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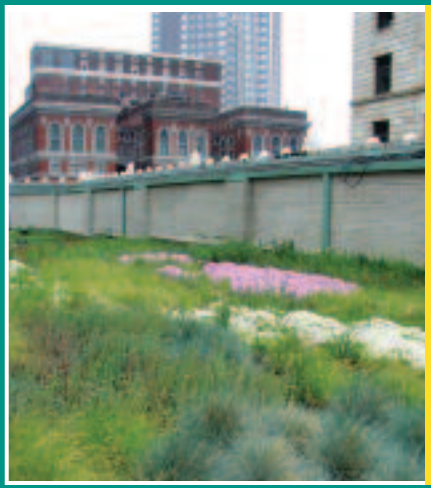

Building Better II

A Guide to America's Best New Development Projects

CLEAN WATER EDITION

Acknowledgments

This project was made possible through the hard work of many Sierra Club volunteers and staff, including:

The Safe and Healthy Communities Conservation Initiative Committee: Huma Ahmed, James H. Baker, Ruth Caplan, Jessica Frohman, C. Elaine Giessel, Hank Graddy, Ed Hopkins, Robin Mann, Marilyn Wall, Paul Wilson, Doris Cellarius, Emily Green, Anne Woiwode.

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Cover photos (clockwise from top left): Alberici Constructors headquarters, Overland, Missouri; Heinz 57 Center's green roof, Pittsburgh, Pennsylvania; Brays Bayou restored wetland, Mason Park, Houston, Texas; Street Edge Alternatives natural drainage system, Seattle, Washington.

Thank you to all who contributed to this report.

Building Better II: A Guide to America's Best New Development Projects can be found on the Sierra Club's website at: *www.sierraclub.org/buildingbetter*

The Sierra Club's members are 750,000 of your friends and neighbors. Inspired by nature, we work together to protect our communities and the planet. The Sierra Club is America's oldest, largest and most influential grassroots environmental organization.

This report was funded by a grant from The Sierra Club Foundation.

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NOVEMBER 2006

PRINTED ON RECYCLED PAPER

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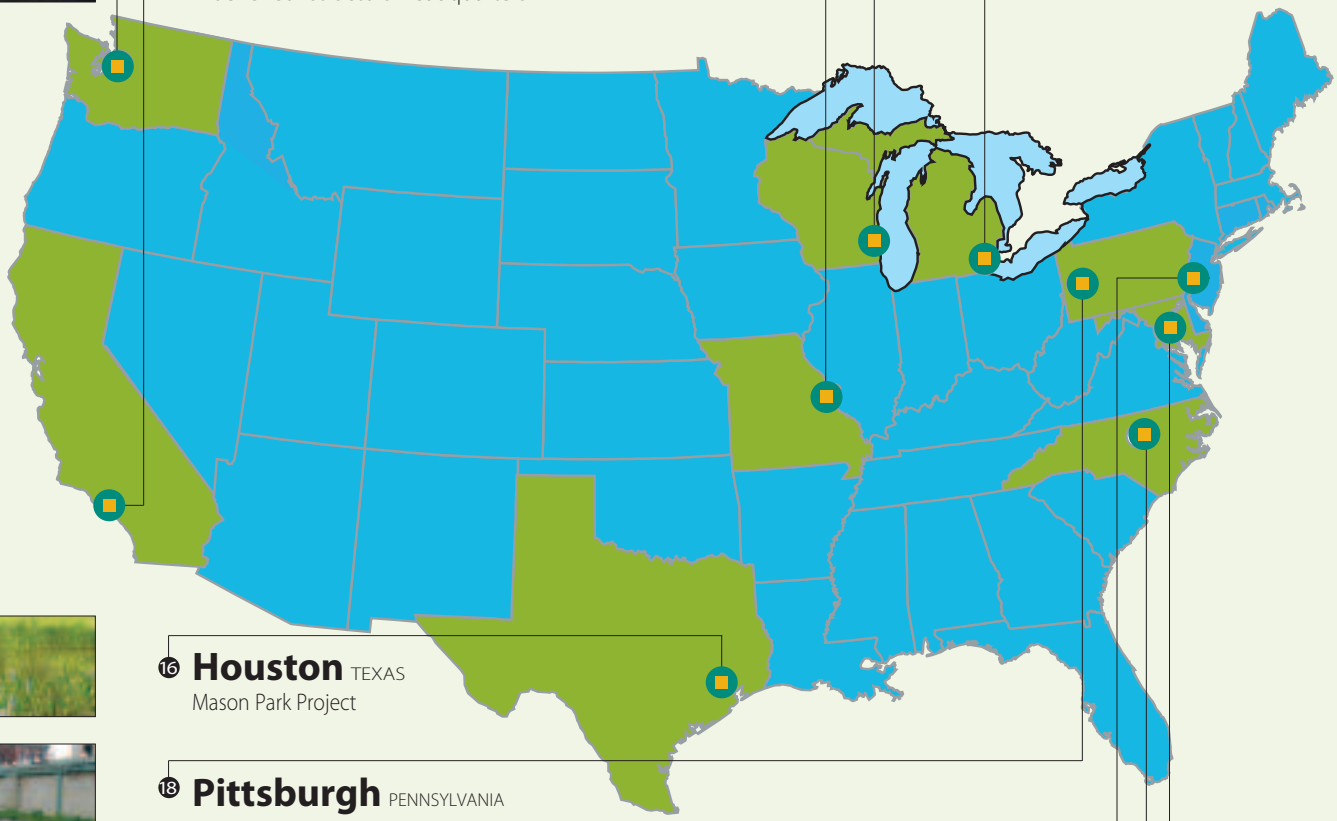

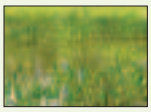

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Building Better II

A Guide to America's Best New Development Projects **CLEAN WATER EDITION**

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Above: Seattle "SEA Streets" natural drainage system. See page 6.

Right: Children look into cistern at Open Charter Magnet Elementary School, Westchester, California. See page 8.

