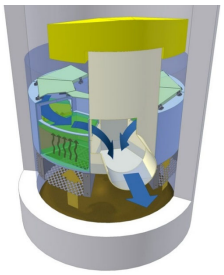
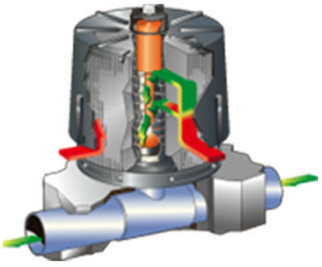
11a. Proprietary Stormwater Controls in WinSLAMM





PV & Associates

ADS Isolator Row and StormTech Infiltration Chambers in WinSLAMM

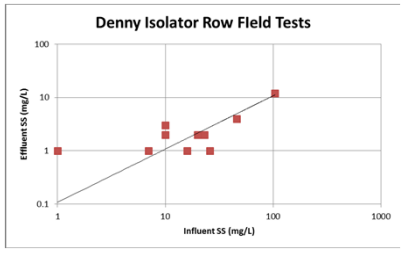
2

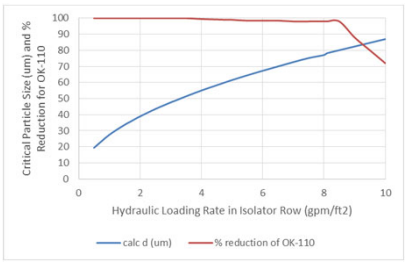
Influent and Effluent Median Concentrations and Reductions for Cherry Gardens Apartments Site (Charlotte, NC; footprint 10% of 0.41 ac site))

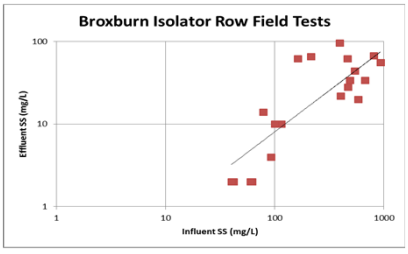
Constituent	Influent (median concentration)	Effluent (median concentration)	Percent Reduction	Significance of reduction (p value)
SSC (mg/L)	98	5.9	94	0.0017
TSS (mg/L)	54	5.6	90	0.0001
Turbidity (NTU)	18	6.9	62	0.0001
Ammonia N (mg/L)	0.32	0.09	72	0.018
Nitrite + Nitrate (mg/L)	0.28	0.35	not significant.	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

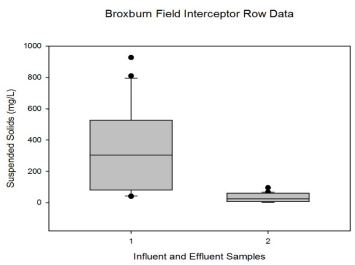
3

ADS Isolator Row Performance Data

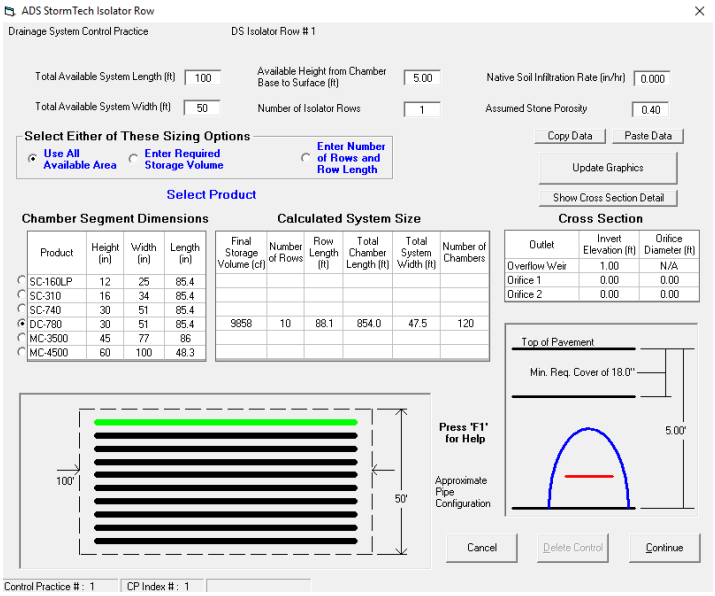








The ADS StormTech Isolator Row System is Incorporated into WinSLAMM based on Field and Lab Data

