

Portland's Green Streets, SW 12th Avenue

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12th Avenue Green Street featuring bioswales near the Portland State University campus
(<http://flickr.com/photos/sitephocus/2629874914/>)

Portland is well known in urban design and planning communities for its innovative Green Streets. According to Portland's Metro government these Green Streets have the following qualities:

- 1) Integrate a system of stormwater management within the public right of way.
- 2) Reduce the amount of water that is piped directly to streams and rivers.
- 3) Are a visible component of a system of "green infrastructure" that is incorporated into the aesthetics of the community.
- 4) Make the best use of the street tree canopy for stormwater interception as well as temperature mitigation and air quality improvement.
- 5) Ensure the street has the least impact on its surroundings, particularly at locations where it crosses a stream or other sensitive area. (Portland Metro)

Many of the Green Street projects involve building curb extensions to transform a street's parking strip into a planted stormwater management area. NE Siskiyou Street, completed in 2003 was Portland's first Green Street project to use landscaped stormwater curb extensions to manage street runoff.

The SW 12th Ave Green Street was the first project to transform an existing landscape into street stormwater planters that manage street runoff and safely maintain on-street parking. It demonstrates how new and existing streets in highly urbanized areas can be designed to provide direct environmental benefits and be aesthetically integrated with the urban streetscape.



(<http://flickr.com/photos/26074955@N02/2447323637/>)



Before installation
(Photo by Kevin Perry, Bureau of Environmental Services, City of Portland)



After installation
(Photo by Kevin Perry, Bureau of Environmental Services, City of Portland)



Street runoff enters planter
(Photo by Kevin Perry, Bureau of Environmental Services, City of Portland)

It is this integration of the landscaped stormwater planters within the urban environment that has gained great public interest. The SW 12th Avenue Green Street project provides a strong precedent for future projects in other highly urban areas.

(Portland Bureau of Environmental Services)

Project Description

Design Features:

The SW 12th Avenue Green Street disconnects street runoff from a storm sewer that drains directly into the Willamette River. The project converted a previously underused landscape area between the sidewalk and street curb into a series of 4 landscaped planters which redirect stormwater to capture, slow, cleanse, and infiltrate street runoff.

The planters are designed to capture and infiltrate approximately 7,500 square feet of runoff from the street, driveways and sidewalk while maintaining a strong pedestrian circulation and on-street parking. The planters improve the existing urban streetscape by adding attractive greenspace and are designed to safely accommodate pedestrians, on-street parking, and vehicle access. Each facility can pond about 7 inches of stormwater runoff and retain it for onsite infiltration. The planters can treat and infiltrate most of the runoff they receive, providing volume and flow control and water quality benefits.

(Portland Bureau of Environmental Services)

Function:

Stormwater runoff from the street flows downhill along the existing curb until it reaches the first of four consecutive stormwater planters. A 12-inch-wide trench drain channels the street runoff into the first stormwater planter. The trench drain moves the water under the vehicle step-out area and into the facility. The runoff is directed over a concrete pad, where sediment and debris are deposited for easy removal. Stormwater is allowed to pond to a depth of 7 inches before infiltrating through the soil at a rate of approximately 4 inches per hour. During large storm events, water may enter the planter at a rate faster than the soil can infiltrate, resulting in a ponding depth greater than 7 inches. In that case, the runoff exits a second curb cut, flows back into the street, and enters the second (downhill) planter. This process continues for the third and fourth planters. If the fourth planter ponds to capacity, it overflows to the existing stormwater system. The adjacent sidewalk slopes toward the planters, and sidewalk runoff enters the planters through curb cuts. (Portland Bureau of Environmental Services)

Planter Detail:

Each of the 4 planters measures 18 by 4 feet, excluding the 6 inch curb running the perimeter of each planter, creating a total landscaped area of 72 square feet. The planter depth averages 13 inches (raised 4 inches above the sidewalk), safely accommodating a pooling depth of 7 inches. A 12 inch curb cut at the uphill and downhill end of each planter, covered by an attractive grate, allows stormwater to penetrate the facility. A design modification placed asphalt berms (1 inch high) on the downhill side of each curb cut to help runoff make the 90-degree turn into the planter. An 18-inch-wide concrete pad at each planter's uphill curb cut dissipates flow and collects sediment and debris. A 3 foot wide parking egress zone made of sand-set concrete pavers provides for vehicle access and a 2 foot wide landscape buffer at each end of the planters directs people safely around the facilities. (Portland Bureau of Environmental Services)

Soil and Plantings:

In an urban landscape soil conditions are important to consider with stormwater projects that are designed to infiltrate water. The Natural Resources Conservation Service soil survey for Multnomah County classifies the soils on the project area as 51C-Urban Land and well-drained Multnomah soils. The surface horizon typically is dark brown loam about 16 inches thick. Soil below this depth is gravelly sand to a depth of approximately 60 inches or more. No rock sub-base was used underneath the planters. The facilities were excavated throughout to 24 inches below grade and backfilled in 6- to 9-inch lifts with a three-way mix of sand, topsoil, and compost. The mix was tilled into the native soil and spread to create a flat cross section.

