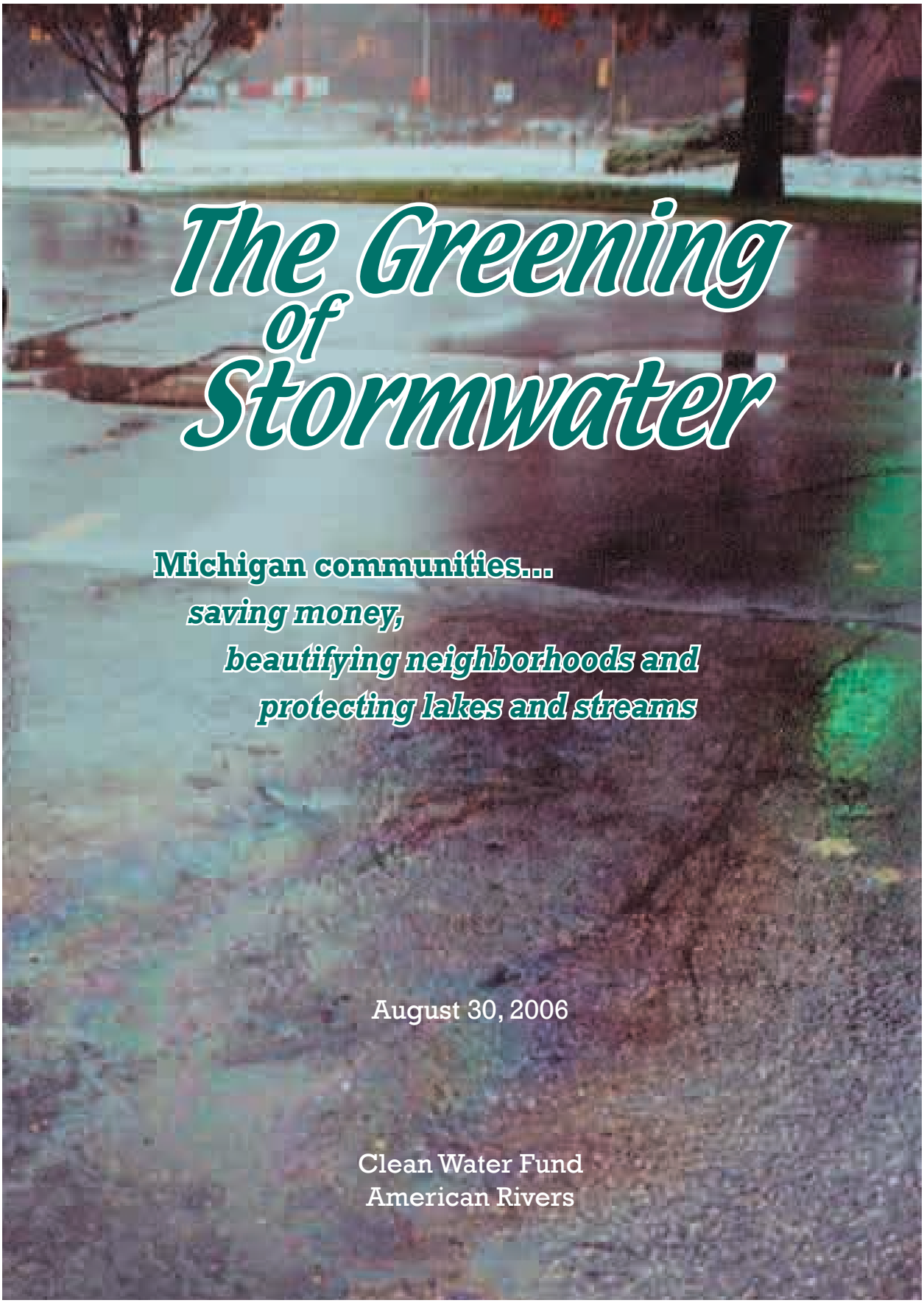

The Greening of Stormwater

Michigan communities...

saving money,

beautifying neighborhoods and

protecting lakes and streams

August 30, 2006

Clean Water Fund
American Rivers

The Greening of Stormwater

Michigan communities ...
saving money,
beautifying neighborhoods and
protecting lakes and streams

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Funded by — Joyce Foundation

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Stormwater 101: The basic problem

Unless there's a spring thaw or a heavy rain, stormwater controls have not traditionally been as high a priority for most communities as filling potholes in roads or maintaining fire and police protections. As a consequence, stormwater systems throughout Michigan are inadequate or in dire need of repair. And our rivers and lakes are suffering because of it.

In the 1987 amendments to the federal Clean Water Act, Congress directed the U.S. Environmental Protection Agency (EPA) and state agencies to require communities to address stormwater pollution. The goal of these changes was to make virtually all of America's rivers and lakes swimmable, fishable and drinkable.

In 1990, the EPA issued rules for Phase I of the stormwater program, affecting communities of more than 100,000. In 1999, the EPA issued rules for Phase II of the program, which addresses communities with populations greater than 10,000.

To meet the new requirements, communities across Michigan are developing plans for addressing polluted stormwater runoff. While many cities are looking at traditional concrete and pipe approaches to address runoff problems, innovative new approaches—sometimes referred to as "soft path" or "green infrastructure"—are multiplying that promise to better protect rivers and lakes while enhancing community beauty and sustainability.

