and runoff management** are the top reasons municipalities invest in green infrastructure. Quantifying these benefits help decision-makers choose green infrastructure, but exact numbers depend on project specifics like location, topographical features, plant species type, etc.

The tables on this page can help municipal staff, planners, and stormwater engineers calculate the stormwater runoff benefits of green infrastructure practices for specific projects.

**Average stormwater holding capacity** describes the volume of stormwater each practice could hold before it is saturated. This can help planners calculate how much water could be prevented from entering conventional stormwater systems through green infrastructure. Below is a summary of the average holding capacity of different green infrastructure practices from a meta-analysis conducted by Wisconsin Sea Grant[17].

**Average annual retention performance** describes the rate of stormwater reduction for a green infrastructure practice.

**Average annual runoff reduction** can be calculated by using Wisconsin's average rainfall (34 inches), the annual retention rate, and a conversion factor of volume of precipitation over a given area. This calculation is from the Center for Neighborhood Technology's The Value of Green Infrastructure guide.[12]

| Green Infrastructure Practice | Average Stormwater Holding Capacity[17] | Average Annual Retention[17] | Average Annual Runoff Reduction |
|---|---|---|---|
| Rain barrel | Up to 55 gallons | 100% | Depends on collection area |
| Rain garden | 5.37 gallons/sq ft | 80% | 17 gallons/sq ft |
| Bioswale | 7.48 gallons/sq ft | 80% | 17 gallons/sq ft |
| Infiltration basin | Depends on size of basin (can be thousands of gallons) | 100% | Depends on collection area |
| Green roof | 2.2 gallons/sq ft | 75% | 16 gallons/sq ft |
| Permeable pavement | 7.09 gallons/sq ft | 65% | 14 gallons/sq ft |
| Constructed wetland | 14.36 gallons/sq ft | 72% | 15 gallons/sq ft |
| Medium street tree | 50 gallons/tree | 25% | 1,130 gallons/tree |

| Green Infrastructure Practice | Average Annual Runoff Reduction | Area of Practice Implementation | Annual Stormwater Runoff Reduction |
|---|---|---|---|
| Rain garden | 17 gallons/sq ft | 100 sq ft (approximately 10 rain gardens) | 1,700 gallons |
| Bioswale | 17 gallons/sq ft | One 1,000 sq ft bioswale collecting runoff from 2,000 sq ft parking lot | 51,000 gallons |
| Green roof | 16 gallons/sq ft | 4,000 sq ft (approximately 5 homes) | 64,000 gallons |
| Permeable pavement | 14 gallons/sq ft | 7,500 sq ft (approximately one block) | 105,000 gallons |
| Medium street tree | 1,130 gallons/tree | 10 trees at maturation (approximately one block) | 11,300 gallons |
| | | **Total** | **233,000 gallons** |

To the left is a scenario where a neighborhood ***reduces their annual stormwater runoff by 233,000 gallons*** through green infrastructure. This reduction would lower water treatment and stormwater management costs for the municipality.

