Youngstown State Environmental Protection Agency Rainworks Challenge

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Abstract

Our research group outlined a rainwater management plan for a section of the Youngstown State University campus under the guidelines of the Environmental Protection Agency's Campus Rainworks Challenge. Overland flow calculations were performed to evaluate the site in its current state and the site after it would be remodeled to improve rainwater flow. Environmental sustainability was kept in mind, through incorporating permeable pavement, rain gardens, and bioswales. The final priority of the project was to make the area more appealing to the campus community

Purpose

- To reduce the environmental impact that the campus has on the local environment.
- To improve the aesthetics of campus to make a more appealing student environment.
- To gain a better understanding of stormwater runoff and how to effectively manage it.

Introduction

The EPA Campus Rainworks Challenge has teams from universities across the United States compete in two separate competitions which involve planning and designing ways to improve the handling of rainwater throughout the team's campus. The focus of the study site for our research is located on the west side of the campus. In the area, we currently have two open large acreage parking lots, a large amount of green space in front of the campus recreational facility, and a large courtyard in the middle of campus. Our plan, if put into action, would improve rainwater management on campus, as well as create a greener campus scape at Youngstown State University.

Project Area Outline

Area 1

- Permeable pavement on parking lots
- Bioswales along parking lots
- Rain gardens along edge of area

Area 2

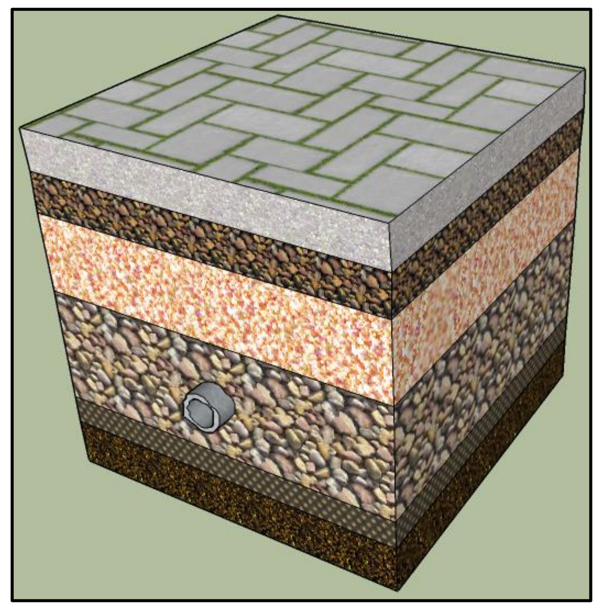
- Rain garden on the downslope of area
- Student seating area
- Bus stop with green roof and wall

Area 3

- Rain gardens in select center circles
- Bioswale-connected sprinkler system
- Bicycle racks near student areas

