

Module 5e: Wet Detention Basins in WinSLAMM

Problem Description

You are the stormwater engineer for a commercial site that must reduce its pollution load by 40 percent. The site is fully developed with silty soils. Determine the site's pollution load if a wet detention basin is installed. Instructions for modifying the file begin on page 2. A schematic of the inputs for the detention basin is shown at the end of the example (page 12).

How much runoff and pollution does the site generate (Answers to be filled in throughout example)?

- i. Runoff (cu ft): _____
- ii. TSS (mg/L): _____
- iii. TSS (lbs): _____
- iv. Total Copper (lbs): _____
- v. Particulate Lead (lbs): _____

What is the percent reduction of TSS (lbs)?

Steps:

- 1) Review the data regarding the detention basin
- 2) Save the file as another name and update the site description
- 3) Enter the detention basin data
- 4) Run the model
- 5) View the output
- 6) Save the output

Problem

- 1) Review the data regarding the detention basin

Put a detention basin at the site's outfall. Start with Example 1a. Follow the steps starting on page 3 to enter the data.

Particle Size Distribution: Nurp
 Initial Stage Elevation (ft): 5
 Peak to Average Flow Ratio: 3.8 - default

Stage (ft)	Area (ac)
0	0
0.01	0.001
2	0.006
4	0.024
6	0.053
8	0.067

Outlet

Orifice

Orifice Diameter (ft): 0.5
 Invert elevation above datum (ft): 5

Broad Crested Weir

Weir Crest Length (ft): 15
 Weir Crest Width (ft): 1
 Discharge Coefficient (ft): default
 Height of Weir Opening (ft): 1
 Height from Datum to Bottom of Weir Opening (ft): 6

- 2) Save the file as another name and update the site description

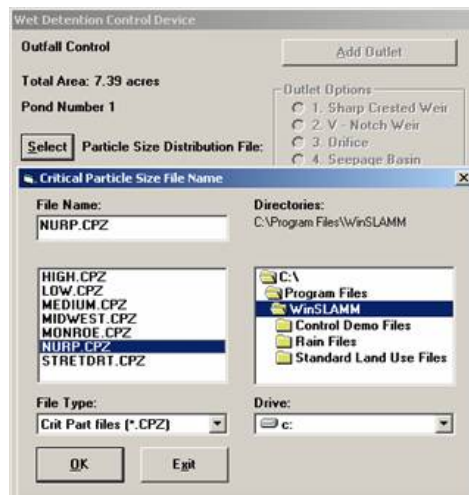
Save Example 1a as "Example 1g"

Change the description of the file to reflect the detention basin

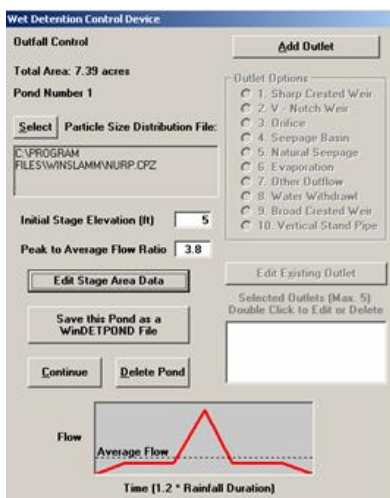
3) Enter the detention basin data

To enter the detention basin data at the outfall, click **Land Use** then **Outfall** then **Wet Detention**

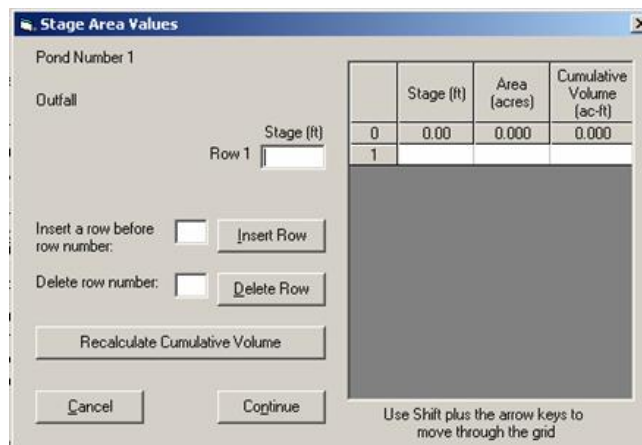
Select the particle size distribution – Click **Select** next to “Particle Size Distribution File” – go to the directory where the distributions are stored and select **Nurp.cpz** – Click **OK**