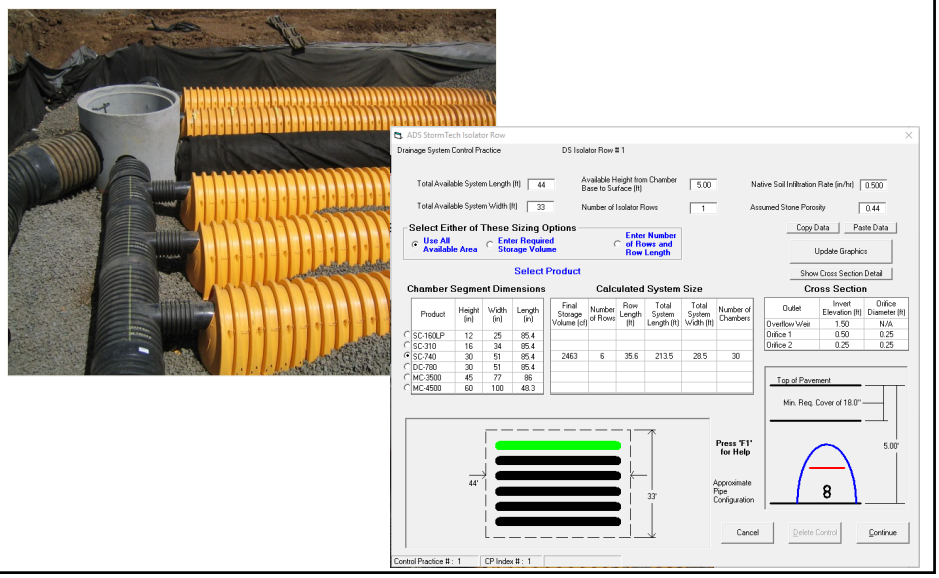


5

1i. Selected topics – proprietary underground vaults

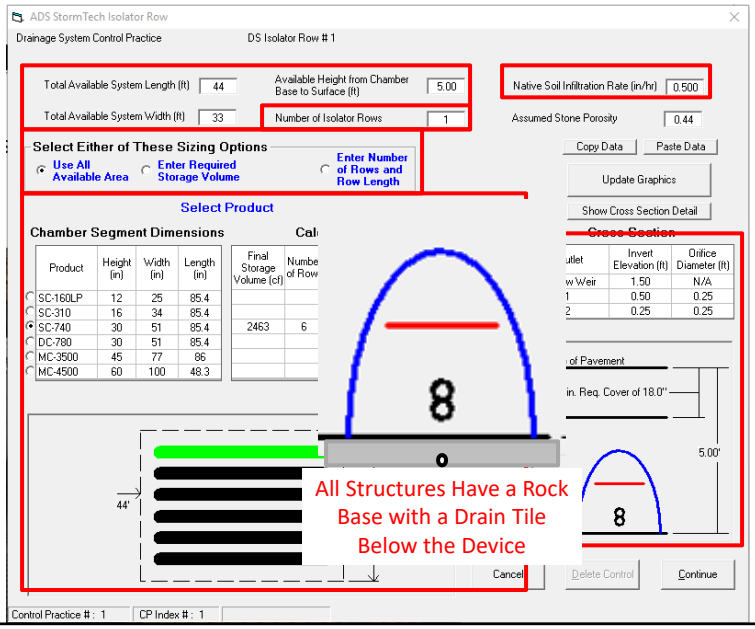
StormTech Isolator Row

The StormTech Isolator Row has been added to WinSLAMM v 10.4



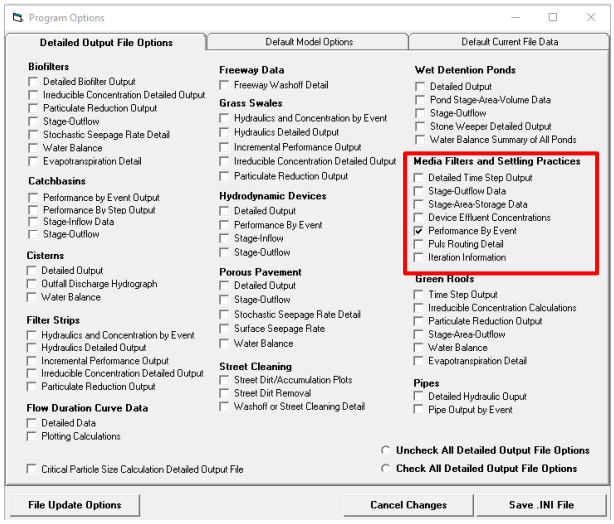
1i. Selected topics – proprietary underground vaults

StormTech Isolator Row



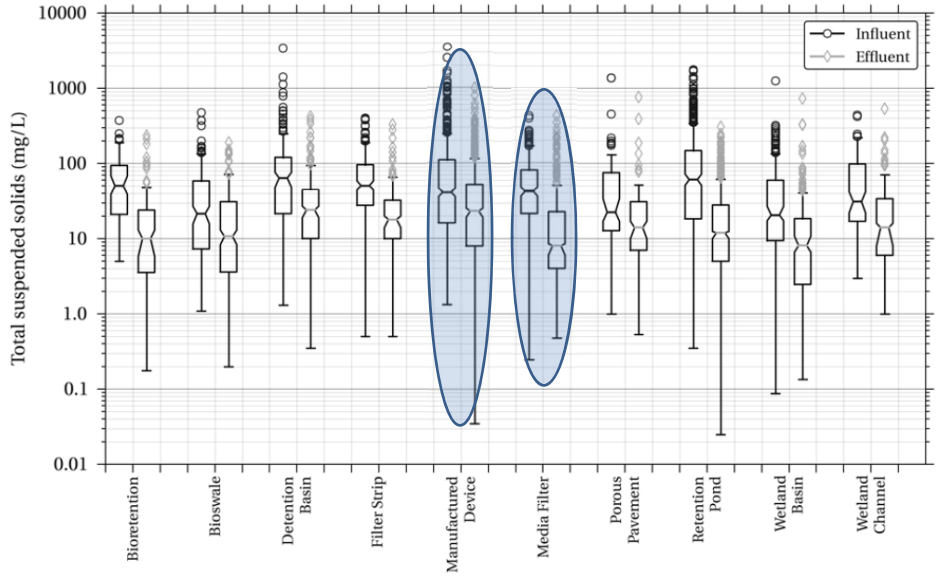
1i. Selected topics – proprietary underground vaults

StormTech Isolator Row



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



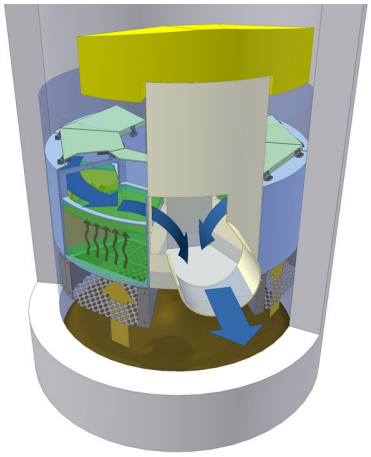
- TSS influent and effluent for different stormwater practices: International Stormwater BMP Database
- Manufactured devices (hydrodynamic devices) and media filters had about the same median influent TSS concentrations, but the media filters had substantially lower effluent TSS concentrations.

