Astor Elementary School Water Garden
5601 N Yale Street, Portland, Oregon

PROJECT SUMMARY

Project Type:	Public school stormwater retrofit—demonstration project
Technologies:	Asphalt removal; downspout disconnection; vegetated swale; vegetated infiltration basins; cistern
Major Benefits:	• Approximately 289,000 gallons of stormwater are infiltrated and treated onsite each year instead of entering the combined sewer system. • Stormwater stored in a cistern can be used for onsite irrigation. • The addition of native landscaping improves the urban environment and the aesthetic appeal of the property. • The project involved considerable education of and participation by students and community members.
Cost:	$130,384 - Funding included an $8,500 EPA grant and a $25,000 Community Benefit Opportunity Program grant.
Constructed:	2003-2005

Overview of the Stormwater System

- The Astor Elementary School Water Garden is a joint project of the Bureau of Environmental Services (BES), Portland Public Schools, and Urban Water Works (a local non-profit organization).

- An 8,000-square-foot asphalt courtyard was removed and replaced with a water garden—an interrelated, linked system comprised of a cistern, three infiltration basins, and a vegetated swale. (See Figures 1 to 6.)

- Two downspouts were disconnected from the school's roof and directed to the cistern. Overflow from the cistern exits to a spiral-shaped infiltration basin.

- Three other downspouts were disconnected from the school's roof and directed to two infiltration basins shaped like fish. A graded connection links these two infiltration basins with the spiral infiltration basin.

- The spiral infiltration basin overflows to a long, narrow vegetated swale.

- A portion of existing sidewalk also drains to the new vegetated area.

- In addition to providing stormwater management, the water garden functions as an outdoor classroom, green space, and place for students to explore nature and art. Features include gravel pathways, bridges, and a stage area constructed of brick pavers.

Figure 1: Footprint of Astor School before retrofit

Figure 2: Astor courtyard before asphalt removal

Figure 3: Water garden under construction

Figure 4: Water garden under construction

Figure 5: Completed water garden

Figure 6: Completed water garden

STORMWATER CAPACITY AND SYSTEM COMPONENTS

Stormwater Management Goal

The stormwater management goal was to provide onsite stormwater infiltration and reduce the volume of stormwater entering Portland's combined sewer system. The project was designed in accordance with the City of Portland's 2002 *Stormwater Management Manual.*

Geotechnical Evaluation/Infiltration Test

Site-specific infiltration tests were not conducted because local drainage characteristics had been adequately documented by other projects in the vicinity. The Natural Resources Conservation Service (NRCS) soil survey for Multnomah County classifies the soils as 50A - Urban Land/ Multnomah Complex. The survey indicates the soils typically have been disturbed and mixed with fill material. The predicted infiltration range is 0.6 – 2.0 inches per hour.

System Components

(See plan on page 4)

Facility footprint: 1,500 square feet (1,060 square feet for the spiral infiltration basin and vegetated swale; 440 square feet for the fish-shaped infiltration basins)