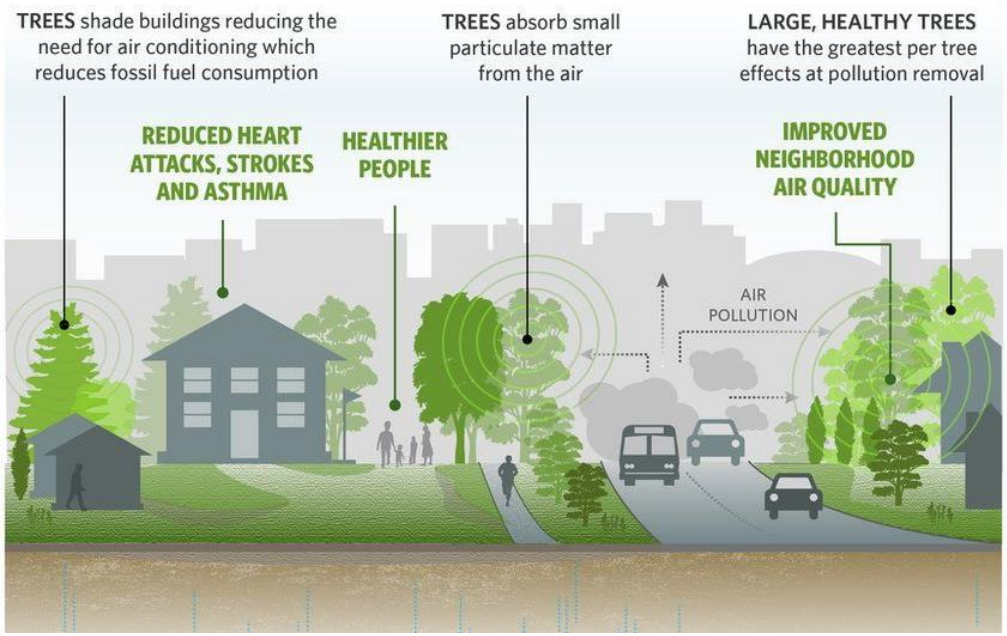
## Air quality and temperature benefits

Certain green infrastructure practices can **remove air pollutants and reduce air and surface temperatures**. These practices help mitigate the urban heat island effect, which disproportionately affects lower income groups. Green roofs and mature street trees provide shade and remove heat from the air, reducing the temperature of surfaces, such as buildings and roofs and the surrounding air. Cooler temperatures also reduce energy emissions related to air conditioning in buildings. Street trees and other vegetation barriers close to roads can reduce the impact of vehicle emissions through both direct removal and dispersion of pollutants. Breathing pollution can cause and exacerbate existing serious health issues and even lead to premature death. Research shows vegetative green infrastructure **reduces pollution levels enough to significantly reduce mortality, hospital admissions, and work loss days**.[18]

- Green roof temperatures can be 30 to 40 degrees Fahrenheit cooler than conventional roofs and can reduce neighborhood-wide ambient temperatures by up to five degrees Fahrenheit[19,20]
- Shade and evapotranspiration from street trees can reduce ambient air temperatures by 20 to 45 degrees Fahrenheit compared to nearby unshaded areas[21]
- All vegetative green infrastructure can improve air quality by removing the following pollutants:
  - Ground-level ozone ($O_3$)
  - Carbon dioxide ($CO_2$)
  - Nitrates ($NO_3$) and nitrites ($NO_2$)
  - Sulfur dioxide ($SO_2$)
  - Particulate matter (PM) such as tiny bits of dust, chemicals, and metals

## Public health and recreation benefits

Green infrastructure practices positively impact health outcomes for communities because of increasing access to natural spaces for passive recreation and improving water and air quality. Health benefits of green spaces **include decreased rates of obesity and chronic diseases that include heart disease, high blood pressure, stroke, Type 2 diabetes, arthritis, and certain types of cancer**.[22] Urban tree canopies such as street trees, forested areas, parks, and wetlands (including human-made infiltration basins) have been linked to increased physical activity outdoors. Tree canopy cover reduces surrounding air temperatures from shade, making the green space a comfortable place to spend time in. Green infrastructure can also improve memory and attention restoration and help people feel less anxious, stressed, and depressed.[22] Increased greenery is also correlated to a **reduction of violence and crimes**.[23,24]




*Green infrastructure can have significant health benefits from improvement to water and air quality. [8]*

## $ Avoided and reduced costs

Green infrastructure is often significantly more affordable than conventional gray infrastructure. Reasons include reduced energy costs, reduced water treatment costs, lower capital expenses and longer life expectancy of green materials.

