ACF ENVIRONMENTAL

Let's Get It Done

FocalPoint

High Performance Modular Biofiltration System (HPMBS)

Introduction, HydroCAD Design and Review Guide

(Philadelphia Water Department)

FocalPoint High Performance Modular Biofiltration System (HPMBS)

Introduction, HydroCAD Design and Review Guide

Table of Contents

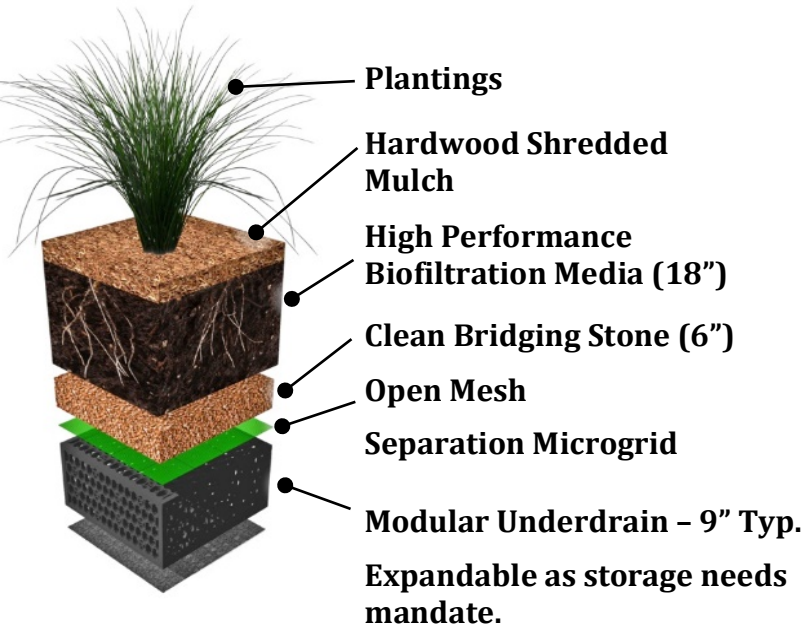
Introduction to FocalPoint HPMBS

The FocalPoint is an ultra-efficient, modular and scalable biofiltration system that treats and drains large volumes of stormwater runoff in a small footprint to meet post construction Green Infrastructure (GI) Low Impact Development (LID) or Traditional PCSM stormwater treatment requirements. The system can be installed along the edge of a roadway behind curb line, in landscaped stormwater basins and be incorporated into an urban green infrastructure streetscape. Some examples of the system are illustrated below:



The modular FocalPoint HPMBS is a complete, integrated system with a demanding specification that insures functionality, performance and maintainability. With rigorous quality assurance standards and post-construction in-situ performance verification, FocalPoint HPMBS provides guaranteed performance.

The FocalPoint System is designed and sold on a sq. ft. basis. The system profile (right) is provided as a complete package. With it's soft-shell and scalability design it brings new flexibility to stormwater treatment design. The FocalPoint System profile can be incorporated as an alternative to traditional low flow bioretention mixes into bump-outs, tree trenches or boxes, rain gardens or other areas where higher efficiency are desired or demanded.

