



WinSLAMM v 10.5 Porous Pavement

Tab 8a

Using WinSLAMM v10.5 to Meet Urban Stormwater Management Goals

John Voorhees

PV & Associates LLC

January 2022

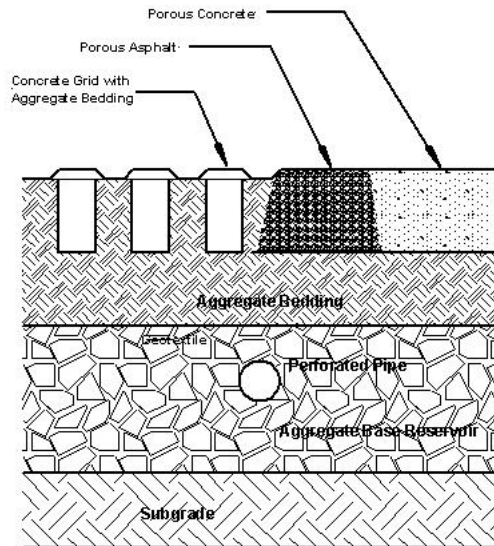
1

We will cover . . .

- Porous Pavement Options in WinSLAMM
- Porous Pavement Performance Algorithm
- Entering Porous Pavement Data into the Program
- Modeling Notes
- Example Input and Output



Porous Pavement Cross Section



Pavement Surface can be

- Paver Blocks
- Porous Asphalt
- Porous Concrete

Source Area #	Source Area	Area (acres)	Source Area Parameters	First Control Practice	Second Control Practice
Roofs					
1	Roofs 1	10.183	Entered	--	--
2	Roofs 2				
3	Roofs 3				
4	Roofs 4				
5	Roofs 5				
6	Roofs 6				
7	Roofs 7				
8	Roofs 8				
9	Roofs 9				
10	Roofs 10				
11	Roofs 11				
12	Roofs 12				
Parking					
13	Paved Parking 1	5.753	Entered	PP	--
14	Paved Parking 2				
15	Paved Parking 3				
16	Paved Parking 4				
17	Paved Parking 5				
18	Paved Parking 6				

Land Use #	Land Use Type	Land Use Label	Land Use Area (acres)
1	Commercial	Downtown Commercial	25.002

CP #	Control Practice Type	Control Practice Name or Location
1	Porous Pavement	SA Device, LU# 1, SA# 13

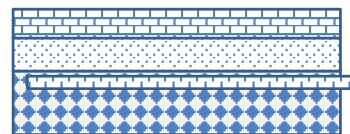
The screenshot shows the WinSI software interface. The top menu bar includes File, Current File Data, Pollutants, Tools, Run, Utilities, and Help. The toolbar contains various icons, with 'PP' (Porous Pavement) highlighted by a red box. The main window is divided into two panes. The left pane displays a table for 'Downtown Commercial' land use, and the right pane shows a flow diagram with a red box highlighting a 'DS Porous Pavement # 1' junction.

Source Area #	Source Area	Area (acres)	Source Area parameters	First Control Practice	Second Control Practice
Roofs					
1	Roofs 1	10.183	Entered	--	--
2	Roofs 2				
3	Roofs 3				
4	Roofs 4				
5	Roofs 5				
6	Roofs 6				
7	Roofs 7				
8	Roofs 8				
9	Roofs 9				
10	Roofs 10				
11	Roofs 11				
12	Roofs 12				
Parking					
13	Paved Parking 1	5.753	Entered	--	--
14	Paved Parking 2				
15	Paved Parking 3				
16	Paved Parking 4				

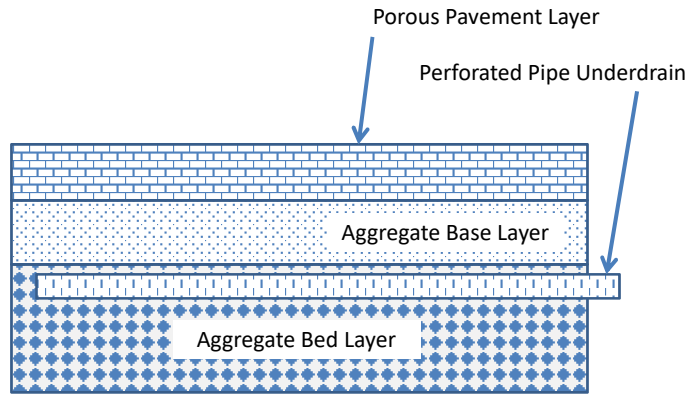
Land Use #	Land Use Type	Land Use Label	Land Use Area (acres)
1	Commercial	Downtown Commercial	15.936

CP #	Control Practice Type	Control Practice Name or Location
1	Porous Pavement	DS Porous Pavement # 1