9

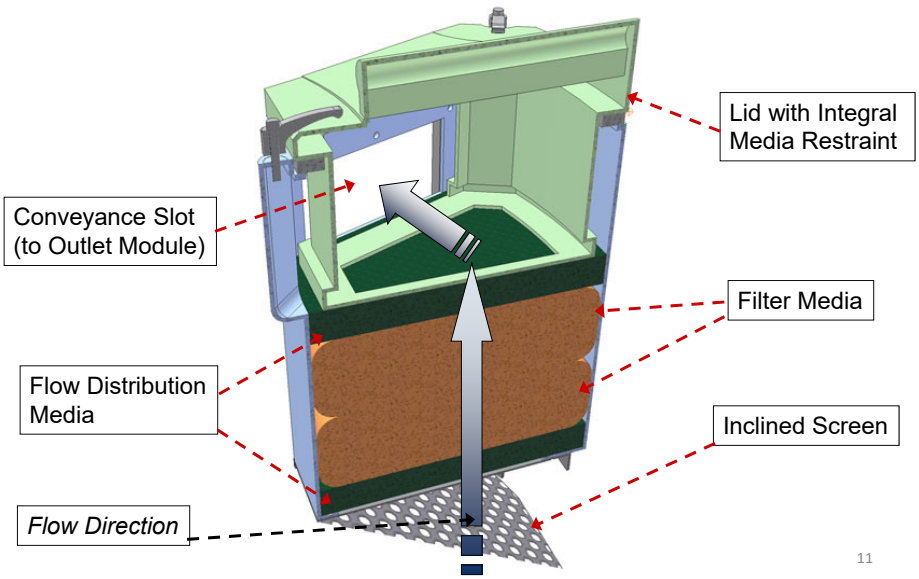
Up-Flo® Filter

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)

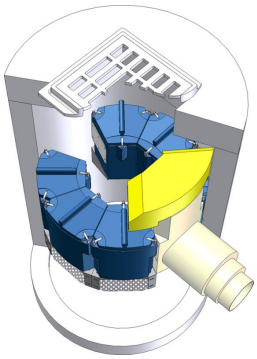


Up-Flo® Filter Module



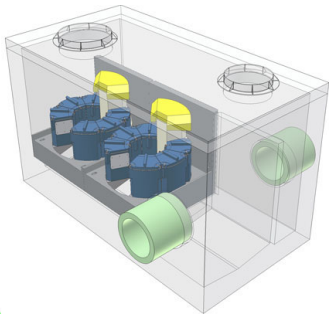
11

Up-Flo® Installation Configurations



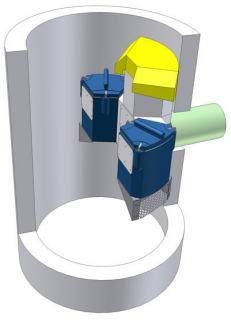
Standard Manhole

(1 Ring) Upstream source control small drainage sites



Vault

(2 -3 Rings)
Larger catchments



Up-Flo Retro

Retrofit applications for small or irregular catch basins

12

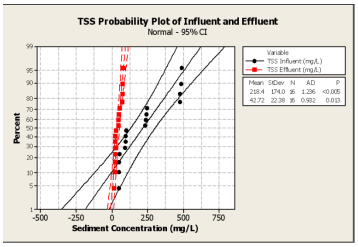
Current Full-Scale Monitoring in Tuscaloosa, AL

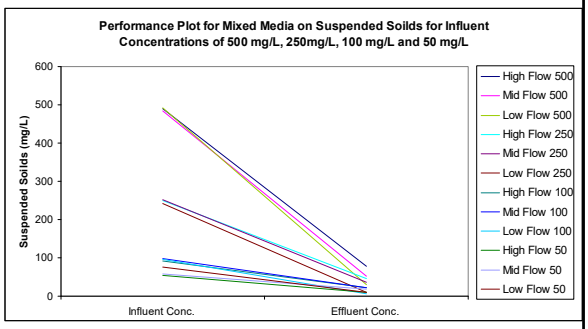
One acre, mostly paved drainage area

13

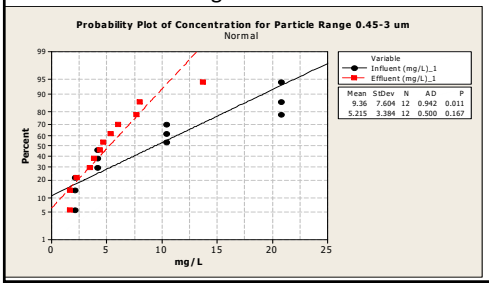
Pilot-Scale Tests, Controlled Tests and Three Years of Actual Runoff Events