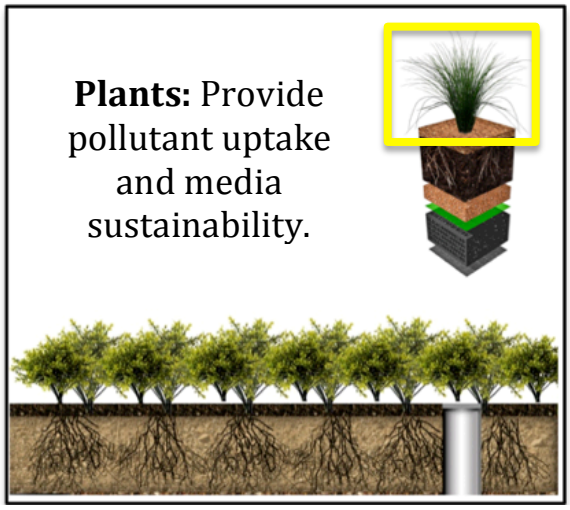


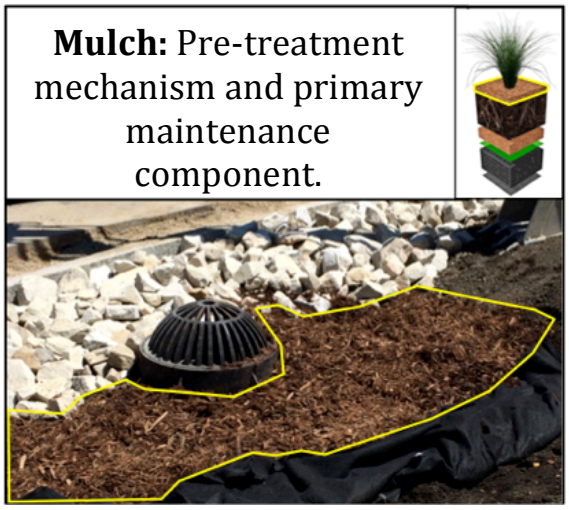
FocalPoint HPMBS Components

As shown, the system (From the top down) consists of:

Plants: Placed in the media that provide sustainability of the system by providing both long-term aeration and drainage through the media as well as uptake of the pollutants the media has previously removed from the runoff treated in the media.

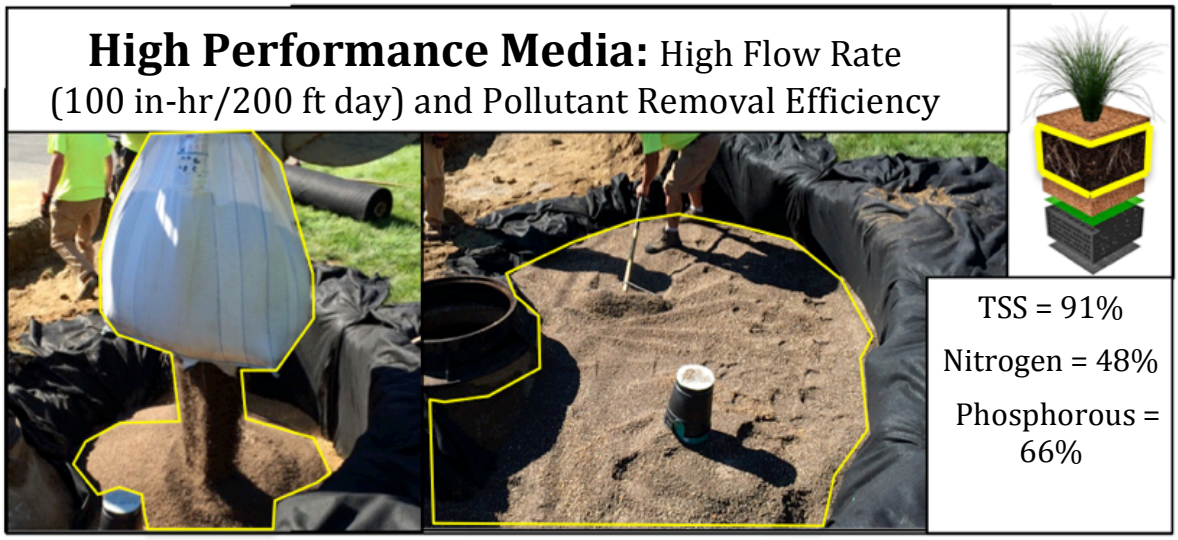
The plants represent the only component that is not supplied by ACF Environmental. A recommended plant list is available upon request.



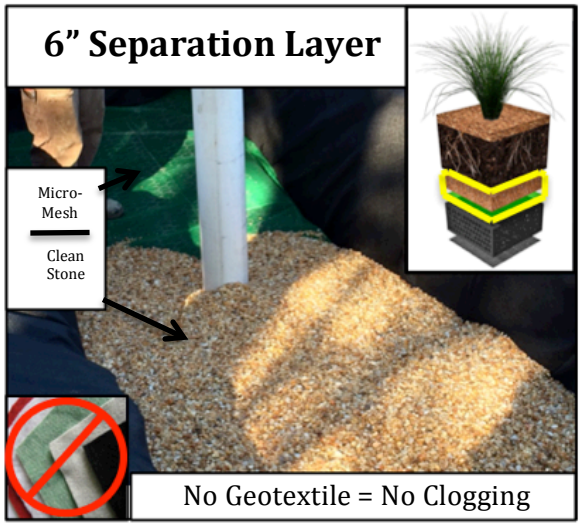


Mulch: Three inch of clean shredded hardwood mulch is placed on top of the media to serve as a pretreatment and thermal-barrier layer. The replacement of the 3" mulch layer at 6 to 12 month intervals represents the main component of long-term system maintenance. Maintenance is discussed on page 9.