Porous Pavement Performance Algorithm



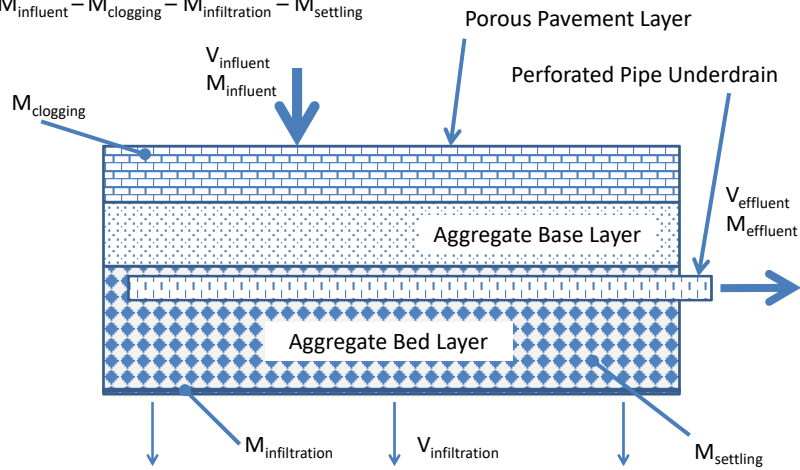
TSS Removal Processes

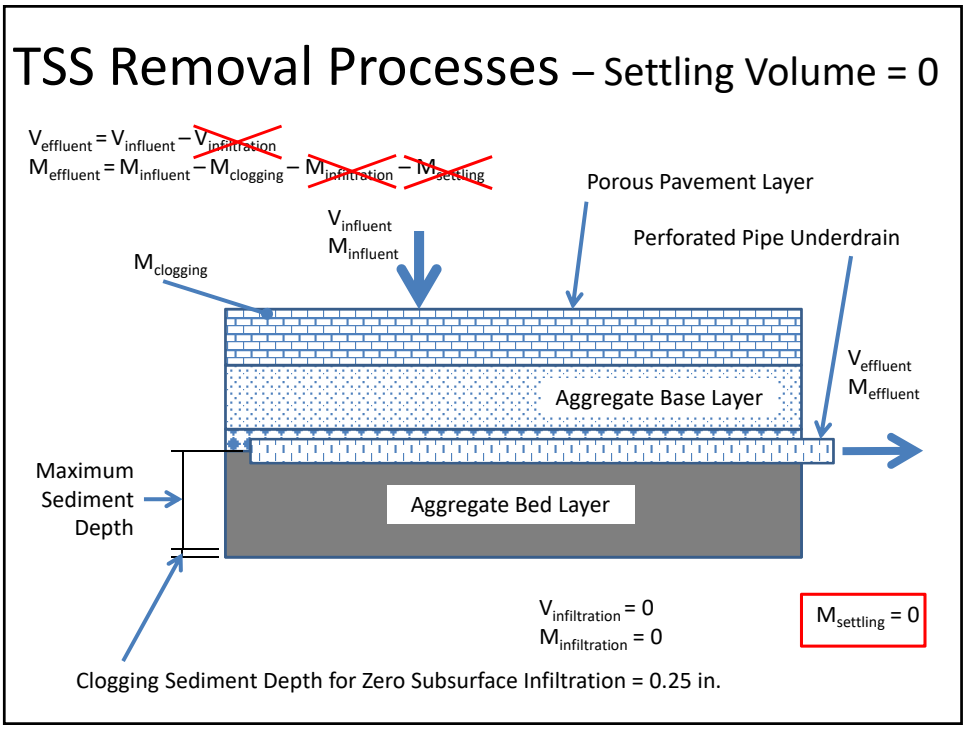
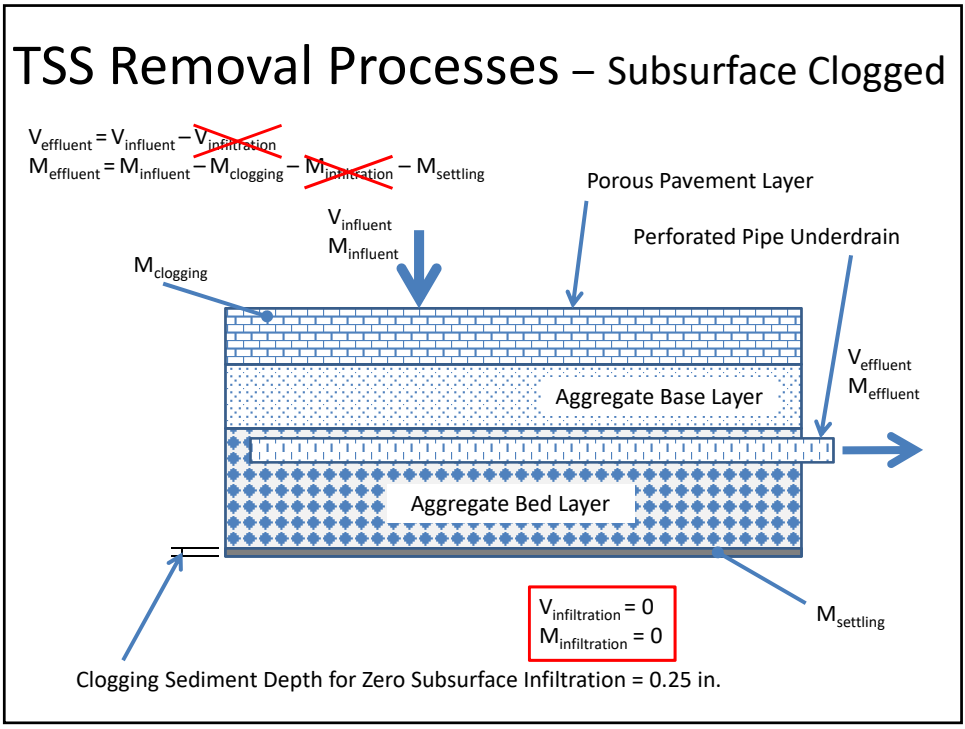


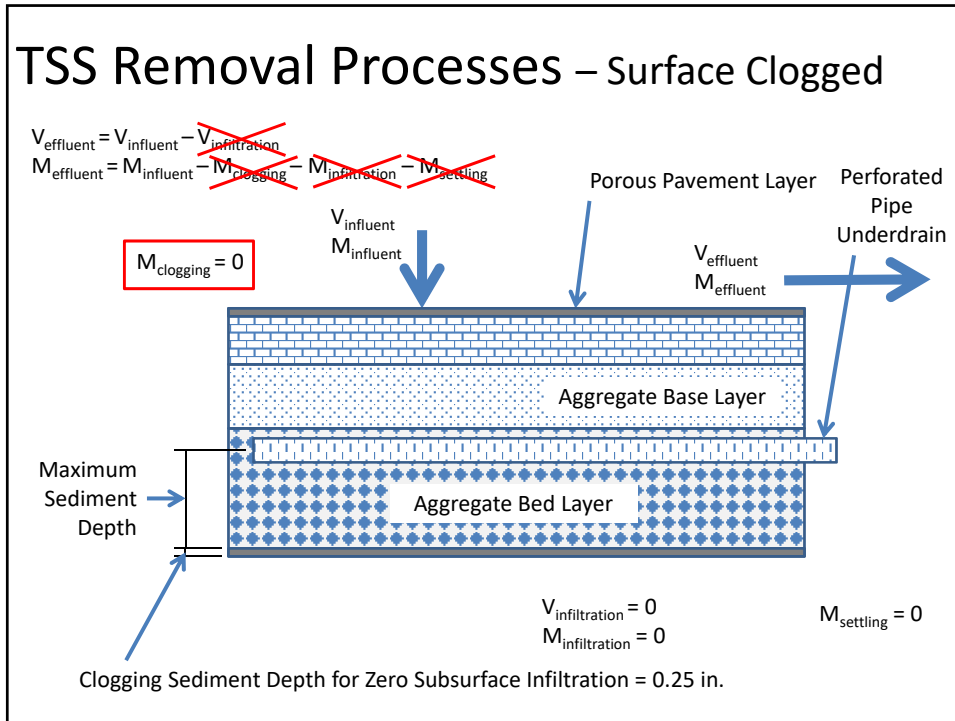
TSS Removal Processes - Initial

$$V_{\text{effluent}} = V_{\text{influent}} - V_{\text{infiltration}}$$

$$M_{\text{effluent}} = M_{\text{influent}} - M_{\text{clogging}} - M_{\text{infiltration}} - M_{\text{settling}}$$







Entering Porous Pavement Data into the Program

- **Pavement Geometry and Properties**
- **Outlet/Discharge Options**
- **Surface Pavement Layer and Cleaning Data**
- **Native Soil Infiltration Data**

Porous Pavement Control Device

First Source Area Control Practice
 Land Use: Commercial 1
 Source Area: Paved Parking 1
 Total Porous and Impervious Pavement Area: 1.000 ac.
 Porous pavement area (acres): 0.400

Inflow Hydrograph Peak to Average Flow Ratio: 3.8

Surface Pavement Layer Infiltration Rate Data
 Initial Infiltration Rate (in/hr): 100.00
 Surface Pavement Percent Solids Removal Upon Cleaning (0-100): 50.0
 Restorative Cleaning Frequency: Never Cleaned

Enter either these three values:
 Percent of Infiltration Rate After 3 Years (0-100):
 Percent of Infiltration Rate After 5 Years (0-100):
 Time Period Until Complete Clogging Occurs (yrs):
 Or this value:
 Surface Clogging Load (lb/sf): 0.10
 Every Seven Years
 Every Ten Years

Pavement Area Graphic
 Select File: [Select File]
 Percent of Total Area that is Porous Pavement: 40.0%

