Liberty Centre Parking Garage

633 NE Liberty Place (650 NE Holladay Street)

Project Summary

Project Type:	Commercial building retrofit - demonstration project			
Technologies:	Stormwater planter (infiltration planter)			
Major Benefits:	 Runoff from 36,155 sq. ft. (.83 acres) of parking deck enterstwo vegetated planters, reducing the volume of stormwater draining to the combined sewer and improving runoff water quality. The landscaping includes a variety of native trees and vegetation, improving the urban environment and aesthetic appeal of the property and surrounding commercial area. 			
Cost:	\$75,530 (\$2.10 per sq. ft. of impervious area managed). Environmental Services granted \$30,000 for the project through the Willamette Stormwater Control Program ¹ .			
Constructed:	Summer 2002			

Overview of the Stormwater System

- The stormwater planters were constructed in existing landscape areas bordering the parking deck.
- Drainage from the parking deck is evenly divided; half is discharged to the eastern planter and half is discharged to the western planter.
- Runoff enters each planter at two locations at the north end and at the mid-point.
- The floor of each planter slopes gently toward the south end, where runoff ponds to a depth of 11 in. before overflowing into a raised standpipe. Any overflow goes to the combined sewer.
- The foundation is protected with an impervious seal and drainage panels. There is also a footing drain at the bottom of the foundation.



Aerial view of Liberty Centre parking garage, after project construction, 2002.

¹ Portland's Bureau of Environmental Services implemented the Willamette Stormwater Control Program in 2001. The Program offered financial grants and technical support for a series of projects to retrofit existing commercial properties with stormwater controls incorporating green technologies. The Program recruited these demonstration projects to research the feasibility, cost and performance of commercial stormwater retrofits in the area served by the combined sewer. The Program provided grant funds for eleven projects. The projects were completed by July 1, 2003.

Stormwater Capacity and System Components

Stormwater Management Goal

The goal was to manage as much runoff as possible within the space available – within the existing landscape areas. The design maximizes the amount of runoff that is captured and infiltrated within the space. The design was influenced by the following factors:

- The available landscape area was just 5% of the drainage catchment.
- The configuration of the existing storm drains determined the points at which drainage could be brought into the planters (some flow enters at the mid-points of the planters).
- The designers specified that runoff should not pond directly against the foundation, so the planter floors are trapezoidal and slope toward the south (similar to swales).

Geotechnical Evaluation/Infiltration Test

Before construction, consulting engineers conducted infiltration tests at two locations in each planter. The four tests yielded infiltration rates of 0.5-1.0 in. per hour at depths of between 2 and 3 ft. below grade. The engine eers incorporated these rates into their hydraulic simulations, which indicated the planters have enough capacity to retain a storm somewhat smaller than the 2-year storm (prior to overflowing). The simulations did not include assumptions about the effect of the drainage panels encasing the foundation, which may increase the infiltration rate.

The Natural Resource Conservation Service (NRCS) Soil Survey for Multnomah County classifies the local soils as 50C-urban land - highly developed lands with stratified soils and sometimes fill. The soil survey does not provide expected infiltration rates for the soil group.



Excavated easts ide infiltration planter under construction 2001 (prior to curbs)



Eastside infiltration planter; summer 2003

Facility components

Eastern Infiltration Planter

(See Site Plan for drainage details; Figure 1, pg.10)

Catchment Area: 18,000 sq. ft. Facility footprint²: 1,155 sq. ft. Internal Volume: 585 cu. ft.

Overflow: The standpipe at the southern end of the planter overflows to the adjacent street inlet to facilitate flow monitoring.

Capacity: The planter has less internal volume than the comparable eastside soakage trench³ that would be required for a catchment of 18,000 sq. ft. (the soakage trench would have a footprint of 1,080 square feet and a volume of 1,134 cu. ft).

Additional Information:

- The planter is 175 ft. long and averages 6.6 ft. in width. A 6-in. curb along the outer edge results in an average total depth of 12 in
- The planter floor has the configuration of a swale. It slopes gently toward the south (< 1%), it has trapezoidal side slopes (2:1 to 3:1), and it has four check dams to promote retention and infiltration. The side slopes ensure that runoff doesn't pond directly against the foundation.
- The standpipe inlet (overflow elevation) is 11in. above the floor of the planter.
- The soils were excavated 6 in. at the center of the planter and amended with compost. No other changes were made to the soils.
- The slope beneath each scupper (inflow point) is lined with impervious HDPE fabric, and the entire cross section of the planter at those locations is covered with river rock to reduce erosion.
- The top of the drainage protection system along the foundation exceeds the height of maximum ponding within the planter it was raised 6 in. during construction.



