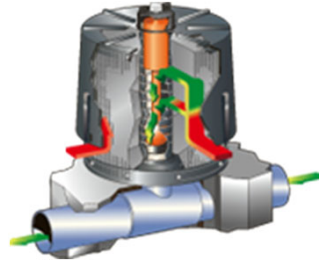
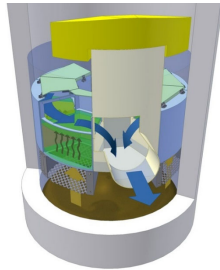
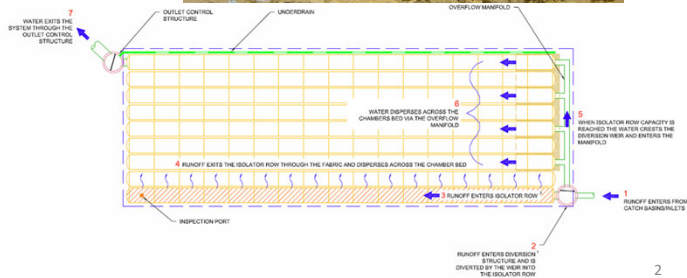
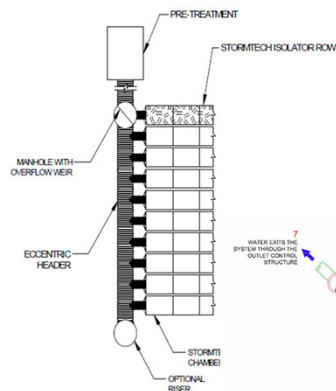


11a. Proprietary Stormwater Controls in WinSLAMM



ADS Isolator Row and StormTech Infiltration Chambers in WinSLAMM

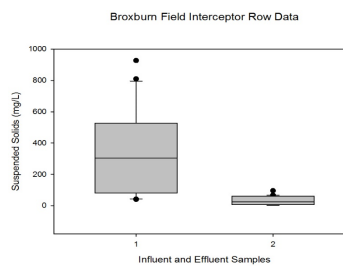
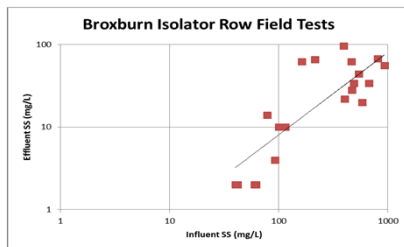
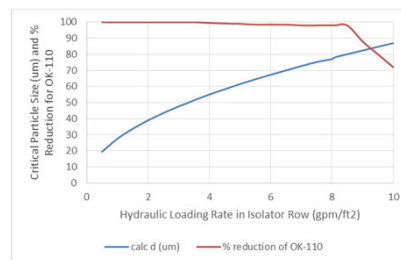
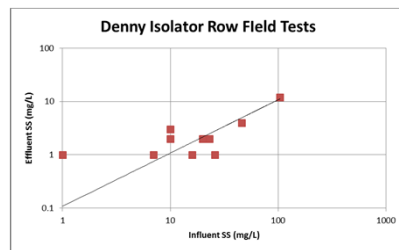


Influent and Effluent Median Concentrations and Reductions for Cherry Gardens Apartments Site (Charlotte, NC; footprint 10% of 0.41 ac site)

Constituent	Influent (median concentration)	Effluent (median concentration)	Percent Reduction	Significance of reduction (p value)
SSC (mg/L)	98	5.9	94	0.0017
TSS (mg/L)	54	5.6	90	0.0001
Turbidity (NTU)	18	6.9	62	0.0001
Ammonia N (mg/L)	0.32	0.09	72	0.018
Nitrite + Nitrate (mg/L)	0.28	0.35	not significant.	0.97
Total Kjeldahl N (mg/L)	1.1	0.45	60	0.0001
Total Phosphorus (mg/l)	0.19	0.06	68	0.0001
Copper (µg/L)	10	9.5	not significant.	0.60
Zinc (µg/L)	55	13	76	0.0001

3

ADS Isolator Row Performance Data



The ADS StormTech Isolator Row System is Incorporated into WinSLAMM based on Field and Lab Data

ADS StormTech Isolator Row
Drainage System Control Practice DS Isolator Row # 1

Total Available System Length (ft) Available Height from Chamber Base to Surface (ft) Native Soil Infiltration Rate (in/hr)

