Page 19 L.L.C.

(Previously the United Salad Co. Garage)

939 SE Alder St.

Project Summary

Project Type:	Light industrial retrofit (parking lot) - demonstration project
Technologies:	Landscape infiltration basin and porous gravel courtyard
Major Benefits:	• Runoff from the modified parking lot, including the gravel courtyard, drains to a landscape infiltration basin. The basin reduces stormwater and pollutants draining to the combined sewer. • Over 1,000 sq. ft. of native and sustainable landscaping was added, improving the urban environment and the aesthetic appeal of the property.
Cost:	$37,080 (unit cost of $3.80/ sq. ft. of impervious area managed). BES provided a $30,000 grant[1] for the project.
Constructed:	Summer 2002

Overview of the Stormwater System

The existing 10,000 sq. ft. asphalt parking lot was replaced with a smaller, re-graded asphalt parking lot, a gravel courtyard, a landscape infiltration basin, and perimeter landscape areas.

- Runoff from the asphalt parking lot (7,000 sq. ft.) drains into the infiltration basin.
- The gravel courtyard (1,825 sq. ft.) captures and infiltrates rainfall. If it reaches capacity, it will overflow into the landscape infiltration basin.
- The infiltration basin fills to a depth of about 6 in. (deepest point) before it overflows into a standpipe. The standpipe is located at the lowest point in the basin; it drains to the combined sewer.

Aerial view of the Page 19 property before the project – the parking lot where the project was implemented is outlined in red; 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 in order 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 a total of eleven projects. The projects were completed by July 1, 2003

Stormwater Capacity and System Components

Overview of the retrofitted parking lot

Stormwater Management Goal

The overall stormwater management goal was to meet the sizing and design standards of the "Simplified Approach" of the City's Stormwater Management Manual (SWMM). These standards do not typically provide for complete stormwater disposal; actual performance is dependent on soil infiltration rates. All design standards used for reference in this report were current in the year 2002.

Geotechnical Evaluation / Infiltration Test

The property owners contracted with a geotechnical firm in 1998 to perform a field investigation of the property. A soil probe encountered 4 to 7 ft. of fill material on top of a base of silt and clay-silt.

The Natural Resources Conservation Service (NRCS) soil survey for Multnomah County classifies the soils as 50C-Urban Land: highly developed lands atop stratified soils and sometimes fill. Because the soils are variable and not typically native, NRCS does not provide a typical infiltration rate.

L-shaped infiltration basin with emergency overflow (see arrow) and gravel courtyard

System Components

Landscape Infiltration Basin

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

Catchment Area: 7,000 sq. ft. of asphalt (parking lot)

Facility footprint[2]*:* 400 sq. ft. (within the confines of the basin)

Internal Volume: 105 cu. ft. (volume in the basin to the level of overflow)

Overflow: The overflow standpipe connects to the city sewer system.

Capacity: Within the basin itself, there is substantially less storage capacity than would be provided by a standard soakage trench – a catchment of 7,000 sq. ft. would require a soakage trench[3] with a footprint of 420 sq. ft. and a volume of 441 cu. ft. However, there is substantial additional storage volume in the asphalt parking lot; prior to overflowing into the standpipe, the area of ponding expands beyond the basin into the adjacent areas of the parking lot. The volume of this additional capacity is unknown.

[2]For 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 approximately 63 cu. ft. per 1000 sq. ft. of catchment.

Additional Information:

- The L-shaped infiltration basin has a total length of 60 ft.. It is 11 ft. wide and it has 2:1 side slopes. Although it is 6 in. deep (ponding depth) at the standpipe, the average depth is just 3 in. – the basin is very shallow at its ends.
- Evenly-spaced curbstones border the basin along the edge of the parking lot. In addition to serving as attractive tire stops, the spaces between the stones allow runoff to enter the basin.
- During large storm events runoff ponds on adjacent asphalt areas prior to overflowing via the standpipe.

Removal of parking lot asphalt during project construction, summer 2002

Pervious Courtyard

Catchment Area: 1,825 sq. ft. of gravel

Internal Volume: 365 cu. ft. (total void space in the gravel and rock).

Overflow: The courtyard slopes gently toward the landscape infiltration basin; any overflow will drain into the basin.

Capacity: The gravel courtyard provides substantially more internal capacity than the standard soakage trench[3] that would be required for the same catchment – a 1,825 sq. ft. catchment would require a soakage trench with a footprint of 153 sq. ft. and a volume of 161 cu. ft..