Run-on Allowed

Copy Porous Pavement Data
 Paste Porous Pavement Data

Porosity and Properties

1 - Pavement Thickness (in)	3.0
Pavement Porosity (>0 and <1)	0.25
2 - Aggregate Bedding Thickness (in)	9.0
Aggregate Bedding Porosity (>0 and <1)	0.25
3 - Aggregate Base Reservoir Thickness (in)	9.0
Aggregate Base Reservoir Porosity (>0 and <1)	0.25
Porosity Area to Agg Base Area Ratio	1.00

Outlet/Discharge Options

Perforated Pipe Underdrain Diameter, if used (inches)	3.00
4 - Perforated Pipe Underdrain Outlet Invert Elevation (inches above Datum)	6.0
Number of Perforated Pipe Underdrains (<250)	1
Subgrade Seepage Rate (in/hr) - select below or enter	0.050
Use Random Number Generation to Account for Uncertainty in Seepage Rate	<input type="checkbox"/>
Subgrade Seepage Rate COV	1.60
Underdrain Discharge Percent TSS Reduction (0-100) or leave blank for program to calculate	0

Select Subgrade Seepage Rate

<input type="radio"/> Sand - 8 in/hr	<input type="radio"/> Clay loam - 0.1 in/hr
<input type="radio"/> Loamy sand - 2.5 in/hr	<input checked="" type="radio"/> Silty clay loam - 0.05 in/hr
<input type="radio"/> Sandy loam - 1.0 in/hr	<input type="radio"/> Sandy clay - 0.05 in/hr
<input type="radio"/> Loam - 0.5 in/hr	<input type="radio"/> Silty clay - 0.04 in/hr
<input type="radio"/> Silt loam - 0.3 in/hr	<input type="radio"/> Clay - 0.02 in/hr
<input type="radio"/> Sandy silt loam - 0.2 in/hr	

Porosity and Properties Schematic

Control Practice #: 1 Land Use #: 1 Source Area #: 13 Porous Pavement Device Number 1

Porous Pavement Control Device

First Source Area Control Practice
 Land Use: Commercial 1
 Source Area: Paved Parking 1
 Total Porous and Impervious Pavement Area: 1.000 ac.
 Porous pavement area (acres): 0.400

Inflow Hydrograph Peak to Average Flow Ratio: 3.8

Surface Pavement Layer Infiltration Rate Data
 Initial Infiltration Rate (in/hr): 100.00
 Surface Pavement Percent Solids Removal Upon Cleaning (0-100): 50.0
 Restorative Cleaning Frequency: Never Cleaned
 Three Times per Year
 Semi-Annually
 Annually
 Every Two Years
 Every Three Years
 Every Four Years
 Every Five Years
 Every Seven Years
 Every Ten Years

Enter either these three values:
 Percent of Infiltration Rate After 3 Years (0-100):
 Percent of Infiltration Rate After 5 Years (0-100):
 Time Period Until Complete Clogging Occurs (yrs):
 Or this value:
 Surface Clogging Load (lb/sf): 0.10

Pavement Area Graphic
 Select File: [Select File]
 Percent of Total Area that is Porous Pavement: 40.0%

Pavement Geometry and Properties

1 - Pavement Thickness (in)	3.0
Pavement Porosity (>0 and <1)	0.25
2 - Aggregate Bedding Thickness (in)	9.0
Aggregate Bedding Porosity (>0 and <1)	0.25
3 - Aggregate Base Reservoir Thickness (in)	9.0
Aggregate Base Reservoir Porosity (>0 and <1)	0.25
Porosity Area to Agg Base Area Ratio	1.00

Outlet/Discharge Options

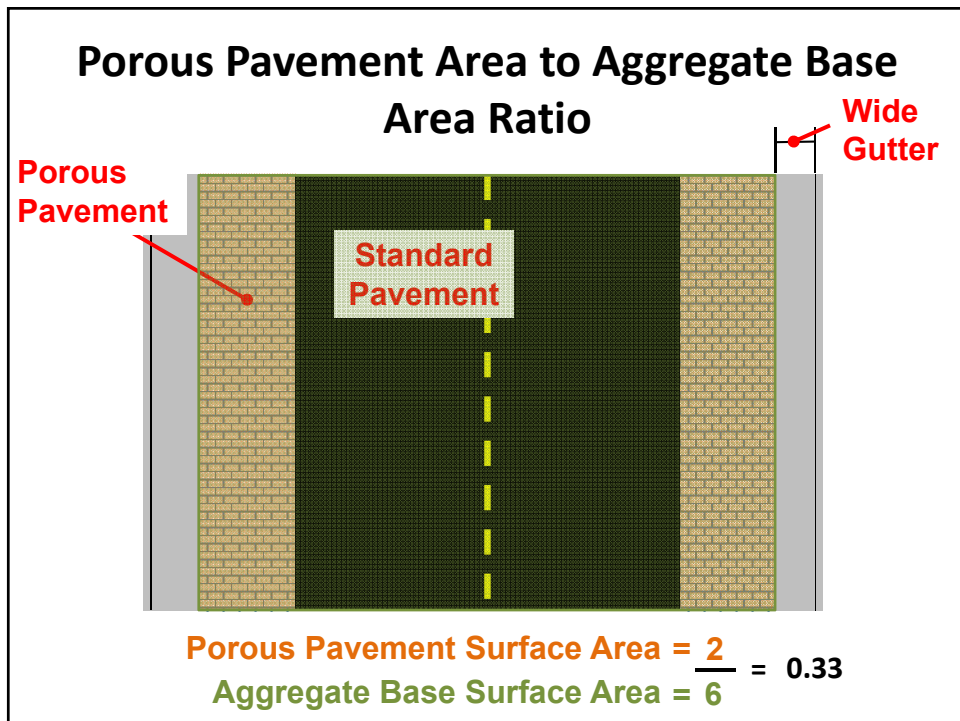
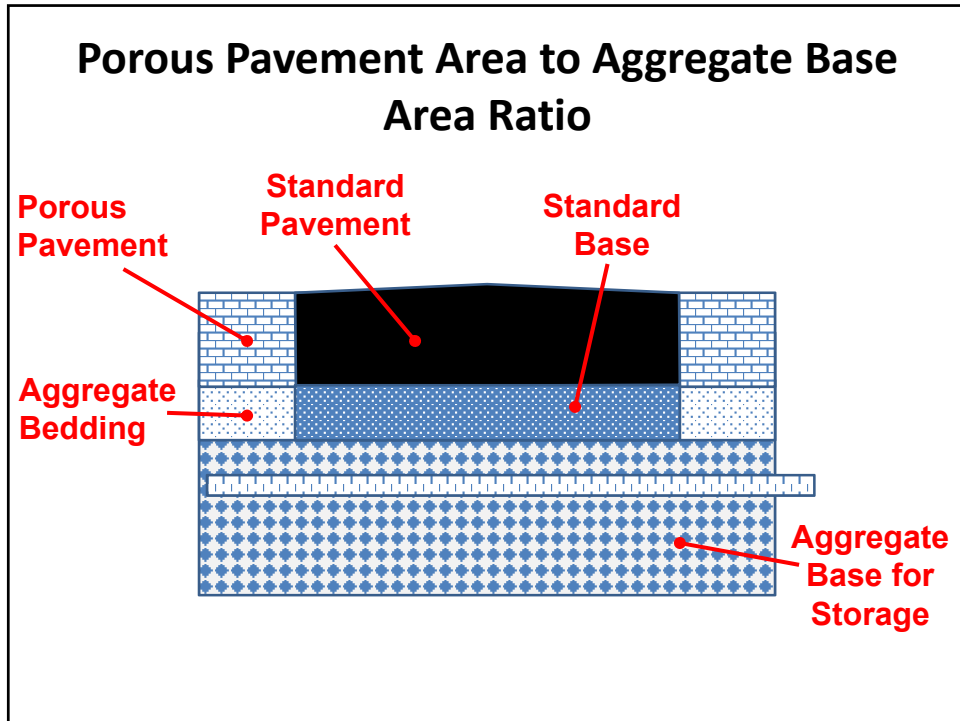
Perforated Pipe Underdrain Diameter, if used (inches)	3.00
4 - Perforated Pipe Underdrain Outlet Invert Elevation (inches above Datum)	6.0
Number of Perforated Pipe Underdrains (<250)	1
Subgrade Seepage Rate (in/hr) - select below or enter	0.050
Use Random Number Generation to Account for Uncertainty in Seepage Rate	<input type="checkbox"/>
Subgrade Seepage Rate COV	1.60
Underdrain Discharge Percent TSS Reduction (0-100) or leave blank for program to calculate	0