Total Available System Width (ft) Number of Isolator Rows Assumed Stone Porosity

Select Either of These Sizing Options
 Use All Available Area Enter Required Storage Volume Enter Number of Rows and Row Length

Select Product

Product	Height (in)	Width (in)	Length (in)
<input type="radio"/> SC-160LP	12	25	85.4
<input type="radio"/> SC-310	16	34	85.4
<input type="radio"/> SC-740	30	51	85.4
<input type="radio"/> DC-790	30	51	85.4
<input type="radio"/> MC-3500	45	77	86
<input type="radio"/> MC-4500	60	100	48.3

Final Storage Volume (cf)	Number of Rows	Row Length (ft)	Total Chamber Length (ft)	Total System Width (ft)	Number of Chambers
9858	10	88.1	854.0	47.5	120

Outlet	Invert Elevation (ft)	Orifice Diameter (ft)
Overflow Weir	1.00	N/A
Orifice 1	0.00	0.00
Orifice 2	0.00	0.00

Top of Pavement
Min. Req. Cover of 18.0"
5.00'
Approximate Pipe Configuration

Control Practice #: 1 CP Index #: 1

1i. Selected topics – proprietary underground vaults

StormTech Isolator Row

The StormTech Isolator Row has been added to WinSLAMM v 10.4



ADS StormTech Isolator Row
Drainage System Control Practice DS Isolator Row # 1

Total Available System Length (ft) Available Height from Chamber Base to Surface (ft) Native Soil Infiltration Rate (in/hr)

Total Available System Width (ft) Number of Isolator Rows Assumed Stone Porosity

Select Either of These Sizing Options
 Use All Available Area Enter Required Storage Volume Enter Number of Rows and Row Length

Select Product

Product	Height (in)	Width (in)	Length (in)
<input type="radio"/> SC-160LP	12	25	85.4
<input type="radio"/> SC-310	16	34	85.4
<input type="radio"/> SC-740	30	51	85.4
<input type="radio"/> DC-790	30	51	85.4
<input type="radio"/> MC-3500	45	77	86
<input type="radio"/> MC-4500	60	100	48.3

Final Storage Volume (cf)	Number of Rows	Row Length (ft)	Total Chamber Length (ft)	Total System Width (ft)	Number of Chambers
2463	6	39.6	213.5	28.5	30

Outlet	Invert Elevation (ft)	Orifice Diameter (ft)
Overflow Weir	1.50	N/A
Orifice 1	0.50	0.25
Orifice 2	0.25	0.25

Top of Pavement
Min. Req. Cover of 18.0"
5.00'
Approximate Pipe Configuration
8

Control Practice #: 1 CP Index #: 1

1i. Selected topics – proprietary underground vaults

StormTech Isolator Row

ADS StormTech Isolator Row

Drainage System Control Practice DS Isolator Row #1

Total Available System Length (ft) 44 Available Height from Chamber Base to Surface (ft) 5.00 Native Soil Infiltration Rate (in/hr) 0.500

Total Available System Width (ft) 33 Number of Isolator Rows 1 Assumed Stone Porosity 0.44

Select Either of These Sizing Options

Use All Available Area Enter Required Storage Volume Enter Number of Rows and Row Length

Select Product

Product	Height (in)	Width (in)	Length (in)	Final Storage Volume (cu ft)	Number of Flow
<input type="radio"/> SC-160LP	12	25	85.4		
<input type="radio"/> SC-310	16	34	85.4		
<input type="radio"/> SC-740	30	51	85.4	2463	6
<input type="radio"/> DC-780	30	51	85.4		
<input type="radio"/> MC-3500	45	77	86		
<input type="radio"/> MC-4500	60	100	48.3		

Calculate

Cross Section

Outlet	Invert Elevation (ft)	Orifice Diameter (ft)
1	1.50	N/A
2	0.25	0.25

of Pavement

in. Req. Cover of 18.0"

5.00'

All Structures Have a Rock Base with a Drain Tile Below the Device

Control Practice #: 1 CP Index #: 1

1i. Selected topics – proprietary underground vaults

StormTech Isolator Row

Program Options

Detailed Output File Options Default Model Options Default Current File Data

Bioretters

- Detailed Biorefilter Output
- Irreducible Concentration Detailed Output
- Particulate Reduction Output
- Stage-Outlet
- Stochastic Seepage Rate Detail
- Water Balance
- Evapotranspiration Detail

