### Module 5g: Biofiltration

## Problem Description

This example will show you how to run the biofiltration option.

Steps involved:

- 1) Revise Example 1a
- 2) Calculate pre-conditions
- 3) Add a bioretention trench under biofiltration as a land use control practice
- 4) Calculate post-conditions
- 5) Add bioretention trench under biofiltration as a drainage control practice

The class will be filling out Table E in steps 2, 4 and 5

Table E. B	ioretention	results	under	biofiltratio	٥n
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	A	В	С	D
Constituent	Site Totals	Roof Area 1 Pre-condition	Roof Area 1 Post-condition	Outfall Post- Condition
Runoff (cu ft)				
TSS (mg/L)				
TSS (lbs)				
Total Copper (lbs)				
Particulate Lead (lbs)				

1) Revise Example 1a

Save "Example 1 a" as "Example 1e". Add "Biofiltration for Rooftop" to the Site Description.

2) Calculate pre-conditions

Run the model.

Enter the results for the entire site for Runoff (cu ft), TSS (mg/L), TSS (lbs), Total Copper (lbs), and Particulate Lead (lbs) in Column A, Table E on this page.

Question: The total load in TSS from the site is 4,390 lbs. The goal is a 40% reduction. What is the pollutant load, in terms of TSS (lbs), from the rooftop? What percentage of the site's loading is from rooftops?

Answer: TSS Load = 269 / 4,390 = 6%By removing just the load from the rooftop, 6 percent of the load can be removed. *Enter the results for just the rooftop in Column B, Table E on this page.* 

Note: A Biofilter can also be used as a Source Area Control. The user would click on the cell below the "B" in the same row as the Source Area in the Land Use screen. After all the relevant data is entered, "B" would then appear just as a "S" does for Street Sweeping. See example1d for more explanation on Source Area Controls. 3) Add a bioretention trench under biofiltration as a land use control practice

To add bioretention trench on rooftops click on Land Use tab then Land Use Biofiltration then Commercial

Note: All other landuses should be grayed out

	- for the second of the	m SLAMM SLAMM_Class (2005 (Example Ed.dat)	
le LandUse Pollutant	s Options Run Ut	ilties Help	
Residential Institutional SL - Commercial Exit Industrial Other Urban Cur Freeways			
Cur Land Use Biolikra	tion 🔸	Rendervol	
Pro Dovolopment	Runoff Quantities	Conversal	
Catchbasin or Dra Outfall	ainage Control	Indu Rad Commission	
Current File S	tatus	the Cano Use menu item, and select the desired Land Use.	
Current File Data	Entered		
Land Use A	reas		
Tesidential Area: nstitutional Area: commercial Area: ndustrial Area: ther Urban Area: reeway Area: Total Area:	0.00 Acres 0.00 Acres 7.39 Acres 0.00 Acres 0.00 Acres 0.00 Acres 0.00 Acres 1.00 Acres 7.39 Acres		
Light Progra	Help		

The following window pops up.

and Use: Commercial	Select Seepage Bate	Add Duth	d/Discharge
Sofilter Humber 1 Device Geometry 1. Top Acea [s]	C Sand Shrift C Loany sand 25 in/tr C Sandy loan - 1.0 in/tr C Sandy loan - 1.0 in/tr C Sandy sit loan - 0.2 in/tr C Sandy sit loan - 0.2 in/tr C Sandy sit loan - 0.1 in/tr C Sandy sit loan - 0.05 in/tr	- Duffet/Diret C 1. Sha C 2. Bran C 3. Verb C 4. Eva C 5. Hain	harge Options p Created West of Created West cal Stand Pipe rotation B anal/Cistern
3. Depth (It)	Sandy clay - 0.05 in/te	C 6. Unite	OF.
4. Depth of Biolilter that is Rock Filled (It)	C Clay - 0.02 m/tv C Clay - 0.02 m/tv C Rain Barrel/Cintern - 0.00	iv/v Edition	ving Outlet
5. Fraction of Rock Filled	.00	Select	ed Outlety
7. Seepage Rate (in/hr) Seepage Rate COV Seepage Rate Side: 1 Multiplier (0-1) Bottom: 1	00 Control Devices in 00 Source Area or Land Use	Inflow Hydrog	aph Peak av Ratio (3.8
Select Source Areas from Land Runoff to Biofiltration Control D	Use that Contribute evice(s)	Fraction of Runoff Fr Selected Source Areas Rou to Land Use Rightness 10	ted
Rooftop 1 F	Urpaved Piking/Storage 2	Street Area J Large Landscaped Area T	Delete
Roottop J F	Playground 2	Large Landscaped Area 2 Undeveloped Area	-
E Roottop 5	Dirynwars 2	Small Landscaped Area 1	Continue
Paved Parking/Storage 1 Paved Parking/Storage 2 Paved Parking/Storage 3	Driveways 3 F Sidewalks/Walks 1 F Sidewalks/Walks 2 F	Small Landscaped Area 2 Small Landscaped Area 3 Other Pervicus Area	Cancel
Unpaved Priceo/Storage 1	Stepped dama 1	A DEPARTY A PARTY PROPERTY PROPERTY	