Melinda Kelley, TreePeople

Stormwater runoff and sewage overflows are growing threats to the health of our water. Across the country sprawling developments are generating huge amounts of sewage and stormwater runoff. Land that used to absorb rain is being paved over, creating more runoff than treatment systems can handle. The end result is that more untreated or poorly treated sewage and urban runoff is polluting the sources of our drinking water.

Fortunately, there are simple solutions that can make a big difference. The key is to think of stormwater as a resource, not a waste product. By changing this perspective, we can reap a host of benefits from recycling stormwater. This report highlights ten outstanding projects using innovative design to protect clean water and recognizes developers, institutions and communities who are leading the way toward combining a respect for nature with development and redevelopment.

Stormwater's Toll on the Environment

Almost 35 years after passage of the Clean Water Act, many of our nation's waterways are still polluted. When Congress enacted the law, industrial dumping and other "point source" contamination was the major cause of polluted rivers, streams, lakes and bays. Today the largest source of water pollution comes from two areas: (1) stormwater runoff washing contaminants into the water from parking lots and roads; and (2) combined sewer overflows, which occur when stormwater overwhelms the sanitary sewer system. An explanation of both methods of contamination follows.

Pollutant Runoff

The pollutants that wash into our waterways during storms are an ugly toxic soup. They range from auto-related fluids from roads and parking lots—including oil, grease, gasoline and hydrocarbons—to metals and other contaminants like copper, zinc, lead, cadmium, chloride, and nitrate. Runoff can also contain bacteria and other pathogens, pesticides, fertilizers, nutrients, sediment, debris, and much more. Each of these pollutants and toxins threatens water quality and aquatic life in their own way. Sediment clouds the water, killing plants and destroying habitat,[1] while nutrients contribute to algae blooms that can deplete oxygen, creating "dead zones" in water.[2] Bacteria can cause human illness, and heavy metals and chemicals can be harmful or deadly to both animals and humans.[3]

Sewer Overflows

In many of our older urban areas, the storm drain system and the sewer system are connected. This normally poses little problem during dry weather, but when rainstorms occur, runoff can overwhelm the sewers, causing both stormwater and raw sewage to overflow into streams and rivers without ever receiving treatment at a sewage treatment facility. The EPA estimates that an astounding 1.2 trillion gallons of untreated sewage combined with stormwater and industrial waste are dumped into our waterways each year due to combined sewer overflows, contaminating our waters.[4] According to the EPA, sewer overflows "pose major health concerns to the general public, and are responsible for gastrointestinal diseases, many beach closings, shellfishing restrictions, and limitations on other recreational activities."[5]

Development's Role in Stormwater Runoff

Runoff is produced largely through conventional development which creates swaths of impermeable surfaces—roofs, roads, and parking lots that rain falls on and drains off into waterways, picking up trash and toxins along the way.

The volume of stormwater runoff from developed sites is staggering. Twenty-five thousand gallons of water run off a single acre of impermeable surface, as opposed to only 2,700 gallons that run off an undeveloped acre during a one-inch storm.[6] With development occurring at a rapid rate across our nation, the runoff of harmful pollutants entering our waterways has far surpassed acceptable levels. According to the EPA, over 10 trillion gallons of urban stormwater runoff flows into the nation's rivers, streams and other waterways each year.[7]

Historically, as is noted by an engineer in one of our stories in the following pages, stormwater has been treated as a waste product—to be disposed of as quickly and efficiently as possible. This approach has led to expensive projects involving large volumes of concrete, elaborate piping, and other mechanisms to channel runoff—and its pollutants—from streets, parking lots and rooftops out to our natural waterways.

However, by viewing stormwater as a resource, not a waste product, we can create a host of benefits. Retaining natural features and vegetation slows and filters stormwater before it reaches waterways. Capturing and re-using stormwater from our roofs and other surfaces will not only help prevent pollutants from entering waterways, but will also conserve water, replenish groundwater and reduce flooding. These methods of managing stormwater are better for our environment, and in many cases they are less expensive than conventional approaches.

Debbie Franke

Alberici Constructors Headquarters, in Overland, Missouri, keeps 100 percent of runoff on site. See page 14.

Redevelopment and Revitalization Help Water Quality

In addition to the particular stormwater management practices outlined in these stories, communities can continue to advocate for redevelopment of existing urbanized areas, which reduces the amount of sprawl and creates more opportunities for people to live, work and shop within walking distance. It can help reduce both impermeable surfaces like parking lots and roads, and the need to drive—which helps cut down on the pollutants that get washed into streams during wet weather. The Sierra Club has long advocated for these approaches to development, since they disturb less land, use less energy, promote more walking and less driving, and produce less polluted runoff.

Charting a Course for the Future

While vast acres of poorly planned development continue to contribute to sprawl and polluted stormwater runoff, many developers, institutions and communities, are recognizing the environmental benefits and long-term savings of easily implemented, more natural stormwater management practices. In the following pages, we offer ten outstanding examples of environmentally responsible stormwater runoff management projects, with the hope that the leadership shown by the proponents of these projects will become

Charriss York

Restored wetland at Houston's Mason Park. See page 16.

Innovative Stormwater Solutions

Re-creating wetlands: Over 120 million wetland acres have been destroyed in the nation's history to make way for development and other uses.[8] Creating new and restored wetlands that hold and filter stormwater runoff is a key to controlling flooding and cleansing the water.

Rain gardens and swales: These are depressed, landscaped areas that catch and hold rain water and runoff, allowing it to slowly seep into the ground. Plants in these rain gardens and swales also absorb the stormwater.

Stormwater parks, bio-retention ponds: Like rain gardens and swales, these depressed areas hold excess stormwater so that it does not simply run off into waterways. These areas help prevent flooding, while also helping filter the stormwater. Stormwater parks and bioretention ponds are generally larger areas, and temporarily hold water only during wet weather.

Green roofs: Unlike conventional roofs, these have a thin layer of soil with native plantings which absorb rainfall. They also provide good insulation, which saves energy, and they have twice the lifetime of a conventional roof.

Cisterns and rain barrels: These storage tanks hold stormwater runoff for re-use. The runoff can be used to water plants and athletic fields, and for non-potable indoor uses like toilets.