Catchbasins

- Performance by Event Output
- Performance By Step Output
- Stage-Inflow Data
- Stage-Outlet

Cisterns

- Detailed Output
- Outfall Discharge Hydrograph
- Water Balance

Filter Strips

- Hydraulics and Concentration by Event
- Hydraulics Detailed Output
- Incremental Performance Output
- Irreducible Concentration Detailed Output
- Particulate Reduction Output

Flow Duration Curve Data

- Detailed Data
- Plotting Calculations

Critical Particle Size Calculation Detailed Output File

Freeway Data

- Freeway Washoff Detail

Grass Swales

- Hydraulics and Concentration by Event
- Hydraulics Detailed Output
- Incremental Performance Output
- Irreducible Concentration Detailed Output

Hydrodynamic Devices

- Detailed Output
- Performance By Event
- Stage-Inflow
- Stage-Outlet

Porous Pavement

- Detailed Output
- Stage-Outlet
- Stochastic Seepage Rate Detail
- Surface Seepage Rate
- Water Balance

Street Cleaning

- Street Dirt/Accumulation Plots
- Street Dirt Removal
- Washoff or Street Cleaning Detail

Wet Detention Ponds

- Detailed Output
- Pond Stage-Area-Volume Data
- Stage-Outlet
- Stone Weeper Detailed Output
- Water Balance Summary of All Ponds

Media Filters and Setting Practices

- Detailed Time Step Output
- Stage-Outlet Data
- Stage-Area-Storage Data
- Device Effluent Concentrations
- Performance By Event
- Pulse Routing Detail
- Iteration Information

Green Roofs

- Time Step Output
- Irreducible Concentration Calculations
- Particulate Reduction Output
- Stage-Area-Outlet
- Water Balance
- Evapotranspiration Detail

Pipes

- Detailed Hydraulic Output
- Pipe Output by Event

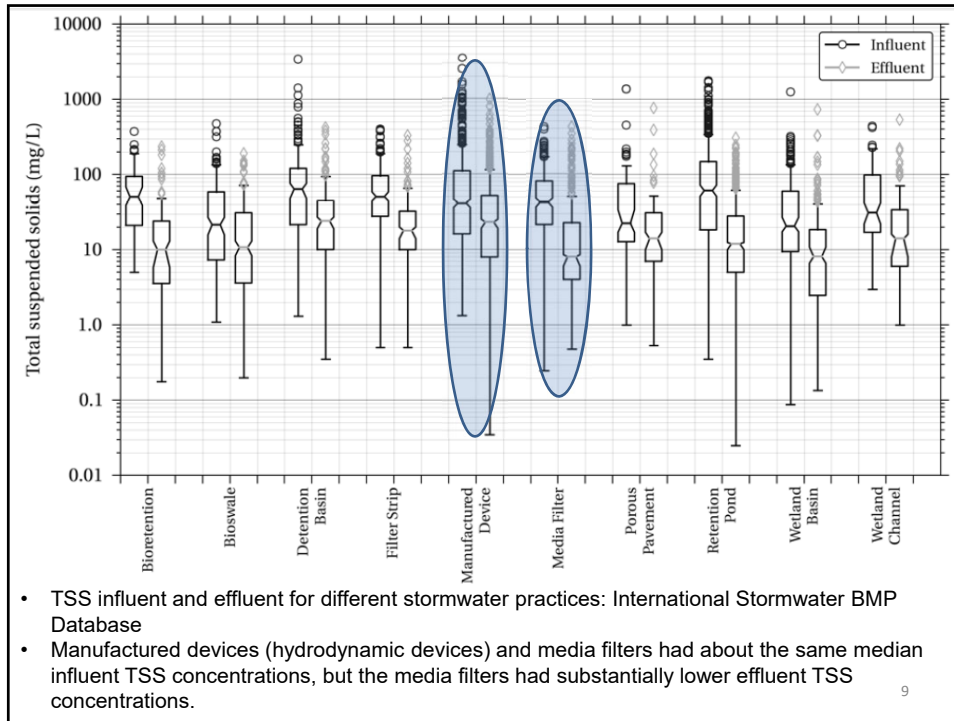
Uncheck All Detailed Output File Options

