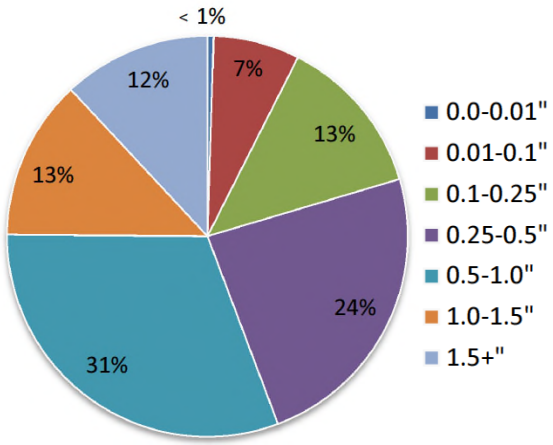
Abundant and Frequent Rainfall

Green Infrastructure: Opportunities for Pittsburgh
Fact Sheet Series

The roofs, roads, and parking lots in our urban areas prevent rainfall from soaking into the ground, overwhelming sewers and leading to flooding and polluted rivers. Green infrastructure helps solve flooding and prevent water pollution by using soil, vegetation, and natural processes to restore natural drainage patterns in our communities. Green infrastructure can also clean our air, revitalize our neighborhoods, create jobs, save our communities money, and provide other lasting community benefits.

The Challenge

The Pittsburgh area receives 37 to 45 inches of rainfall per year, which is typical for the region. With the area's humid climate and frequent rain events, some practitioners may view green infrastructure as inappropriate for the Pittsburgh area.



Southwest Pennsylvania Annual Rainfall Grouped by Storm Depth
Source: Westmoreland Conservation District www.wcdpa.com

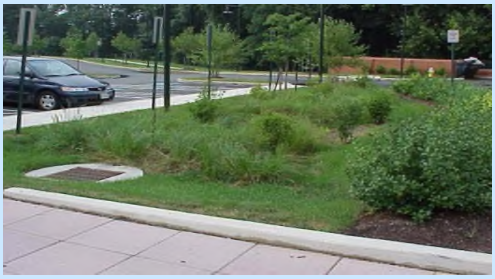
Analyzing the area's rainfall pattern, however, shows that green infrastructure works very well with Pittsburgh's climate. As shown in the figure above, the Pittsburgh area receives most of its annual precipitation as small rain events of one inch or less. Green infrastructure can effectively manage these small events.

Opportunities

Green Infrastructure practices such as rain gardens, permeable pavement, and green roofs are all practices that can succeed in Pittsburgh's climate.

- Rain Gardens capture stormwater draining from roofs. When the garden is full of water, extra water is channeled downhill away from the building.
- Permeable pavement is used for sidewalks, parking lots, and roads. It allows water to drain through it to a stone storage reservoir and then infiltrate into the soil. Underdrains laid in the storage reservoir help the practice drain between rainfall events.
- Green roofs introduce vegetation and soil onto roofs to absorb and filter rainfall. When the soil is saturated, the extra water overflows through a roof drain to a vegetated area, such as a rain garden.

Green Infrastructure Practices that Work with Frequent Rainfall



A storm inlet is used in this bioretention area to drain overflowing stormwater.
Source: Pennsylvania Stormwater BMP Manual

A stone channel is used in this residential rain garden to direct overflowing stormwater to the street.
Source: Stewardship Partners/Flickr

When this bioretention planter box is full of stormwater, the extra water "backs up" into the street to drain into a storm inlet.
Source: ASLA HQs, Washington, DC

This underdrain pipe system will help to drain the bioretention area above it.
Source: Brisbane City Hall, San Mateo County

Case Studies

Michigan Avenue Bioretention Planter Boxes, built 2006, Lansing, MI

In 2006, bioretention planter boxes were installed along four blocks of Michigan Avenue, a busy 5-lane street in Lansing, MI. The planters can treat the runoff from 1 to 4 inches of rain falling on the adjacent street and sidewalk.

If the planter reaches its maximum capacity, the extra stormwater "backs up" into the street and drains to a curb storm inlet. Water held in the soil is used by the plants, infiltrates to groundwater, or is released through an underdrain.

Bioretention planter boxes in Lansing help treat stormwater from roads and sidewalk.
Source: Christian and Novaes, 2011

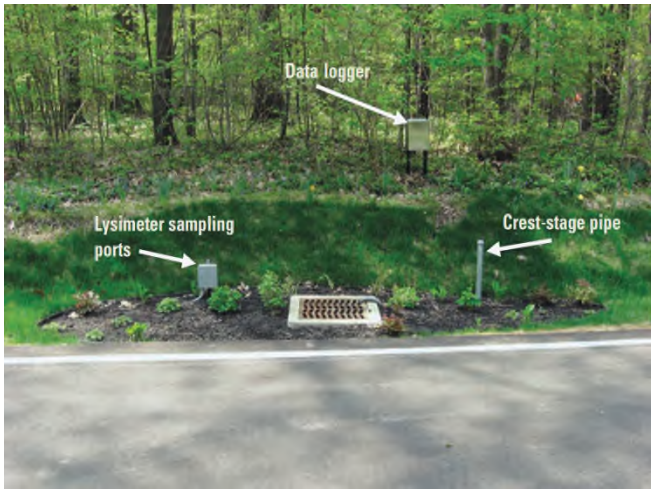
Results

- Flow meters were used to monitor the system, and model results show that about 90% of the total annual stormwater volume was treated by the planter box.
- While only 16% of the stormwater volume is kept within the planters, the peak flow rate of the water released through the underdrain is reduced by 87%.

Source: Christian, D. and Novaes, V. 2011. Michigan Avenue Bioretention: Monitoring the Results Three Years Later. MWEA 86th Annual Conference.

Sterncrest Drive Bioswale and Rain Gardens, built 2007, Cuyahoga County, OH

In 2007, the Chagrin River Watershed Partners with a grant from the U.S. EPA replaced 1,400 feet of roadside ditch with grassed bioswale and nine rain gardens to conduct a study. The U. S. Geological Survey (USGS) then monitored the site from 2008-2010 to better define the effect of green infrastructure on stormwater runoff. The bioswales and rain gardens were designed to handle a 0.75-inch rainfall falling on the adjacent roadway. Rainfall and runoff data were collected along with overflow data to determine how well the system performed.



Roadside rain garden in Cuyahoga County is monitored for its effectiveness in absorbing stormwater.
Source: USGS, 2011.

Results

- Numerous rainfall events greater than 0.75-inch were absorbed by the bioswales and rain gardens.
- Over the three years of monitoring, the system only overflowed 22 times.
- The bioswales and rain gardens performed better than expected in that there were more rainfall events greater than 0.75-inch that did not cause an overflow than events that caused an overflow.

Source: Darner, R.A., and Dumouchelle, D. H. 2011. Hydraulic characteristics of low-impact development practices in northeastern Ohio, 2008-2010: U.S. Geological Survey Scientific Investigations Report 2011-5165, 19 p.

Green infrastructure practices can be designed to effectively manage the frequent small rainfall events in the Pittsburgh area.