Cascades: In steeper areas, these "mini-waterfalls" and pools help to slow the flow of water. This prevents erosion and sedimentation, while also holding water in pools and helping filter the water through vegetation.

Urban "greening" and natural plantings: Planting trees, native vegetation, and breaking up impervious surfaces all help absorb stormwater and prevent it from running off into streams and rivers.

commonplace in communities throughout the country in the years to come. Carried out on a watershed-wide basis, these relatively easy-to-implement types of projects could make a large-scale, lasting improvement in cleaning up our polluted rivers and bays. Government agencies—from the local and state level up to federal government—should provide incentives for more of these low impact development projects rather than throwing money into ineffective methods of stormwater management.

When citizens and local officials demand better development projects and more environmentally sound stormwater management practices, we help protect our drinking water sources and make our rivers, lakes and beaches safe for recreation and wildlife.

Nancy Aten

Milwaukee's new Menomonee Valley Park after a two-inch rainstorm, holding stormwater. See page 12.

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Seattle WASHINGTON

SEA Streets Project

In response to the high mortality of the endangered Coho salmon in Puget Sound estuaries, likely caused by toxic stormwater runoff, Seattle and Seattle Public Utilities (SPU) have developed an innovative plan requiring any new development or street to incorporate better stormwater management when redevelopment occurs. Consideration must be given to expansion of basic drainage systems, flood protection, protecting ditch drainage systems, coordination of landslide mitigation and expanding water quality monitoring.

Street Edge Alternatives (SEA Streets) Project

SPU initiated Street Edge Alternative (SEA Streets), its first Natural Drainage System project, with the goal of catching, detaining and filtering runoff from a 2.3-acre area near Pipers Creek.

Instead of installing a "traditional" stormwater system exclusively involving culverts, drains and pipes, SPU created a drainage system along streets and sidewalks which incorporated native plantings and swales with soils that catch, hold and filter water. In the process of creating more natural drainage systems, SEA Streets reduced the impervious surface area of city streets by 11 percent, helping to rein in the pavement that contributes to high velocity, toxic rainwater runoff.[1]

The impressive results of the SEA Streets project – a decrease in the volume of stormwater runoff by 98 percent for a 2-year storm event—have led the way for other Natural Drainage System projects, such as the 110th Street Cascade project.[2]

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110th Street Cascade Project

The Cascade project contains and filters runoff from a steeply sloped, 21-acre area by employing a system of pools that step down through a series of mini-waterfalls that mimic nature,[3] slowing the velocity of the water. Vegetation and swales that form part of the system help to filter out and break down polluted runoff, before the water reaches Pipers Creek.

An example of one of Seattle's "Street Edge Alternative" projects—a natural drainage system.

Seattle's Green Future

As the Natural Drainage System project continues to grow, areas like the Broadview Green Grid, a 32-acre, 15 square block area are incorporating techniques from both the SEA Streets and Cascade projects, using vegetated swales and tiered water pools to control stormwater. Ambitious projects are planned for the Thornton Creek watershed and are underway for the 129-acre High Point Housing project, where SPU is partnering with the Seattle Public Housing Authority to improve stormwater management in this project that comprises 10 percent of the Longfellow Creek watershed.[4]

Working in conjunction with the Seattle Department of Transportation, Seattle Public Utilities has started a path toward a cleaner, better way of building residential streets. Already, university researchers and other local government officials have made Seattle's streets a destination to learn about these good models of stormwater stewardship.

Used with permission © 2005, Seattle Public Utilities, City of Seattle, Washington

A cascade helps slow the downhill flow of runoff, protecting land from erosion while helping filter stormwater.

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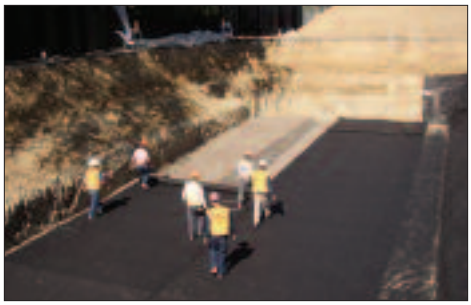
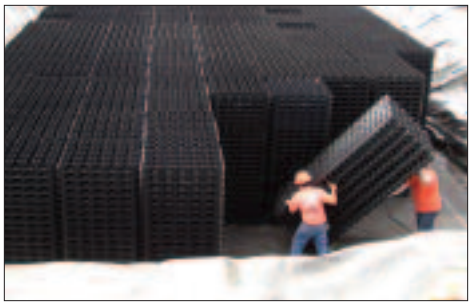
CALIFORNIA

Westchester





Small photos by Rebecca Drayse, TreePeople

Melinda Kelley, TreePeople

Open Charter Magnet Elementary School

Photos at top show before and during construction of the cistern project, which is now beneath the grassy field in the larger picture.

Los Angeles and Santa Monica Bay have faced their share of water quality problems. The loss of 98 percent of L.A.'s wetlands has jeopardized the health of its waterways. The health of the Bay has improved from horribly poor water quality several decades ago, but challenges still remain. Following the heavy rains of 2004-2005, Heal the Bay wrote, "Wet weather water quality trends look fairly dismal…exceedingly heavy rainfall magnifies a continuing problem in Los Angeles, the lack of significant progress on wet weather water quality and lack of appropriate funding to clean up wet weather water quality. In the near future, wet weather water quality, it appears, will only improve with less rain."[1]

Parents, Teachers and Children Working Together

In a watershed that can empty more than 80 billion gallons of runoff into the Santa Monica Bay in a year, one school is leading the way toward a more innovative future.[2] The Open Charter Magnet Elementary School in Westchester, California made a

number of improvements to its grounds to capture and re-use stormwater under the leadership of Andy Lipkis, an Open Charter parent and founder of Tree People, an environmental non-profit best known for its work planting over two million trees in the Los Angeles area.