Check All Detailed Output File Options

File Update Options Cancel Changes Save .INI File

IR_Geometry.csv

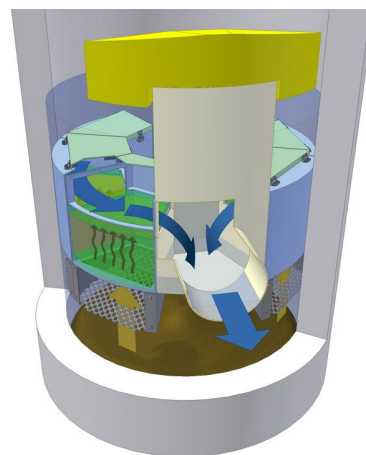
IR Number =	2
IR Chamber Number =	2
Sizing option number =	3
Stone depth below chambers (ft) =	0.5
Chamber Height (ft) =	1.333333
Stone depth above chambers (ft) =	0.5
Required storage volume (cf) =	0
Number of rows =	1
Row length (ft) =	30
Number of chambers per row =	4
Number of chambers =	4
Height of inlet bypass weir (ft) =	1.1666

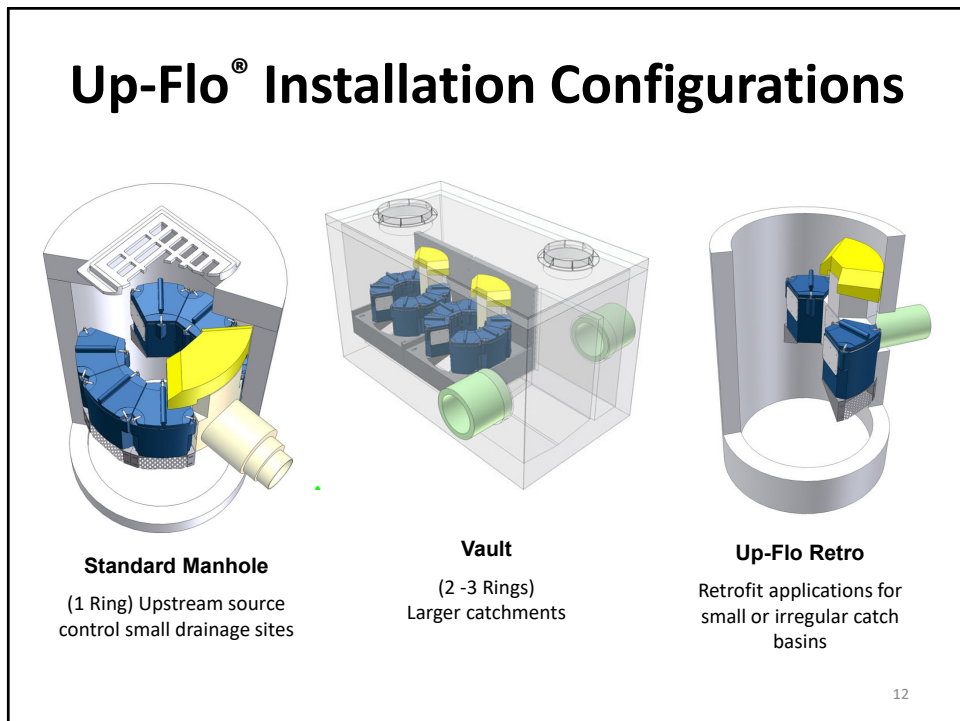
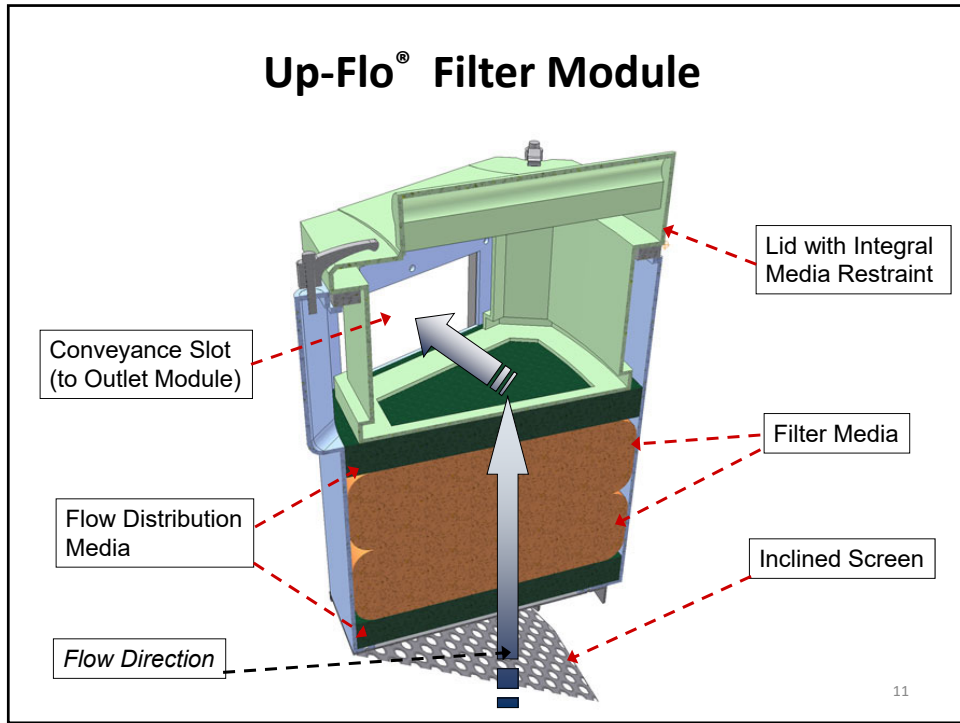