L-shaped basin under construction, 2002

Additional Information:

- There is 3 in. of quarter-inch minus gravel above 3 in. of crushed rock (the sub base).
- The courtyard is bordered on the south and west sides by the infiltration basin; perimeter landscaping borders its east and north sides.
- The courtyard is sometimes used by building tenants for overflow parking.

New subsurface irrigation pipe for hose bib, looking north.

Emergency Overflow

The overflow inlet (standpipe) is approximately 6 in. above the basin floor. The standpipe is located at the elbow of the L-shaped landscape basin. The standpipe is a modification to the old parking lot catch basin, which was removed and re-plumbed to the location of the standpipe.

Landscaping

The vegetation within the basin is predominantly native plants such as Gaultheria Shallon (salal), Fragaria Chiloensis (Coastal Strawberry), and Juncus Effusus (Common Rush). These species are adaptable to both moist and dry soil conditions.

Perimeter landscaping includes a variety of native and sustainable (edible or harvestable) plants such as Evergreen Huckleberry, which produces an edible berry (and also fulfills city code requirements for a parking lot hedge). The Clumping Bamboo can be harvested for a multitude of uses, and the Serviceberry provides food and habitat for wildlife.

All of the soils in the landscape areas were amended with a mix of topsoil and compost (total average thickness of 5 in.).

Pavement Replacement

The new 7,000 sq. ft. parking lot slopes toward the landscape infiltration basin. The job required much more than simply re-grading the surface with additional layers of asphalt; the asphalt contractor recommended complete removal of the old asphalt surface, including the gravel sub-grade, in order to ensure the integrity of the new asphalt surface. About two-thirds of the surface was excavated to an average depth of one foot; in some areas excavation was as deep as 3 ft. below grade.

The new asphalt layer is 3 in. thick, on average, to accommodate commercial trucks.

Irrigation

Four temporary soaker hoses were installed to irrigate the new plantings during the 2-year establishment period. A new hose bib at the north end of the landscape infiltration basin supplies the hoses. Water service for the bib required a new water line from the building. The pipe work included the installation of a backflow prevention device.

Repaved asphalt parking lot, graded to drain into infiltration basin; 2002

Flow paths draining to the location of the landscape infiltration basin (yet to be built; 2002

Landscape infiltration basin in a rain event; 2003

Budget

Page 19 L.L.C. submitted a final project budget of $37,080, including management, design, and construction. BES contributed $30,000 in grant funding to the project. The final budget is shown below in Table 1.

Page 19 Parking Lot Retrofit Project
Budget Summary

Item	Item Cost	Total Cost
Design	$2,000	**$2,000**
Project and Construction Management	$2,000	**$2,000**
Demolition, grading, site prep		**$5,971**
Mobilization	$250	
Asphalt (10,000 sq. ft.) - removal, disposal	$3,100	
Excavate swale and planting areas	$1,631	
Excavate water line (irrigation)	$840	
Sawcut concrete slab	$150	
Construction		**$18,906**
Piping Work		
Move existing drain and install new drain	$950	
piping	$1,101	
Install new overflow	$100	
Paving - earthwork		
Mobilization of grading crew	$400	
Mobilization of paving crew	$600	
Backfill 6in. sub-grade (gravel)	$4,039	
Paving - construction		
Install asphalt (7,036 sq. ft; 3 in. thick)	$7,036	
Install curbstones and concrete pavers	$3,955	
Striping	$200	
Install 3 in. gravel (1/4 in. minus). Includes courtyard.	$525	
Landscaping (1,147 sq.ft**)**		**$6,913**
Install topsoil/compost (1350 sq ft, 4 in.deep)	$2,241	
Install river rock (to 2 in. depth in swale)	$150	
Plants & trees (installed)	$3,525	
Three street trees (installed)	$600	
Irrigation System (soaker hoses)	$400	
Miscellaneous		**$1,290**
Permit fees	$1,165	
Core drilling	$125	
TOTAL		**$37,080**

Summary of pavement removal and replacement costs (7,000 sq. ft.) *	
Paving - earthwork:	
Asphalt/fill demo, removal, and disposal	$ 2,170.00
Mobilization of grading crew	$ 400.00
Mobilization of paving crew	$ 600.00
Backfill sub-grade (gravel)	$ 4,039.00
Paving - construction:	
Install asphaltic concrete (7000 sq. ft.; 3 in. thick)	$ 7,036.00
Striping	$ 200.00
Total	**$ 14,445.00**
Cost per sq. ft.	**$ 2.06**

*These costs are subsets from the total budget and reflect only those costs pertaining to the area of asphalt that was replaced.