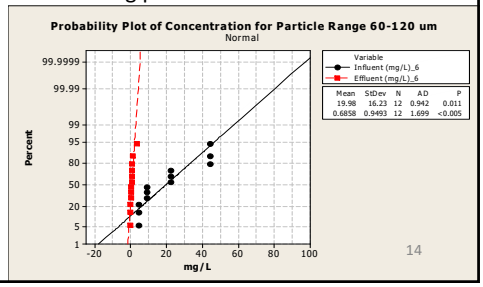
Flow rate has only a small effect on effluent quality. Effluent quality is relatively constant over broad range of influent concentrations and flows.





Performance during actual rains over a 10 month monitoring period:





14

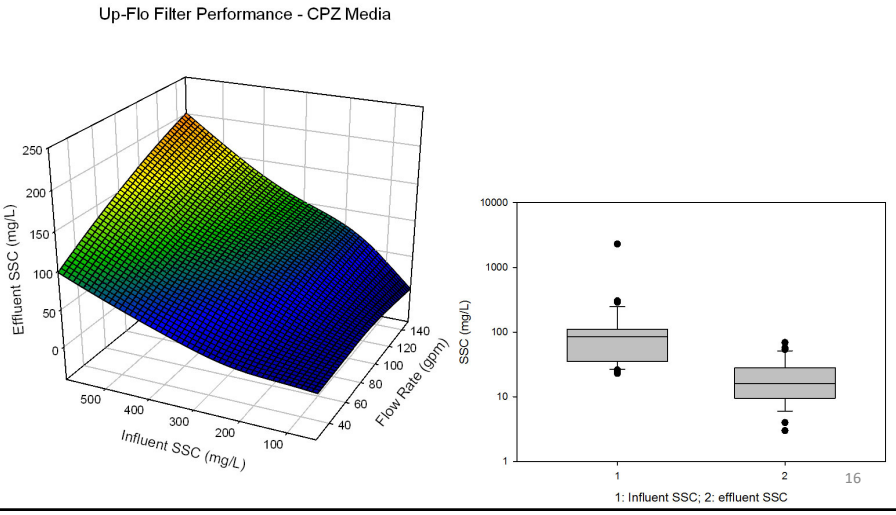
Performance Summary by Particle Size