Select Subgrade Seepage Rate

<input type="radio"/> Sand - 8 in/hr	<input type="radio"/> Clay loam - 0.1 in/hr
<input type="radio"/> Loamy sand - 2.5 in/hr	<input checked="" type="radio"/> Silty clay loam - 0.05 in/hr
<input type="radio"/> Sandy loam - 1.0 in/hr	<input type="radio"/> Sandy clay - 0.05 in/hr
<input type="radio"/> Loam - 0.5 in/hr	<input type="radio"/> Silty clay - 0.04 in/hr
<input type="radio"/> Silt loam - 0.3 in/hr	<input type="radio"/> Clay - 0.02 in/hr
<input type="radio"/> Sandy silt loam - 0.2 in/hr	

Porosity and Properties Schematic

Control Practice #: 1 Land Use #: 1 Source Area #: 13 Porous Pavement Device Number 1



Porous Pavement Control Device

First Source Area Control Practice
 Land Use: Commercial 1
 Source Area: Paved Parking 1
 Total Porous and Impervious Pavement Area: 1.000 ac.

Porous pavement area (acres): 0.400
 Inflow Hydrograph Peak to Average Flow Ratio: 3.8

Surface Pavement Layer Infiltration Rate Data
 Initial Infiltration Rate (in/hr): 100.00
 Surface Pavement Percent Solids Removal Upon Cleaning (0-100): 50.0

Enter either these three values:
 Percent of Infiltration Rate After 3 Years (0-100):
 Percent of Infiltration Rate After 5 Years (0-100):
 Time Period Until Complete Clogging Occurs (yrs):

Or this value:
 Surface Clogging Load (lb/sf): 0.10

Restorative Cleaning Frequency
 Never Cleaned
 Three Times per Year
 Semi-Annually
 Annually
 Every Two Years
 Every Three Years
 Every Four Years
 Every Five Years
 Every Seven Years
 Every Ten Years

Pavement Geometry and Properties

1 - Pavement Thickness (in)	3.0
Pavement Porosity (>0 and <1)	0.25
2 - Aggregate Bedding Thickness (in)	9.0
Aggregate Bedding Porosity (>0 and <1)	0.25
3 - Aggregate Base Reservoir Thickness (in)	9.0
Aggregate Base Reservoir Porosity (>0 and <1)	0.25
Porous Pavement Area to Agg Base Area Ratio	1.00

Outlet/Discharge Options

Perforated Pipe Underdrain Diameter, if used (inches)	3.00
4 - Perforated Pipe Underdrain Outlet Invert Elevation (inches above Datum)	6.0
Number of Perforated Pipe Underdrains (<250)	1
Subgrade Seepage Rate (in/hr) - select below or enter	0.050
Use Random Number Generation to Account for Uncertainty in Seepage Rate	<input type="checkbox"/>
Subgrade Seepage Rate COV	1.60
Underdrain Discharge Percent TSS Reduction (0-100) or leave blank for program to calculate	0

Select Subgrade Seepage Rate

Sand - 8 in/hr Clay loam - 0.1 in/hr
 Loamy sand - 2.5 in/hr Silty clay loam - 0.05 in/hr
 Sandy loam - 1.0 in/hr Sandy clay - 0.05 in/hr
 Loam - 0.5 in/hr Silty clay - 0.04 in/hr
 Silt loam - 0.3 in/hr Clay - 0.02 in/hr
 Sandy silt loam - 0.2 in/hr

Percent of Total Area that is Porous Pavement
40.0 %

Porous Pavement Geometry Schematic

Buttons: Delete Control, Cancel, Continue

Control Practice #: 1 | Land Use #: 1 | Source Area #: 13 | Porous Pavement Device Number 1

Porous Pavement Control Device

First Source Area Control Practice
 Land Use: Commercial 1
 Source Area: Paved Parking 1
 Total Porous and Impervious Pavement Area: 1.000 ac.

Porous pavement area (ac): 0.400
 Inflow Hydrograph Peak to Average Flow Ratio: 3.8

Surface Pavement Layer Infiltration Rate Data
 Initial Infiltration Rate (in/hr): 100.00
 Surface Pavement Percent Solids Removal Upon Cleaning (0-100): 50.0

Enter either these three values:
 Percent of Infiltration Rate After 3 Years (0-100):
 Percent of Infiltration Rate After 5 Years (0-100):
 Time Period Until Complete Clogging Occurs (yrs):

Or this value:
 Surface Clogging Load (lb/sf): 0.10

Restorative Cleaning Frequency
 Never Cleaned
 Three Times per Year
 Semi-Annually
 Annually
 Every Two Years
 Every Three Years
 Every Four Years
 Every Five Years
 Every Seven Years
 Every Ten Years

Pavement Geometry and Properties

1 - Pavement Thickness (in)	3.0
Pavement Porosity (>0 and <1)	0.25
2 - Aggregate Bedding Thickness (in)	9.0
Aggregate Bedding Porosity (>0 and <1)	0.25
3 - Aggregate Base Reservoir Thickness (in)	9.0
Aggregate Base Reservoir Porosity (>0 and <1)	0.25
Porous Pavement Area to Agg Base Area Ratio	1.00

Outlet/Discharge Options

Perforated Pipe Underdrain Diameter, if used (inches)	3.00
4 - Perforated Pipe Underdrain Outlet Invert Elevation (inches above Datum)	6.0
Number of Perforated Pipe Underdrains (<250)	1
Subgrade Seepage Rate (in/hr) - select below or enter	0.050
Use Random Number Generation to Account for Uncertainty in Seepage Rate	<input type="checkbox"/>
Subgrade Seepage Rate COV	1.60
Underdrain Discharge Percent TSS Reduction (0-100) or leave blank for program to calculate	0