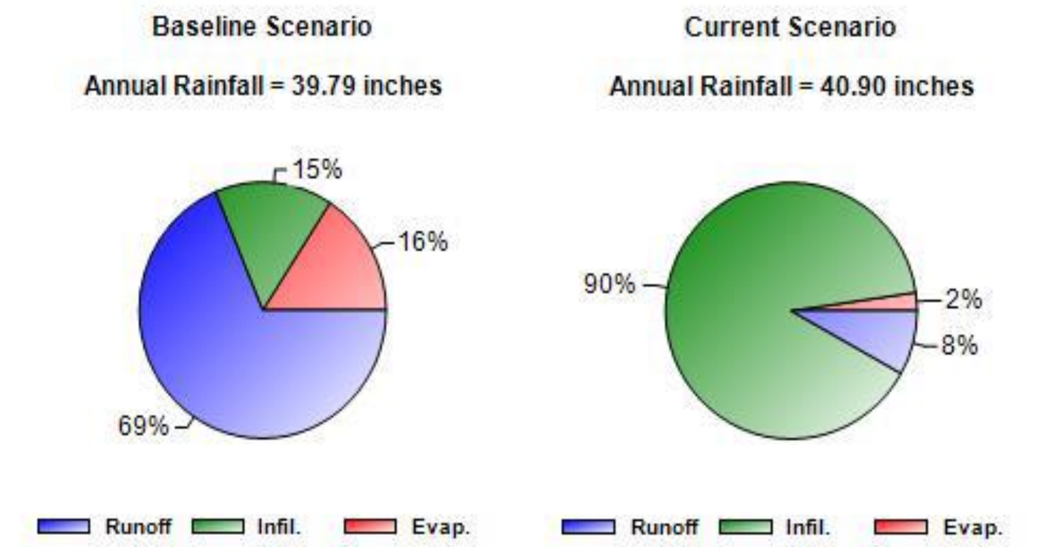
Proposed Project Area

Permeable Paver Parking Lot



Bioswale

Rainfall Management



Statistic	Current Scenario	Baseline Scenario
Average Annual Rainfall	40.9 in.	39.79 in.
Average Annual Runoff	3.31 in.	27.52 in.
Days per Year With Rainfall	87.04	87.49
Days per Year with Runoff	6.60	65.90
Percent of Wet Days Retained	92.42	24.67
Smallest Rainfall w/ Runoff	1.04 in.	0.1 in.
Largest Rainfall w/o Runoff	1.1 in.	0.23 in.
Max. Rainfall Retained	3.62 in.	0.62 in.

Select Sources

"Campus Rainworks Challenge." *United States Environmental Protection Agency*, n.p., 2016, https://www.epa.gov/green-infrastructure/campus-rainworks-challenge-0. Accessed 23 November 2016.

Neal, Catherine. "Native Plant Selection for Biofilters and Rain Gardens." *Ecological Landscape Alliance*, Ecological landscape Alliance, 2016, http://www.ecolandscaping.org/12/uncategorized/native-plant-selection-biofilters-rain -gardens/. Accessed 23 November 2016.

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Flow Calculations

C Values

	Area	%Area	C_{pre}	C_{post}
A1	5.55	0.247989	0.95	0.585135
A2	2.83	0.126452	0.95	0.603357
A3	14.00	0.625559	0.46	0.46
A total	22.38	1	0.643476	0.50916

Q values

Year	Q_{pre}	Q_{post}
10	68.83678	54.4681
25	78.19743	61.87485
50	85.25392	67.4584
100	92.1664	72.928

I Values

Year Storm	I
10	4.78
25	5.43
50	5.92
100	6.4

Equations

$C_{pre} = (Area1_{\%} * C_{pre}1) + (Area2_{\%} * C_{pre}2) + (Area3_{\%} * C_{pre}3)$

$C_{post} = (Area1_{\%} * C_{post}1) + (Area2_{\%} * C_{post}2) + (Area3_{\%} * C_{post}3)$

$Area_{\%} = Area/Area_{total}$

$Q = Area_{total} * C_{total}$

C1post

Type	Area	%Area	C
Permeable	4.65	83.7838	0.65
Park	0.9	16.2162	0.25
Total	5.55		0.5851351

C2post

Type	Area	%Area	C
Permeable	2.5	88.3392	~0.65
Park	0.33	11.6608	0.25
Total	2.83		0.603357

C3post

Type	Area	% Area	C
Roof	4.2	30	0.95
Park	9.8	70	0.25
Total	14		0.46

Native Plants

Scientific Name	Common Name	Placement
Perennials		
Lobelia cardinalis	Cardinal Flower	Moist Soil
Aster novaeangliae	New England Aster	Moist Soil
Asclepias incarnata	Swamp Milkweed	Moist Soil
Asclepias tuberosa	Butterflyweed	Drier Soils
Rudbeckia hirta	Black-eyed Susan	Drier Soils
Echinacea purpurea	Purple Coneflower	Drier Soils
Grasses		
Schizachyrium scoparium	Little Bluestem	Moist/Dry Soil
Elymus virginicus	Virginia Wild Rye	Moist/Dry Soil
Shrubs		
Cephalanthus occidentalis	Buttonbush	Moist Soil
Myrica pensylvanica	Northern Bayberry	Drier Soils
Trees		
Acer rubrum	Red Maple	Moist/Dry Soil
Betula nigra	River Birch	Moist/Dry Soil

Conclusion

Campus would become more aesthetically pleasing from the added plant life through the implementation of rain gardens and bioswales. Permeable pavers and asphalt will keep the integrity of the parking lots for longer than traditional methods. Not only did this decrease run-off, but the overall infiltration rate of water into the soil increased; other improvements include reduced water use due to the connection of the sprinkler systems to bioswale water collection, an increased permeability in the area, and an increase in the amount of carbon dioxide sequestered by the added vegetation.

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