Diagram of the bioretention trench



Enter in the following Biofilter information:

Biofilter Geometry		
Top Area (sf)		1500
Bottom Area (SI) Depth (ft)		1500 4 0
Depth of Biofilter that is Rock filled (ft)		1.0
Fraction of Rock Filled Volume as Voids	0.33	
Infiltration information		
Seepage Rate exiting biofilter (in/hr)		0.5
Sides		1
Bottom		1
Flow and structure number information		
Number of Biofiltrarion Control Devices		1
The Inflow Hydrograph Peak to Average Ratio		3.8
Runoff Sources in Land Use Area		
Select rooftops only		þ Rooftop1
Fraction of Runoff from Selected Areas Rout	ted to E	Biofilter 1

Random Number Generator to account for uncertainty in infiltration rates should not be checked

Enter the outlet structure data – First add a Broad Crested Weir – Click Add Outlet/Discharge and select Broad Crested Weir

La So Bio	nd Use: Drainage System wrce Area: Drainage System ofiltration Device Number 1	Outlet Number 1
1.	Weir Crest Length (ft)	0
2.	Weir Crest Width (It)	0
3.	Height from datum to bottom of weir opening (ft)	0
4.	Check to use Default Weir Co	efficients 🔽
	Or Enter Weir Coefficient (English Units)	

Enter in the following information.

0	
1. Weir Crest Length (ft)	10
2. Weir Crest Width (ft)	0.5
3. Height from Datum to Bottom of weir opening (ft)	3.8
4. Check to use Default Weir Coefficients	þ

# Click Continue

Note: the Biofiltration routine will produce an error unless a Broad Crested Weir is added as an outlet structure.

## Next add an Orifice - Click Add Outlet/Discharge and select Orifice

This window will pop up

So	urce Area:		
Bio	filtration Device	Outlet	Number 2
1.	Orifice diamete	97 (ft)	0
2.	Invert elevatio	n above datum (ft	)
3.	Number of Ori	lices 🕞	0
	Cancel	Continue	Delete

Enter in the following information regarding the Orifice:

1. Orifice diameter (ft)0.52. Invert elevation above datum (ft)1.53. Number of Orifices1.0Click Continue1.04) Calculate post-conditions

Run the model. Enter results for the rooftops in Table E, Column C.

5) Add bioretention trench under biofiltration as a drainage control practice

Open Example 1a again and save "Example 1a" as "Example 1e2." Change the file description to reflect Biofiltration as a Drainage Control Practice.

To add Biofiltration as a	Drainage Control -	Click Landuse ther	n Catchbasin d	or Drainage Control	
Select Biofiltration					

WurSLAMM Data File: [D1\JAHData\urba	IN SLAMPT SLAMPL (	lass\2005(fxample1d2.dat)	× IDI ×
Residential Institutional SL - Commercial Industrial Other Urban Cast Presenvys			
Land Use Biofiltration +			
Pre-Development Runoff Quantities			
Catchbasin or Drainage Control	Bolitration		
Current File Status	Infibration Catchbasin Upflow Filter Drainage Control Other Control	ariba data, select muitem, and select Use.	
Land Use Areas		-	
Residential Ansa:     0.00 Acres       Institutional Ansa:     0.00 Acres       Commercial Ansa:     0.00 Acres       Industrial Ansa:     0.00 Acres       Industrial Ansa:     0.00 Acres       Total Ansa:     0.00 Acres       Total Ansa:     0.00 Acres       Total Ansa:     7.33 Acres			
East Program Press F1 for Help			