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	86

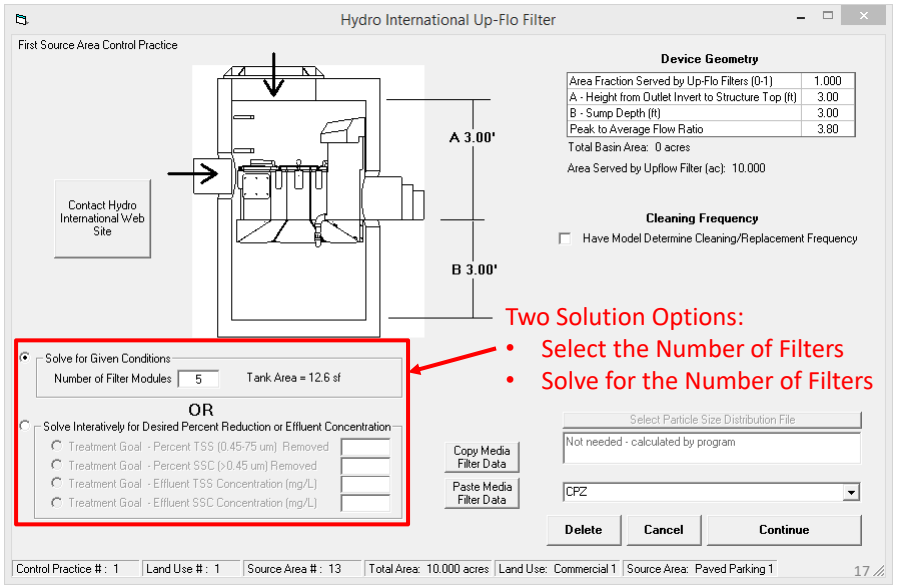
15

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



16

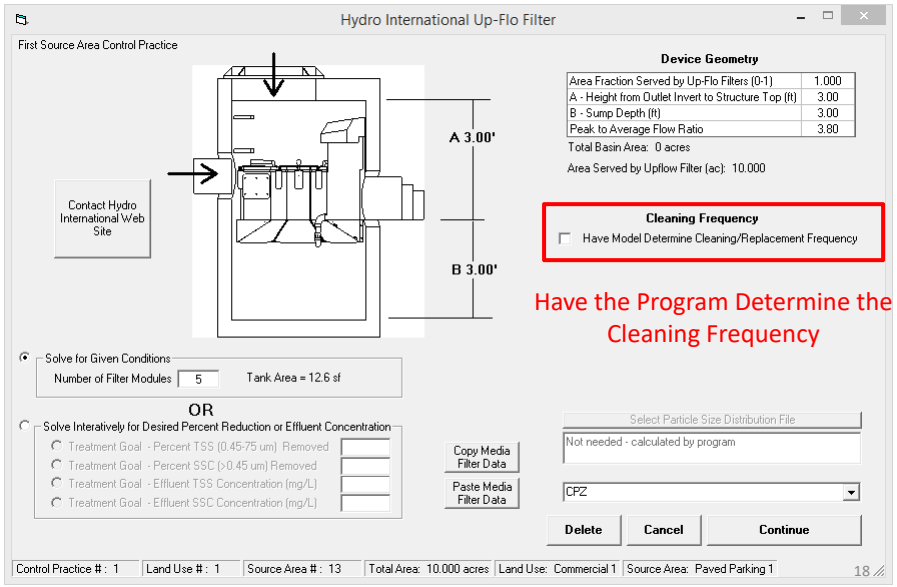
Up-flo® Filter Incorporated into WinSLAMM Based on Lab and Field Tests



Two Solution Options:

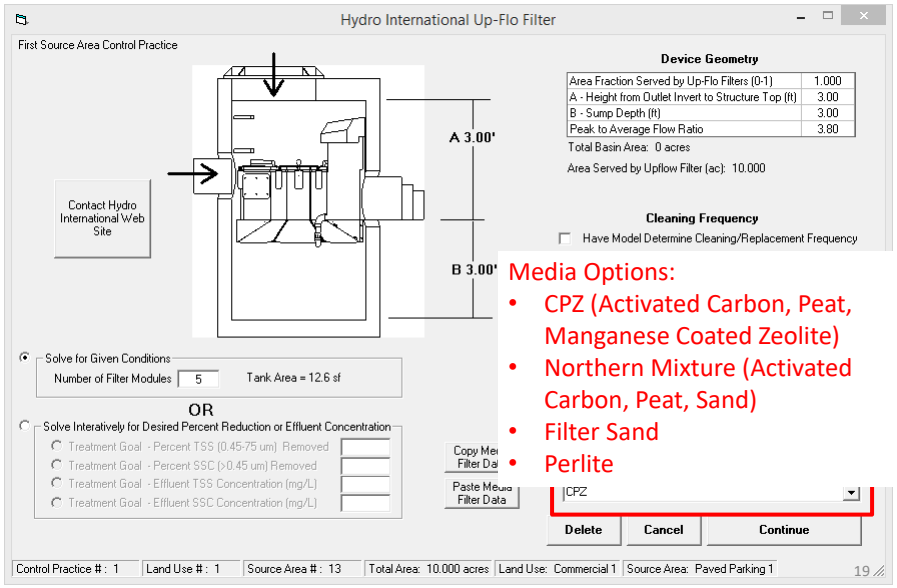
- Select the Number of Filters
- Solve for the Number of Filters