Select Subgrade Seepage Rate

Sand - 8 in/hr Clay loam - 0.1 in/hr
 Loamy sand - 2.5 in/hr Silty clay loam - 0.05 in/hr
 Sandy loam - 1.0 in/hr Sandy clay - 0.05 in/hr
 Loam - 0.5 in/hr Silty clay - 0.04 in/hr
 Silt loam - 0.3 in/hr Clay - 0.02 in/hr
 Sandy silt loam - 0.2 in/hr

Percent of Total Area that is Porous Pavement
40.0 %

Porous Pavement Geometry Schematic

Buttons: Delete Control, Cancel, Continue

Control Practice #: 1 | Land Use #: 1 | Source Area #: 13 | Porous Pavement Device Number 1

Porous Pavement Control Device

First Source Area Control Practice
 Land Use: Commercial 1
 Source Area: Paved Parking 1
 Total Porous and Impervious Pavement Area: 1.000 ac.
 Porous pavement area (acres): 0.17(0)
 Inflow Hydrograph Peak to Average Flow Ratio: 3.8

Surface Pavement Layer Infiltration Rate Data

Initial Infiltration Rate (in/hr)	100.00
Surface Pavement Percent Solids Removal Upon Cleaning (0-100)	50.0

Enter either these three values:
 Percent of Infiltration Rate After 3 Years (0-100) _____
 Percent of Infiltration Rate After 5 Years (0-100) _____
 Time Period Until Complete Clogging Occurs (yrs) _____
 Or this value:
 Surface Clogging Load (lb/sf) 0.06

Restorative Cleaning Frequency

- Never Cleaned
- Three Times per Year
- Semi-Annually
- Annually
- Every Two Years
- Every Three Years
- Every Four Years
- Every Five Years
- Every Seven Years
- Every Ten Years

Pavement Geometry and Properties

1 - Pavement Thickness (in)	3.0
Pavement Porosity (>0 and <1)	0.25
2 - Aggregate Bedding Thickness (in)	9.0
Aggregate Bedding Porosity (>0 and <1)	0.30
3 - Aggregate Base Reservoir Thickness (in)	12.0
Aggregate Base Reservoir Porosity (>0 and <1)	0.30
Porous Pavement Area to Agg Base Area Ratio	1.00

Outlet/Discharge Options

Perforated Pipe Underdrain Diameter, if used (inches)	3.00
4 - Perforated Pipe Underdrain Outlet Invert Elevation (inches above Datum)	6.0
Number of Perforated Pipe Underdrains (<250) or enter	5
Subgrade Seepage Rate (in/hr) - select below or enter	0.100
Use Random Number Generation to Account for Uncertainty in Seepage Rate	<input type="checkbox"/>
Subgrade Seepage Rate CDV	
Underdrain Discharge Percent TSS Reduction (0-100) or leave blank for program to calculate	0

Select Subgrade Seepage Rate

- Sand - 8 in/hr
- Loamy sand - 2.5 in/hr
- Sandy loam - 1.0 in/hr
- Loam - 0.5 in/hr
- Silt loam - 0.3 in/hr
- Sandy silt loam - 0.2 in/hr
- Clay loam - 0.1 in/hr
- Silty clay loam - 0.05 in/hr
- Sandy clay - 0.05 in/hr
- Silty clay - 0.04 in/hr
- Clay - 0.02 in/hr

Surface Clogging Option 1

Select File | Not needed - calculated by program

Percent of Total Area that is Porous Pavement
17.0 %

Copy Porous Pavement Data | Paste Porous Pavement Data

Porous Pavement Geometry Schematic

Delete Control | Cancel | Continue

Control Practice #: 1 | Land Use #: 1 | Source Area #: 13 | Porous Pavement Device Number 1

Porous Pavement Control Device

First Source Area Control Practice
 Land Use: Commercial 1
 Source Area: Paved Parking 1
 Total Porous and Impervious Pavement Area: 1.000 ac.
 Porous pavement area (acres): 0.17(0)
 Inflow Hydrograph Peak to Average Flow Ratio: 3.8

Surface Pavement Layer Infiltration Rate Data

Initial Infiltration Rate (in/hr)	100.00
Surface Pavement Percent Solids Removal Upon Cleaning (0-100)	50.0

Enter either these three values:
 Percent of Infiltration Rate After 3 Years (0-100) _____
 Percent of Infiltration Rate After 5 Years (0-100) _____
 Time Period Until Complete Clogging Occurs (yrs) _____
 Or this value:
 Surface Clogging Load (lb/sf) 0.06

Restorative Cleaning Frequency

- Never Cleaned
- Three Times per Year
- Semi-Annually
- Annually
- Every Two Years
- Every Three Years
- Every Four Years
- Every Five Years
- Every Seven Years
- Every Ten Years

Pavement Geometry and Properties

1 - Pavement Thickness (in)	3.0
Pavement Porosity (>0 and <1)	0.25
2 - Aggregate Bedding Thickness (in)	9.0
Aggregate Bedding Porosity (>0 and <1)	0.30
3 - Aggregate Base Reservoir Thickness (in)	12.0
Aggregate Base Reservoir Porosity (>0 and <1)	0.30
Porous Pavement Area to Agg Base Area Ratio	1.00

Outlet/Discharge Options

Perforated Pipe Underdrain Diameter, if used (inches)	3.00
4 - Perforated Pipe Underdrain Outlet Invert Elevation (inches above Datum)	6.0
Number of Perforated Pipe Underdrains (<250) or enter	5
Subgrade Seepage Rate (in/hr) - select below or enter	0.100
Use Random Number Generation to Account for Uncertainty in Seepage Rate	<input type="checkbox"/>
Subgrade Seepage Rate CDV	
Underdrain Discharge Percent TSS Reduction (0-100) or leave blank for program to calculate	0

Select Subgrade Seepage Rate

- Sand - 8 in/hr
- Loamy sand - 2.5 in/hr
- Sandy loam - 1.0 in/hr
- Loam - 0.5 in/hr
- Silt loam - 0.3 in/hr
- Sandy silt loam - 0.2 in/hr
- Clay loam - 0.1 in/hr
- Silty clay loam - 0.05 in/hr
- Sandy clay - 0.05 in/hr
- Silty clay - 0.04 in/hr
- Clay - 0.02 in/hr

Surface Clogging Option 2

Select File | Not needed - calculated by program

Percent of Total Area that is Porous Pavement
17.0 %

Copy Porous Pavement Data | Paste Porous Pavement Data

Porous Pavement Geometry Schematic

Delete Control | Cancel | Continue

Control Practice #: 1 | Land Use #: 1 | Source Area #: 13 | Porous Pavement Device Number 1

Modeling Notes

- Porous Pavement routing is performed using the Modified Puls Storage – Indication Method.
- Time increments user established and vary by event.
- Yield reductions due to
 - surface pavement filtering
 - subsurface settling
 - runoff volume reduction through infiltration
- The porous pavement structure is assumed to be flat