I. Budget Components

Non-construction Activities
The total estimated cost for management, design, and permitting was $5,290, comprising approximately 14% of the total budget.

- **Management (Project and Construction Management)**
  The total for project and construction management was $2,000, comprising approximately 5% of the total budget. The owners managed all phases of the project; they hired contractors and oversaw construction.

- **Design**
  The landscape architect (one of the property owners) designed the project at a cost of $2,000, comprising approximately 5% of the total budget.

- **Permitting**
  The cost of the site development permit was $1,165, comprising 4% of the total budget.

Construction Activities
Demolition, excavation, construction, and landscaping costs amounted to $31,790, comprising 86% of the total budget.

- **Demolition, Excavation, and Grading**
  The total for these activities was $5,971, comprising about 16% of the total project budget. The effort included demolition and removal of 10,000 sq. ft. of existing asphalt and subgrade (excavation depth of up to 3 ft.), import of topsoil, re-grading, and excavation.

- **Construction**
  Construction activities, including installation of more than 7,000 sq. ft. of new asphalt surface and relocation of the drain, totaled $18,906. The total is approximately 51% of the total project budget.

- **Landscaping**
  The project included a total of 1,147 sq. ft. of landscaping (includes the infiltration basin and the landscape around the perimeter of the parking lot). The cost was $6,913, comprising about 19% of the total project budget. The total unit cost was approximately $5.76 per sq. ft. of landscape. The unit cost for the imported topsoil/compost was $1.66 per sq. ft. Other elements included material and labor for planting, river rock, and irrigation.

II. Cost Elements

Asphalt work
Asphalt removal and construction dominated the project budget, accounting for almost 45% of the total budget. Activities included removing the existing parking lot (including the sub-base) and installation of a new smaller asphalt lot. The contractor recommended replacement of the asphalt and sub grade (rather than simple resurfacing) because of use by commercial trucks.

Landscaping
The project incurred higher unit landscaping costs than is typical for stormwater projects. Almost a third of the landscaping costs were attributed to imported compost and topsoil necessary to improve growing conditions. Part of the increased cost is also explained by installation of more expensive plant species such as Bamboo.

Plumbing
The project required limited pipe work compared to other retrofit projects. The work included removing the existing catch basin, extending the existing storm line 20 ft. to serve the stormwater basin, and installing a hose bib and new water connection to the building.

Gravel Courtyard
The gravel courtyard was a cost-effective alternative to re-paving the entire parking lot. It required less paving and therefore reduced the size of the stormwater facility. In addition to providing an outdoor recreation area (picnicking, etc.), the courtyard is occasionally used as an overflow parking area.

III. Cost Comparisons

This retrofit project required replacement of much of the asphalt surface, making it an example of the most intensive type of parking lot retrofit. Many parking lot retrofits do not require removal (and replacement) of the existing surface; re-grading can be achieved by applying new asphalt in local areas. There were other components of the project, such as the plants and the curbstones that were also more expensive than typical for many stormwater projects. While there may have been some savings in the pipe work, the costs for the project should probably be viewed as the upper end of parking lot retrofit costs, particularly because of the small size of the project – larger projects would realize economies of scale.

Landscape infiltration basin after a storm, 2003. Note damp pavement where runoff recently ponded on asphalt surface.

Maintenance and Monitoring

The owner of the property is responsible for all maintenance activities. BES will monitor the performance of the facilities at Page 19 L.L.C. for at least five years, and perhaps longer. Confirming the hydraulic performance of the facility will be a primary concern. BES 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

