Honey, It's Time to Mow the Roof!
Incorporating Green Infrastructure into Municipal Planning

by Sara Jade Pesek and Sarah Kelsen

"Green infrastructure" has been a common practice in planning and landscape architecture for several years. More recently, we have been hearing this phrase used in the water, wastewater and stormwater management fields. This green design approach is gaining momentum as communities struggle with stormwater challenges and municipal separate storm sewer systems (MS4s) regulation.

Traditional approaches to stormwater management, or "gray infrastructure," require considerable capital and maintenance. The number of municipalities with significant needs to repair or replace their traditional storm sewer systems is significant. This reality, combined with the cost of gray infrastructure and the difficulty of getting public financing or the construction grants of the post-World War II era to pay for infrastructure, has created urgency in the field to find innovative and cost effective ways to manage stormwater. It is with this motivation that communities and organizations around the country and around New York State have implemented a variety of green infrastructure projects.

Green infrastructure refers to natural and engineered ecological systems that act as living infrastructure. Green infrastructure elements are planned and managed primarily for stormwater control, but also exhibit social, economic and environmental benefits (for further explanation see West Coast Environmental Law at www.wcel.org). Also referred to as "ecological infrastructure" in many European countries, specifically Germany, the concept of green infrastructure has been practiced for decades.

Green infrastructure projects are most often implemented in urban settings, where there is a high percentage of impervious cover, to restore ecosystem function, specifically focusing on the management of stormwater. Green infrastructure systems capture stormwater, cleansing the water to recharge groundwater or to be used for watering gardens and flushing toilets. Green infrastructure techniques, such as bioretention basins or bioswales, also are used to slow the velocity of stormwater so as to decrease the scouring effect and to allow infiltration into the soil and groundwater below.

Types of Green Infrastructure Communities Can Implement

There are many green infrastructure techniques available for communities to employ and the choice depends on site specifications and on whether they plan to add the green infrastructure components on to an existing structure, utilize them in open spaces, or work them into existing streetscapes. Some of the more common green infrastructure systems are:

- Rain gardens
- Bioretention basins
- Porous pavement
- Rain barrels
- Reforestation/revegetation using native species
- Green roofs
- Vegetated swales or vegetated curb extensions
- Protection and enhancement of riparian buffers and floodplains

The choice of which green infrastructure elements to employ also depends on the goals of decision-makers and other stakeholders. For instance, is diverted stormwater going to be managed by utilizing rain water to water gardens or would the community prefer the sound buffering capabilities of urban trees?

Green Infrastructure Projects in Central New York

Bioretention Basins: Emergy Analysis in Syracuse's Near Westside

A new student-led green infrastructure project began in Fall 2008 in a section of Syracuse, NY known as the Near Westside neighborhood. Five students of various disciplines and backgrounds from the Sustainable Design course at the State University of New York College of Environmental Science and Forestry (SUNY-ESF) are using "emergy analysis" to evaluate the sustainability of a rain garden or vegetated bioretention basin in the neighborhood.

Emergy analysis is a tool developed in the fields of ecological engineering and systems ecology to analyze resource use and sustainability of systems. H.T. Odum in his book, *Environmental Accounting: Emergy and Environmental Decision Making,* defines emergy as "a form of energy analysis that quantifies values of natural and economic resources on a common basis" which allows us to derive "the value of nature to the human economy."(The word "emergy" is a contraction of the term "**em**bodied en**ergy**.")

In Syracuse, emergy analysis will provide a framework for implementing the most sustainable design for the bioretention basin and will serve as a sustainability tool for the evaluation of future green infrastructure projects in the area. The students are working with community members, as well as the Atlantic States Legal Foundation (ASLF), a local nonprofit organization, to identify possible sites for the project and to develop various site-specific designs. One possible location for creating a bioretention basin is a city owned island triangle along a major street in Syracuse, which would be designed to capture stormwater runoff from the pavement. The students also plan to design a vegetated roof on a local school and urban tree plantings in a community park.