This report illustrates the innovations and processes of several communities that are leading the way to more sustainable methods of addressing stormwater pollution. We urge other communities to learn from the approaches outlined herein. And we urge the Michigan Department of Environmental Quality (DEQ) to promote statewide awareness of these projects among local government officials while offering meaningful financial incentives for their implementation, including:

1. Providing additional funding for decentralized and nonstructural projects by reforming the Clean Water State Revolving Fund and other funding sources to give priority to projects that utilize **Low Impact Development (LID)** techniques beneficial to the environment and community beautification.
2. Providing lower interest rates, loan forgiveness or other incentives to encourage nonstructural projects through the Clean Water State Revolving Fund.
3. Educating public sewer utilities on how to incorporate green infrastructure approaches with conventional projects the utility is already planning.
4. Supporting amendments to state law authorizing local governments to charge fees for nonstructural LID projects thus assuring a revenue stream to pay for the projects.
5. Promulgating a statewide stormwater management policy with a preference for LID approaches to help guide local efforts.

What is stormwater?

Stormwater is the flow of water that results from precipitation and snowmelt. Some of the precipitation seeps into the soil, plants absorb some, and some evaporates into the atmosphere. **Stormwater** is the remainder of the precipitation that runs off land surfaces and pavement. Stormwater runoff accumulates pollutants such as **oil and grease, chemicals, nutrients, metals and bacteria** as it travels across land. Heavy precipitation or snowmelt can also cause sewer overflows that may contaminate water sources with **untreated human and industrial waste, toxic materials and other debris.**

Why is stormwater a problem?

Land development and the subsequent redirection of rainwater and snowmelt have serious impacts on water quality. In fact, according to federal government findings, rain washing off concrete and asphalt in cities and suburbs poses as big a threat to the Great Lakes as waste coming out of factory pipes.

In an undisturbed setting, rainwater and snowmelt, otherwise known as stormwater, evaporate into the air, are absorbed by plant roots or penetrate the soil near where they fall. However, as development takes place and soil and plants are replaced with pavement, rooftops and other impervious surfaces, stormwater has fewer and fewer natural places to go. Instead, stormwater runs off roofs and travels down driveways and streets, picking up pollutants. In urban areas, this polluted stormwater runoff often makes its way through a system of city storm drains and underground pipes that empty untreated into local waterways.

Yards not constructed to handle large amounts of stormwater allow it to pool in low lying areas.

Polluted stormwater not only degrades water quality but can also change the natural flow of a river or stream, causing a myriad of other problems. Dramatic changes in flow result in flooding, streambank erosion and water temperature variations, all of which can damage aquatic habitats and wildlife. Flooding can harm private property in the vicinity of a river and transport pollutants from sewers and flooded land, including pesticides, fertilizers and phosphorus.

Stream bank erosion results in sediment entering the river, altering delicate aquatic habitat and affecting aquatic life. Additionally, the conveyance of stormwater to local waterways can harm water tables by redirecting water that would ordinarily filter through soil and recharge groundwater supplies.

What's the potential for stormwater becoming an even larger problem?

As communities continue to expand, housing, stores, parking lots, roads and industrial developments replace green space. This change in land produces numerous stresses on water quality, including an increase in polluted runoff from impervious (paved) surfaces. **As a general rule, once the proportion of paved surface in a watershed exceeds 10 percent, lake and stream health and water quality decline.** As Michigan's population continues to grow and suburban sprawl persists, threats to water quality will increase.

Historically, sewers were designed to handle both sanitary waste and stormwater. The problem with this design is that when it rains or there is a big snow melt, the increase in stormwater overwhelms the system (see box at right). The EPA's mandate to control stormwater pollution is forcing cities to take action by separating their sewers. However, most cities are simply removing stormwater from sewage systems and often leave stormwater untreated. Separating sewers carries its own price in degraded water quality. Although we recommend separating sewers from stormwater, if the stormwater is not dealt with adequately, water quality is degraded.

Combined sewers involve single pipes collecting waste from homes, businesses and storm drains before sending the waste to the local treatment facility. In large communities, heavy rainfall or sudden snowmelt can overwhelm treatment systems. When communities separate a single pipe into two pipes, one to carry the stormwater and the other to collect the rest of the community's sanitary waste, sewage plants can bypass stormwater without treatment, allowing polluted runoff to be directly discharged to local waterways. Consequently, communities should work to manage stormwater on-site to reduce the runoff, which will flow untreated into area waterways.

What are CSOs?

Combined sewer overflows (CSOs) are caused by combined sewer systems, which are sewers designed to collect rainwater runoff, domestic sewage and industrial wastewater in the same pipe. Ideally, combined sewer systems transport all of their wastewater to a sewage treatment plant, where it is treated and then discharged to a water body. When CSOs occur, which typically happens during rain events or snowmelt, the system discharges excess sewage directly into nearby waterways.

When not properly managed, stormwaters overflow drains untreated to nearby lakes, rivers and streams.

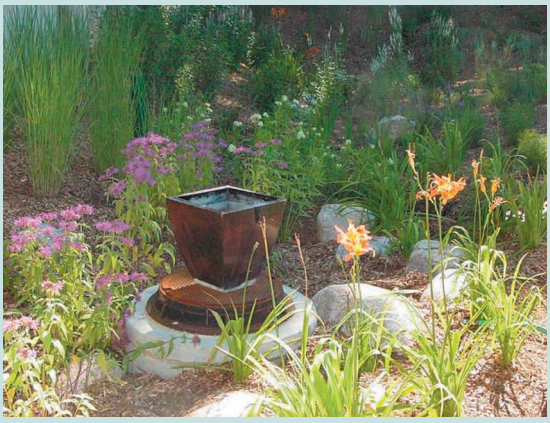
What is Low Impact Development (LID)?