Starting in 1999, Tree People worked with the school's staff, students, and parents to create a more environmentally friendly site, by planting trees and other vegetation on school grounds and breaking up impervious parking lot surfaces to help prevent polluted stormwater runoff. However, the largest, most significant stormwater improvement to the school grounds was a 110,000 gallon cistern buried beneath the campus's playing fields. This underground tank collects, holds, and cleans runoff from the property, enabling the school to use the recycled water for watering the vegetation on the site instead of letting wasted water gather pollution and flow into the Bay.

Melinda Kelley, TreePeople

Children get an education in stormwater pollution as they look into the school's cistern.

Stormwater: A Resource, Not a Waste Product

The system created for the Open Charter cistern project varies from the traditional engineering approach, which is to treat stormwater as a waste product to be disposed of as quickly as possible. One of the engineers for the project, Michael Drennan, P.E. explains, "As we look at how the system evolved over time we realize that the way we designed the (stormwater) system was reactionary and single purpose in its approach … if you think about multiple objectives like flooding, pollution reduction, and water supply, then you might design a system like we did at Open Charter, which manages stormwater as a resource rather than a waste."[3]

Los Angeles: A Look Ahead

The Open Charter project is helping lead the way for more positive stormwater solutions in Los Angeles. Los Angeles voters recently passed a $500 million bond to underwrite projects to meet the goals of the new Integrated Resources Plan (IRP) which seeks to capture, clean and reuse water, while also creating open space and wildlife habitat where possible. The State's Regional Water Quality Control Board has come to recognize the value of natural treatment systems for cleaning polluted stormwater, including swales, treatment wetlands and vegetated buffers. Sierra Club activists have proposed a treatment wetland just down the hill from Open Charter Elementary on more than 100 acres in the Ballona Valley floodplain where the Los Angeles River historically converged with Centinela Creek. These treatment wetlands will not only capture stormwater, but also cleanse pollutants before the waters empty into the Santa Monica Bay. Bringing back more of the natural landscape throughout the watershed, rather than pouring more concrete, can best help L.A. improve its water quality.

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2. The Daily Breeze, March 4, 2005, on Tree People Web site, it says in a season of 30 inches of rainfall, 82 billion gallons of runoff emptied into the Bay. The average rainfall in a year is 15 inches. *http://home.att.net/~station_climo/LACVPRCP.GIF*
3. "Collection and Reuse of Stormwater," Government Engineering Magazine, March/April 2005. *http://govengr.com/ArticlesMar05/invisible.pdf*

MICHIGAN
Monroe

Both photos by Holly Knight

Sisters, Servants of the Immaculate Heart of Mary Motherhouse Renovation

Dedicated to the Earth

For the Sisters, Servants of the Immaculate Heart of Mary (IHM), good stewardship of their corner of the environment is part of their larger social and economic justice mission. So when their Motherhouse began showing its age after 70 years of wear, the home's 250 Sisters set about the updates with an eye toward preserving the natural environment, creating a building and grounds that tread lightly on the earth.

The Sisters preserved much of the landscaping during construction, including all of the trees on the 280-acre site, while also restoring portions of the campus grounds to wetlands and meadows which help hold and filter water. The creation of these natural sponges keeps and cleans water, preventing polluted runoff from flowing into the River Raisin where *E. coli* and pollution levels are already elevated.

The wetlands also collect greywater from the facility's sinks and showers, recycling it to be treated and re-used in the building's toilets instead of going into the sewer system. Recycling reduces the Sisters' water usage by 55 percent, diverting 7,000 gallons per day to wetlands and recycling 4,500 per day to flush toilets.[1]

To further reduce stormwater runoff, the parking lots have been retrofitted with vegetated swales that break up the large impervious surface and create natural drainage systems.

Building Renovation

In addition to recycling wastewater, there are hosts of energy, resource, and water conservation features built into the project, which has received the bronze level Leadership in Energy and Environmental Design (LEED) certification. The renovation maximizes the use of natural daylight, uses low-flow shower spigots and uses environmentally sustainable products like fast-growing cork in the flooring. It also employs an innovative geothermal heating and cooling system, as well as a heat recovery system to reclaim heat from ductwork exhaust. The geothermal system sends water deep into the ground where it taps into the earth's natural temperature instead of relying on other energy sources to heat and cool the building.

People Making the Difference

The Sisters, who studied and became experts in ecological design, were aided in their renovation endeavor by architect William McDonough, a national leader in ecological design and sustainability. The Christman Company managed construction, the H.F. Lenz Company handled engineering and design, while the Middleton Corporation and Jackson & Sons Drilling Company were responsible for the geothermal drilling.

1. Hucal, Michelle Clark. "For the Sake of Heaven and Earth," *Environmental Design and Construction Magazine.* June 1, 2004.

A swale of native planting helps absorb parking lot runoff.

Both photos by Shirley Mathus

WISCONSIN

Milwaukee

All Milwaukee photos by Nancy Aten

Menomonee Valley Industrial Site

Menomonee Valley's stormwater park.

A Wasteland Made Green

The former rail yard and manufacturing center in the Menomonee Valley had long been an environmental wasteland until a $20 million cleanup project of this Brownfield site was completed in 2004.[1] It took nearly two dozen state and federal Brownfield grants to address the environmental hazards—from free petroleum to arsenic, asbestos and other contaminants on the site. Now that the site is clean, portions of the 1,200-acre space in the heart of Milwaukee, are slated for light industrial redevelopment and a business park.

Already on the site, Harley-Davidson, Inc. is building a $95 million motorcycle museum, and Palermo Villa, Inc., a frozen pizza company, is currently developing a 14-acre site.[2] Caleffi North America, a division of an Italian company manufacturing hydronic systems, plans to build a 35,000-square-foot plant, while Badger Railing, which makes ornamental iron products, is planning an 18,400-square-foot building to house 41 employees.[3]

Water Woes

Worries over stormwater management heavily influenced the Menomonee Valley development after heavy rains overwhelmed the Milwaukee sewer system in 2004, dumping 1.7 billion gallons of raw sewage into Lake Michigan.[4] During the same period, surrounding communities released another 5.1 million gallons of sewage into the lake, which is a drinking water source for more than 10 million people.[5,6] The relatively small drainage area of the lower Menomonee and Milwaukee Rivers contributes disproportionately large amounts of pollutants associated with urban runoff and are designated as "areas of concern," meaning that the water quality impairments affect recreation, fish consumption and drinking water.[7]

Stormwater Park

In an effort to better stormwater management practices, a stormwater park has been created on 70 acres of the Menomonee Valley site, which runs along the Menomonee River. The park which will feature natural areas, open space, playing fields, and the Hank Aaron State Trail, is expected to capture every drop of rain that falls on the business park.[8] The native plants, woodlands and new topography will serve to detain flood water and will clean water contaminants from the new commercial and industrial area that would otherwise drain into the river. Two large smokestacks from the original rail yard on the site have been left standing, and serve as a visual contrast to link Milwaukee's future to its industrial past. The site plan for the park has been recognized for excellence by the American Society of Landscape Architects.