The basin's permanent pool is 5 feet deep. Set the "Initial Stage Elevation" at "5" - Press **Enter** - Leave the "Peak to Average Flow Ratio" at the default of "3.8" - Press **Enter**



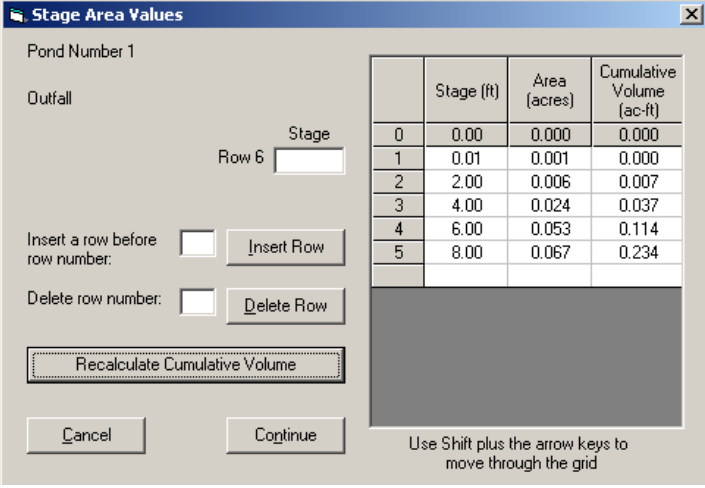
Enter the Stage-Area data by selecting **Edit Stage Area Data**



To enter the Stage-Area data, enter the data in the box next to the table.

The basin has a 1600 square foot permanent pool surface area. The permanent pool is 5 feet deep. The basin has 4:1 side slopes and 1 foot of freeboard.

The Row number will appear to the left of the box. The Column heading will appear just above the box. You can place your cursor on a particular box and it will change the Row and Column. Place your cursor in the box for Row 1, Stage (ft), enter the corresponding Stage, press **Enter**, (the Column heading will change), enter the Area, press **Enter**. Follow the sequence until all the Stage-Area data is entered.



Stage Area Values

Pond Number 1

Outfall

Stage

Row 6

Insert a row before row number: ☐ Insert Row

Delete row number: ☐ Delete Row

Recalculate Cumulative Volume

Cancel Continue

	Stage (ft)	Area (acres)	Cumulative Volume (ac-ft)
0	0.00	0.000	0.000
1	0.01	0.001	0.000
2	2.00	0.006	0.007
3	4.00	0.024	0.037
4	6.00	0.053	0.114
5	8.00	0.067	0.234

Use Shift plus the arrow keys to move through the grid

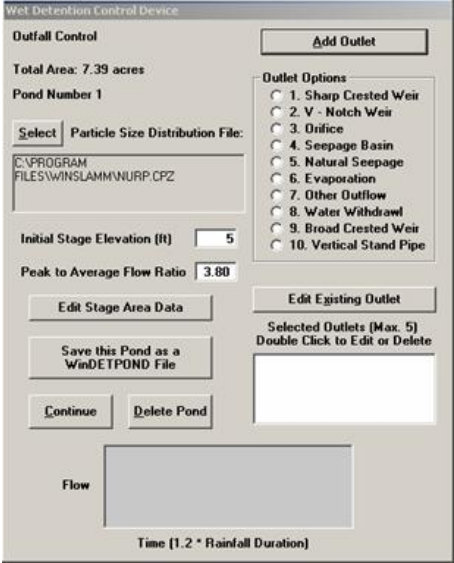
If you need to insert or delete a row, put the row number in the box next to "Insert Row" or "Delete Row".