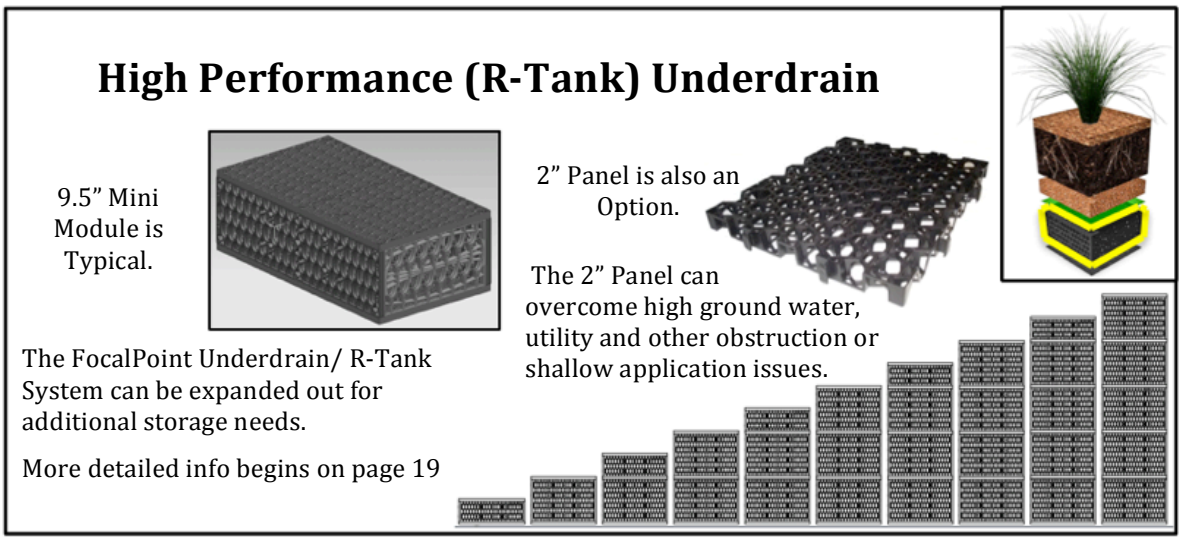
High Flow Media: The high flow media infiltrates/processes/conveys at a rate of 100 inches per hour. As such, the size and volume of the engineered media beds can be reduced by 80% or more, when compared to typical bioretention systems that infiltrate at rates of less than five (5) inches per hour. Reducing system size brings multiple benefits, including reduced and simplified maintenance procedures, savings in the amount of excavation (great benefit when working with contaminated soils and shallow bedrock), reduction in quantity of impermeable liner (if required), stone, underdrain, materials to name a few. FocalPoint assures performance by providing media testing reports prior to shipment and performing an in-situ test after installation to confirm the infiltration rate.



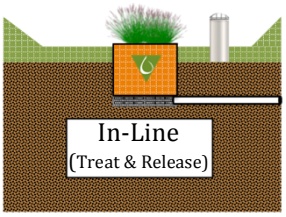
Separation Layer: Below the high flow media is a 6-inch bridging stone layer (washed/clean stone) and then an open mesh "Micro-Grid". This is an **open grid** mesh, not a restrictive non-woven fabric (which is commonly a primary source of premature failure of bioretention and biofiltration systems). The purpose of the open grid is to prevent the 6-inch bridging stone layer from entering the FocalPoint modular underdrain. All of the FocalPoint components are shipped as a "bundled" package to provide quality control and quality assurance of the entire system.