Col. #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Control Practice No.	Control Practice Type	Control Practice Name or Location	Total Inflow Volume (ft ³)	Total Outflow Volume (ft ³)	Percent Volume Reduction	Total Inflow Load (lbs)	Total Effluent Load (lbs)	Percent Load Reduction	Flow Weighted Inflow Conc (mg/L)	Flow Weighted Effluent Conc (mg/L)	Percent Conc Reduction	Influent Median Part Size (microns)	Effluent Median Part Size (microns)	3rd Clogging Factor	Maximum Subsurface Flooding Time (hrs)	Volume Infiltrated (ft ³)	Underdrain Discharge Vol (ft ³)	Final Surface Infiltration Rate (in/hr)	Runoff Production Rate (in/hr)																																									
1	Porous Pavement	SA Device, LU#1, S4# 13	75536	37960	49.72	613.0	94.06	94.66	130.0	29.67	69.403	7.80	2.33	0.12	68.50	37524.94	37979.71	87.93	21.98																																									

Modeling Notes

- In Northern Climates, groundwater contamination due to Chlorides may be a problem – check with your regulatory agency
- Porous pavement clogging and cleaning time frames may require a multi-year analysis to correctly evaluate performance
- Clogging due to run on increases as the porous pavement area to drainage area ratio decreases

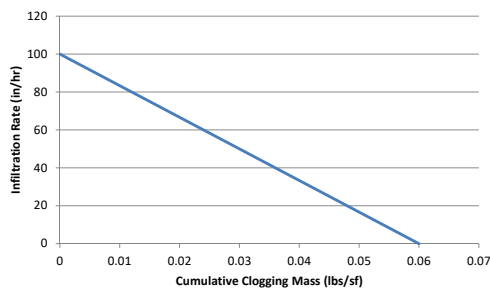


Surface Seepage Rate Changes due to Surface Clogging

Table 1 - Particulate Treatment in Porous Pavement Devices
Fractional Removal of Stormwater Particulates

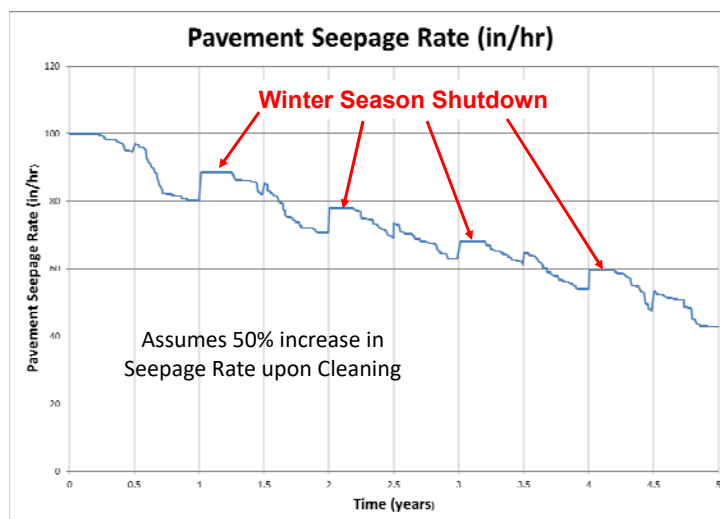
Media	0.45 to 3µm	3 to 12µm	12 to 30µm	30 to 60µm	60 to 120µm	120 to 250µm	>250µm
Porous pavement surface (asphalt or concrete)	0.00	0.00	0.00	0.00	0.25	0.50	1.00

Surface Infiltration Rate Changes due to Pavement Clogging

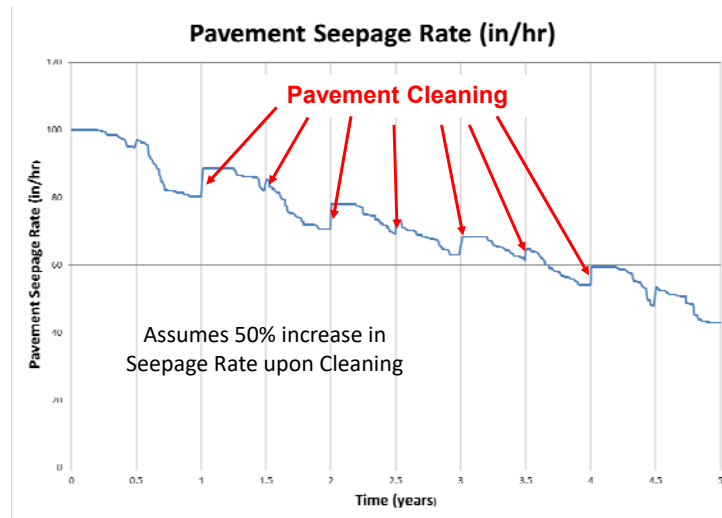


Infiltration rate decreases as sediment clogs the surface

Surface Seepage Rate Changes to the Control Practice

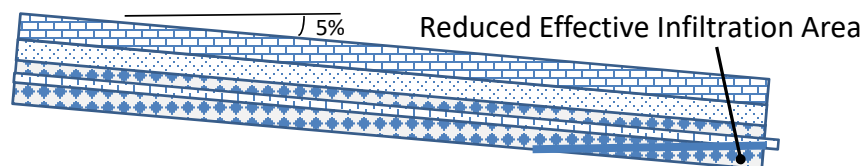


Surface Seepage Rate Changes to the Control Practice

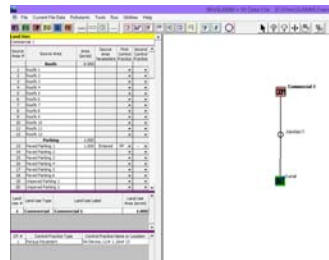


Wisconsin Permeable Pavement Standard 1006 (Feb 2016)

- TSS Removal Credit for any Underdrain Discharge = 65%
- Total Phosphorus Removal Credit for any Underdrain Discharge = 35%
- Removal Credit for any Infiltration Discharge = 100%
- Water must be Discharged from the Entire System after 72 hours
- Design the System to have a grade no greater than 2%



Example Input and Output



WinSLAMM v 10 Data File: [C:\Files\SLAMM\Training-

File Current File Data Pollutants Tools Run Utilities Help

RES INS COM IND OU FRE CS CB WP BF PP HD QD FS SF UF

Land Use:

Commercial 1

Source Area #	Source Area	Area (acres)	Source Area Parameters	First Control Practice	Second Control Practice
Roofs		0.000			
1	Roofs 1				
2	Roofs 2				
3	Roofs 3				
4	Roofs 4				
5	Roofs 5				
6	Roofs 6				
7	Roofs 7				
8	Roofs 8				
9	Roofs 9				
10	Roofs 10				
11	Roofs 11				
12	Roofs 12				
Parking		1.000			
13	Paved Parking 1	1.000	Entered	PP	--
14	Paved Parking 2				
15	Paved Parking 3				
16	Paved Parking 4				
17	Paved Parking 5				
18	Paved Parking 6				
19	Unpaved Parking 1				
20	Unpaved Parking 2				

Land Use #	Land Use Type	Land Use Label	Land Use Area (acres)
1	Commercial	Commercial 1	1.000

CP #	Control Practice Type	Control Practice Name or Location
1	Porous Pavement	SA Device, LU# 1, SA# 13

Commercial 1

Junction 1

Outfall

Porous Pavement Control Device

First Source Area Control Practice
Land Use: Commercial 1
Source Area: Paved Parking 1
Total Porous and Impervious Pavement Area: 1.000 ac.
Porous pavement area (acres): 0.170
Inflow Hydrograph Peak to Average Flow Ratio: 3.8