Up-Flo® Filter

Developed by Pitt as part of an EPA SBIR project and marketed by HydroInternational

- **Chamber** – Retains floatables and trash
- **Angled Screens** – Deflects neutrally buoyant material from media interface
- **Sump** – Stores coarse grit and gross debris
- **Filter media** – high rate of flow due to partial bed expansion of contained media:
 - Fine sediment
 - Hydrocarbons
 - Metals
 - Organics (PAHs, pesticides, herbicides)
 - Nutrients (particulate phosphorus)

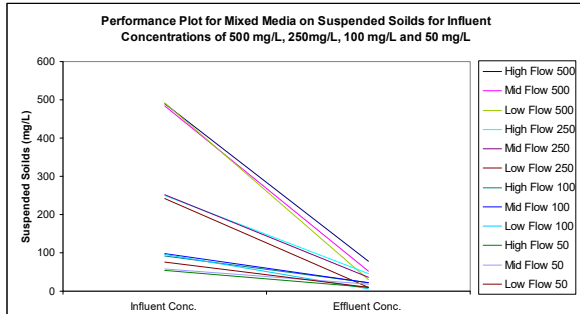
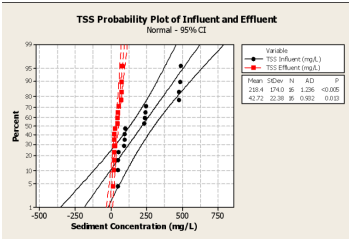




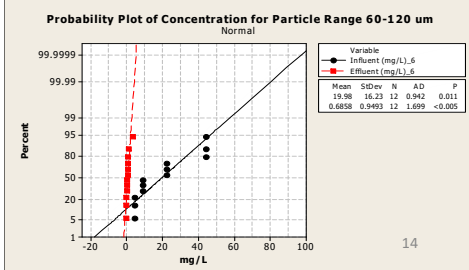
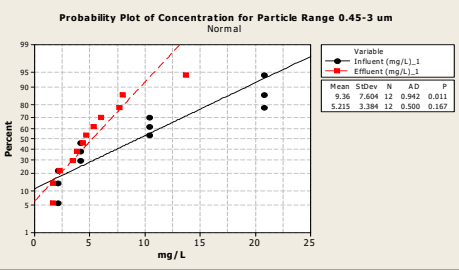


Flow rate has only a small effect on effluent quality. Effluent quality is relatively constant over broad range of influent concentrations and flows.

Pilot-Scale Tests, Controlled Tests and Three Years of Actual Runoff Events



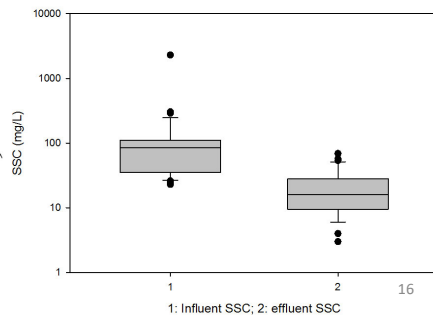
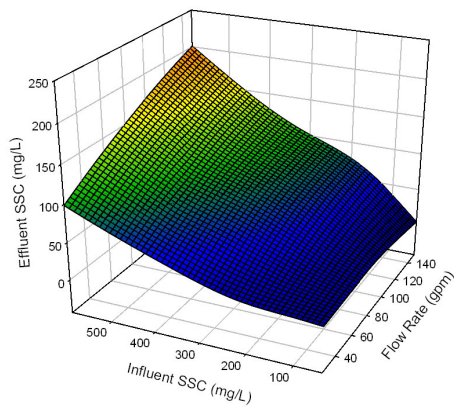
Performance during actual rains over a 10 month monitoring period:



Performance Summary by Particle Size			
25 gallon/min Flow Rate and 500 mg/L Concentration			
Particle Size (µm)	Average Influent Concentration (mg/L)	Average Effluent Concentration (mg/L)	Average Reduction (%)
< 0.45	240	120	49
0.45 to 3	26	3.2	88
3 to 12	92	32	65
12 to 30	130	28	79
30 to 120	81	3.9	95
120 to 1180	142	0.55	100
> 1180	30	0	100
sum >0.45 µm	500	67.7	15 86

SSC Influent and Effluent Concentrations during 40 Monitored Events at Full-Scale Up-Flo® Filter Installation at BamaBelle Site, Tuscaloosa, AL

Up-Flo Filter Performance - CPZ Media



Up-flo® Filter Incorporated into WinSLAMM Based on Lab and Field Tests

Two Solution Options:

- Select the Number of Filters
- Solve for the Number of Filters

Up-flo® Filter Incorporated into WinSLAMM Based on Lab and Field Tests

Have the Program Determine the Cleaning Frequency

Up-flo® Filter Incorporated into WinSLAMM Based on Lab and Field Tests

Hydro International Up-Flo Filter

First Source Area Control Practice

Contact Hydro International Web Site

Solve for Given Conditions:
 Number of Filter Modules: 5 Tank Area = 12.6 sf

OR

Solve Interactively for Desired Percent Reduction or Effluent Concentration:

- Treatment Goal - Percent TSS (0.45-75 um) Removed
- Treatment Goal - Percent SSC (>0.45 um) Removed
- Treatment Goal - Effluent TSS Concentration (mg/L)
- Treatment Goal - Effluent SSC Concentration (mg/L)

Copy Media Filter Data
 Paste Media Filter Data

Control Practice #: 1 Land Use #: 1 Source Area #: 13 Total Area: 10.000 acres Land Use: Commercial 1 Source Area: Paved Parking 1 19

Device Geometry

Area Fraction Served by Up-Flo Filters (0-1)	1.000
A - Height from Outlet Invert to Structure Top (ft)	3.00
B - Sump Depth (ft)	3.00
Peak to Average Flow Ratio	3.80

Total Basin Area: 0 acres
 Area Served by Upflow Filter (ac): 10.000

Cleaning Frequency

Have Model Determine Cleaning/Replacement Frequency

Media Options:

- CPZ (Activated Carbon, Peat, Manganese Coated Zeolite)
- Northern Mixture (Activated Carbon, Peat, Sand)
- Filter Sand
- Perlite

Media Selection: CPZ

Delete Cancel Continue

Contech's StormFilter also has substantial performance information (from both laboratory and field tests).

Q (gpm)

Driving Head (in)

DRAIN

FILL

StormFilter Performance (SSC Removal)

Regression of EMC (%)

95% Confidence Intervals

sand loamy sand sandy loam silt loam silt

% Silt

Specific flow rate: 2 gpm/ft² (red), 1 gpm/ft² (blue)

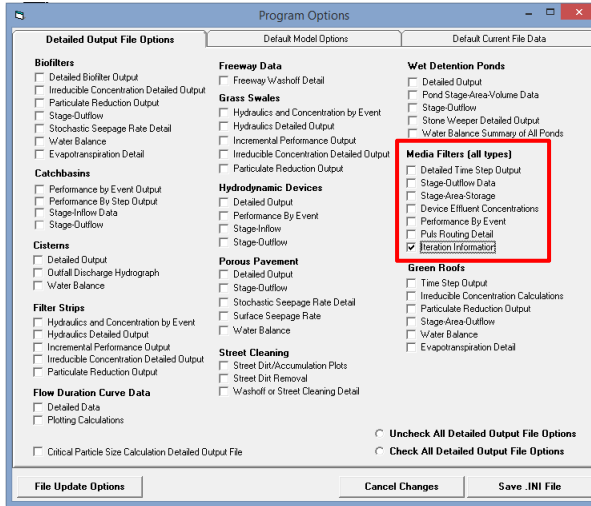
20

The Contech StormFilter is Incorporated into WinSLAMM based on Field and Lab Data