Overview of westside infiltration planter, spring 2004



Foundation protection system: impervious seal and drainage panel

²For the purpose of comparing the capacity of the facility with the standard eastside soakage trench, the footprint has been calculated as the wetted (ponded) surface area when the facility reaches maximum capacity.

³ The standard eastside soakage trench meets the City's standard for complete stormwater disposal in soils, which infiltrate at least 2 in. per hour. The City requires 24 ft. of trench per 1000 sq. ft. of impervious area (drainage catchment). The trench is 3 ft. deep, 2.5 ft. wide, and filled with drainage rock. Flow enters the trench through a pervious pipe that travels the length of the top of the trench. Assuming a porosity of 35%, the trench provides an internal volume of 63 cu. ft. per 1,000 sq. ft. of catchment.

Western Infiltration Planter

(See Site Plan for drainage details; Figure 1, pg.10)

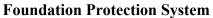
Catchment Area: 18,000 sq. ft. Facility footprint²: 1,155 sq. ft. Internal Volume: 214 cu. ft.

Overflow: An overflow standpipe, located at the southern end of the planter, drains to an existing subsurface pipe that connects to the combined sewer.

Capacity: The swale has less capacity than the comparable eastside soakage trench³ that would be required for a catchment of 18,000 sq. ft. The soakage trench would have a footprint of 1,080 sq. ft. and a volume of 1,134 cu. ft.

Additional Information: The planter is similar in configuration to the eastern planter with the following exceptions:

- The western planter has a slightly larger footprint and greater stormwater capacity.
- The overall slope of the floor is 1% over 165 ft. (slightly more than the eastern planter).



The structure was built in 1996 with extensive drainage protection - waterproof seal, drainage panels, and a foundation drain ("toe drain").

- The waterproofing system consists of bentonite panels.
- The drainage panels have a reported flow capacity of 10-16 gallons per minute per lineal ft. They include a fabric cover to limit the passage of sediment.
- The foundation drains are pervious pipes that run the length of the bottom of the foundations edge. They drain to the combined sewer.

Landscaping

Construction of the planters required removal of most of the existing vegetation and excavation to a depth of 6 in. (center of the planters). Ashforth Pacific originally hoped to maintain the existing young maple trees, but there was uncertainty about the risks associated with excavating around the roots and inundating the trees with stormwater. To limit the risk, Ashforth decided to replace the Red Maples with 2-in. caliper Red Alder saplings.



Westside infiltration planter and scupper; fall 2003



Coring through concrete wall for stormdrain and scupper, 2002

Ashforth installed native plants throughout, including grasses, sedges and rushes. The plants were selected to provide water quality treatment and promote stormwater uptake. The careful selection and dense plantings of native vegetation has allowed Ashforth Pacific to eliminate the use of chemicals in the maintenance of the facilities.

Storm drains and Scuppers

Four internal drains were re-directed to the exterior of the building. The new extensions (6-8 in. iron pipe) travel along the ceiling of the main floor, reaching as far as 50 ft. to the locations of the scuppers that drain into the planters. The pipes penetrate the foundation wall and terminate in attractive bronze scuppers.

Emergency Overflow

An overflow standpipe routes excess flows from the southern end of each planter underneath the sidewalk to the adjacent street inlet⁴. The overflow is a small lynch-style catch basin with a metal grate. Each overflow grate is 11 in. above the floor of the planter, allowing stormwater to pond to a depth of 11 in. when the system reaches capacity. The City does not typically allow direct connection of private stormwater management facilities to public catch basins due to an increased risk of damage to private property in the event of a system failure.

Budget

Ashforth Pacific submitted a project budget of \$75,530, which includes management, design, and construction.

Liberty Centre Parking Garage Budget Summary						
Item		Item Cost		Total Cost		
Project Management			\$	3,072.00		
Design			\$	12,135.00		
Landscape design	\$	1,835.00				
Surveying, geotechnical & structural evaluation	\$	10,300.00				
Construction Management			\$	1,695.00		
Construction			\$	33,015.00		
Site plumbing/drainage systems	\$	32,480.00				
Moisture barrier labor and material	\$	535.00				
Landscaping (2300 s.f.)			\$	24,140.00		
labor and materials	\$	22,350.00				
Additional planting	\$	1,790.00				
Miscellaneous:						
Permitting			\$	1,473.00		
Total			\$	75,530.00		

Table 1.

⁴ The City does not normally allow connections to street inlets. This connection was allowed to create easy access to the pipes for flow monitoring.

Non-Construction Activities

The estimated cost for management, design, and permitting was \$18,375, comprising approximately 25% of the budget.

• Management (Project and Construction Management)

The cost for both project and construction management was \$4,767, comprising 7% of the budget.