Low Impact Development (LID) is a decentralized, or on-site, approach to managing stormwater that focuses on maintaining or restoring the natural hydrologic functions of a watershed. The goal of LID is to mimic the natural water cycle by keeping water as close as possible to where it falls and allowing vegetation and soils to filter contaminants as the water makes its way to underground aquifers. LID works to prevent polluted stormwater runoff by replicating the natural movement of water. The benefits of this approach are causing many communities and organizations to reevaluate their stormwater programs to see how LID can be used as part of a comprehensive watershed protection and restoration strategy.

LID includes maintaining native vegetation wherever possible, intercepting rainfall with tree canopies, minimizing pavement where feasible, utilizing pervious pavement, disconnecting areas of impervious surfaces to increase opportunities for infiltration, directing water to surface depressions and detaining water close to where it falls. These techniques are used in conjunction with one another to control stormwater at its source and thus reduce the quantity of runoff.

The benefits of LID to the environment, to taxpayers and to urban quality of life are illustrated by the case studies in this report. Each community highlighted has taken a unique path to implementing widespread use of LID. These models are meant to be examples for other Michigan communities to follow, but are by no means an exhaustive treatment of methods that can be used.

Two Low Impact Development (LID) design techniques



Rain gardens: Also known as bioretention systems, rain gardens hold and filter stormwater in plant systems constructed adjacent to buildings and paved surfaces. While beautifying urban sites, they also remove large amounts of pollution through plant uptake and filtration through soils.

Green roofs: These involve installation of vegetation on urban building roofs to trap and treat stormwater, reducing the volume of water and amount of pollution that is discharged through building drains to nearby creeks, rivers and lakes.

A Leader in Managing Stormwater

Improving a community's quality of life through education, partnerships

Population:
197,800 (2000 census)
Location:
Southwest Lower Michigan

Grand Rapids is the second largest city in Michigan and part of the fastest growing metropolitan area in the state. Kent County's 2000 population of 580,000 is projected to increase by nearly 50 percent by the year 2020. As a result, development is projected to expand by more than 150,000 acres in order to accommodate growth.[1] This rapid growth threatens to impede the progress that has been made to clean up and preserve local waterways.

Grand Rapids' stormwater solutions are a part of a larger vision for the city. In an attempt to increase the overall quality of life and to protect the natural resources and beauty of Grand Rapids, elected officials, businesses and organizations are working to implement green methods, like green infrastructure, of controlling polluted stormwater runoff. Kent County has developed a model stormwater ordinance (see Appendix A). Local governments, like the City of Grand Rapids, have gone even further by developing their own stormwater ordinance, working with partners to implement public education campaigns and teaming with numerous organizations and businesses to implement LID at sites throughout the city.

City stormwater ordinance

Grand Rapids created a **city stormwater ordinance** (see Appendix B) to bring the community into compliance and protect local water resources from further degradation. The Grand Rapids ordinance operates through a permit system. All new development projects are to be designed in such a way that they will not degrade local water quality. Under the ordinance, most new development requires a stormwater permit. To receive a permit, a developer must submit acceptable drainage and stormwater management plans falling under the ordinance's design and performance standards. The standards for the plan are stringent. The development must have on-site accommodation for a 25-year storm event and on- or off-site accommodation for a 100-year storm event. The permit also requires that stormwater management control methods be used during the construction process. Developers pay fees associated with the application process, which helps to cover the cost of the management system.

Rain gardens range in size and design but their vegetation enhances residential and public spaces alike.

[1]Annis Water Resources Institute: www.gvsu.edu/wri/isc/stormwater

Randy Lemoine, head of Stormwater Management for the City of Grand Rapids Environmental Services Department and a member of the Stormwater Management Task Force, says the real strength of the ordinance lies in the development review and project development processes. Through these processes, developers are aided in implementing **Best Management Practices (BMPs)**. The department looks at each project individually in order to custom fit the most cost-effective methods to bring projects into compliance.

The city ordinance has resulted in the construction of more than 20 separate, porous asphalt pavement projects as a means to recharge groundwater to prevent runoff pollution. This type of pavement allows water to seep into the ground rather than becoming runoff and picking up sediment and pollutants en route to local waterways. It also is generally more cost effective when compared with the added infrastructure costs (gutters, moldings and other water trapping features) of regular pavement.

Partnering with nonprofits to implement and educate

Numerous nonprofit organizations are working to educate the citizens of Grand Rapids and Kent County on the benefits of LID as a means to address polluted stormwater runoff. Projects include green roofs, better drainage systems and rain gardens. As a result of the multiple efforts and innovations in Grand Rapids' stormwater management system, the city became the first in Michigan to receive the Leadership in Energy and Environmental Design (LEED) Certification on January 27, 2005.[2]

An initiative spearheaded by the **West Michigan Environmental Action Council's (WMEAC) Rain Gardens of West Michigan**[3] project is bringing state-of-the-art rain gardens to Grand Rapids. The gardens are located at schools, businesses and homes.