Click **Recalculate Cumulative Volume** and the program will calculate the volumes.

Press **Continue**

Enter the outlet structure. The basin has an orifice at the top of the permanent pool, then an overflow spillway 1 foot above the permanent pool.

First, enter the Orifice. Click **Add Outlet**



Wet Detention Control Device

Outfall Control

Total Area: 7.39 acres

Pond Number 1

Select Particle Size Distribution File:

C:\PROGRAM FILES\WINSLAMM\NURP.CPZ

Initial Stage Elevation (ft) 5

Peak to Average Flow Ratio 3.80

Edit Stage Area Data

Save this Pond as a WinDETPOND File

Continue Delete Pond

Add Outlet

Outlet Options

- ☐ 1. Sharp Crested Weir
- ☐ 2. V - Notch Weir
- ☐ 3. Orifice
- ☐ 4. Seepage Basin
- ☐ 5. Natural Seepage
- ☐ 6. Evaporation
- ☐ 7. Other Outflow
- ☐ 8. Water Withdrawal
- ☐ 9. Broad Crested Weir
- ☐ 10. Vertical Stand Pipe

Edit Existing Outlet

Selected Outlets (Max. 5)
Double Click to Edit or Delete

Flow

Time (1.2 * Rainfall Duration)

Select **3. Orifice** – The Orifice Outlet input screen will appear. Enter the "Orifice diameter" and "Invert elevation above datum" – Click **Continue**

Orifice Outlet

Outfall

Pond Number 1 Outlet Number 1

1. Orifice diameter (ft)

2. Invert elevation above datum (ft)

"Orifice" will appear in the Selected Outlets in the lower right side of the screen.

Wet Detention Control Device

Outfall Control

Total Area: 7.39 acres

Pond Number 1

Select Particle Size Distribution File:
C:\PROGRAM FILES\WINSLAMM\NURP.CPZ

Initial Stage Elevation (ft)

Peak to Average Flow Ratio

Outlet Options

- ☐ 1. Sharp Crested Weir
- ☐ 2. V - Notch Weir
- ☐ 3. Orifice
- ☐ 4. Seepage Basin
- ☐ 5. Natural Seepage
- ☐ 6. Evaporation
- ☐ 7. Other Outflow
- ☐ 8. Water Withdrawal
- ☐ 9. Broad Crested Weir
- ☐ 10. Vertical Stand Pipe

Selected Outlets (Max. 5)
Double Click to Edit or Delete

1 - Orifice

Flow

Average Flow

Time (1.2 * Rainfall Duration)

Enter the Overflow Spillway. Click **Add Outlet** – Select **9. Broad Crested Weir** – Enter the data describing the Spillway – Click **Continue**

Broad Crested Weir

Outfall

Pond Number 1 Outlet Number 2

1. Weir Crest Length (ft)

2. Weir Crest Width (ft)

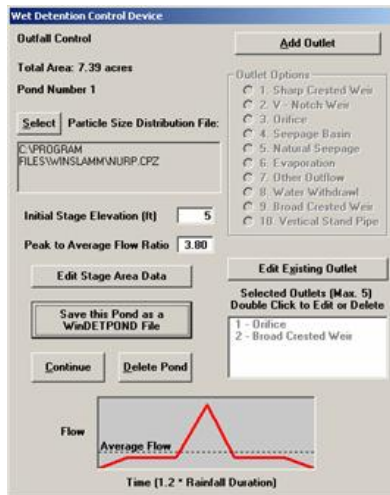
3. Discharge Coefficient (English Units)

☒ Default Discharge Coefficients

4. Height of Weir Opening (ft)

5. Height from Datum to Bottom of Weir Opening (ft)

"Broad Crested Weir" will appear in the Selected Outlets in the lower right side of the screen.