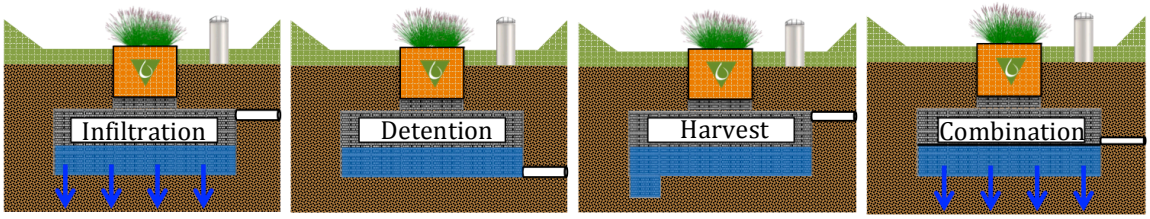


Modular Underdrain – R-Tank System: The FocalPoint underdrain system typically consists of a 9.5 inch tall box underdrain (R-Tank), but can be expanded both vertically and horizontally to achieve infiltration and detention goals. The box underdrain is more efficient at collecting and conveying the runoff than a typical crushed stone and pipe configuration, and can be accessed via the system inspection port. This is important when considering the rate at which the runoff is passing through the media (discussed above).



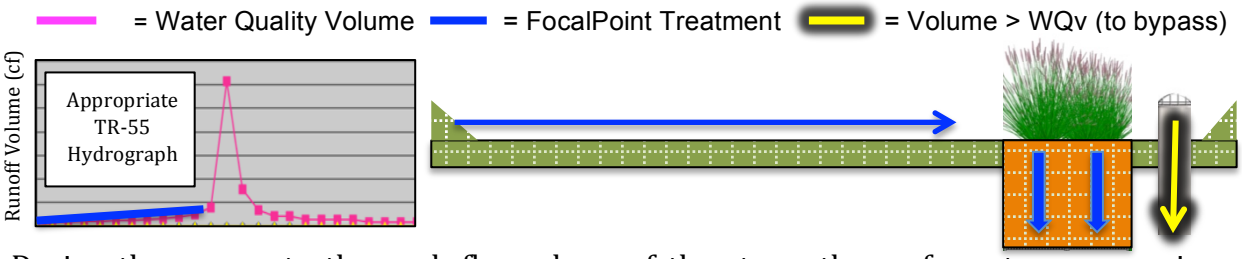
The option to expand the R-Tank modular under-drain allows for unprecedented versatility; FocalPoint can provide full treatment for in-line "treat and release" or detention designs or pre-treatment for infiltration, harvesting and combination applications.



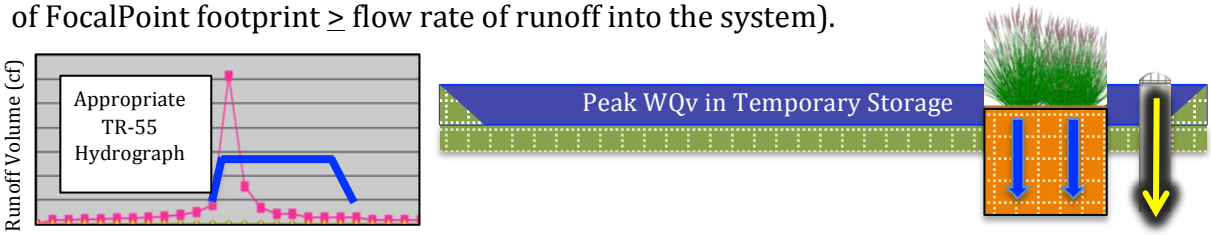


More detailed information on the under-drain applications begins on page 19.

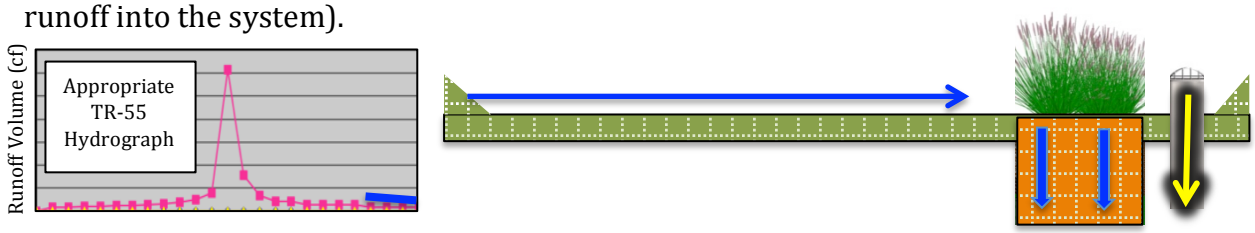
Surface Depression / Temporary Storage: The FocalPoint HPMBS utilizes berms or curbs to create a shallow depression that provides temporary storage to mitigate the issues associated with peak flow discharges. As the flow increases during the runoff event this surface storage (typically to a depth of 6-8 inches) can be leveraged to provide maximum flexibility and efficiency in taking advantage of whatever stormwater management footprint is available for any given site.