Surface Pavement Layer Infiltration Rate Data

Initial Infiltration Rate (in/hr)
 Surface Pavement Percent Solids Removal Upon Cleaning (0-100)

Enter either these three values:
 Percent of Infiltration Rate After 3 Years (0-100)
 Percent of Infiltration Rate After 5 Years (0-100)
 Time Period Until Complete Clogging Occurs (yrs)

Or this value:
 Surface Clogging Load (lb/sf)

Restorative Cleaning Frequency

Never Cleaned
 Three Times per Year
 Semi-Annually
 Annually
 Every Two Years
 Every Three Years
 Every Four Years
 Every Five Years
 Every Seven Years
 Every Ten Years

Pavement Geometry and Properties

1 - Pavement Thickness (in)	3.0
Pavement Porosity (>0 and <1)	0.25
2 - Aggregate Bedding Thickness (in)	9.0
Aggregate Bedding Porosity (>0 and <1)	0.30
3 - Aggregate Base Reservoir Thickness (in)	12.0
Aggregate Base Reservoir Porosity (>0 and <1)	0.30
Porous Pavement Area to Agg Base Area Ratio	1.00

Outlet/Discharge Options

Perforated Pipe Underdrain Diameter, if used (inches)	3.00
4 - Perforated Pipe Underdrain Outlet Invert Elevation (inches above Datum)	6.0
Number of Perforated Pipe Underdrains (<250)	5
Subgrade Seepage Rate (in/hr) - select below or enter	0.100
Use Random Number Generation to Account for Uncertainty in Seepage Rate	<input type="checkbox"/>
Subgrade Seepage Rate COV	<input type="text"/>
Underdrain Discharge Percent TSS Reduction (0-100) or leave blank for program to calculate	0

Select Subgrade Seepage Rate

<input type="radio"/> Sand - 8 in/hr	<input type="radio"/> Clay loam - 0.1 in/hr
<input type="radio"/> Loamy sand - 2.5 in/hr	<input type="radio"/> Silty clay loam - 0.05 in/hr
<input type="radio"/> Sandy loam - 1.0 in/hr	<input type="radio"/> Silty clay - 0.05 in/hr
<input type="radio"/> Loam - 0.5 in/hr	<input type="radio"/> Silty clay - 0.04 in/hr
<input type="radio"/> Silt loam - 0.3 in/hr	<input type="radio"/> Clay - 0.02 in/hr
<input type="radio"/> Sandy silt loam - 0.2 in/hr	

Percent of Total Area that is Porous Pavement: 17.0 %

Copy Porous Pavement Data

Paste Porous Pavement Data

Porous Pavement Geometry Schematic

Control Practice #: 1 Land Use #: 1 Source Area #: 13 Porous Pavement Device Number 1

Output Summary

File Name:
 C:\Files\SLAMM\Training-Presentations\DNR PP Feb 2015\Webinar\PPTTest.mdb

Outfall Output Summary

	Runoff Volume (cu. ft.)	Percent Runoff Reduction	Runoff Coefficient (Rv)	Particulate Solids Conc. (mg/L)	Particulate Solids Yield (lbs)	Percent Particulate Solids Reduction
Total of All Land Uses without Controls	75538		0.71	130.0	613.0	
Outfall Total with Controls	38001	49.69 %	0.36	39.67	94.11	84.65 %

Current File Output: Annualized Total After Outfall Controls Years in Model Run:

Pollutant	Concentration - No Controls	Concentration - With Controls	Concentration Units	Pollutant Yield - No Controls	Pollutant Yield - With Controls	Pollutant Yield Units	Percent Yield Reduction
Particulate Solids	130.0	39.67	mg/L	613.0	94.11	lbs	84.65 %
Total Phosphorus	0.2150	0.08646	mg/L	1.014	0.2051	lbs	79.77 %

Total Area Modeled (ac)

Total Control Practice Costs

Capital Cost
 Land Cost
 Annual Maintenance Cost
 Present Value of All Costs
 Annualized Value of All Costs

Receiving Water Impacts Due To Stormwater Runoff (SWP Impervious Cover Model)

	Calculated Rv	Approximate Urban Stream Classification
Without Controls	0.71	Poor
With Controls	0.36	Poor

15

Land Uses Junctions Control Practices Outfall **Output Summary**

File Name: C:\Files\SLAMM\Training-Presentations\DNR PP Feb 2015 Webinar\PPTest.mdb

Outfall Output Summary

	Runoff Volume (cu. ft.)	Percent Runoff Reduction	Runoff Coefficient (Rv)	Particulate Solids Conc. (mg/L)	Particulate Solids Yield (lbs)	Percent Particulate Solids Reduction
Total of All Land Uses without Controls	75538		0.71	130.0	613.0	
Outfall Total with Controls	38001	49.69 %	0.36	39.67	94.11	84.65 %

Current File Output: Annualized Total After Outfall Controls: 50994 Years in Model Run: 0.75 126.3

Pollutant	Concentration - No Controls	Concentration - With Controls	Concentration Units	Pollutant Yield - No Controls	Pollutant Yield - With Controls	Pollutant Yield Units	Percent Yield Reduction
Particulate Solids	130.0	39.67	mg/L	613.0	94.11	lbs	84.65 %
Total Phosphorus	0.2150	0.08646	mg/L	1.014	0.2051	lbs	79.77 %

Print Output Summary to Text File Print Output Summary to csv File Total Area Modeled (ac): 1.000

Total Control Practice Costs

Capital Cost: \$ 14730
 Land Cost: \$ 0
 Annual Maintenance Cost: \$ 49
 Present Value of All Costs: \$ 15463
 Annualized Value of All Costs: \$ 1039

Perform Outfall Flow Duration Curve Calculations

Receiving Water Impacts Due To Stormwater Runoff (CWP Impermeous Cover Model)

	Calculated Rv	Approximate Urban Stream Classification
Without Controls	0.71	Poor
With Controls	0.36	Poor

Land Uses Junctions **Control Practices** Outfall Output Summary

Runoff Volume Part. Solids Yield (lbs) Part. Solids Conc. (mg/L) **Summary Table**

Data File: C:\Files\SLAMM\Training-Presentations\DNR PP Feb 2015 Webinar\PPTest.mdb
 Rain File: WisReg - Madison WI 1981.RAN
 Date: 01-26-15 Time: 12:50:06 PM

Site Description:

Col. #	2	3	4	5	6	7	8	9	10
Control Practice No.	Control Practice Type	Control Practice Name or Location	Total Inflow Volume (cf)	Total Outflow Volume (cf)	Percent Volume Reduction	Total Influent Load (lbs)	Total Effluent Load (lbs)	Percent Load Reduction	Flow Weight Influent Conc (m)
1	Porous Pavement	SA Device, LU# 1, SA# 13	75538	38001	49.69	613.0	94.12	84.65	1

Control Practice Summary Table

Data File: C:\Files\SLAMM\Training-Presentations\DNR PP Feb 2015 Webinar\PPTest.mdb										
Rain File: WisReg - Madison WI 1981.RAN										
Date: 01-25-15 Time: 12:38:41 PM										
Site Description:										
Col #:	2	3	4	5	6	7	8	9		
Control Practice No.	Control Practice Type	Control Practice Name or Location	Total Inflow Volume (cf)	Total Outflow Volume (cf)	Percent Volume Reduction	Total Influent Load (lbs)	Total Effluent Load (lbs)	Percent Load Reduction		
1	Porous Pavement	SA Device, LU# 1 ,SA# 13	75538	37980	49.72	613.0	94.06	84.66		