City Leadership Combating Stormwater Runoff

The city is answering the wake up call of tragic floods which overwhelmed Milwaukee in 1997 and 1998, costing several lives and $35 million in damages. The stormwater park is only one part of Milwaukee's Mayor Tom Barrett's initiative to control flooding and implement better stormwater management practices. Among other strategies, he plans to reduce stormwater runoff from city properties through the use of green roofs, rain gardens, and native plantings along roadways and public green spaces.

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8. See "City Completes"

All Milwaukee photos by Nancy Aten

Milwaukee's stormwater park and the Menomonee River.

MISSOURI Overland

Debbie Franke

Alberici Constructors Headquarters

Alberici's headquarters keeps 100 percent of runoff on site.

Building Greener

As one of the largest general contracting construction companies in the nation, Alberici Constructors has been building large-scale projects since 1918.[1] Yet, their experience building green began much later, in 2003, when the company decided to build a new headquarters in Overland, Missouri. The goal was to construct an example of the very best in environmental design and construction and receive a platinum-rated Leadership in Energy and Environmental Design (LEED) building. Alberici was successful and their headquarters is one of only six buildings worldwide to achieve this top rating of environmental excellence.

Protecting Water Quality—Zero Runoff

While the building has many remarkable energy saving and environmental features, perhaps the most notable is that the building and surrounding property produce zero stormwater runoff.

Rainwater from the one-acre roof is captured by a 38,000 gallon, underground cistern.[2] The captured water is then used in the building's urinals and toilets, saving an estimated 300,000 gallons of water annually and saving it from running off the site.[3] According to Thomas Taylor, Alberici Constructors' Vice President of Special Projects, water-saving measures like using recycled water and low-flow faucets result in a 67 percent reduction in water use over a comparable, conventional building.

Alberici removed an unneeded 60,000 square foot building from the site and reduced the impermeable surface by removing large surface parking and replacing both the building and the parking lot with landscaping made up exclusively of native plants. Six acres of prairie and wetlands were constructed to filter out pollutants and help keep 100 percent of the water on site as it runs slowly into the vegetation where it is absorbed.

A Better Building for People and Nature

The platinum-rated LEED building has a number of other environmentally-friendly features. A significant portion of the building was constructed using recycled materials. Alberici saved 93 percent of potential construction waste

from going to the landfill[4] and approximately 30 percent of the new building materials were recycled.

Through the use of energy recovery—which extracts heat from the air without the need to recirculate stale air—and a number of other features like operable windows, under-floor air distribution, a passive solar preheat system for heating the building's water, and a 65kW refurbished wind turbine, which supplies 20 percent of the energy for the building,[5] the building is "60 percent more energy efficient than a conventional building."[6] The building is designed to take advantage of natural daylight, which minimizes the need for indoor lighting and reduces the stress of employees.

Alberici encourages employees to carpool by giving parking preference to carpoolers, and they provide bike racks inside the parking garage protected from the elements. They also provide showers and locker rooms for employees who bike to work. While it is a suburban location, with limited public transportation options, there is a bus stop a short distance from the building.[7]

Industry Inspiration

Alberici Constructors has used their headquarters to create a real-life example of innovative, cost-effective green building. Through their attention to environmental excellence Alberici is leading the construction industry in green building and stormwater management. Alberici hosts tours of the facility, and encourages others to learn from their work.

Alberici Constructors

1. Alberici was named the 60th largest United States contractor by *Engineering News Record*. *http://www.alberici.com/index.cfm/Press%20Room/National%20Award%20Cites%20Alberici's%20Commitment%20to%20Safety*
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TEXAS
Houston

Diane Humes

Mason Park Project and Better Bayou Protection

Correcting Mistakes of the Past

In the race for urbanization, Houston's Harris County lost many of its estimated 800 miles of bayous to artificial, concrete gulches that moved water—and the pollution in it—quickly to Galveston Bay, destroying water quality. High concentrations of fecal coliform and increased nitrate nitrogen levels have forced the closing of about one-half of the Bay's shellfish harvesting areas.[1] However, an array of local partners including the City of Houston and Harris County are now taking action to address polluted stormwater runoff, the top water quality problem facing the Bay, by creating new wetlands at Mason Park in southeast Houston and in other locations.

Mason Park Project

Constructed through a partnership between the Harris County Flood Control District, the Army Corps of Engineers, the Houston Parks Department, and the Texas Parks and Wildlife Department, a new 3.5-acre wetland area at Houston's Mason Park serves as a filter for runoff from a 30-acre urban residential watershed. Where a stormwater culvert once dumped polluted runoff directly into the bayou, now three terraced ponds with native plantings seek to re-create a freshwater marsh that existed in the area nearly 50 years ago.[2] This marsh, which helps hold and cleanse water before it makes its way on to the Bay, is part of a pilot project that will eventually lead to the creation of a series of wetlands along the length of Brays Bayou. The Mason Park project is one of several efforts that began after recent severe floods to address flooding along Brays Bayou by using re-created wetlands as an effective means of slowing and cleaning large volumes of stormwater.