Wet Detention Control Device

Outfall Control

Total Area: 7.39 acres

Pond Number 1

Select Particle Size Distribution File:
C:\PROGRAM FILES\WINSLAMM\WURP.DPZ

Initial Stage Elevation (ft) 5

Peak to Average Flow Ratio 3.00

Edit Stage Area Data

Save this Pond as a WinDETPOD File

Continue Delete Pond

Add Outlet

Outlet Options

- ☐ 1. Sharp Crested Weir
- ☐ 2. V-Notch Weir
- ☐ 3. Orifice
- ☐ 4. Seepage Basin
- ☐ 5. Natural Seepage
- ☐ 6. Evaporation
- ☐ 7. Other Outflow
- ☐ 8. Water Withdrawal
- ☐ 9. Broad Crested Weir
- ☐ 10. Vertical Stand Pipe

Edit Existing Outlet

Selected Outlets (Max. 5)
Double Click to Edit or Delete

- 1 - Orifice
- 2 - Broad Crested Weir

Flow

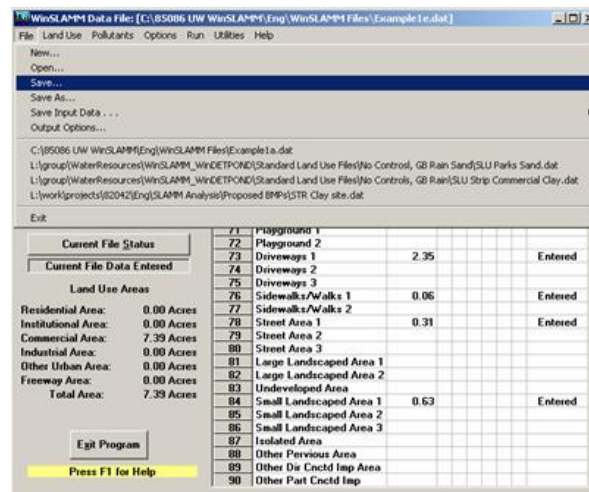
Average Flow

Time (1.2 * Rainfall Duration)

If you need to edit an outlet structure or delete an outlet structure – Click **Edit Existing Outlet**, then double click on the outlet structure to be edited.

Now all the data describing the detention basin is entered. Click **Continue**

Save your changes



WinSLAMM Data File: [C:\85086 UW WinSLAMM\Eng\WinSLAMM Files\Example1.e.dat]

File Land Use Pollutants Options Run Utilities Help

New...

Open...

Save...

Save As...

Save Input Data...

Output Options...

C:\85086 UW WinSLAMM\Eng\WinSLAMM Files\Example1.e.dat

L:\group\WaterResources\WinSLAMM_WinDETPOD\Standard Land Use Files\No Controls, GB Rain Sand\SLU Parks Sand.dat

L:\group\WaterResources\WinSLAMM_WinDETPOD\Standard Land Use Files\No Controls, GB Rain\SLU Strip Commercial Clay.dat

L:\work\projects\82042\Eng\SLAMM Analysis\Proposed BMPs\STR Clay site.dat

Exit

Current File Status

Current File Data Entered

Land Use Areas

Residential Area: 0.00 Acres

Institutional Area: 0.00 Acres

Commercial Area: 7.39 Acres

Industrial Area: 0.00 Acres

Other Urban Area: 0.00 Acres

Freeway Area: 0.00 Acres

Total Area: 7.39 Acres

Exit Program

Press F1 for Help

71	Playground 1				
72	Playground 2				
73	Driveways 1	2.35			Entered
74	Driveways 2				
75	Driveways 3				
76	Sidewalks/Walks 1	0.06			Entered
77	Sidewalks/Walks 2				
78	Street Area 1	0.31			Entered
79	Street Area 2				
80	Street Area 3				
81	Large Landscaped Area 1				
82	Large Landscaped Area 2				
83	Undeveloped Area				
84	Small Landscaped Area 1	0.63			Entered
85	Small Landscaped Area 2				
86	Small Landscaped Area 3				
87	Isolated Area				
88	Other Previous Area				
89	Other Dis Cnctd Imp Area				
90	Other Part Cnctd Imp				