During the run-up to the peak flow phase of the storm the surface storage remains empty while the runoff flows through the FocalPoint treatment footprint (Flow capacity of FocalPoint footprint ≥ flow rate of runoff into the system).



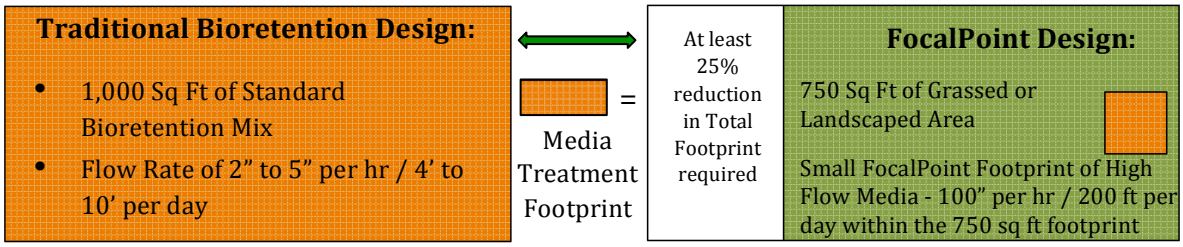
During the peak flow phase of the storm the surface depression provides temporary storage for the peak volume (Flow capacity of FocalPoint footprint < flow rate of runoff into the system).



After the peak flow phase of the storm event the volume in the temporary storage begins to draw down as the FocalPoint continues to treat at a rate higher than the incoming runoff (Flow capacity of FocalPoint footprint ≥ flow rate of runoff into the system).

Why FocalPoint BioFiltration? Basic Design & Implementation

FocalPoint's high flow media allows for flexible and cost effective alternative approaches to both traditional bioretention and manufactured treatment devices (MTDs) and does so based on a fundamental TR-55 rainfall and distribution approach. The FocalPoint System is sized to treat the entire "Water Quality Volume (WQv)". Below is a comparison of a standard bioretention approach and a FocalPoint biofiltration example (ACF Design Support provides calculation assistance for all hydraulic design requirements).



FocalPoint Design can treat the same volume at 75% or less of the footprint. The 25% footprint reduction above is a minimum expectation when comparing FocalPoint biofiltration design to traditional Bioretention design. Further reduction can be achieved per FocalPoint scalability (as discussed on the following page).

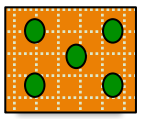
FocalPoint System Scalability

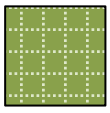
FocalPoint's fundamental TR-55 rainfall and distribution approach to sizing provides exact computations as to where every cubic foot of runoff is at any time during the rainfall / runoff event. This approach eliminates the "black box" sizing approach promoted by most of the Manufactured Treatment Devices (MTDs) as state of the practice. The ability to leverage the size of the FocalPoint treatment footprint within the surface depression available for temporary storage allows for the unique scalability of the system.

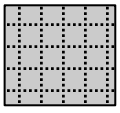
Presented below are some example calculations and images of projects using this design approach to meet the Water Quality Volume (WQv) regulatory requirements. All scalability examples are based on a Drainage Area (DA) of 0.20 acres with a Curve Number (CN) of 98 and a 24 hour Type II design storm distribution and treat the same WQv.