Improving Habitat

Not only will the project help control stormwater pollution, it will also provide habitat for fish and wildlife. Birds such as ibis, white pelicans, osprey, heron and egrets that are found in the area will flock to

Diane Humes

The re-created wetland at Mason Park controls stormwater and provides wildlife habitat.

the restored marsh and fish will use the natural freshwater marsh as a nursery.[3]

Community Involvement and Partnerships

Students from Chavez and Austin High Schools spent months planting natural vegetation on the Mason Park site,[4] which will serve as a laboratory they will use to see natural science in action. Eventually the project will even include an outdoor education area for classes.[5] In 2006, the Harris County Flood Control District was honored for a Brave Bayou Tidal Marsh Project by the nonprofit Park People. Park People is "dedicated to promoting the importance of park and green space" in Houston.[6]

Innovative Work in Harris County

In addition to the 3.5-acre wetland at Mason Park, significant work in and around Houston to protect its bayous is being done by the Harris County Flood Control District. These significant projects include a multiple use detention basin called the Hill at Sims Greenway, where existing dirt has been sculpted into hills, and where a trail system and recreational facility is being established.[7] This project—and the overall 19-mile work on the Sims Bayou Main Channel—is a tremendous move away from the typical "concrete ditch" system. The Main Channel work, which was started in 1992, includes no concrete and instead has a gentler, more natural and sloping channel. Thousands of trees were planted along the bayou and the work preserved existing trees. Other innovative detention facilities have been constructed in the White Oak Bayou watershed and on the northwest side of Houston.

Promise for a Cleaner Watershed

The pioneering work that occurred in Harris County to advocate for, and construct, the Mason Park wetland, the Hill at Sims Greenway, and other projects, is a step toward reducing the threat of flooding as well as cleaning up polluted runoff into Galveston Bay's tributaries. With more marshland restoration planned in the regional watershed, there is positive movement toward reversing some of the past environmental damage that was done to the waterways. Managing urban watersheds and creating more natural stormwater filters is a key to improving overall water quality in Houston.

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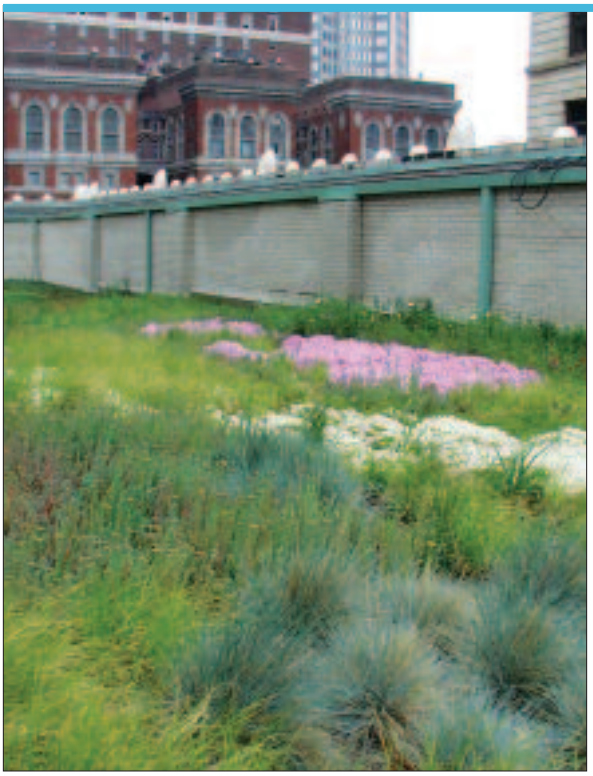
PENNSYLVANIA

Pittsburgh

Pittsburgh's Sewer Problems

Pittsburgh, which sits at the juncture of the Monongohela, Allegheny, and Ohio Rivers, has serious problems with combined sewer overflows in the Three Rivers. "I would not go swimming in the Three Rivers after it rains," said Noel Hefele, who has worked on a Carnegie Mellon University project studying pollution in Allegheny County's rivers and streams over the last five years. "One-tenth of an inch of rainfall can lead to a sewage overflow."[1] However, the average rainfall in Pittsburgh is one-quarter of an inch.[2] Each year an estimated 16 billion gallons of raw sewage are discharged from hundreds of outfalls in the region's sewage collection system to local waterways in the Pittsburgh area.[3]

Capturing rainwater before it makes its way into the storm system, however, can be an affordable key to preventing an overload of the system that contributes to these sewer overflows.



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Heinz 57 Center

Heinz 57 Center's green roof and plantings absorb rainfall.

An Environmental Renovation: Saving Runoff, Energy, Reducing Heat

In 2001, the Heinz Corporation moved its North American headquarters into a renovated, 14-story, historic Gimbels Department Store building in downtown Pittsburgh. Heinz worked with McKnight Development Partners to add an atrium to the top seven floors of the building, which lets in light, reducing energy use and creating a more comfortable environment.

The most impressive environmental feature of the building is its 12,000-square-foot green roof, completed in 2001. No outside irrigation is needed for the plants in the five inch thick roof, which absorb rainfall that would otherwise make its way into the stormwater system and contribute to sewage overflows. The roof is estimated to have a 55 percent annual rainfall retention rate and since green roofs last twice as long as traditional roofs, the Heinz building will continue to reduce stormwater for years to come.

As an added bonus the green roof helps bring down energy costs by providing insulation, and reducing the rooftop heat generated in the summer. By absorbing the sun's warmth, the roof will

help mitigate the "heat island effect," caused by a lack of vegetation and the presence of dark roofs and pavement in cities. Summer heat is about eight degrees hotter in cities due to the heat island effect.[4]

The Heinz 57 Center's roof was constructed by Philadelphia's Roofscapes, Incorporated, in cooperation with the architects Burt, Hill, Kozar, Rittlemann Associates.

Pittsburgh's Past Becomes its Future

Thanks to the environmentally sound decision to renovate a historical and until recently vacant building, the Heinz 57 Center reflects a strong sense of Pittsburgh's history and architecture. Originally constructed in 1914, the Heinz building has now become an example of using revitalization and green construction to minimize the environmental footprint of growth.

Conveniently located in a pedestrian friendly mixed-use area, with shops, restaurants and businesses, the Heinz Center is worker friendly as well as eco-friendly. The location and the transportation options it provides help the more than 800 employees who work in the building avoid having to drive. The building that once stood during Pittsburgh's industrial past now helps point to a cleaner future.