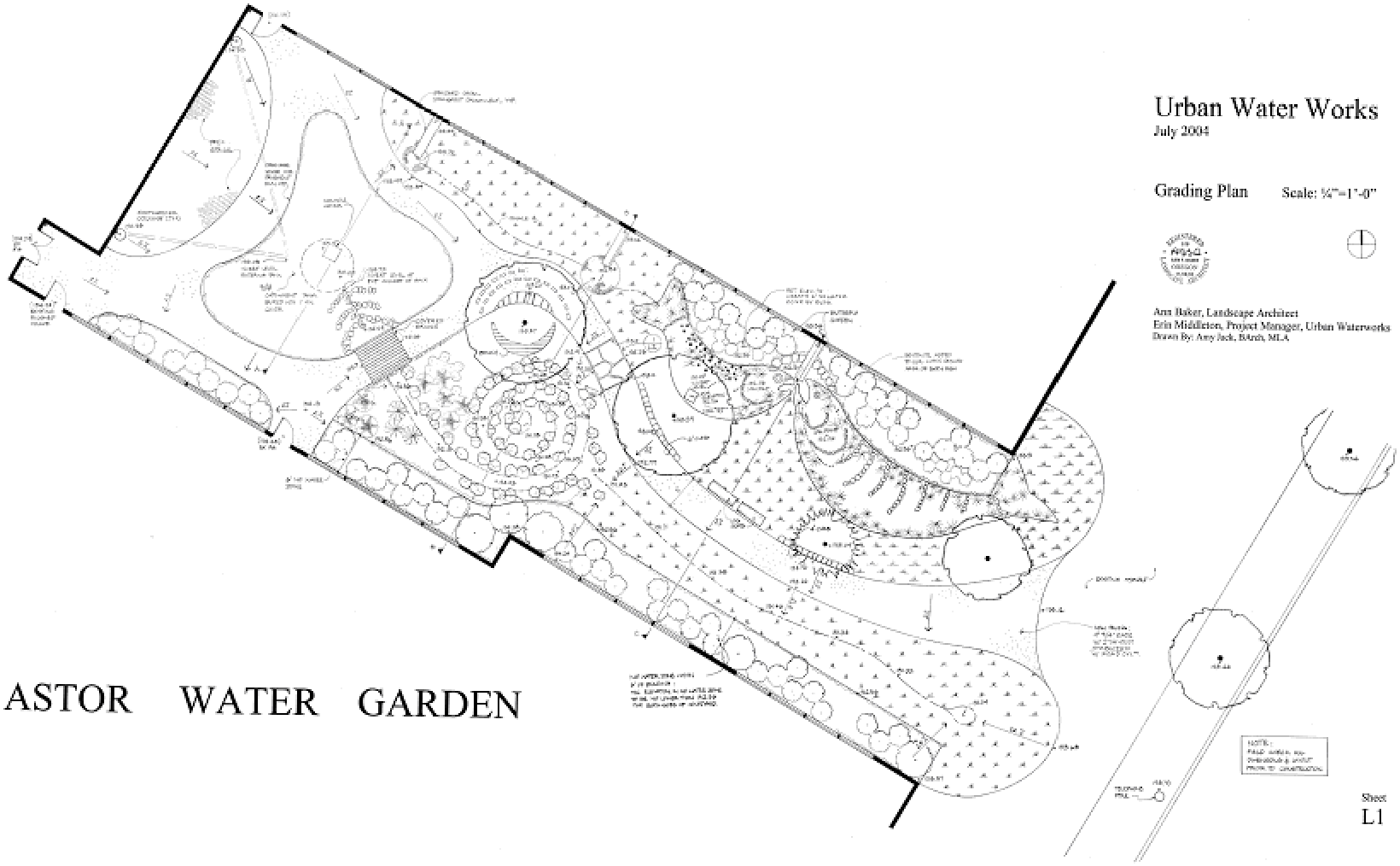
Catchment area: 17,700 square feet (9,000 roof; 8,000 asphalt removal; 700 sidewalk)

Cistern: 3,000 gallons - Runoff from two downspout disconnections is piped to the cistern, which is partly below grade on a small hill. A 180-square-foot stage area covers the places where the downspouts direct the flow underground into the cistern. During heavy rains, overflow from the cistern exits on the southeast side of the hill in a waterfall effect, continues under a footbridge, and flows into the spiral-shaped infiltration basin.

Infiltration basins: The three infiltration basins are shallow depressions (typically 6 inches deep) that capture and infiltrate runoff. The two fish-shaped basins contain check dams to slow flow, and small areas are lightly lined with bentonite to temporarily retain some water. Channels provide for overflow between the two fish-shaped basins.

Vegetated swale: Wetland plants in the long, narrow vegetated swale filter and slow any overflow from the spiral-shaped infiltration basin.

Overflow: During large storm events, any overflow from the basin/swale system enters an existing onsite storm inlet connected to the combined sewer system or flows to street inlets.



Urban Water Works
July 2004

Grading Plan Scale: ¼"=1'-0"

Ann Baker, Landscape Architect
Erin Middleton, Project Manager, Urban Waterworks
Drawn By: Amy Jack, BArch, MLA

Sheet
L1

Landscaping: The landscaping includes mostly native plants—trees, shrubs, grasses, and wildflowers selected for their tolerance to dry and moist soil conditions. Prairie grass plugs and eco-lawn seed were planted on the hill as an alternative to a standard lawn. Trees and tall shrubs were placed in strategic locations to help reduce the seasonal heating and cooling needs for the building. Clean fill was imported to grade the landscape areas as basins. The imported soil consisted of a blend of composted (weed-free) yard debris and soil.

A concealed PVC irrigation system was installed to support irrigation of the plants during the 2-year establishment period. Because the landscape contains native plant species adapted to regional climate conditions, supplemental summer irrigation will typically not be required after the vegetation is established. However, the cistern has a hand pump for summer irrigation if needed.

BUDGET

The total project cost was $130,384, including management, design, and construction. Of this total, $45,531 (35 percent) was cash expenses, and $84,853 (65 percent) was volunteer contributions (donated services, materials, and labor). The table on the following page summarizes the project budget.

Funding sources included:

- $8,500 from an EPA Innovative Wet Weather Projects (IWWP) grant (through BES)
- $25,000 from a BES Community Benefit Opportunity Program grant
- Grants from Metro (in partnership with the U.S. Fish and Wildlife Service) and the Regional Arts and Culture Council (RACC)
- Private donations

Budget Elements

Non-Construction Activities

Non-construction activities included project design, project management, construction management, public education activities, and permitting.