WMEAC's work to popularize rain gardens as an aesthetically pleasing, more efficient method of reducing and treating stormwater pollution is pay-

[2]http://www.ftch.com/2005/02/grand-rapids-earns-states-first-leed.html. February 10, 2005

[3]www.raingardens.org

Rain gardens help slow the flow of stormwater, taking up much of the moisture in the roots of native plants.

Do rain gardens work?

Yes! And better than conventional stormwater ponds, while providing an urban/suburban aesthetic resource.

Rain gardens can remove:

- 85% of total suspended solids (or sediments)
- 95% of metals such as cadmium
- 80% of chemical toxins
- 50-60% of nutrients such as phosphorus
- 50-75% of runoff volume

Conventional stormwater ponds remove:

- 80% of solids
- 60% of metals
- 80% of toxins
- 30-40% of nutrients
- 5-10% of the runoff volume (through infiltration and evaporation)

Source: Emmons & Olivier Resources, Inc., Oakdale, MN

ing big dividends in the Grand Rapids area. During the initial three years of the rain garden project, WMEAC installed 25 demonstration rain gardens at schools, colleges, homes, local government buildings and many other public sites. Although no estimate could be exact, given the loss of water per square foot due to transpiration, evaporation and infiltration, WMEAC calculates the total volume of water managed by the rain gardens installed during the three-year project between fall 2002 and spring 2006, as 5,171,823 gallons, or the equivalent of 129,296 bathtubs.

"There is a need to connect with decision makers in a way that means something to them about the values of LID methods, of Smart Growth for Clean Water," says Patricia Pennell, coordinator of WMEAC's Rain Gardens of West Michigan Project. "We need to show them the economics, teach about the positive impacts on our communities of doing things differently. We need to prove to them that LID is not only going to protect water quality, but is of social and economic value to our communities. We need to show them beautiful local examples. And then we need to make sure that developers and contractors actually know how to do this stuff. That is what is going to make it work."

Pennell says rain gardens "really connect with people, in ways I have not seen with any other stormwater education method. People love the idea of protecting streams and rivers with a beautiful garden. People who would never come to a meeting about stormwater will flock to a rain garden presentation. We lure them in with the prospect of beautiful rain gardens, and they leave feeling empowered to protect their local waterways; and that was the last thing on their minds when they came to us."

"People who would never come to a meeting about stormwater will flock to a rain garden presentation. We lure them in with the prospect of beautiful rain gardens, and they leave feeling empowered to protect their local waterways; and that was the last thing on their minds when they came to us."

—Patricia Pennell

WMEAC has developed a web site, www.raingardens.org. The visibility of the site has enabled the organization to communicate with people all over the world. The site showcases local rain gardens in a variety of communities, hoping to inspire people to do the same thing elsewhere.

Last spring, ground was broken for an innovative rain garden project in a Grand Rapids neighborhood bordering US-131 near the Grand River. The **Turner Gateway Cool Cities Rain Gardens Project** originated from a combination of community interest and support from several large donors

The aesthetic benefits of rain gardens in cities are considerable.

The Turner Gateway Cool Cities Rain Gardens Project was inspired by the Chicago Gateway Green

"Founded in 1986 by the late Donald J. DePorter, formerly of Hyatt Hotels & Resorts, Chicago Gateway Green is a non-profit organization dedicated to the beautification of the Chicagoland area, benefiting the environment and improving the quality-of-life for millions of residents and annual visitors."

—www.gatewaygreen.org

The West Michigan Environmental Action Council's Rain Gardens of West Michigan project has promoted dozens of the gardens and other LID features in Grand Rapids.

and was inspired by the Chicago Gateway Green. The West Grand Neighborhood Organization, area businesses and other local organizations were committed to neighborhood beautification. The premise of the Cool Cities project is to start drawing people to this quarter of the city and toward its business districts.

WMEAC provided initial assistance, facilitating a rain garden designed by JF NEW Engineers of Grand Haven. Other native gardens are provided along US-131 as beautification. WMEAC coordinates volunteers for maintaining the rain garden site and will use the site in working with local school districts, hoping to teach LID and stormwater management techniques to students.

The primary rain garden will be located on Turner Street. An enhancement grant from the Michigan Department of Transportation provides the bulk of the funding for the rain garden. To qualify, the neighborhood organization agreed to a 20-year maintenance program and had to assure maintenance funding. Parkland Properties contributed a significant share of funding.

"Collaborating requires a lot of compromising and consensus-building," says Andrea Bardelmeier, project manager for the West Grand Neighborhood Association. "We worked with nonprofits and business associations in both districts and, of course, WMEAC. The AIA (American Institute of Architecture) sponsored a design charrette in the neighborhood—their drawings were crucial. I definitely recommend having a visual document to show people. We also worked with the city...it took five years of negotiations and collaboration to get this program to this point."

Adds Bardelmeier: "It took a considerable amount of door-knocking and footwork by community organizers to really understand what residents in the community want in their neighborhoods because ultimately it is these people who will be maintaining the gardens. It is an ongoing process of evaluation and implementation...we had a lot of block meetings. There are many components to the project, but it's the Cool Cities designation that has given us the most recognition and attention at the state level."

