

Improved Performance of Green Stormwater Infrastructure through Outlet Control

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Objective

Estimate the potential benefits of providing outlet control of a rain garden (RG)

- Develop a model for a rain garden.
- Run simulations with varying conditions.
- Quantify benefits of outlet control.





What is outlet control?





Underdrain

soils infiltration rate < 0.5 in/hr include an underdrain





Rain Garden Performance

- <u>BEST</u>: Exfiltrated Volume stormwater diverted from outlet (aquifer recharge)
- <u>NEXT BEST</u>: Treatment flow is infiltrated and delivered through underdrain.
- Overflow untreated







Methods - Hydrologic Modeling

EPA's Storm Water Management Model (SWMM) -dynamic hydrology-hydraulic model for single event or long-term continuous simulation.

Variables: RG size, storm size, soil type

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Title/Notes	Control Name:	Surface Soil Storage Drain	Property	Value	·
Climatology		nu curring for	Name	BRC	
Hydrology	LID Type: Bio-Retention Cell v	Flow Coefficient: 0.5	X-Coordinate	1665470.033	/
- Kain Gages - Subcatchments		Flow Exponent 0.5	Y-Coordinate	728692.784	
- Aquifers	Surface	Offset Height	Description		
 Snow Packs Unit Hydrographs 		(in. or mm)	Tag		
LID Controls	Storage	<u>Drain Advis</u>	Rain Gage	SCS_24h_Type_II_0.1in	
Hydraulics Ouality	Drain*		Outlet	Savage_CB1	
Curves			Area	0.1	BRC
Time Series Time Patterns	*Optional	"Units are for flow in either in/hr or mm/hr; use 0 if there is no drain.	Width	51.429	
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			Percent Routed	100	//////////////////////////////////////
			Infiltration	GREEN_AMPT	
			Groundwater	NO	
			Snow Pack		
			LID Controls	1	
			Land Uses	0	
			Initial Buildup	NONE	
			Curb Length	0	
			User-assigned nam	ne of subcatchment	
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Controls					
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Variables Studied

- Soil Type: Ksat (sat hydr conductivity) 0.02 to 0.5 in/hr
- Area Ratios (area of RG/area of watershed): 0.2 to 2.0
- Storm Size : 0.1 to 2.0 inches in 24 hours





RG Performance-Exfiltrated Volume





Exfiltrated Volume (Opened Vs Closed)



- Better performance when valve is closed
- Better performance for better drained soils
- Better performance for bigger systems



Size of the storm causes some change in rate of performance – more apparent in small systems



Importance of Control



- More important in better drained soils except the highlights
- More important in bigger systems



RG Performance - Reduce Load (TSS)





TSS Load - Open vs. Closed Valve



- Better performance when valve is closed except when undersized, poor soils and big storm
- Better performance for bigger systems
- Better performance for better drained soils except in bigger systems with big storms



Importance of Control



- More important in bigger systems
- More important in worse drained soils except the highlights

Discussion

- Rain gardens typically are built with static (open) underdrain. Control (closed valve) is beneficial under certain conditions.
- Exfiltration Volume is increased when the value is closed. Benefits increase for bigger rain gardens. Larger storms have a reduced benefit.
- TSS Load is reduced when the valve is closed. Benefits increase for bigger rain gardens and bigger storms.
- The ability to open and close the valve with consecutive days of rain (to drain the system) would be helpful.



Conclusion



- Rain gardens are typically static (no ability to control flows).
- Implementing outlet control can improve their performance outcomes.
- The reduced cost of valves and actuators will encourage their implementation and facilitate improved performance.



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Thank you! Questions?

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