• Design

Design costs were \$12,135, comprising 16% of the budget. The cost of design attributable to the Landscape Architect was \$1,835 or 2% of the budget. Engineering costs were \$10,300 or 14% of the budget and consisted of surveying work, a geotechnical evaluation, and a structural analysis (due to siting the infiltration facilities next to the foundation).

• Permitting

The permit costs were \$1,473, comprising 2% of the budget. Permits included a permit from Portland Department of Transportation (PDOT) for construction within the public right-of-way.

Construction Activities

Construction and landscaping costs were \$57,155 or 75% of the budget.

• Demolition, Excavation, and Grading

The cost for excavation and grading is not provided as a separate figure in the budget. The project required only minimal excavation in the existing landscaped area; no demolition was required.

Construction

The cost for construction activities was \$33,015, comprising 44% of the budget. Two project components that notably contributed to construction costs were plumbing for the overflow pipes and plumbing to redirect runoff to the exterior of the building, an essential component to the feasibility of the project.

Landscaping

The project included almost 2,300 sq. ft. of landscaping area, approximately 5% of the catchment area. The cost was \$24,140, comprising 31% of the budget. Items included labor, materials, and the removal of ten 3 in. caliper trees.

II. Cost Elements

<u>Engineering Design</u>. Although the facilities appear rather simple in scope, substantial engineering support was required to design the plumbing and drainage system, conduct the hydraulic analyses for the planters, conduct soil infiltration tests, and provide a structural evaluation for siting an infiltration facility next to the foundation.

<u>Plumbing</u>. Piping costs account for a substantial part of the construction budget, largely due to the rerouting of 4 existing interior drains to the exterior of the structure. More than 150 ft. of new iron pipe was hung from the ceiling to complete the project.

Landscaping. The unit cost for landscaping, almost \$11 per sq. ft., is relatively high. More typical planting costs are less than \$5 per sq. ft. The costs are partly explained by the density of the plantings. Due to the time of year, plugs were used instead of seeds. The removal and replacement of the existing trees was probably the largest factor in the high unit cost. The replacement of the trees also affected the project management costs. Extra effort was expended to evaluate the risks associated with retaining the existing trees, research the associated permitting issues, and obtain adequately sized replacement trees.

<u>Foundation Protection System.</u> Despite minimal cost to increase the height of the existing foundation protection system, the project might have cost substantially more if the drainage protection system was not already in place.

<u>Planter Construction</u>. The property owner saved money through the relatively simple design of the planter...it only required the addition of a 6-inch curb along the sidewalks (the foundation serves as the inside wall). Many other planter projects would require more concrete construction work.



Eastside iInfiltration planter under construction, 2001



Stormdrain and bronze scupper, winter 2003



Overflow standpipe at southern end of infiltration basins

III. Cost Comparisons

Despite the relatively high costs for engineering, piping, and landscaping, this project is an example of a relatively cost-effective stormwater retrofit. The unit cost was \$2.08 per square foot of impervious area, or catchment area. The design does not provide complete onsite disposal for all storm events, making the project costs a difficult basis for comparison with other projects that provide total disposal.

Maintenance and Monitoring

The owner of the property is responsible for all maintenance activities.

Environmental Services will monitor the performance of the facilities at the Liberty Centre Parking Garage for at least five years, and perhaps longer. Confirming the hydraulic performance of the facility will be a primary concern. Environmental Services will also regularly evaluate the level of effort required to maintain the facility, the success of the planting regime, and comments from the owner.

Successes and Lessons Learned

<u>Good Design</u> - the design successfully incorporates a stormwater feature into a highly urban setting, adjacent to a heavily-used sidewalk.

<u>Stormwater Capacity</u> - Although the design does not provide total on-site disposal, it makes the most of the limited landscape available for stormwater management. The walls of the planter substantially increase the internal volume of the stormwater system.

<u>Landscaping</u> - The project showcases the appropriate use of trees and native plantings within stormwater planters. It also highlights the careful scrutiny required for existing trees in areas that are excavated or converted for stormwater management. Concern over the viability of the existing Red Maples led to their removal and replacement with Alder saplings.

<u>Re-direction of Internal Plumbing</u> - The project provides helpful information about the feasibility and cost of re-directing internal storm drains to the exterior of a large commercial structure. For this project, the pipes were easy to access because the were not enclosed behind ceilings or walls.

<u>Infiltration Adjacent to a Structure</u> - The project is a great example of how a landscape infiltration facility can be sited adjacent to a foundation. In this case adequate drainage protection was installed during the construction of the building in 1996.

<u>LEEDS Certification</u> - Ashforth Pacific qualified for LEED certification in the "Existing Building" category for sustainable design. The project complied with the certification criteria for its use of native vegetation and a 25% minimum reduction in stormwater volume.