Construction Activities

Construction activities included demolition, excavation, and grading; construction (bridges, pathways, cistern, downspout disconnection, plumbing); and landscaping.

Item	Total Cost	Volunteer Effort	Cash Expense
Project Design, Project Management, and Construction Management			
Project manager	$ 14,320.00	$4,550.00	$ 9,770.00
Design manager	$ 5,239.77	$1,000.00	$ 4,239.77
Project assistance/interns	$ 8,280.25	$3,525.00	$ 4,755.25
Design: landscape contractors and designers ($30/hr)	$ 15,000.00	$15,000.00	$ -
Landscape drawings	$ 500.00	$500.00	$ -
Accountant	$ 1,000.00	$1,000.00	$ -
Design charette, artists, educational activities	$ 6,772.00	$5,800.00	$ 972.00
Subtotal	**$ 51,112.02**	**$31,375.00**	**$ 19,737.02**
Demolition, Excavation, Grading			
Remove asphalt and sub-base (8,000 sq. ft.)	$ 7,300.00	$ 7,300.00	
Excavate stormwater management facilities	$ 4,500.00	$ 4,500.00	**$ -**
Grading plan	$ 1,500.00	$ 1,500.00	**$ -**
Subtotal	**$ 13,300.00**	**$ 13,300.00**	**$ -**
Construction			
Bridge/site improvements/supplies	$ 4,866.38		$ 4,866.38
Cistern	$ 2,130.00		$ 2,130.00
Modify office downspouts (downspout disconnect)	$ 4,010.00	$ 1,000.00	$3,010.00
Temporary fencing and erosion control	$ 1,657.02		$ 1,657.02
Rental equipment	$ 201.15		$ 201.15
Subtotal	**$ 12,864.55**	**$ 1,000.00**	**$ 11,864.55**
Landscaping			
Plant material (trees, shrubs, seed, groundcover)	$ 7,689.73	$ 2,500.00	$ 5,189.73
Rock and gravel	$ 4,552.05	$ 1,500.00	$ 3,052.05
Irrigation (hose bibs and soaker hoses)	$ 1,171.74	$ 1,000.00	$ 171.74
Soil	$ 893.73		$ 893.73
Subtotal	**$ 14,307.25**	**$ 5,000.00**	**$ 9,307.25**
Unpaid Volunteer Labor			
Installation - volunteers ($7.25/ hr)	$ 8,917.50	$ 8,917.50	$ -
Installation - school personnel and volunteers ($15/ hr)	$ 20,100.00	$ 20,100.00	$ -
Installation - school principal ($30/ hr)	$ 4,500.00	$ 4,500.00	$ -
Subtotal	**$ 33,517.50**	**$ 33,517.50**	**$ -**
Permitting			
Permit - planning/zoning/land use	$ 2,383.39		$ 2,383.39
Subtotal	**$ 2,383.39**		**$ 2,383.39**
Other Materials, Misc.			
Transportation	$ 352.83		$ 352.83
Art/design materials	$ 1,763.95	$300.00	$ 1,463.95
Copying, printing/promotional materials	$ 781.98	$ 360.00	$ 421.98
Subtotal	**$ 2,898.76**	**$ 660.00**	**$ 2,238.76**
TOTAL	**$ 130,383.47**	**$84,852.50**	**$ 45,530.97**
Percentage of investment	100.00%	65.08%	34.92%

Cost Components

Non-Construction Activities

Activity	Total Cost/ % of Total Project Budget	Cash Expense / % of Total Cash Expenditures	Volunteer Contributions/ % of Total Volunteer Contributions
Design, project/ construction management, public education	$51,112/39%	$19,737/43%	$31,375/37%
Permitting	$2,383/2%	$2,383/5%	-
Total	**$53,495/41%**	**$22,120/48%**	**$31,375/37%**

Construction Activities

Activity	Total Cost/ % of Total Project Budget	Cash Expense / % of Total Cash Expenditures	Volunteer Contributions/ % of Total Volunteer Contributions
Demolition, excavation, grading	$13,300/10%	-	$13,300/16%
Construction	$12,865/10%	$11,865/26%	$1,000/1%
Landscaping	$14,307/11%	$9,307/20%	$5,000/6%
Unpaid volunteer labor	$33,518/26%	-	$33,518/40%
Other materials, misc.	$2,899/2%	$2,239/5%	$660/1%
Total	**$76,889/59%**	**$23,411/51%**	**$53,478/63%**

Cost components can also be broken down as follows:

Activity	Percentage of Total Budget (Cash and Volunteer)
Project/construction management	39%
Design	3%
Public education activities	1%
Permitting	2%
Excavation, grading, and construction	20%
Landscaping (labor and materials)	36%
Total	**100% (rounded)**

Cost Comparisons

Because of the large amount of donated services, materials, and labor, actual project costs were lower than they would be for private-sector projects of this scope.