Bardelmeier says the project "has definitely given new energy to the area and local businesses. It generates new ideas about investing on this side of town, and it inspires local business owners. The

Green roofs (which have other shades in fall) capture moisture that would otherwise pour out of gutters and into storm drains, sending oil, grease and other pollutants into creeks and rivers, and increasing flash flooding.

idea is to create a livable community where people can walk to businesses and enjoy the scenery. We're looking at making the neighborhood healthier by taking a more holistic approach to development. We want to put in a fresh farmer's market to create a closer community where people can walk to the market. The idea is to beautify the neighborhood and make it more self-sustaining so that people do not have to drive to the suburbs and strip malls to get their groceries and supplies. We are working on long-term goals. It's really the community/ecology/economy triple bottom line."

For a program like this to be successful, people need to understand the program and take action. In order to educate people, the City of Grand Rapids Storm Water Management Division (in partnership with the Center for Environmental Studies) has developed radio ads used to raise public awareness of stormwater issues. The radio ads stress the need for action to control natural and man-made pollutants. Grand Rapids residents are urged to clean up yard waste and educated about the hazards of pet wastes, salts and fertilizers.[4]

As Grand Rapids has demonstrated, governmental bodies, agencies, neighborhoods and businesses need to cooperate and work towards a shared vision of improving the quality of life and the environmental efficiency of our surroundings in order to create the successful and beautiful communities for which Michigan is known. Using our rivers, lakes and beautiful landscapes to our advantage by protecting them and admiring them will serve to improve the quality of life in and protect the beauty of Michigan.

[4]http://www.ci.grand-rapids.mi.us/index.pl?page_id=142

A Northern Community Protecting Nationally-Recognized Waters: *A complete, city-wide overhaul*

Population:
1,952 (2000 census)
Location:
Northern Lower Michigan

Classified as a "Wild and Scenic River" by Congress and a nationally-known wild trout and canoeing stream, the main stem of the Au Sable River flows through the City of Grayling, with the headwaters just a short distance from town. The river is a major tourist draw but is threatened by pollution. Contaminated stormwater runoff from the small city makes its way to the Au Sable. If pollution were left unaddressed, this magnificent river could face increased pollution loading as the city grows.

Without stormwater runoff control measures, future development along the Au Sable will result in fluctuating water levels, loss of aquatic habitat due to increased sedimentation, warmer water temperature, greater turbidity and increased levels of pollution from oils, greases, trash and pesticides. The Grayling stormwater management project is not waiting for the growth and pollution to happen; instead, it's getting ahead of the game and taking preventative action.

The community is utilizing a LID approach that will allow the Au Sable River to continue to be fed by groundwater recharge, rather than warmer, dirtier overland runoff. Groundwater recharge is the reason for the Au Sable's extremely stable natural water levels (important for erosion control and recreation) and cold temperatures (important for trout).

The project aims to redirect as much as 80 percent of polluted stormwater runoff from paved surfaces in the community to filter systems. Project proponents believe this will translate into financial savings for the community, higher quality of life and reduced water pollution.

Grayling is one of the first communities in Michigan to retrofit the entire city's drain system. Because the city has few examples to follow, the project is very much a pioneering effort, which will likely extend the completion date of the project beyond what most subsequent communities will require.

Grayling has targeted 12 major drainage zones within the city. Grayling's plan involves a three-pronged approach. First, the city will address areas where high-density development is located close to water and where treatment options are limited to treating the water coming out of the end of pipes. Second, the city will address areas where future growth and development are likely to occur. In addition, this phase will also consider where runoff can be controlled on-site through proper planning. Third, the city will address areas where there exists an opportunity to use simple, low impact approaches to reduce runoff. This will include

Grayling's citywide stormwater overhaul will help protect one of the world's finest blue-ribbon trout streams, the AuSable River.

According to some involved in the process, the aesthetic improvements that the plants, shrubs and flowers in the numerous rain gardens provide are a benefit almost as important as the improved water quality. The public has been eager and excited to see the shift from cement to greenery.

areas that are linked into the storm sewer system but are not yet completely paved. Begun in 2004, Grayling's plan is still in the implementation stage. The project's first phase, consisting of 86 different small rain gardens, is scheduled for completion by fall of 2006.

The city is also implementing BMPs to minimize stormwater pollution. Efforts include public education campaigns such as marking all storm drains so the public is aware that the drain flows to the river, giving out information on how to wash cars to minimize runoff, and why it's important to address automobile maintenance (including safe disposal of used oil) in a timely manner. In addition, information is being made available to citizens about how to create gardens or grass swales to address stormwater on private property.

Retention basins will be installed in road rights-of-way, along with oil-grit separators. Water will flow off streets and through strategically placed curbs to retention basins. There the water will be filtered through the natural Grayling sands in the ground.

Project planners launched the initiative by teaming with community groups and presenting the Grayling City Council with information on the current state of the Au Sable River and its compromised future. Although the general public was not initially involved in the planning process, the city and project team discovered that open lines of communication with the public were essential. As a result, the public has been supportive of the project.

The city made extensive efforts to educate the community at large. Because members of the community jointly own many of the rain garden locations, emphasis on good communication has been crucial. The city also found that the visually appealing gardens have served as an effective way of engaging the public and providing an opportunity to involve and make the citizenry aware of the program's goals. According to some involved in the process, the aesthetic improvements that the plants, shrubs and flowers in the numerous rain gardens provide are a benefit almost as important as the improved water quality. The public has been eager and excited to see the shift from cement to greenery.

