



# Space Constraints

## 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

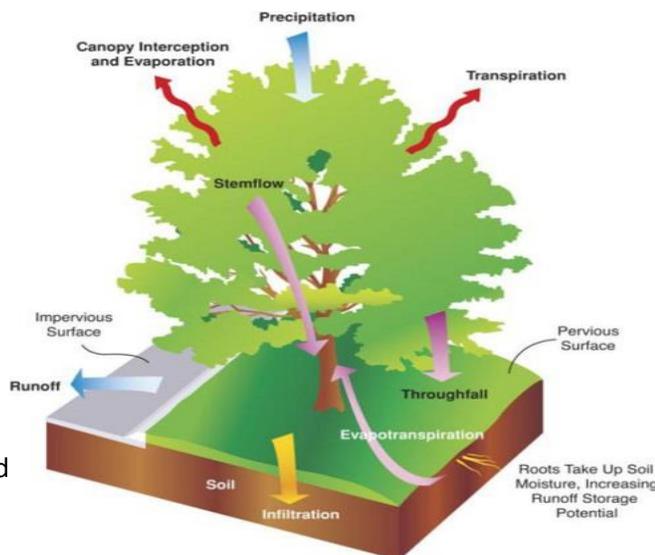
Future development in the Pittsburgh region is expected to require development of previously developed sites (*redevelopment*) or available sites nestled within urban areas (*infill*). Planned construction activities on redevelopment or infill sites and the road right-of-way present the opportunity to incorporate green infrastructure into urban areas. When incorporating green infrastructure into these areas however, limited space may pose a challenge because the existence of buried utilities, mature trees, basements, buildings, and roads pose obstacles.

Fortunately, designers have developed strategies for overcoming this challenge, for example, by using green features that serve multiple purposes or fit into small spaces. With care, the right green infrastructure practices can work well in the Pittsburgh region.

### Opportunities

Green Infrastructure practices such as bioretention, permeable pavement, green roofs, and rain barrels are all practices that are successful in urban space-constrained sites.

- Bioretention practices can be designed next to buildings and roads to absorb stormwater. Planted with trees, they become even more efficient at absorbing water.
- Permeable pavement can be substituted for traditional pavement, thereby not taking up additional space. Reducing the overall area of pavement also helps.
- Green roofs absorb rainfall while protecting the roof at the same time.
- Draining a roof to a rain barrel to water a garden helps reduce stormwater and saves drinking water.



### Green Infrastructure Practices that Work in Constrained Spaces



**This bioretention planter box was designed into a pedestrian corridor.**

Source: Tetra Tech



**Stormwater from a rooftop drains into this terraced bioretention facility.**

Source: SvR Design Company Green Factor Workshop



**This large parking lot helps to infiltrate stormwater through a permeable pavement system.**

Source: Clean Water Services

**This diagram shows the many natural routes rain water may take when it falls on a tree as opposed to merely running off of an impervious surface.**

Source: Xiao, Q.; McPherson, E. G.; Ustin, S. L.; Grismer, M. E. 2000. A new approach to modeling tree rainfall interception. *Journal of Geographical Research Atmospheres* 105: 29173-29188.

## Case Studies

### **Albert M. Greenfield Elementary School, built 2010, Philadelphia, PA**

Albert M. Greenfield Elementary School is a pilot site for using green infrastructure to reduce the number and volume of combined sewer overflows within Philadelphia. The school is located within an urban corridor and is bordered on all sides by busy streets. As a collaborative effort, a plan was created to transform the existing impervious school yard into a green space complete with green infrastructure.

The installed green infrastructure includes a woodland garden and rain gardens, which are installed along the perimeter of the playground, and permeable pavement, which doubles as a forgiving play surface. Combined, these practices capture and infiltrate 97 percent of the annual runoff from the school yard.

#### Results

- This project shows the ability of an urban site to infiltrate a significant amount of water.
- Innovative design features were used to protect the gardens, such as installing strategically placed nets/climbing structures (pictured) near the basketball courts; an idea courtesy of a student involved in the design process.
- The overall lesson learned is the importance of involving all interested parties in the design process to successfully share space in a constrained urban setting.

Source: Michele Adams, President, Meliora Design, LLC; American Society of Landscape Architects; Schuylkill Action Network



**Green infrastructure is incorporated into this school yard as permeable play surface and garden areas.**

Source: <http://phillywatersheds.org/category/blog-tags/stream-restoration>

### **Market Street Bioretention, built 2010, Lemoyne, PA**

The Lemoyne Borough in Cumberland County, PA has a downtown revitalization project underway. The overall multi-phase streetscape improvements project uses green infrastructure as part of the stormwater management system.

Bioretention and permeable pavers were used within the Market Street right-of-way to capture and infiltrate the “first flush” of rainfall. Stormwater runs off of the street and into the bioretention areas through cuts in the curb. The stormwater is treated through an engineered soil mixture before infiltrating through the underlying soil.

#### Results

- The green infrastructure practices provide green space as well as stormwater treatment and volume reduction.
- Because of the use of road salt in the winter and lack of rain in the summer, a variety of salt- and drought-tolerant native plant species were planted in the bioretention areas.
- The design accommodates typical roadside challenges including buried utilities, roadside parking, pedestrian traffic, and gutter flow for the larger storm events.

Source: Kairos Design Group, LLC



**This roadside bioretention captures stormwater from the road. The paved shoulder and metal grates provide roadside parking access.**

Source: Kairos Design Group, LLC

***With innovation and collaboration, green infrastructure practices can be effectively incorporated into constrained urban areas***