MAINTENANCE AND MONITORING

Urban Water Works is responsible for maintenance of the water garden until 2010. A Friends of the Astor Water Garden group has been formed to assist Urban Water Works. That group includes students, teachers, parents, and community members and has committed to ongoing implementation of an operations and maintenance plan.

BES and Urban Water Works staff will periodically assess the performance of the water garden.

PUBLIC INVOLVEMENT

The first year of the project included a cross-disciplinary curriculum at Astor School. Over 350 students and 12 teachers took part in classroom and after-school activities that investigated watersheds, urban pollution, plants, insects, recycling, and art. This prepared them for the garden design process, which also included parents, neighbors, and design professionals.

The second year involved removal of the asphalt and activities to design, build, and plant the garden. Students provided input through in-class workshops, and community input was obtained through evening design charrettes. Volunteers did most of the labor during weekend work parties. In total, a largely volunteer labor force of parents, neighbors, and school personnel contributed an estimated 4,077 hours to the project. (See Figures 7 and 8)

A permanent interpretive sign will be installed at the project site to provide information about the sustainable stormwater management techniques used.

SUCCESSES AND LESSONS LEARNED

Community and school involvement: Strong advocates within the school and the community drove this project and will likely continue to serve as ongoing stewards through maintenance and education activities. This kind of interest and support is very important for initiating and completing this kind of project and ensuring its long-term success.

Role of organizer: Although the project enjoyed considerable school and community support, the role of the adjunct organizer was very important in creating context (bringing in supporting information), ensuring continuity (managing a calendar of activities amid competing priorities), and providing support/fundraising (acquiring contributors beyond those already identified).

Figure 7: Design charette

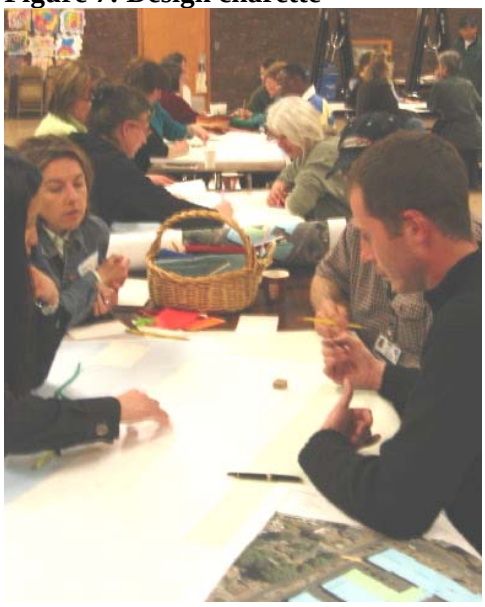


Figure 8: Design process

Demonstration project: The project is a good example of a site retrofit with a mix of simple components (downspout disconnection, excavated shallow landscape depressions) and more complex components (replumbing of roof drains, asphalt removal and earth recontouring). The components clearly demonstrate to residential homeowners and public and commercial property owners the different ways a site can be assessed and retrofitted for stormwater management.

Optional planting areas: A small portion of the new landscape area has been set aside for two do-it-yourself planting areas that are open for the school community to compose seasonally. These areas enable teachers and parents to grow any of their favorite plants. This is not related to the stormwater management function of the garden, but rather is intended to nurture ownership and engagement. The parent community is vocal about the need for this freedom and signature-making—a kind of relief from the native plantings that form the majority of the garden.

Plugs versus seeds: Native grasslands were selected for the upland area because they are deep rooted, require no supplemental irrigation, and provide habitat for a variety of insects, including pollinators. After the hill was seeded, the grasses became established quickly. The first year's maintenance did not involve cutting the grasses, and the area soon became impenetrable. Sheet mulching is now underway, with students participating in soil preparation for the next round of eco-grass. For future gardens, Urban Water Works recommends installing plugs of three native perennial bunchgrasses, as well as seeds and plugs of a variety of native wildflower species. Plugs are typically more expensive and require more labor to plant than seeds, but tend to have a higher success rate than many seeds. This approach would produce a high-quality cover of diverse species.

Contouring: The project manager provided expert oversight to produce the relatively subtle slope needed to convey runoff into the landscape facilities. The success of similar projects is expected to require the same degree of oversight.

Irrigation: A temporary irrigation system helped the initial plantings become established quickly and well. Irrigation may be important for future gardens developed on school property where watering during the first two years must be sufficient to handle summer drought.

Project coordination: This project involved multiple parties: public agencies, private contractors, and volunteers. It is essential for all parties to maintain clear communication of expectations, agreed-upon performance standards and measures, and accountable project documentation. These elements sometimes fell short, detracting from the project's efficiency and cost-effectiveness.