Green infrastructure projects are particularly important to implement in Onondaga County due to the strain that stormwater puts on the combined sewers in the area, which intermittently overflow into Onondaga Creek and Onondaga Lake. Bioretention basins serve to alleviate this problem by storing water during heavy storm events, which reduces the quantity during peak flow. This natural storage provides time for the water to seep into the earth below the bioretention basin and recharge the groundwater. Decreasing the runoff volume also decreases the conveyance of pollutants such as soil, litter, fertilizers and pesticides; bacteria and other pathogens; household hazardous waste; and oil, grease, and other automotive fluids. In other words, vegetation acts as a filter for stormwater pollutants.

In 1998, Onondaga County was sued by ASLF over the pollution storm water overflows created for adjoining local bodies of water. As part of the Amended Consent Judgment, Onondaga County, the New York Department of Environmental Conservation (DEC), and ASLF are now collaborating to find ways to implement community-wide green infrastructure projects as a supplement to gray infrastructure. This is a significant partnership since parties that were once seen as being on opposite sides of an issue are now pursuing inventive technical solutions to a shared environmental problem. They are

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Toshiko Mori Architect

An architect's rendering of the Syracuse Center of Excellence headquarters being constructed in downtown Syracuse. The ramp will serve as a green roof that will test which designs are best for the Northeast climate.

working together to create innovative planning and procedural methods to address stormwater challenges with a goal of treating 12 million gallons of stormwater.

Green Roofs: SyracuseCoE and King & King Architects

There are two other innovative stormwater management projects developing in downtown Syracuse. The future headquarters of the Syracuse Center of Excellence (SyracuseCoE) and King and King Architects are both under construction and will be showcases for green building and design. This nonprofit organization and architecture firm, respectively, are both building on brownfield sites and are incorporating green infrastructure in their designs.

SyracuseCoE's goal is to manage all of its stormwater onsite, without requiring any of it to enter the municipal sewer system. One such design feature is its green roof, which will be used to test several different types of green roof systems. It will be a living laboratory for green roof design, testing the success of various native plants that are specifically adapted to the cold winter and heavy snowfall of Central New York.

King and King Architects is renovating a building in downtown Syracuse and also plans to install a green roof. Site designs for the project also focus on protecting existing pervious areas while also reducing site paved areas and restoring green space. The architects hope to divert fourth-fifths of their stormwater from the sewer system through their green spaces and green roof.

The types of plants and depths of soil used on green roofs differ according to the climate and the structural capacity of the building. Likewise, the vegetative layer absorbs varying amounts of water depending on depth, thus reducing stormwater runoff. Green roofs have several benefits for the buildings they crown and for the communities in which they exist. For instance, they serve to reduce the urban heat island effect by providing shade and reflecting solar rays rather than absorbing them like traditional dark roofs. The plants also cool ambient air through the process of evapotranspiration.

One of the better known municipal green infrastructure projects is the green roof on Chicago's City Hall. The city hall's roof temperature is on average 10° to 15°F lower than nearby black tar roofs, reducing the amount of air conditioning needed during the summer months. The city of Chicago estimates that the energy savings from a reduction in summer cooling costs to be $3,600 per year (according to the Natural Resources Defense Council publication, *Rooftops to Rivers*). The plants can retain 75 percent of an inch of rainfall before any of the stormwater joins the sewer system.

Additional innovative components of the SyracuseCoE's headquarters are the designs for rainwater collection, installation of photovoltaic arrays, passive solar orientation of the building, planting of various shade trees on the property to add in passive cooling of the building, and use of reflective paving on the premises. King and King will also be utilizing low-flow plumbing components to reduce water use and incorporating other energy saving technologies into building operational designs. These two buildings will be resources for communities, businesses and organizations in the region to learn about the successes and challenges of implementing green infrastructure.