- In 2018, the City of Philadelphia saved $7.2 billion by investing in their green infrastructure plan over installing larger pipes and other gray infrastructure.[25]
- A small town in Iowa found that using permeable pavement instead of asphalt for a new parking lot could save $2.5 million over the lifespan of the lot.[26]
- According to a Dane County report, about 10-30 percent of heating or cooling energy costs are reduced by green roofs when compared to conventional roofs.[6] A 2,100 square foot green roof can save about $20,000 in energy savings over its lifetime.[27]
- Practices that reuse rainwater, like rain barrels and cisterns, reduce the amount of potable tap water being used, which requires energy to produce, treat, and transport. This is significant because water treatment and transportation to homes can account for up to 40 percent of electricity use in municipal governments.[28]
- Street trees, when properly placed, can reduce heating and cooling energy by providing shade and reducing wind speed.
- A Dane County study reported permeable pavement decreased 77 percent of annual road salt usage.

## Noise pollution reduction

Just as rugs and curtains in a house can help reduce sound, vegetative green infrastructure and permeable pavements can **reduce noise pollution**. These practices dampen noise from planes, trains, and roadways, which is especially significant in urban areas where noise pollution can exceed 100 decibels, well above the level at which noise becomes a health risk.

- Green roofs can reduce outside sound by 40-50 decibels.[29]
- Permeable pavement can reduce traffic noise by up to 10 decibels[30]
- Street trees, agroforestry, and other vegetative features can significantly reduce noise pollution in parks and residential areas but vary depending on type and size.[31]

## Job creation

Green infrastructure investments are **better for economic growth and create more jobs** than climate-unfriendly investments.[32] The increase in green infrastructure implementation has spring boarded new businesses, trade associations, jobs, and provided job stability in communities. Green infrastructure projects can employ a workforce during every phase of a project such as planning and design, construction, operations and maintenance, and monitoring. New training and certificate programs are emerging as the demand for green infrastructure skills and knowledge increases.

## Property values

Increased green infrastructure and greenery increases community aesthetics. Research shows a strong correlation between green infrastructure aesthetics and property values - **benefiting both developers and homeowners**. People are willing to pay more to live in neighborhoods with more greenery and greater aesthetics. Beautified transportation corridors and retail areas are more attractive to consumers and investors alike. Land value for properties around green infrastructure projects can increase anywhere from 8 to 20 percent, which can lead to higher property taxes, meaning **increased revenue for municipalities**.[12]

*A monarch enjoying native milkweed from a rain garden in Milwaukee.* [9]

## Habitat and wildlife benefits

Green infrastructure can be strategically designed to benefit wildlife by **improving habitat quality and increasing habitat area and connectivity**. Implementing large-scale green infrastructure such as parks, greenways, and urban forests can be help manage land for mixed use of both people and wildlife. These practices can help connect populations of wildlife between habitats and help facilitate wildlife movement. Rain gardens or bioswales, especially when filled with native plants, can provide habitat for pollinators and other animals. Fish and other wetland wildlife benefit from wetland construction, restoration, and other green infrastructure that improve water quality and reduce erosion and sedimentation. Enhancing habitats that benefit wildlife also offer increased opportunities for wildlife viewing and environmental education.

## Equity and access to green space

Planning and implementing green infrastructure thoughtfully and alongside community members can increase equity and access to nature. Oftentimes, access to green spaces is not equal or equitable, as such, community-drive green infrastructure plans may address equity in making decisions about green infrastructure solutions to climate threats. Increasing green space in urban areas allows more people to reap the benefits of greenery without having to travel far from home. This is especially important in urban areas where residents may not have the means to leave their city to enjoy green spaces. Furthermore, not everyone feels comfortable or safe in green spaces outside of their city.

**Green infrastructure can also be an environmental justice solution.** Lower income urban areas have more impervious surfaces, fewer trees and greenery, less access to air conditioning, are more vulnerable to floods, and experience hotter temperatures during heat waves by an average of 5 and 13 degrees Fahrenheit.[33] Therefore, green infrastructure projects that are planned alongside communities and executed equitably could be most impactful.