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A closeup of the Heinz 57 Center's green roof.

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PENNSYLVANIA

Philadelphia

Pennsylvania Horticultural Society

'Philadelphia Green' Urban Greening and Stormwater Projects

One of many re-created "natural" drainage areas in Philadelphia that absorb stormwater.

Philadelphia has a significant problem with sewage overflows, which means that the local sewer systems are overwhelmed during periods of heavy rain and untreated sewage overflows into the surrounding rivers and streams. At 165 locations around the city sewage routinely overflows into the Delaware and Schuylkill Rivers and other waterways during rainstorms.[1] The Schulkill supplies drinking water to 1.5 million people in Philadelphia[2] and both are important centers of commerce and recreation in the region. Experts agree that the main contributor to the poor water quality of these rivers is stormwater runoff.

Philadelphia Green: Cleaning Philadelphia's Stormwater

Philadelphia Green—a program of the Pennsylvania Horticultural Society and the City of Philadelphia—has initiated projects across the city to clean up vacant lots, green the city, and improve stormwater management.

Teaming up with the Philadelphia Water Department in 2003, and with grant support from the Pennsylvania Department of Environmental Protection's Growing Greener Program, Philadelphia Green has transformed five plots of land into models of good stormwater management by installing shallow trenches and berms that harness the rainfall and allow it to seep slowly into the ground over a 24- to 36-hour period.[3] "We hope to create a whole series of 'natural sponges' in the city that reconnect the urban land to the natural water cycle," said Gerry Abrams, an urban watershed planner at the Philadelphia Water Department.[4] These natural sponges help reduce the volume of water contributing to sewer overflows and purify the water before it reaches the rivers.

Greening Schools, Reducing Impervious Surface

In 2005, Philadelphia Green, in conjunction with the Philadelphia Water Department (PWD), started work on a project with seven

Philadelphia schools to address stormwater runoff, while promoting environmental education.[5] At S. Weir Mitchell Elementary School, one of the seven schools participating in the project, children created a raised bed vegetable garden in a paved parking lot, which will help to reduce the "heat island effect" and absorb stormwater instead of contributing to runoff.

Mitchell Elementary is also slated for a stormwater retrofit project by Philadelphia Green and the PWD in the near future, which calls for the addition of vegetation, infiltration trenches, bio-swales and a rain garden on the 3-acre impervious site.[6] According to the designers of the plan, "the stormwater management and planting plan at the Mitchell School is designed to capture a significant portion of this [stormwater] volume by mitigating runoff generated by all storms less than or equal to the 1 inch rainfall."[7]

A Greener Future

Philadelphia, like many older American cities, faces severe stormwater challenges due to its massive combined sewer system and the large, paved surface area of the metropolitan area. But Philadelphia is making strides toward a greener city and cleaner water since the city and the Philadelphia Horticultural Society have teamed up to take on the problem. With more projects on the horizon to green vacant lots and school grounds, Philadelphia Green continues to make strides to improve water quality in and around Philadelphia.

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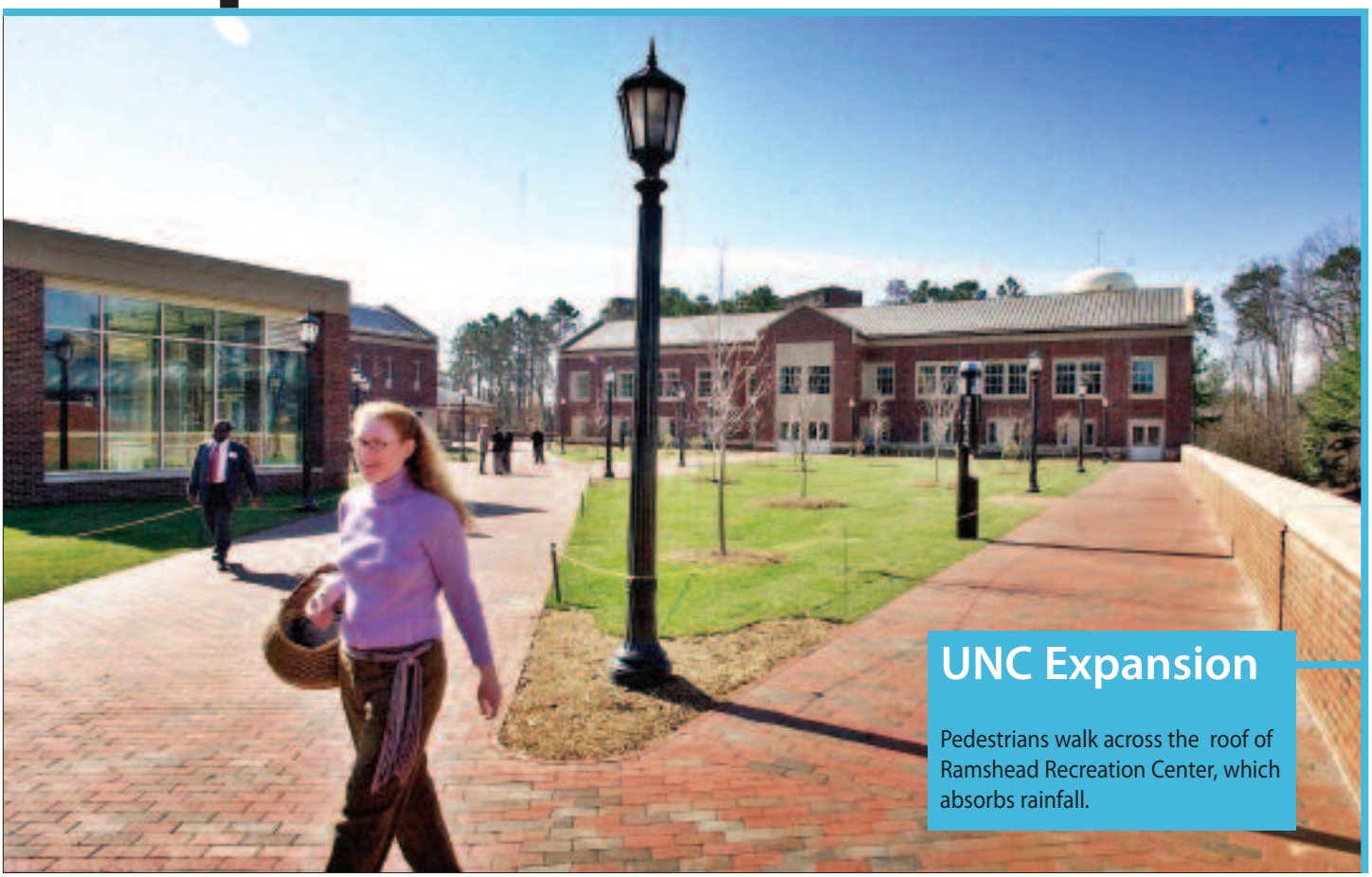
Chapel Hill NORTH CAROLINA