4) Run the model

No.	Name	Area (acres)	I	W	P	O	S	B	Source Area Parameters
61	Roofs 1	1.48							Entered
62	Roofs 2								
63	Roofs 3								
64	Roofs 4								
65	Roofs 5								
66	Paved Parking/Storage 1	2.56							Entered
67	Paved Parking/Storage 2								
68	Paved Parking/Storage 3								
69	Unpaved Pking/Storage								
70	Unpaved Pking/Storage								
71	Playground 1								
72	Playground 2								
73	Driveways 1	2.35							Entered
74	Driveways 2								
75	Driveways 3								
76	Sidewalks/Walks 1	0.06							Entered
77	Sidewalks/Walks 2								
78	Street Area 1	0.31							Entered
79	Street Area 2								
80	Street Area 3								
81	Large Landscaped Area 1								
82	Large Landscaped Area 2								
83	Undeveloped Area								
84	Small Landscaped Area 1	0.63							Entered
85	Small Landscaped Area 2								
86	Small Landscaped Area 3								
87	Isolated Area								
88	Other Previous Area								
89	Other Dis Encl'd Imp Area								
90	Other Part Encl'd Imp								

5) View the output

How much runoff and pollution does the site generate (fill in the table on page 1)?

File Name	Runoff Volume (cu. ft.)	Percent Runoff Reduction	Particulate Solids Conc. (mg/L)	Particulate Solids Yield (lbs)	Percent Particulate Solids Reduction
Total Before Drainage System	561484	Base	125.3	4390	Base
Total After Drainage System	561484	0.00 %	125.3	4390	0.00 %
Total After Outlet Controls	561503	0.00 %	71.59	2507	42.89 %
Total Area Modeled (ac)	7.39				

- Runoff (cu ft): **561,503 cu. ft.**
- TSS (mg/L): **71.59 mg/L**
- TSS (lbs): **2,507 lbs**

WinSLAMM Model Output

File View

Runoff Volume Particulate Solids **Pollutants** Output Summary

Concentration	Yield (lbs)			Percent SA Contribution
Data File: Example T1.DAT				
Rain File: MSN1981.RAN				
Date: 09-05-05 Time: 2:58:47 PM				
Site Description: Example T1				
Total Area, with Drainage and Outfall Controls - Yield of TOTAL COPPER (lbs)				
Summary of Runoff Producing Events				
	Rain Total (inches)	Total Before Drainage System	Total After Drainage System	Total After Outfall Controls
Minimum:	0.01	6.691E-06	6.691E-06	5.279E-06
Maximum:	2.59	0.06604	0.06604	0.05686
FWt Ave:		0.02668	0.02668	0.02190
Total:	32.10	0.6765	0.6765	0.5285
Total Area, with Drainage and Outfall Controls - Yield of PARTICULATE LEAD (lbs)				
Summary of Runoff Producing Events				
	Rain Total (inches)	Total Before Drainage System	Total After Drainage System	Total After Outfall Controls