## Community cohesion and trust in local government

Green infrastructure projects can build trust in local government and social cohesion among community members.[34] Projects that are well-executed and maintained after installation, especially those that were developed with significant community involvement, can **increase trust and satisfaction with local government**. When community members are involved in projects, there is **increased community cooperation**, making community members more likely to participate in future social and volunteer opportunities. Green infrastructure, especially when implemented in existing parks or designed as parks, can enhance opportunities for socialization, which leads to **greater trust within the neighborhood**.

Small plots and gardens in town and city settings are increasingly being considered as solutions to hunger issues. Green infrastructure can support these systems in numerous ways. Parks, street trees, and other vegetative practices can incorporate fruit trees and other fruit or vegetable garden plants. Re-used water from rain barrels or cisterns can support community food-growing projects. In this way, green infrastructure can help **increase food availability, reduce energy costs** from consuming imported foods, and **encourage healthier eating within communities.**

# Green Case Studies from Wisconsin Communities

As Wisconsin continues to experience higher temperatures, increased precipitation, and the cascading effects of the two, communities across the state are implementing green stormwater infrastructure to reduce risks to life and property from natural disasters. The next section of this toolkit demonstrates what communities can accomplish by investing in green infrastructure by diving deeper into case studies of green infrastructure initiatives. We also help answer the question – ***what else do we get with green infrastructure aside from stormwater management?***


*A flood monitoring station in Monroe County [10]*

## *Case study: Monroe County and Climate Change Task Force*[2]

Monroe County has experienced severe flooding and unprecedented rainfall in recent decades. Like many communities in Wisconsin, especially in the Driftless region, severe flooding is now an expected part of life. The cost of flood-related damages in the county is 1000-times greater now (nearly $33.2 million from 2010-19) compared to two decades ago ($33,000 1990-1999).[2] In response to another severe flood, county leaders created the Climate Change Task Force in 2019. Leaders recognized that **relying on their reactive mode to damage and replacing infrastructure to its original state was no longer a viable option – their community required a more proactive approach**.

**The Monroe County Climate Change Task Force (CCTF)** is a consortium of partners from various agencies and departments like the DNR, DATCP, US Army at Fort McCoy, University of Wisconsin-Madison, Ho Chunk Nation, and Monroe County leaders (administrators, conservationists, highway commissioners, district supervisors, engineers, etc.). Activities of the task force that are related to flood mitigation, green infrastructure, and stormwater management include:

- Drafted a climate change resolution that was passed by the County Board, which recognizes climate change and supports efforts of the CCTF
- Installed flood monitoring stations along Kickapoo and Little La Crosse watersheds
- Inventoried and assessed town crossings (culverts and bridges) with objectives to target resources to address worst case scenarios and climate resiliency, improve aquatic habitat for trout populations and local tourism revenue – with interns from UW universities
- Removed structures (homes), roads, crossings within the floodway that have a history or increased risk of being flooded
- Conducted a land use assessment, looking at precipitation trends, conservation practices, and land use within the Coon Creek Watershed – then published the results in the Flood Resilience in the Coon Creek Watershed report with the support of UW-Madison students
- Hosted demonstration projects related to green infrastructure, infiltration, and stormwater management – highlighting practices in agroforestry and soil health

In addition to these efforts, the task force partnered with Wisconsin Green Fire (an environmental non-profit) to develop the **Monroe County Readiness and Rural Economic Opportunity Assessment.**[2] This project was a rapid and comprehensive assessment that presents climate readiness and conservation-based economic opportunities at the county level. It was initiated as a pilot project with intentions to be rapidly replicated in other counties and county groups. The project involved municipal leaders and professionals in hydrology, conservation, and engineering from around Wisconsin. They brought people with local knowledge who have experienced the impacts of climate change firsthand together with experts in climate resiliency. The effort was led by Bob Micheel, the Monroe County Land Conservation Department Director, and Fred Clark, the Executive Director of Wisconsin's Green Fire.