The City of Grayling is being used as a pilot demonstration project for LID stormwater management. Of the projected $1 million cost of the project,

Above, a typical rain garden along a Grayling city street, shown right after seeding and mulching in 2005. This vegetation will be supplemented with perennials and more shrubs in 2006.

Below is a computerized projection of what the same area will look like after five years.

roughly three-quarters is coming in the form of a state grant from the DEQ's Clean Michigan Initiative program.

Multiple stakeholders cooperated to create a diversified funding pool for the project. While the largest portion of the project funding came from the state, at least 14 other entities contributed to the project. Funders ranged from the area Chamber of Commerce to local environmental and conservation organizations as well as the city.

Grayling recognized that in order to be a viable community, the citizens and authoritative body must recognize the importance of the Au Sable River and their economic dependence on it. As a result, the city itself has contributed $119,812 to the project. Some of the funds supporting the project come from the city income tax[5], which means everyone in Grayling assists in paying for the project. The city council uses a portion of the city tax to help fund the project. There was no increase in tax rates or other assessments. The council recognized that in the long run, it would be more cost effective to implement BMPs now than to wait for the city to become more developed and have to reroute storm drains.

The city's contribution was matched by numerous local watershed, conservation and environmental organizations. Local nonprofits have jumped in to help because they are committed to preserving one of the area's most valuable natural resources, the Au Sable River (see Appendix C).

Grayling, like many small towns in northern Michigan, depends heavily on the tourism industry to support its local economy and way of life. Preserving and protecting a high quality water body is critical to the community. Educating the community on the positive impacts of innovative stormwater management will go a long way in creating buy-in from the public, both for the cost of the project as well as for the non-traditional approach. Most northerners take great pride in living outside of the "concrete jungle" of downstate. LID approaches to addressing polluted stormwater runoff are another way of preserving nature and the northern Michigan way of life.

When Grayling City Council members were made aware that large amounts of pollution were being directed into the river via stormwater, council members realized that taking immediate action to protect a major feature of the community would save them money in the long run. The council recognized the opportunity to take action and protect their most valuable natural resource before it's too late.

With over 3,000 river miles and 11,000 inland lakes in Michigan, nearly every community can identify at least one important water feature in its area.

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[5]Grayling is the smallest city in the state with a city income tax. It is 1 percent for city residents and .5 percent for those who live outside the city.

A Drain Commissioner's Big Picture View of the Drain Code

A visionary commissioner protects land values with nature

Population:
280,073 (2000 Census)
Location:
South Central Michigan

Ingham County Drain Commissioner Patrick Lindemann has transformed an office that has traditionally been viewed as disrupting natural hydrology. Believing that LID is an aesthetically superior, cost-effective means of treating stormwater, Lindemann has acted on his vision for an environmentally safe and progressive community that has resulted in multiple LID projects, the grants to fund the projects and standards for development that are among the most progressive in the state.

Lindemann uses his power as a drain commissioner to ensure that the beauty of his county is preserved. The **Ingham County Rules and Regulations** issued by Lindemann (see Appendix D) prevent damage by requiring permits and inspections to insure that BMPs are used in development projects under his office's jurisdiction. Such practices include source controls (see Appendix E) and site controls, used in combination in order to have the most effective result possible.

One innovative project put in place by Lindemann that uses BMPs is the **Tollgate Wetlands** in the Groesbeck neighborhood. It is one of the first projects in Michigan to create wetlands and implement infrastructure that will contain and filter out stormwater pollution. Lindemann had the idea to use a previously under-utilized urban park as a retention basin to control neighborhood stormwater. Installing pleasing vegetation and a series of ponds to help filter pollution, Lindemann has won international attention for a project that protects water quality while providing an amenity for nearby residents.

Tollgate is essentially a cost-effective way for the Groesbeck neighborhood to manage its growing stormwater problems. Instead of separating its combined sewer system and then sending the stormwater miles away to the river at a huge cost without any filtration or treatment, the community now has a system with stormwater retention basins that provide a high quality ecosystem, 18 acres of wetlands and holding ponds, and indigenous plants and peat to filter out pollutants.

Although many municipalities contributed to the Tollgate project cost, Lindemann supplemented those funds by using his powers as drain commissioner to assess costs against residences contributing stormwater to the area.

An aerial view of the Tollgate Wetlands project. The constructed wetland contains and cleanses stormwater runoff from the Groesbeck neighborhood and golf course in Lansing.

This rocky pathway for water in the Tollgate Wetlands helps to aerate water as it rushes over the rocks.

Traditional methods to alleviate storm water problems for this area would have cost between $23 million and $30 million, but this approach costs roughly $6 million, saving at least $17 million. Lansing Township paid 15 percent of the costs, the City of Lansing paid six percent, and the Ingham County Road Commission paid 30 percent. The remainder of the cost was assessed to property owners within the drainage district. The average cost to a homeowner was $3,000 over a 20-year period, an annual cost of $150. The City of Lansing paid the $3 million bill for the sanitary sewer remedy and financed the rebuilding of a nearby golf course through a revenue bond.