The Contech StormFilter is Incorporated into WinSLAMM based on Field and Lab Data

Analysis Procedure When Solving Iteratively

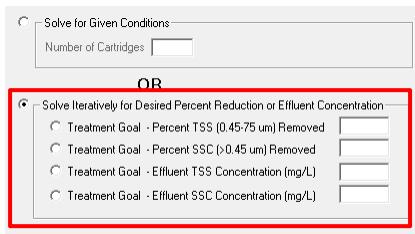
From the Tools menu, select "Program Options", and go to the "Detailed Output File Options"



Select the "Iteration Information" Checkbox in the Media Filters group

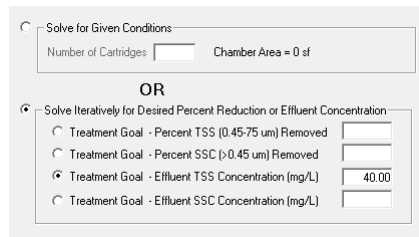
23

Analysis Procedure When Solving Iteratively



Two Solution Options:
 • Select the Number of Filters
 • Solve for the Number of Filters

Select "Solve Iteratively for Desired Percent Reduction or Effluent Concentration" then select the Treatment Goal for either TSS (0.45 to 75 um) or SSC (>0.45 um),



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Analysis Procedure When Solving Iteratively

Output from Three Model Runs with Different Final TSS Concentration Goals
 File Name: [filename] SF#001 -87_ Iterations.csv

Number of Iterations	Final TSS Conc.(mg/L) Goal	Number of Cartridges	Final TSS Concentration (mg/L)	Current - Previous TSS Conc. (mg/L)	Final Percent Reduction
1	40	12	43.64159	43.64159	68.81%
2	40	18	39.10429	-4.537292	
3	40	15	40.41138	1.307083	
1	30	12	43.64159	43.64159	71.70%
2	30	18	39.10429	-4.537292	
3	30	21	36.75288	-2.35141	
4	30	22	36.61931	-0.1335716	
1	20	12	43.64159	43.64159	71.70%
2	20	18	39.10429	-4.537292	
3	20	21	36.75288	-2.35141	
4	20	22	36.61931	-0.1335716	

- Final iteration concentration slightly above goal, due to Iteration Tolerance of 2 mg/L (and one less cartridge may not be sufficient, so it rounds up)
 Use "Solve for Given Conditions" Option to determine Number of Cartridges needed to get below the Final TSS Concentration Goal

25

Analysis Procedure When Solving Iteratively

Output from Three Model Runs with Different Final TSS Concentration Goals
 File Name: [filename] SF#001 -87_ Iterations.csv

Number of Iterations	Final TSS Conc.(mg/L) Goal	Number of Cartridges	Final TSS Concentration (mg/L)	Current - Previous TSS Conc. (mg/L)	Final Percent Reduction
1	40	12	43.64159	43.64159	68.81%
2	40	18	39.10429	-4.537292	
3	40	15	40.41138	1.307083	
1	30	12	43.64159	43.64159	71.70%
2	30	18	39.10429	-4.537292	
3	30	21	36.75288	-2.35141	
4	30	22	36.61931	-0.1335716	
1	20	12	43.64159	43.64159	71.70%
2	20	18	39.10429	-4.537292	
3	20	21	36.75288	-2.35141	
4	20	22	36.61931	-0.1335716	

- Final iteration concentration unable to meet goal in this example because selected media unable to remove finer particles needed to reach the goal, even if all the water passed through the media filter with no bypass. Sedimentation of particulates in filter chambers (or upstream storage units) is also calculated and will affect results. However, there is a maximum number of filter units per acre recommended by the manufactures so very large systems are not considered.

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To Summarize, When Using WinSLAMM to Determine the Number of Filters:

1. Set the Detailed Output to Create the Iteration Information file.
2. Select the Desired Output Goal.
3. Run the Program.
4. Review the Iteration Information file, and/or the Stormwater Controls Summary tab, to determine detailed performance information.
5. Test the modified input using the 'Solve For Given Conditions' option in conjunction with other controls at the site.