Key project components:

- **Community engagement–** project leaders recognized the project as an opportunity to deepen relationships with community members and integrate their concerns into efforts. In 2021, there were over a dozen scheduled events to engage with community members about the project (public briefings, tours, public listening sessions, etc.), in addition to ongoing digital communications of project updates with the public.
- **Modeling climate trends and projections–** project partners used historical data and modeling to best understand what rainfall and precipitation patterns will look like in Monroe County in 2050, which informed the various strategies and solutions recommended in the assessment.
- **Modeling factors that affect floods and stormwater runoff–** understanding the movement of water during floods and modeling scenarios with different flood mitigation strategies informed plans for future flood responses.
- **Climate vulnerability assessments–** project partners assessed how climate change is likely to affect local areas and their critical assets to identify strategies to increase climate resiliency.
- **Strategy recommendations–** from the assessment results, project leaders developed recommendations to address climate change at various levels of government (state agencies, counties, cities, villages) in four primary areas including agriculture, forestry, infrastructure, and watersheds.

### Making the economic case

Impacts from increased precipitation and flooding are ***expensive.*** Ways these issues cost communities money in Monroe County (and across Wisconsin) include saturated and flooded croplands, flooded basements, groundwater contamination, infrastructure failings (dams, crossings, etc.), and increased invasive species and pests in forests and agriculture. The assessment demonstrates that the following practices **will save landowners and municipalities money**, mostly in the rural context – focusing on grassland and forest landowners, agriculture producers, and landowners with water bodies on their property:

- Runoff generation is significantly influenced by pre-storm soil moisture and water-holding capacity. Therefore, landowners should consider crops and plants that have deeper root systems.
- Keep forests as forests, grasslands as grasslands, and wetlands wet is important. Protecting these habitats is less expensive than restoring them.
- Restoration and changing land use is still important, though – wetland restoration, restoring stream banks, increasing wooded areas, and increasing permanent groundcover (e.g., meadows instead of seasonal agricultural crops) on less productive agricultural land can significantly reduce runoff (by over 20%)
- Reconnect streams to their floodplains – this relieves pressure from dams, slows flooding, protects infrastructure, and improves ecosystem quality.


Municipalities across the state can take away a lot from this case study and the Monroe County Readiness and Rural Economic Opportunity Assessment, including quantification of costs associated with climate change impacts, how to create a task force with sustainability initiatives, and ideas for partnerships and messaging. Climate and conservation efforts have been so successful in Monroe County because county leaders make the economic case for their proposed initiatives while presenting hard facts of changing climate impacts in their area. In public-facing communications, leaders have said, "You can continue to debate the cause if you want, but that doesn't change the facts on the ground". The task force also recognizes that the work being done in Monroe County benefits communities downstream of the county as well. The full assessment can be found online at: https://wigreenfire.org/2019/wp-content/uploads/2022/03/Monroe-County-CRREOA-Summary-Report-Final.pdf.

## *Case study: Green Stormwater Infrastructure Initiatives of Green Bay, Wisconsin*[11]

Green Bay had its worst flooding in decades in 2019. In March 2019, the City declared a state of emergency during a severe flood. Over 100 people were displaced from their homes and had to be rescued by the fire department.[35] Dozens of homes were condemned, and property damage costs were in the millions.[36] The community recognized that flooding was becoming more severe and called for more innovative solutions. As a response, the City created a resiliency coordinator position to work on improving water quality and mitigate flooding through green infrastructure features. The position was funded 25% by the City's stormwater utility revenue and 75% from grant funding from organizations include Fund for Lake Michigan.