SUNY Campus Renovations: Where Rubber is the Road

During the summer of 2008, SUNY-ESF underwent minor campus renovations. Various green infrastructure methods were implemented during this renovation to manage stormwater, as suggested by the SUNY-ESF Campus Master Plan. One of the methods utilized, along with rain gardens and high albedo (a term referring to reflection of light off a surface) sidewalks, was the installation of porous pavement. Benefits of this technology include the reduction of stormwater runoff, decreasing contaminant and pollutant runoff into storm sewers, decreased flooding potential, and money savings on the installation of drainage and retention systems.

SUNY-ESF chose to install Flexi-Pave porous paving, just one brand of porous pavement available on the market. The paving material is made with a 50 percent ratio of stone and recycled tires mixed with a urethane binder. Underneath this material is a "warm zone" heating system to eliminate snow and ice in the winter. The pavement is porous, so rain and melting snow flow through to the ground instead of producing puddles or runoff. Installation of this system means salt

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Courtesy of SUNY-ESF

Practicing what is taught: a demonstration green roof design at the SUNY College of Environmental Science and Forestry campus.

Innovation in Wastewater Treatment

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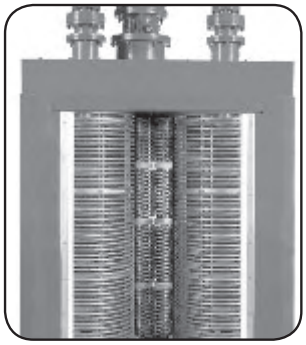

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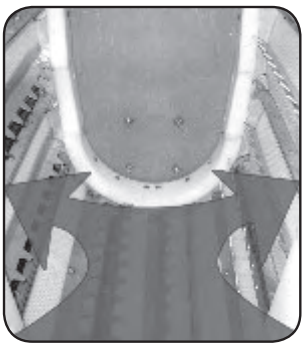

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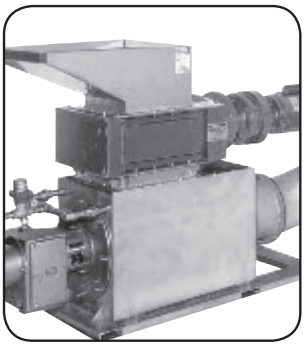

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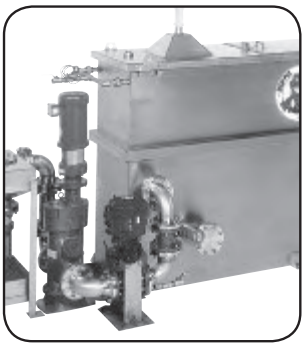

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Courtesy of SUNY-ESF

Porous pavement walkway made from recycled rubber leads to the Franklin Moon Library at SUNY- ESF.

Courtesy of SUNY-ESF

Illick Hall on the SUNY-ESF campus is the location of a new rain garden or bioretention basin made up of soil and plants, where one third of the rainwater from the roof is diverted.

and sand won't be needed and that will help protect the newly refurbished Moon library. This pavement and new bicycle storage racks were also installed at Illick and Marshall Halls on the SUNY-ESF campus. According to Tony Ross of James Ross and Sons Contractors, close to 7,000 tires have been recycled into such projects around New York.

The northeast corner of SUNY-ESF's Illick Hall is the location for a new bioretention basin made up of soil and plants, where one third of the rainwater from the roof will be diverted. The idea, suggested by a class project, is to demonstrate how runoff can be controlled so storm drainage systems are not overwhelmed during heavy rains.

Photo courtesy SyracuseCoE

These 1,000-gallon rain barrels, in the garden of Syracuse Center of Excellence Project Manager Ana Fernandez, are linked with a hose to cope with overflow.

"What we're doing is diverting rainwater from the roof of Illick Hall to the bioretention basin instead of the storm sewers. Plants will use the water, evaporation will return water to the atmosphere, and excess water will be filtered through the soil before entering the natural environment," explains SUNY-ESF Ecological Engineer Douglas Daley. The plants used include spice bush, chokeberry, Virginia sweet spire, witch hazel, and sweet bay magnolia, all of which are very tolerant of wet soil.