Another Ingham County LID initiative is the **Towar Rain Garden Drains** project, located in Meridian Township and the City of East Lansing. In 2003, the Meridian Township Board petitioned Lindemann for improvements to drainage in the Towar neighborhood, an approximately 200-acre area formerly all in Meridian Township, but now partly in the City of East Lansing. The platted neighborhood of nearly 400 homes is almost completely built out, with the majority of homes having been constructed either from the 1920s to the 1940s, or in the 1980s. There has never been an adequate drainage system for the neighborhood, and, historically, even moderate rainfall events have produced flooding, with localized ponding of water often for days, and sometimes for weeks. Further, there has also been a history of sanitary sewer back-ups from inflow and infiltration problems and illegal connections of sump pumps.

The trail surrounding the Tollgate Wetlands project provides access for community residents so they may enjoy the wetland.

A drainage survey of residents/homeowners conducted in 2003-2004 by the Ingham County Drain Commissioner and Meridian Township indicated that 64 percent of Towar residents reported surface drainage problems, with 13.5 percent reporting basement flooding or sanitary sewer backups. Resident complaints such as that reported in the survey have been long-standing.

Previous studies documenting the neighborhood's problems had failed to come up with any practical solutions due to the large cost to retrofit an adequate drainage system into a built-out neighborhood with so many site challenges. These included essentially flat topography, downstream outlet elevations that limited the kind of system that could be designed to collect and convey the stormwater by gravity, lack of available land (without condemning and removing existing affordable housing stock) for constructing adequate detention facilities to hold large storm events, a locally high water table and poor soils.

Further complicating and limiting any drainage project was the fact that Towar is a neighborhood of modest homes that could not sustain large special assessments from a costly project. Furthermore, Phase II federal Clean Water Act compliance requirements potentially added cost to any drainage system that was to be built.

Engineers hired by the drain commissioner assessed the feasibility and potential cost of a traditional concrete pipe and pond drainage system, although from the start, the drain commissioner

When completed, it is believed that the Towar Rain Garden Drains will be the largest retrofitted public drain system in Michigan in which rain gardens have been employed as a primary element for water collection and management.

was more interested in pursuing a project using LID techniques that kept more stormwater on site rather than discharging it downstream. The engineers determined that the more traditional approach likely could not be built without huge costs because of the outlet constraints. The outlet drain, the Remy Chandler Intercounty Drain, would likely have had to be dug deeper than its historic depth for the traditional system to have worked. The estimates were that the traditional system would have cost at a minimum well in excess of $20 million, a pricetag that would have been cost prohibitive for this modest neighborhood.

Instead, a system managing more of the water at its source was designed, in which rain gardens totaling nearly seven acres will be the primary way water quantity and water quality will be managed. Underdrained rain gardens will serve as the collection system in the road right of way and rear and side yards (wherever there are low areas needing drainage or absorption of water) and will connect to the main concrete pipes in the roadway. These concrete pipes will then convey the water to the outlet drain.

The rain gardens were designed following guiding principles that included preference for native plants, biodiversity, wildlife habitat and low maintenance cost. Other LID design elements included in the overall plan are pervious pavement for reconstructing the sidewalk in the township park, reducing impervious surfaces in the watershed and retaining narrow streets without curb and gutter. This system will cost $9.8 million, less than half the estimated cost of a more traditional system, and it will be better for the environment.

This project, involving the construction of two different drains—the Towar Snell Drain and the Towar Gardens and Branches Drain—is currently under construction. Construction progress can be followed on the web site, www.towardrains.org. It is anticipated that both drains will be completed by fall 2007. When completed, it is believed that the Towar Rain Garden Drains will be the largest retrofitted public drain system in Michigan in which rain gardens have been employed as a primary element for water collection and management.

Lindemann says, "Some of the value of projects like this is the educational component. People learn in these living classrooms. Nonpoint source pollution is a function of social behavior, and the only permanent cure is educating people not to pollute. Moreover, the standards are part of that education process as well. Every engineer and developer who reads those, and then must design a project to conform to the standards, will learn about the connection and impact on the environment of the land use

In Ingham County, Drain Commissioner Patrick Lindemann is substituting a number of LID techniques for traditional stormwater pipes and ponds, saving taxpayer money while providing environmental benefits.

change they propose. Changing human behavior isn't easy, but it is the solution."

In addition to these projects, Lindemann has reformed the permit process for new development. All new developments in Ingham County must conform to the following policies:

- Subdivisions and developments are required to submit a preliminary layout of the area intended to be developed which must be prepared and sealed by a licensed engineer. After application fees are paid, the layout and maintenance plans are reviewed by the drain commissioner's office. The entity responsible for long-term maintenance must be identified, and the maintenance plan must pass the drain commissioner's review. This process insures that proper maintenance will occur during construction and for the tenure of the development and that developments will not incur further damage on drainage systems.

- All plans must include LID strategies unless conditions make such plans impossible.

- Development plans must include LID elements unless the site conditions are such that no elements can be incorporated; in such a case, a variance must be requested.

- Plans must not only meet the usual requirements for 10-, 25- and 100-year storm events, but also must consider more frequent storm events such as 24-hour storm events.

By managing the first half-inch of runoff such that it is captured and treated, projects can mitigate the effects of increasing impervious surface area that results from increased urbanization. Fewer infiltration areas for stormwater cause both an increase in untreated stormwater pollutants and an increase in water fluctuations, causing serious stream bank and channel erosion problems that will inevitably need serious repair.