This screen will pop up

and Use: Drainage System	Select Seepage Rate C Sand Enviro C Loany rand 25 m/hr	Add Dates/Discharge
iofilter Number 1 evice Geometry 1. Top Area (st)	C Sandy Isan - 1.5 in/fe Losen - 0.5 in/fe Si8 Isan - 0.2 in/fe Si8 Isan - 0.2 in/fe Cap Isan - 0.2 in/fe Cap Isan - 0.1 in/fe	Date://Oricharge.Options P. 1. Sharp Constel Wey P. 2. Board Constel Wey P. 3. Vertical Stand Pipe P. 4. Except alone C. 5. Each Reveal Content
2. Bottom Area (H) 3. Depth (N)	- Sandy clay - 0.05 m/tv	C & Oder
4. Depth of Biolities that is Rock Filled (It)	Car - Sily clay - 0.04 m/tv Car - Sily clay - 0.02 m/tv C Ran Earth/Caterry - 0.00 m/tv	Late Equiting Elatter
5. Fraction of Rock Filled	00	Selected Outlets
7. Seepage Rate (in/fw)	Use Random Number Generation to Account for Uncertainty in Infiltration Rate	
Seepage Bate Side: 1. Multiplex (9-1) Rotton: 1.	00 8. Number of Binfiltration Control Devices in 500 Source Area or Land Use	Inflow Hydrograph Peak to Average Flow Ratio 3.0
	Fraction of Rosoff Ison Do Rosted to Disansate System	ainage System n Bolitere (0 - 1) Rolete
	R:	Continue

Notice that the Drainage Control Biofiltration window that opens is different than the one that opens for the Land Use Biofiltration. The individual source areas are no longer available. The Drainage Control Biofiltration window is the same as the Outfall Control Biofiltration window.

Enter the data from Pages 3 and 4 into the Biofiltration Screen. Run the model.

Enter results in Table E, Column D.

## Output Analysis

Note: Look at the Example1e.bfo and Example1d2.bfo files to help answer the following questions. These files can be viewed with Microsoft Excel. Open the files in Microsoft Excel using the space-delimited option. The entire file does not load.

-	A	B	C	D	E	F	G	н	1	10	ĸ		M	N	0	P	
1	BFNm	Rain≢	Date	Rain	Incre.	TimeStep	Stage	MaxStage	Volume	Area	HydQOut	NatSeepOut	EvapOut	OrificOut	TtlQOutAr	Qln	
25243	1	11	10644.92	1.58	37	52.0669	1.660198	1.66	2490.298	1500	0.266	0.02	0	0	0.286	0.381	
25244	1	11	10644.92	1.58	38	52.0773	1.714803	1.715	2572.205	1500	0.308	0.02	0	0	0.328	0.415	
25245	1	11	10644.92	1.58	39	52.0878	1.749163	1.749	2623.744	1500	0.333	0.02	0	0	0.353	0.381	
25246	1	11	10644.92	1.58	40	52.0982	1.754521	1.755	2631.782	1500	0.337	0.02	0	0	0.357	0.347	
25247	1	11	10644.92	1.58	41	52.1086	1.741145	1.755	2611.717	1500	0.327	0.02	0	0	0.347	0.313	
25248	1	11	10644.92	1.58	42	52.119	1.715666	1.755	2573.499	1500	0.309	0.02	0	0	0.329	0.279	
25249	1	11	10644.92	1.58	43	52.1294	1.682369	1.755	2523.553	1500	0.285	0.02	0	0	0.305	0.245	
25250	1	11	10644.92	1.58	44	52.1398	1.64561	1.755	2468.415	1500	0.252	0.02	0	0	0.272	0.211	
25251	1	11	10644.92	1.58	45	52.1503	1.608336	1.755	2412.504	1500	0.219	0.02	0	0	0.239	0.176	
14 4 1	HLEN	ample 1	e/	1.50	40	52.1505	1.000330	1.700	2412.004	1500	0.219	0.02		0	0.239	Ē	0.170

The "<filename>.bfo" files can also be viewed within WinSLAMM. To view the files in the model, Click **Utilities** then **View File**. Use **Notepad** and select all files under file type, and look for "<filename>.bfo".

#### Output Analysis

Question: What size would the Bioretenetion trench have to be to reach a goal of 40% reduction of TSS (lbs)?

Answer: If 2% of the site's area is used for a Biofilter, the 40% TSS (lbs) reduction goal is met.

Question: Would you change the depth of the filter to reach the goal?

Answer: No, it does not need to be changed.

Table E. Biofiltration results

	A	В	С	D
Constituent	Site Totals	Roof Area 1 Pre-condition	Roof Area 1 Post-condition	Outfall Post- Condition
Runoff (cu ft)	561,484	130,750	51,893	434,915

TSS (mg/L)	125	33	33	121
TSS (lbs)	4,390	269	107	3,275
Total Copper (lbs)	0.68	.087	0.03	0.58
Particulate Lead (lbs)	1.12	0.17	0.07	0.85