Another rainwater diversion project is being installed as part of the renovation work on Baker Laboratory. Four 1,000 gallon storage tanks have been installed in the basement of Baker Laboratory to collect rainwater from the roof. The water will be used in the building's cooling towers.

Looking Ahead and Realizing Results

It will be clearer after a few years of monitoring and data collection the extent of the impact these projects will have on their sewersheds. However, the secondary benefits of increased green space and improved air quality will have immediate impact on the aesthetics and livability of the Syracuse community.

We can, however, surmise some of the long term impacts of the implementation of projects such as these. By incorporating green

Community Benefits of Green Infrastructure:

- Reduced and delayed stormwater runoff volumes
- Cost-effective, sustainable and environmentally friendly
- Enhanced groundwater recharge
- Stormwater pollutant reduction
- Reduced sewer overflow events
- Increased carbon sequestration
- Urban heat island mitigation and reduced energy costs
- Improved air and water quality
- Additional wildlife habitat and recreational space
- Improved human health
- Increased land values

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infrastructure into stormwater management plans, communities save on the capital costs associated with engineering curbs, gutters, collection systems, and the rest of the capital intensive infrastructure for conveyance and treatment of stormwater. There is also an expected savings on operations and maintenance costs for treatment plants and a savings in energy costs for pumping the excess stormwater out of areas and through the water treatment system.

A useful tool for estimating the costs of implementation and the long term cost savings is the Green Values Stormwater Calculator, developed by the Center for Neighborhood Technology. It can be found at greenvalues.cnt.org/calculator. This calculator helps communities and individuals estimate the financial impacts that different green infrastructure techniques can have on project sites.

An increasing number of large cities has decided that the benefits of green infrastructure are worth the investment. Some of the cities aggressively incorporating green infrastructure include Portland, Chicago, Philadelphia, Kansas City, and Seattle. These cities represent good examples of municipal strategies that focus on the fusion of green and gray infrastructure in managing stormwater.

With a change of administration taking place in 2009, it is an interesting time to be in the water infrastructure field. We will have to wait and see how the transition in Washington, DC will affect the funding that so many New York State communities depend on for infrastructure maintenance, upgrades, and new construction. What we can expect during this time is that we need to be prepared to be innovative and resourceful in the way we protect the environment and provide infrastructure services to our communities.

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Resources

Natural Resources Defense Council (NRDC), 2006 *Rooftops to Rivers: Green Strategies for Controlling Stormwater and Combined Sewer Overflows,* http://www.nrdc.org/water/pollution/rooftops/contents.asp

The Low Impact Urban Development Center, *Low Impact Development (LID) Urban Design Tools,* http://www.lid-stormwater.net/

US Environmental Protection Agency, *Managing Wet Weather with Green Infrastructure,* http://epa.gov/npdes/greeninfrastructure

North East Community Forests, *The Green Infrastructure Planning Guide,* http://greeninfrastructure.eu/

NYWEA

Environmental Finance Center
Syracuse University

About the EFC at SU

The Environmental Finance Center at Syracuse University (EFC) promotes intergovernmental cooperation in addressing environmental improvement projects, encourages collaborative planning among public and private environmental service providers, provides pricing of environmental services, and coordinates technical assistance services for communities. The three focus areas of the EFC are: Fostering Sustainable Communities, Promoting Green Building, and Advancing Sustainable Infrastructure. In each of these areas, EFC either provides customized assistance or facilitates the coordination and delivery of services from public and private agencies. The EFC works closely with the Syracuse Center of Excellence in Environmental and Energy Systems and provides services for the US Environmental Protection Agency's Region 2, which includes New Jersey, New York, Puerto Rico and the US Virgin Islands. It was established in 1993 and has offices in Syracuse and New York City.