In addition to hiring a resiliency coordinator, the City underwent a codes and ordinances audit to remove any obstacles to green infrastructure and add language to promote its implementation in both public and private projects and properties. Other steps the City has taken to address flooding and resiliency include:

- Flood resiliency workshops for municipal staff
- Financing green infrastructure workshop for municipal leaders
- Focus groups with municipal staff, business districts, and residents to better understand perceptions of green infrastructure in collaboration with Clean Wisconsin
- Green infrastructure public works projects
- Virtual educational workshops for high schoolers in collaboration with Clean Wisconsin
- Establishing climate goals of 100% clean energy and carbon neutrality by 2050
- Solar installation in public spaces
- Staff consultations with other municipalities on design and best practices for green infrastructure projects
- Rain barrel pilot project to provide barrels at no cost to interested residents

## Green Bay's Eliza Street Demonstration Project

The City has implemented several green infrastructure projects like the bioswales in North Webster Avenue. In summer of 2022, Green Bay began construction of its first permeable pavement street located on the 400th block of Eliza Street, with the goals to reduce stormwater runoff and improve water quality. This came at a time when many roads were undergoing long overdue reconstruction and resurfacing, so it is worth noting the **importance of connecting green infrastructure goals and projects to existing construction projects**.

Eliza Street, pictured below in 2019, is in an area that is especially vulnerable to flooding during heavy rains given its proximity to the Fox River.[37] Residential yards in this area are frequently washed out from high runoff volume and velocity. This flood resulted in dozens of homes being condemned and caused millions of dollars in damage across the state.

*Eliza Street in Green Bay, 2019* [11]

Modeling shows this project should **reduce annual stormwater runoff by 61% and reduce the amount of phosphate pollution into the river by 90%**.[37] Phosphates enter waterbodies through stormwater runoff and contribute to poor water quality and issues like blue-green algae blooms. Of course, at this scale, a permeable pavement street will not solve all Green Bay's flooding issues – but the Eliza Street project demonstrates how green infrastructure has all these benefits and will save the community even more money when implemented at scale.

The project was primarily funded by a grant from the Fund for Lake Michigan, although some of it was funded by stormwater utility revenue as well.[37] The project will help the City's civil engineers learn more about how to incorporate green infrastructure into designs and establish a replicable framework for future permeable pavement projects across the city.

*A cross view of PaveDrain® pavers* [12]

The Eliza Street project uses a PaveDrain®, a permeable pavement system. The joints allow water to infiltrate and drain to the substrate underneath. This practice allows stormwater to soak into the ground rather than sit or runoff into the river. PaveDrain® pavers also have the benefit of adding an aesthetic appeal to street and alley projects. This type of permeable pavement is not suitable for all streets. Permeable pavers work for Eliza Street because it is not too high-traffic and doesn't have a lot of heavy load-bearing vehicle activity, demonstrating why it's important to consider the context of the community and area when planning a green infrastructure project.

> *Green infrastructure projects in Green Bay have been funded through multiple channels including stormwater utility revenue, grant programs, and the American Rescue Plan Act (ARPA). The use of ARAP is a creative financing solution and demonstrates that* ***green infrastructure can be eligible for a wide range of funding opportunities****.*

## *Case study: Innovative Stormwater Solutions in Milwaukee's Public Spaces*

Like many communities in Wisconsin, Milwaukee is no stranger to flooding. Increasingly heavy storms in Milwaukee have caused millions of dollars in property damage over the years and people have died due to flooding as well. Flooding and erosion in this area are threats to public health and property. As a result of this threat, leaders in Milwaukee have significantly invested in green infrastructure and other sustainability measures in the last several years. The City of Milwaukee's Environmental Collaboration Office (ECO) and the Milwaukee Metropolitan Sewerage District (MMSD) are both leaders in sustainability in the Milwaukee area. MMSD is a regional government agency that provides water reclamation and flood management services for about 1.1 million people in 28 communities in the Greater Milwaukee Area has spearheaded numerous green infrastructure initiatives. They are nationally recognized as a leader in green infrastructure and flood management. ECO and MMSD have established green infrastructure goals related to stormwater and flood management.