Adds Lindemann, "We're getting better at managing the *volume* of runoff, not just the *rate* of runoff. Having standards that address mandatory *source* controls, not just *site* controls, allows us to get at that issue. The overall greater volume of water—even if it is at a pre-development runoff rate—going into our streams is having a devastating effect on ecosystem values. Streams are flashier in urban settings because of it. This flashiness causes greater erosion of banks, which causes greater siltation of aquatic habitat and widening of streams, loss of base flow and other problems. An unbalanced ecosystem is the result."

"Getting a handle on the volume of water being discharged is the future of stormwater management. We used to manage water by *moving* it from point A to point B. Today, we try to manage water *between* point A and point B," the drain commissioner concludes.

The Towar Gardens initiative recognizes the cumulative effects of increased urbanization on water quality and drainage systems. Few Michigan counties have considered the small but ultimately significant cumulative effects of stormwater runoff from multiple smaller storm events. ■

From street level, buildings with green roofs can resemble traditional architecture, but they have significant environmental advantages. They capture excess runoff, reduce water pollution and flooding of streams and creeks, and often save money over conventional stormwater management techniques.

All information relating to Grand Rapids was obtained through personal communications (e-mail and phone conversations) between Dave Dempsey, Great Lakes Policy Advisor, Clean Water Action and: (1) Laurie Beth Nederveld, Environmental Specialist, Fishbeck, Thompson, Carr; (2) Andrea Bardelmeier, Turner Gateway Neighborhood; and (3) Patricia Pennell, West Michigan Environmental Action Council; during the period March 15–31, 2006.

All information relating to Grayling was obtained through personal communications between Bethany Renfer, Clean Water Action, and Brad Jensen, Huron Pines, during spring 2006. Additional information was obtained from the Huron Pines web site: www.huronpines.org.

All information from the Ingham County Drain Commissioner Office was obtained through personal communications (e-mail) between Dave Dempsey, Great Lakes Policy Advisor, Clean Water Action, and Patrick Lindemann, Ingham County Drain Commissioner, on March 15, 17 and 18, 2006.

Appendix A

Kent County Model Stormwater Ordinance

http://www.accesskent.com/YourGovernment/DrainCommisioner/drain_stormwater.htm

Appendix B

City of Grand Rapids Stormwater Ordinance

Chapter 32 at:
http://www.municode.com/resources/gateway.asp?pid=12116&sid=22

Appendix C

Grayling Donors

In addition to the state grant of $758,000 and the City of Grayling match of $120,000, the following donations were received for the Grayling stormwater projects:

Trout Bum Bar-B-Q	$59,000
Michigan Fly Fishing Club	$17,500
Paul H. Young Chapter of Trout Unlimited	$14,000
Kalamazoo Valley Chapter of Trout Unlimited	$5,000
Mason Griffith Founder's Chapter of Trout Unlimited	$3,000
Upper Au Sable River Preservation Association	$2,000
Elliott Donnelley Chapter of Trout Unlimited	$1,750
Ray's Canoeing and The Fly Factory	$1,500
Spike's Keg O' Nails	$1,196
William B. Mershon Chapter of Trout Unlimited	$1,000
Lee Wulff Chapter of Trout Unlimited	$150
Individuals	$905

Appendix D

Ingham County Rules and Regulations

Whereas, Section 105c of the Land Division Act, Act 288 of the Public Acts of Michigan of 1967, as amended, provides for the promulgation and publication of Rules by the Ingham County Drain Commissioner to govern stormwater drainage facilities of new subdivisions; (and the Michigan Drain Code, Act 40 of the Public Acts of 1956, as amended and other applicable statutes);

Whereas, the Ingham County Drain Commissioner conducted a review of previously adopted rules, entitled "Supplementary Design Standards and Procedures for Plat Development," dated September 28, 1990; and,

Whereas, the Ingham County Drain Commissioner has revised the Rules pursuant to applicable statutory amendments and published draft Rules entitled "Design Standards and Procedures for Plat and Commercial Development."

Now, therefore, it is hereby ordered, that the "Rules of the Ingham County Drain Commissioner," pursuant to Section 105c of Act 288 of the Public Acts of Michigan of 1967, as amended, and other applicable statutes shall be hereby adopted, and are also referred to as "Stormwater Standards" and shall be followed in the processing of all subdivision plat and other developments that come under the jurisdiction of the Ingham County Drain Commissioner, including, but not limited to: site condominiums, developments on lands discharging directly to county drains, and any other reviews required by local government ordinances.

It is further ordered, that appendices illustrating the application of these rules are also adopted, but are not part of these published rules, and may be modified, added to, or deleted in the future without prior notice.

It is further ordered, that these rules shall take immediate effect.

Appendix E

Source controls include the following:

- Preservation of existing natural features that perform stormwater management functions, such as depressions, wetlands, and woodland and vegetative buffers along stream banks.
- The minimization of impervious surface area through site planning that makes efficient use of paved, developed areas and maximizes open space. Encouraging flexible street and parking standards and the use of permeable ground cover materials can also reduce impervious surfaces.
- Directions of stormwater discharges to open grassed areas such as swales and lawns rather than allowing stormwater to run off from impervious areas directly into the stormwater conveyance system.
- Careful design and installation of erosion control mechanisms and rigorous maintenance throughout the construction period. Effective erosion control measures include minimizing the area and length of time that a site is cleared and graded and the immediate vegetative stabilization of disturbed areas.
- After the implementation of source controls, site controls are then required to convey, pre-treat and treat the stormwater runoff generated by development.

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