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



Have the Program Determine the Cleaning Frequency

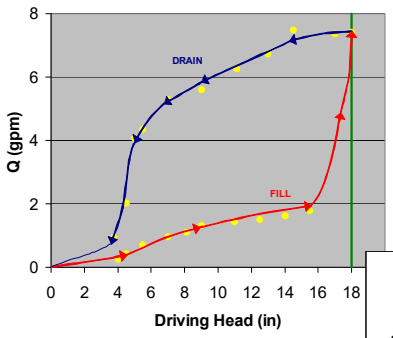
Up-flo® Filter Incorporated into WinSLAMM Based on Lab and Field Tests

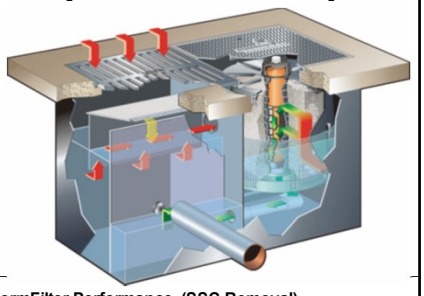


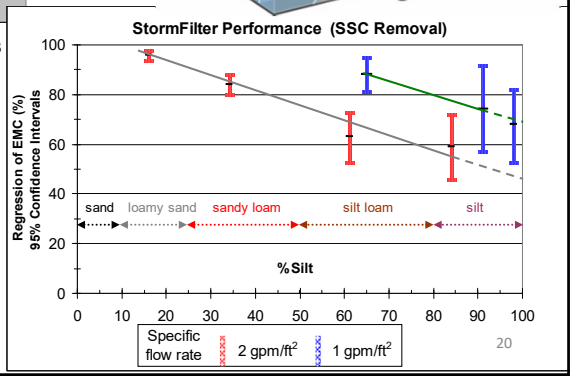
Media Options:

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

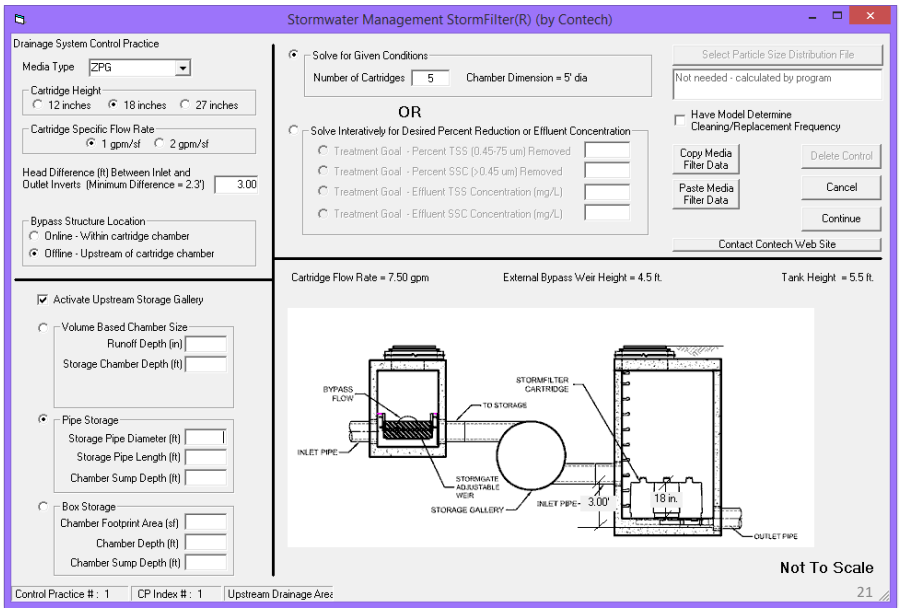
Contech's StormFilter also has substantial performance information (from both laboratory and field tests).