Dan Sears

UNC Expansion

Pedestrians walk across the roof of Ramshead Recreation Center, which absorbs rainfall.

UNC Environmental Sustainability

Impaired biological integrity for aquatic life, including several endangered species, in "Meeting of the Waters Creek," shellfish harvesting closures in the Cape Fear River, and impaired water quality in Jordan Lake – a major source of drinking water – emphasized the need for water quality improvement in North Carolina. "There is no doubt [the Cape Fear River] is impaired, and no doubt stormwater has a large part to do with it," says Bill Murray of Cape Fear River Watch, Inc.[1] To address water quality problems such as these North Carolina established "Project Green" in 1998 to promote environmental sustainability in state government.

As part of this project, the University of North Carolina, Chapel Hill is pursuing a billion-dollar construction plan to meet the needs of its growing programs. The 5.9 million square feet of new buildings on campus will be constructed using methods that accommodate new development without adding to stormwater runoff, something conventional development could never accomplish.[2,3]

The UNC Plan

While the development plan for the University will take a decade, much of it is being implemented now and several projects are already complete. The newly finished Ram's Head recreation center and 750-space parking garage, and the Carrington Hall addition both feature green roofs that catch and clean stormwater to prevent polluted water from entering the waters nearby. The reduction of 20 acres of impermeable surface, and replacement of traditional parking lots with porous pavement and 10 acres of green space also aids in controlling stormwater pollution by reducing the amount of oil, grease and other auto-related pollutants running into waterways.

One of the most enterprising of UNC's stormwater management improvements is the installation of a 70,000 gallon underground cis-

tern beneath Carmichael athletic field. Rainwater gathered from the roofs of nearby buildings, including the School of Government and the Ram's Head recreation center, is stored in the cistern and then used to irrigate the playing fields and landscaping.

Making the Grade

As development continues, UNC has plans to replace lawn areas with mulch beds, which will improve the infiltration of stormwater, and create additional rain gardens on the campus to absorb runoff from paved surfaces. Both during and after construction, streams will be monitored to ensure that water quality is upheld and two streams that were piped through campus will be opened up to restore oxygen and sunlight to the water. With more stormwater solutions in the works UNC is on the leading edge of sustainable development among universities and other large institutions.

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Cindy Shea

Carrington Hall's roof captures rainwater.

Mt. Rainier MARYLAND

The small community of Mt. Rainier, Maryland is taking action to help protect the Chesapeake Bay. About 5 percent of the Bay has been classified as a dead zone because of excessive nutrients from sewage discharges, urban stormwater and fertilizer runoff, and other pollution sources.[1] Gutter filters and bioinlets installed along Route 1 as part of Mt. Rainier's pilot program are making real improvements in preventing polluted stormwater runoff that contributes to poor water quality of the Bay.

What are Bioinlets and Gutter Filters?

These methods of addressing stormwater runoff are uniquely suited to urban areas where there is little land available for other methods of filtering runoff.

"Gutter filters are similar to sand filters which work on the principle of sedimentation and filtration," says Ameya Ulhas Pradhan, who studied these stormwater management methods in a Master's Thesis at the University of Maryland. "They are constructed below grade …. [and] the filtered runoff is discharged to a storm drain or natural channel."[2] In other words, the stormwater runoff flows into the gutter filter where the water is filtered through sand, which catches many of the chemicals, metals and other pollutants before the water flows into the Bay. In Mt. Rainier, these are constructed along the roadside, in the place of a traditional storm drain.

Bioinlets include vegetation to help break down pollutants and provide sedimentation, filtration, soil absorption, microbial decay processes and uptake of pollutants by plants.[3] These act like bio-retention areas, which collect and hold water while it is filtered through soil and into plants. Like the gutter filter, bioinlets fit into the small area of a traditional storm drain.

Results for a Cleaner Watershed

A variety of tests and studies conducted confirm the effectiveness of bioinlets and gutter filters. Gutter filters were found to eliminate Total Suspended Solids by 75 percent, Total Kjeldahl Nitrogen by 50 percent, zinc by 71 percent, copper by 40 percent, lead by 69 percent, and cadmium by 43 percent. However, there was no effect on nitrate or total phosphorus.[4]

With the installation of both the bioinlets and gutter filters, there was generally an even greater reduction in these pollutants. Total Suspended Solids were reduced by 83 percent, cadmium by 86-89 percent, lead by 84 percent, and zinc by 58 percent. Nitrogen was reduced by 42 percent, Total Kjeldahl Nitrogen by 12 percent, and copper by 29 percent. Nitrogen and phosphorus contribute to the growth of algae, which can deplete water of life-sustaining oxygen when it decomposes, and metals can be harmful or toxic to human health and aquatic life.

Urban Roadside Project

A bioinlet absorbs water, and its vegetation helps break down pollutants.

Ameya Pradhan, University of Maryland

An Effective Stormwater Management Practice

These small steps have an effect, and they can make a big difference in water quality if done on a large scale. They can be replicated across the region efficiently, without a lot of retrofitting, and without a huge price tag.

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Ameya Pradhan, University of Maryland

A gutter filter cleanses runoff before sending water to the stormdrain.

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