### Fondy Park

Fondy Park is a project of HOME GR/OWN, an initiative of ECO. Once a vacant lot, the 3/5th acre park is located next to Fondy's Farm Market – providing space for market goers and residents to spend time recreating and enjoying the outdoors.[38] Fondy Park was designed with two major goals – collecting stormwater and providing a safe and accessible space for events and resident recreation.[39] The park has several green infrastructure features, including **planter boxes, rain gardens and bioswales with native plants, trees, and a 1500-gallon underground cistern**. Stormwater from the surrounding streets is diverted to the park through the use of porous pavement made of crushed granite. The green infrastructure features of the park can absorb **88,000 gallons of stormwater in a 24-hour period**, mitigating street flooding and preventing pollutants from entering Lake Michigan through runoff.[39] Other features of the park include educational signs and a six-panel 1.8 kW solar system that powers the lights and free public Wi-Fi in the park. The project was funded by MMSD and the Fund for Lake Michigan.[39]

*Photos from Fondy Park [13] highlight how community green infrastructure projects offer opportunities for:*

- Education
- Commerce
- Social cohesion


## Milwaukee Public Museum

The Milwaukee Public Museum is an exceptional example of how to integrate green infrastructure into existing buildings as a solution for stormwater management and other urban issues like urban heat island effects, energy use, and access to public green space.[40]

### Stormwater Collection Courtyard

- Renovation of a 9,500 square foot, previously underutilized area outside museum into a highly visible green space used for education and recreation
- Funded by grants and the museum


*The use of green infrastructure in multi-use public spaces, like the Stormwater Collection Courtyard illustrated above,[15] is an innovative solution to stormwater management and other issues like urban heat island effects, energy costs, and access to public green space. Parks and public buildings provide excellent opportunities to address those issues, showcase green infrastructure, and help communities meet their sustainability goals.*

*Green roof at Milwaukee Public Museum [14]*

### Green roof

- 4,100 square feet with more than 3,500 plants of 5 varieties of sedum
- Planting process engaged volunteers
- Holds 90,000 gallons of rainwater
- Insulates museum – helps keeps it cool in the summer and warm in the winter , reducing energy demands by over 75%
- Funded by MMSD ($119,000) and museum ($137,000)

### Five-story solar wall

- 234 solar panels on south-facing wall, each 4 ft x 6.5 ft
- Generates over 77,500 kilowatt hours of electricity a year (enough to power 500 60-watt light bulbs for eight hours a day for an entire year)
- Energy savings will exceed construction costs by $300,000 over 30 years
- Linked to a kiosk on the ground that displays how much energy is being generated and information on how solar panels work
- Funded by taxes ($760,000) and museum ($172,000)

## How to Address Municipal Barriers to Green Infrastructure

This toolkit provides strategies and solutions to address the most common municipal barriers to implementing green infrastructure. It was informed by case study research and focus group discussions with communities in Wisconsin. The list below of municipal barriers can also be read as a list of common arguments *against* infrastructure. Following each barrier is a list of strategies and solutions to counter each argument and represents a summary of some of the most important takeaways of the toolkit. A municipal leader could use the list below as talking points and use the greater content in the toolkit to further make their case for implementing green infrastructure.

**Perception of higher costs than gray infrastructure**

- Learn about others' experiences – from the local to the national scale. Case studies in this toolkit feature successful green infrastructure efforts from across Wisconsin.
- Recognize the avoided costs of gray infrastructure and reacting to flooding disasters
- Recognize that green infrastructure benefits (social, environmental, public health) save costs, especially when compared to gray infrastructure

**Perception that green infrastructure performance is unknown**

- Learn about others' experience with green infrastructure – from the local to the national scale. Case studies in this toolkit feature successful green infrastructure efforts from across Wisconsin.
- Learn about design variations – green infrastructure can be extremely flexible and adapted to meet specific environmental conditions and unique community values and needs.
- Recognize the multiple benefits of green infrastructure – green approaches far outperform the status quo, especially when considering all the benefits.
- Develop pilot programs in your community to test feasibility of different practices in different locations – most communities begin with pilot programs!