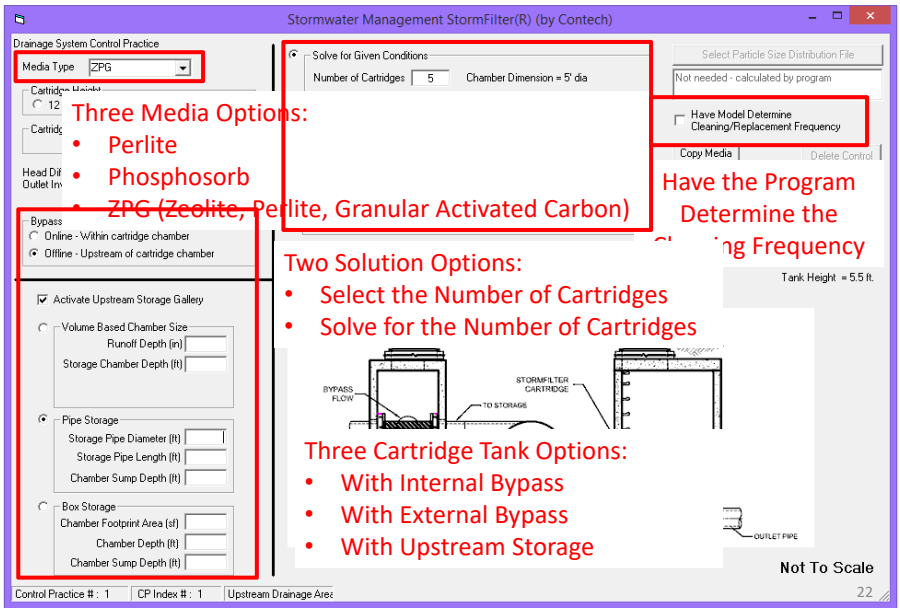




The Contech StormFilter is Incorporated into WinSLAMM based on Field and Lab Data

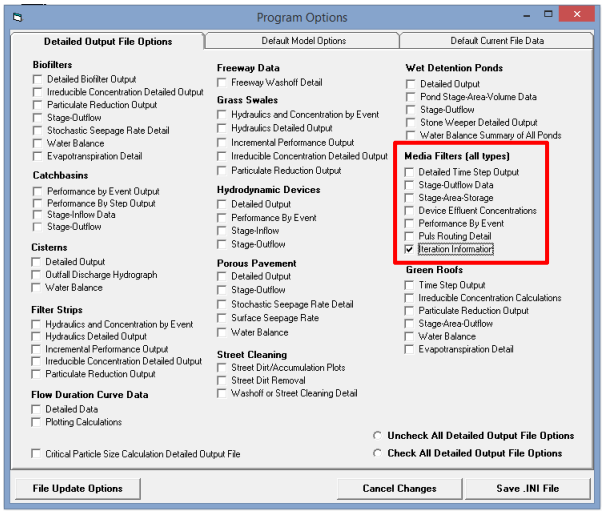


The Contech StormFilter is Incorporated into WinSLAMM based on Field and Lab Data



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

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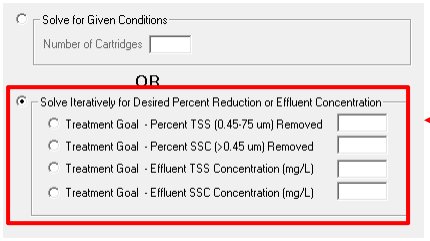
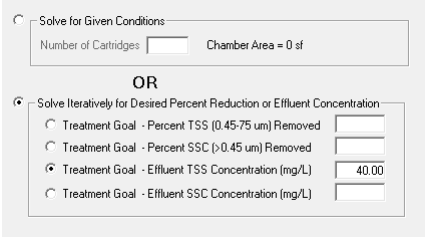
Analysis Procedure When Solving Iteratively



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

1

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	

1. 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

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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

2

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	

2. 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.

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