iv. Total Copper (lbs): **0.5285 lbs**

WinSLAMM Model Output

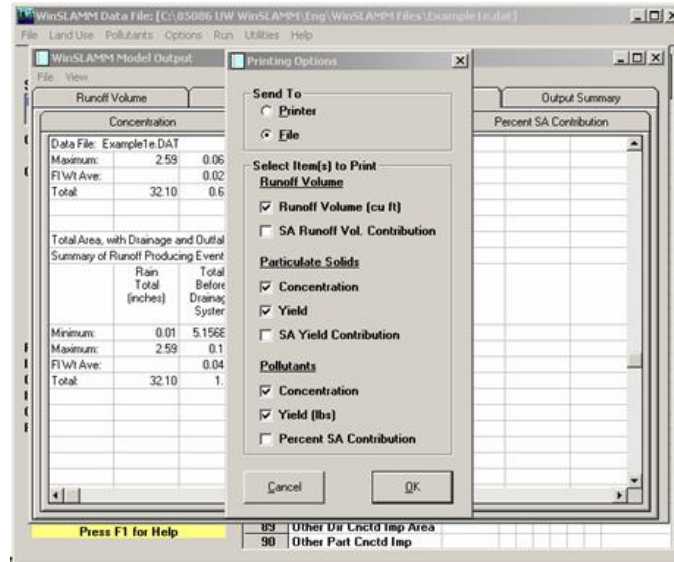
File View

Runoff Volume Particulate Solids **Pollutants** Output Summary

Concentration	Yield (lbs)			Percent SA Contribution
Data File: Example T1.DAT				
Rain File: MSN1981.RAN				
Date: 09-05-05 Time: 2:58:47 PM				
Site Description: Example T1				
Total Area, with Drainage and Outfall Controls - Yield of PARTICULATE LEAD (lbs)				
Summary of Runoff Producing Events				
	Rain Total (inches)	Total Before Drainage System	Total After Drainage System	Total After Outfall Controls
Minimum:	0.01	5.156E-06	5.156E-06	7.524E-08
Maximum:	2.59	0.1098	0.1098	0.07795
FWt Ave:		0.04444	0.04444	0.02813
Total:	32.10	1.128	1.128	0.6479

v. Particulate Lead (lbs): **0.6479 lbs**

6) Save the output

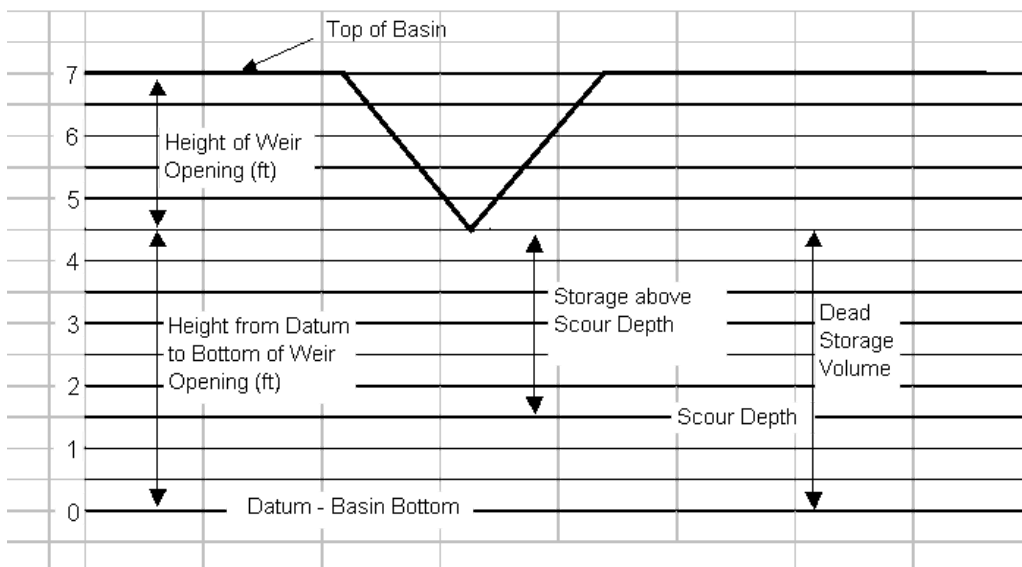


- d. What is the percent reduction from the basin of TSS(%)? **42.89 %**

Alternative Scenarios (if available time)

- b. Question: Instead of 40 percent, you would like to control the pollution from the site by 80%. How do you modify the detention basin to achieve that goal?

Answer: Increase the volume and permanent pool surface area and/or further restrict the flow leaving the basin.



Wet Detention Basin Geometry