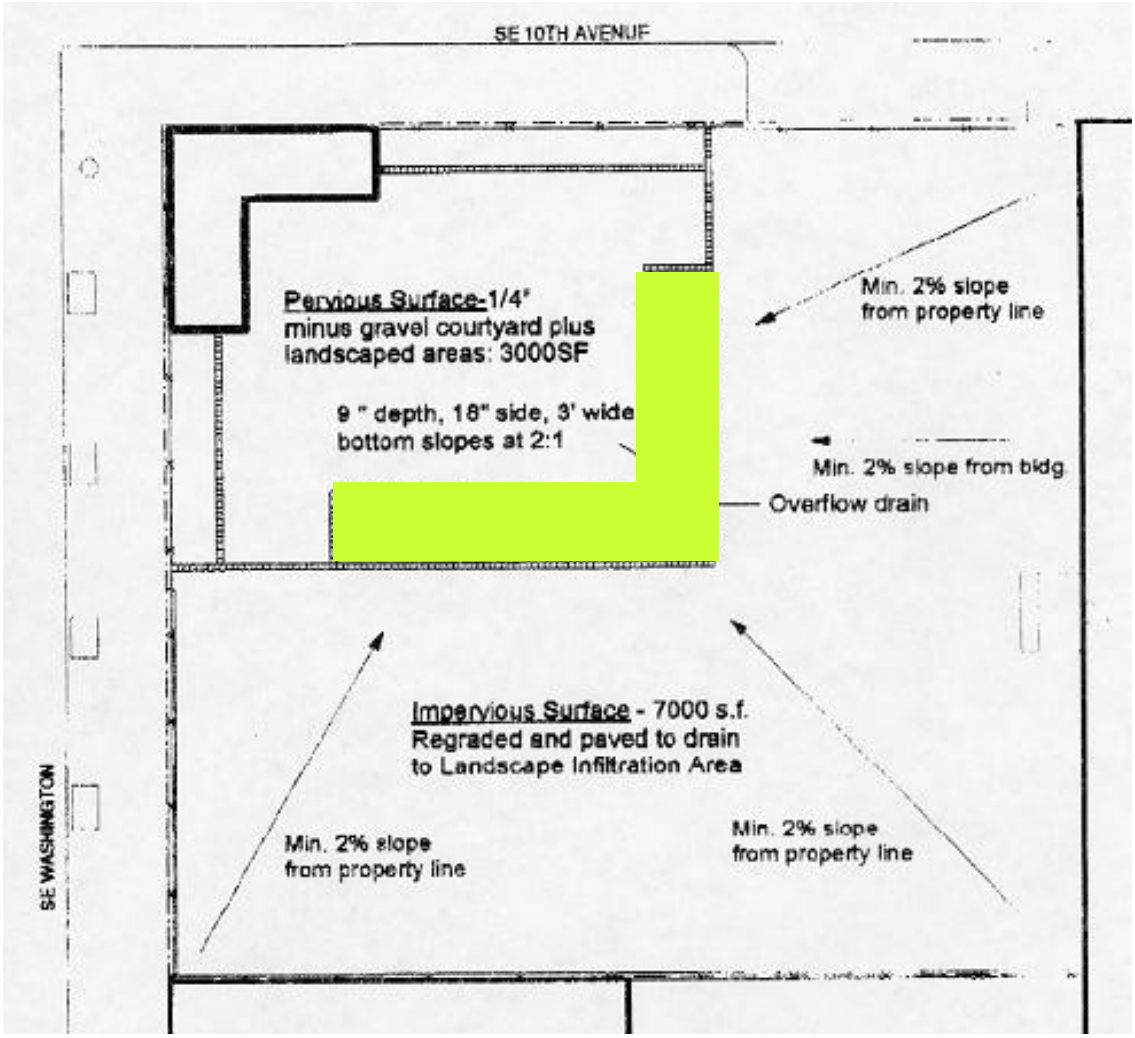
Design - The project is an important example of how a landscape infiltration area can be used as an attractive design element in the interior space of a parking lot (as opposed to shedding the runoff to the exterior or perimeter landscaping). The design was very successful in terms of preserving the existing parking spaces – it resulted in the loss of just two parking spaces.

Pavement Removal - The project demonstrates what is involved in retrofit projects that require asphalt replacement. Replacing asphalt can be more expensive than other options, but it opens a number of options for managing runoff.

Spaced Curbstones – The curbstones are an attractive option for bringing runoff into the landscape infiltration basin: they provide an effective curb stop and spread flows during large storms.

Gravel Courtyard – The courtyard provides a number of benefits: it absorbs much of the stormwater that falls onto it, provides a recreational (picnic) area, and is periodically used for extra parking spaces.

Stormwater Capacity - The internal volume of the landscape infiltration basin is smaller than typical for its size (footprint) – it has an average depth of just 3 inches. However, additional capacity is provided by the parking lot surface: runoff fills the landscape infiltration basin and then temporarily ponds in the parking area before overflowing to the sewer system.



Site plan of parking lot with infiltration basins (highlighted in green) and gravel courtyard.