Each planter was densely planted with *Juncus patens* and a *Nyssa sylvatica* tree, both species tolerant of wet and dry soil conditions. The stiff structure of *J. patens* helps slow the passage of water, and the root structure helps infiltrate water into and through the soil, while the evergreen characteristic helps minimize weed growth. A row of *J. patens* was planted next to the concrete pad in each facility to hold back sediment and debris and keep it from entering the facility. The plants were installed at a density greater than required by the City's Stormwater Management Manual. This was done to reduce maintenance requirements and to create an aesthetically appealing landscape quickly. (Portland Bureau of Environmental Services)



(image courtesy of Sustainable Stormwater Management Program.)



(<http://flickr.com/photos/alta-planning/2765097753/>)



Planning Approach and Implementation

According to Metro, “The design and construction of green streets is one component of a larger watershed approach to improving the region’s water quality, and requires a more broad-based alliance for its planning, funding, maintenance and monitoring.”

(Portland Metro)

Site Selection Criteria:

- 1) Traffic Impacts: The project was not expected to have any traffic impacts.
- 2) Stormwater Catchment Area: The size of the catchment area, approximately 7,500 square feet, was considered fairly representative of conditions in the surrounding area.
- 3) Utility Conflicts: An existing gas service line to the adjacent building was the only subsurface utility that intersected any of the stormwater planters. The existing shut-off valve was located and preserved with a plastic standpipe for easy access. The existing street lighting remained in place.
- 4) Loss of Parking Spaces: The project did not affect existing on-street parking.
- 5) Street Slope: The moderate street slope (2 percent) was suitable for the project.
- 6) Suitability for Monitoring: The configuration of the local combined sewer allowed for placement of a flow monitor. There is also a rain gage near the project to measure rainfall events.
- 7) Soil Infiltration Rates: Specialized infiltration tests were not required at the site.
- 8) Available Space: The existing underused landscape area was 8 feet wide from face of curb to sidewalk edge. This allowed for 3 feet of flat area for parking egress and 5 feet for the stormwater planter, including 6-inch-wide perimeter curbing around the planters.

(Portland Bureau of Environmental Services)



(<http://flickr.com/photos/26074955@N02/2447324685/>)



"This is very relevant and will be influential in the profession. The best executed example of this type of work we've ever seen."
(ASLA)

Evaluation

Professional Critique:

The SW 12th Avenue Green Street received an ASLA Professional Award in 2006. The ASLA jury commented, "This is very relevant and will be influential in the profession. The best executed example of this type of work we've ever seen." (ASLA) Overall this has been a very successful and well-received project, by both the public and professional design community.

The planters have managed the stormwater effectively. When the facility was tested twice in 2006 by simulating a storm of almost 9,500 gallons of runoff (equivalent to about 2 inches of rain), it retained between 50 and 72 percent of the flow. While the facility may saturate for short periods of time during large rain events, the facility infiltrates well (testing indicates least 2 inches per hour even when wet). Based on a performance evaluation, the four planters have the capacity to manage a Water Quality Design Storm (0.83 inches of rain in 24 hours), meaning there is no overflow to the storm sewer for such an event.

Bypassing, or water continuing down the curb and not flowing into the planters has been a small issue. Making runoff take the 90 degree turn from the gutter into the planters is challenging. Gutter depressions, beveled edges, and gutter dams (used at SW 12th) are some potential solutions. The dams work very well for the vast majority of storm events, though some bypassing still occurs during intense rainfall.



Debris build up in swale.
(<http://www.portlandonline.com/shared/cfm/image.cfm?id=167503>)

Maintenance has been raised as issue as well. The facility has had to manage a larger drainage area (increased volume of runoff and sediment) than planned due to blocked inlets upstream. The large sweet gums on the street contribute debris as well. The most upstream planter acts as the sediment trap and must be cleaned out regularly. Sediment needed to be removed 7 times per year compared to a planned frequency of 4 times per year. This is slightly more time consuming than vacuuming out a sediment manhole, but the cost (both capital and environmental) of installing more concrete infrastructure that needs to be maintained with heavy equipment is reduced. The rushes have done so well that they're growing 1 ft or more higher than anticipated and as a result flop over into the sidewalk, requiring trimming at least once a year. (Tim Kurtz, Sustainable Stormwater Management Program)

Personal Critique:

How can this project be replicated at a site with soil infiltration contaminate issues?

Can concrete be minimized to allow for infiltration beyond the ground plane? Overtime does soil and organic matter need to be added or is too much produced?

Does soil wash out into the street in large storm events?

Is there a road edge or sloping that encourages the water to flow into these planters?

Can plant species diversity be improved to promote wildlife habitat?

Would this system work on roads with greater slopes (10%)?

Resources:

Portland Bureau of Environmental Services

<http://www.portlandonline.com/bes/index.cfm?c=44463&>

Metro

<http://www.oregonmetro.gov/index.cfm/go/by.web/id=235>

American Society of Landscape Architects

<http://asla.org/awards/2006/06winners/341.html>

Green Streets Notebook

<http://www.portlandonline.com/shared/cfm/image.cfm?id=153974>

<http://pruned.blogspot.com/2008/02/hyperlocalizing-hydrology-in-post.html>

photos credits: Kevin Perry, Bureau of Environmental Services, City of Portland

diagram credits: Sustainable Stormwater Management Program