10	11	12	13	14	26	28	29	30	36	61
Flow Weighted Influent Conc (mg/L)	Flow Weighted Effluent Conc (mg/L)	Percent Conc. Reduction	Influent Median Part. Size (microns)	Effluent Median Part. Size (microns)	% of Clogging Factor	Maximum Subsurface Ponding Time (hrs)	Volume Infiltrated (cf)	Underdrain Discharge Vol. (cf)	Final Surface Infiltration Rate (in/hr)	Runoff Producing Events/ Ttl. Rains
130.0	39.67	69.483	7.80	2.33	0.12	68.50	37524.94	37979.71	87.93	21/86

Control Practice Detail Tables

Runoff Volume						
Data File: C:\Files\SLAMM\Training-Presentations\DNR PP Feb 2015 Webinar\PPTest.mdb						
Rain File: WisReg - Madison WI 1981.RAN						
Date: 01-25-15 Time: 12:38:40 PM						
Site Description:						
Control Practice Type ==> CPH 1 - Porous Pavement						
Control Practice Name/Location ==> SA Device, LU# 1 ,SA# 13						
Rain Number	Start Date	Rain Total (in)	Influent Runoff Vol.(cf)	Effluent Runoff Vol.(cf)	Runoff Vol. Percent Reduction	
36	05/13/81	0.01	3.227	0	100.00	
37	05/23/81	0.02	12.91	0	100.00	
38	05/24/81	0.10	169.5	0	100.00	
39	05/29/81	0.34	763.0	0	100.00	
40	06/02/81	0.01	3.227	0	100.00	
41	06/03/81	0.01	3.227	0	100.00	
42	06/08/81	0.01	3.227	0	100.00	
43	06/08/81	0.33	735.6	0	100.00	
44	06/09/81	0.07	106.7	0	100.00	
45	06/12/81	0.43	1013	0	100.00	
46	06/15/81	2.59	9810	7311	15.99	
47	06/20/81	0.34	763.0	0	100.00	
48	06/21/81	0.32	708.6	0	100.00	
49	06/23/81	0.51	1240	0	100.00	
50	06/25/81	0.13	236.2	0	100.00	
51	06/28/81	0.24	503.1	0	100.00	
52	07/04/81	0.05	67.94	0	100.00	
53	07/11/81	0.50	1211	56.08	95.37	
54	07/12/81	0.14	258.9	21.94	91.53	
55	07/12/81	0.86	2325	2075	10.74	
56	07/13/81	1.32	3966	3779	4.72	
57	07/14/81	0.12	214.2	0	100.00	

Part. Solids Yield (lbs)						
Data File: C:\Files\SLAMM\Training-Presentations\DNR PP Feb 2015 Webinar\PPTest.mdb						
Rain File: WisReg - Madison WI 1981.RAN						
Date: 01-25-15 Time: 12:38:41 PM						
Site Description:						
Control Practice Type ==> CPH 1 - Porous Pavement						
Control Practice Name/Location ==> SA Device, LU# 1 ,SA# 13						
Rain Number	Start Date	Rain Total (in)	Influent Part. Sol. Yield(lbs)	Effluent Part. Sol. Yield(lbs)	Part.Yield Percent Reduction	
36	05/13/81	0.01	0.02619	0	100.00	
37	05/23/81	0.02	0.1048	0	100.00	
38	05/24/81	0.10	1.376	0	100.00	
39	05/29/81	0.34	6.192	0	100.00	
40	06/02/81	0.01	0.02619	0	100.00	
41	06/03/81	0.01	0.02619	0	100.00	
42	06/08/81	0.01	0.02619	0	100.00	
43	06/08/81	0.33	5.970	0	100.00	
44	06/09/81	0.07	0.8662	0	100.00	
45	06/12/81	0.43	8.224	0	100.00	
46	06/15/81	2.59	69.88	22.59	67.67	
47	06/20/81	0.34	6.192	0	100.00	
48	06/21/81	0.32	5.751	0	100.00	
49	06/23/81	0.51	10.06	0	100.00	
50	06/25/81	0.13	1.917	0	100.00	
51	06/28/81	0.24	4.083	0	100.00	
52	07/04/81	0.05	0.5513	0	100.00	
53	07/11/81	0.50	9.825	0.02718	99.72	
54	07/12/81	0.14	2.101	0.004246	99.80	
55	07/12/81	0.86	18.87	7.473	60.40	
56	07/13/81	1.32	32.18	12.63	60.13	
57	07/14/81	0.12	1.738	0	100.00	

Additional Output

**Available through:
Tools/
Default Model Options**

- Water Balance File
- Mass Balance File
- Stage Outflow File
- Surface Seepage Rate File
- Detailed Output File
- Stochastic Seepage Rate Detail File

PorPav Source Area Number	Rain Number	Rain Depth (in)	Time (Julian Date)	Maximum PorPav Stage (ft)	Minimum PorPav Stage (ft)	Total Source Area Runoff Before Porous Pavement (ac-ft)	Non- Porous Pavement Area Runoff Volume (ac-ft)	Event Inflow Volume onto Porous Pavement (ac-ft)	Event Bypass Volume Due to Surface Clogging (ac-ft)	Event Overflow Volume (ac-ft)	Event Infil Outflow (ac-ft)	Event Orifice Outflow (ac-ft)	Event Total Outflow (ac-ft)	Event Flow Balance (ac-ft)	Volume Reduction Fraction	Solids Reduction Fraction
46	1	0.46	0	0.01	0	0.01	0	0.01	0	0	0.01	0	0.01	0	1	0
46	2	0.58	5	0	0	0.012	0	0.012	0	0	0.012	0	0.012	0	1	0
46	3	0.25	9	0	0	0.005	0	0.005	0	0	0.005	0	0.005	0	1	0
46	4	0.03	11	0	0	0.001	0	0.001	0	0	0.001	0	0.001	0	1	0
46	5	0.39	11	0	0	0.008	0	0.008	0	0	0.008	0	0.008	0	1	0
46	7	0.05	18	0	0	0.001	0	0.001	0	0	0.001	0	0.001	0	1	0
46	8	0.03	22	0	0	0.001	0	0.001	0	0	0.001	0	0.001	0	1	0
46	9	2.33	23	0.01	0	0.049	0	0.049	0	0	0.049	0	0.049	0	1	0
46	12	0.51	34	0	0	0.011	0	0.011	0	0	0.011	0	0.011	0	1	0
46	15	0.67	47	0.01	0	0.014	0	0.014	0	0	0.014	0	0.014	0	1	0
46	16	0.61	50	0.01	0	0.013	0	0.013	0	0	0.013	0	0.013	0	1	0
46	18	0.85	63	0	0	0.018	0	0.018	0	0	0.018	0	0.018	0	1	0
46	20	1.02	66	0.01	0	0.021	0	0.021	0	0	0.021	0	0.021	0	1	0
46	22	1.48	70	0.01	0	0.031	0	0.031	0	0	0.031	0	0.031	0	1	0

Questions?