**Conflicting codes and ordinances**

- Conduct an audit of codes and ordinances – the Wisconsin Sea Grant's resource "Tackling Barriers to Green Infrastructure: An Audit of Local Codes and Ordinances" is a tool that is successfully guided several municipalities in Wisconsin through the auditing process.
- Amend codes and ordinances to enable, incentivize, or require green infrastructure practices - use this toolkit for policy ideas on how to implement more green infrastructure, better manage stormwater, and increase community resiliency
- Develop design guidance for government processes, developers, and property owners.

**Unfamiliarity with maintenance requirements and costs**

- Recognize that all infrastructure requires maintenance. For example, conventional stormwater systems must be maintained to prevent clogging. Green infrastructure generally requires less manual labor and large machinery.
- Use whole life cost tools when comparing costs. The Green Values Calculator from the Center for Neighborhood Technology (CNT) is a great resource for calculating these costs and benefits compared to conventional gray infrastructure.
- Develop a maintenance program that is not funded from just one source. Engage multiple facets of local government and engage community members for additional support.
- Develop communication and outreach materials to educate private property owners on their maintenance responsibilities and understand the benefits of green infrastructure.

**Lack of government staff capacity and disconnect from other departments and sectors**

- Recognize avoided costs from being proactive and investing in more effective, sustainable infrastructure with multiple benefits in addition to stormwater management
- Establish a stormwater utility to fund incentives, educate the public on stormwater issues, and implement more green infrastructure
- Establish an interagency task force to incorporate green infrastructure into existing projects and processes related to public parks, construction, etc.

*Volunteers with Clean Wisconsin install a rain garden in Milwaukee* [16]

# Additional Resources

**Fresh Coast Guardians** – an initiative created by MMSD to engage the public in sustainable stormwater management solutions. The Fresh Coast Guardians has a resource webpage created to empower homeowners, businesses, nonprofits, and the government to take an active role in protecting local water bodies through green infrastructure efforts. The website provides inspiration through project ideas, funding opportunities, education, and tools to plan and implement successful projects. https://www.freshcoastguardians.com/resources

**The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental, and Social Benefits** is a resource developed by the Center for Neighborhood Technology to inform decision makers about the multiple benefits of green infrastructure delivers to communities. https://cnt.org/sites/default/files/publications/CNT_Value-of-Green-Infrastructure.pdf

**Tackling Barriers to Green Infrastructure: An Audit of Local Codes and Ordinances** is a workbook developed by Wisconsin Sea Grant to support municipal governments audit and update their policies to promote green infrastructure implementation. Many local governments throughout Wisconsin have used this workbook, as mentioned in the "Integrating Green Infrastructure into Municipal Processes" section. One of the most useful features of the workbook is the auditing tool which addresses various topics of policy where green infrastructure could be implemented including architectural design standards, parking, landscaping, sanitary and storm sewer disconnections, stormwater management standards, zoning, coastal hazards, community outreach and education, and more. The tool includes a matrix with questions related to each policy topic, listing common barriers and tips, and provides space to note ideas to update codes and ordinances. The workbook provides examples of completed matrices for further support. https://www.seagrant.wisc.edu/wp-content/uploads/2018/09/GIAT.pdf

The United States Environmental Protection Agency's **Water Finance Clearinghouse** is an online portal that searches a database with over $10 billion in water funding sources and over 550 additional resources like reports, webinars, etc., to support local water infrastructure projects, including green infrastructure. It is regularly updated and free to use. Users can search by funder, region, eligibility, and environmental sector. https://www.epa.gov/waterfinancecenter

**The Green Values Calculator** is another free, online resource from the Center for Neighborhood Technology for comparing performance, cost, and benefits of green infrastructure and conventional stormwater practices. It can be used at multiple scales – neighborhood, residential, business, etc. https://greenvalues.cnt.org/

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