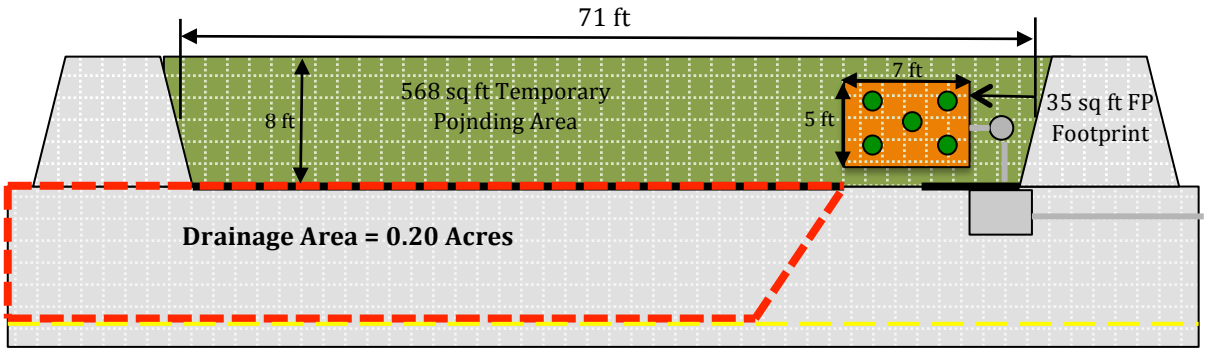
Scalability Design Examples

The following parameters apply for the Drainage Area provided for the scalability examples for the **WQv**: DA = 0.20 Acres (8,712 sf), 24 hour Type II event = 1.70 inches of rain (1.5" runoff) and a total Water Quality Volume (WQv) of 1,073 cf:

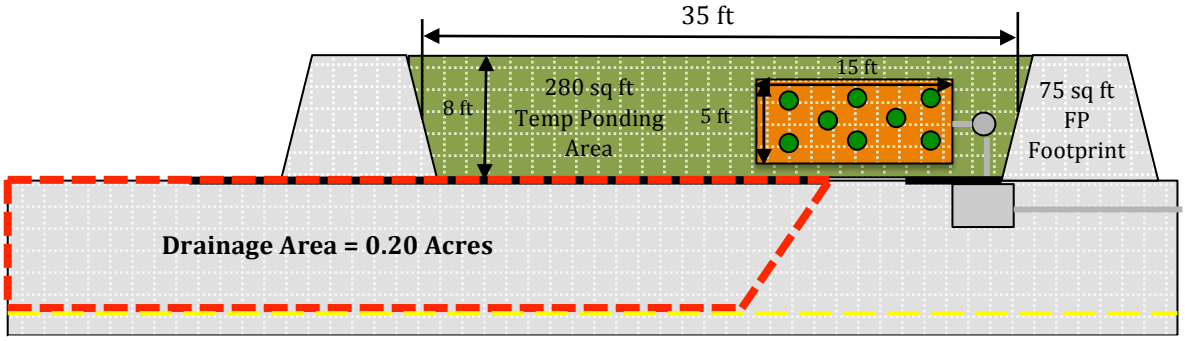

FocalPoint Footprint


Temporary Surface Storage Footprint

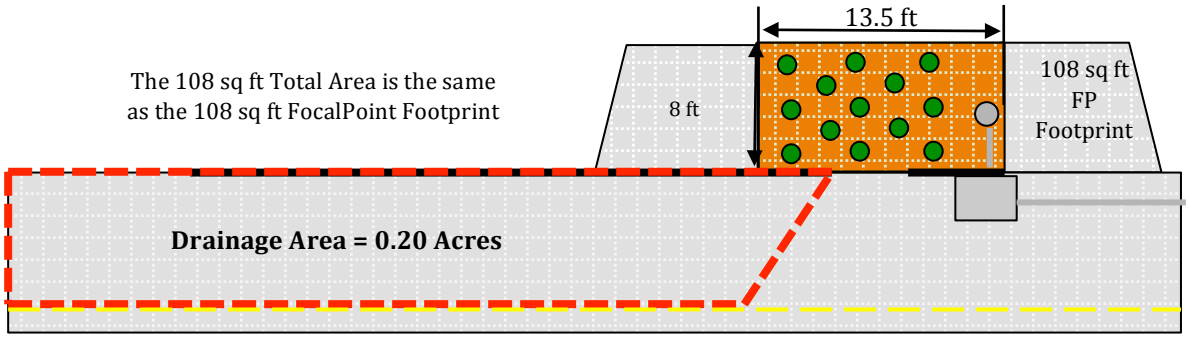

Drain Area (DA)



Option #1: Total Area = 568 Sq Ft (8' x 71'), FocalPoint Footprint = 35 Sq Ft (5' x 7').

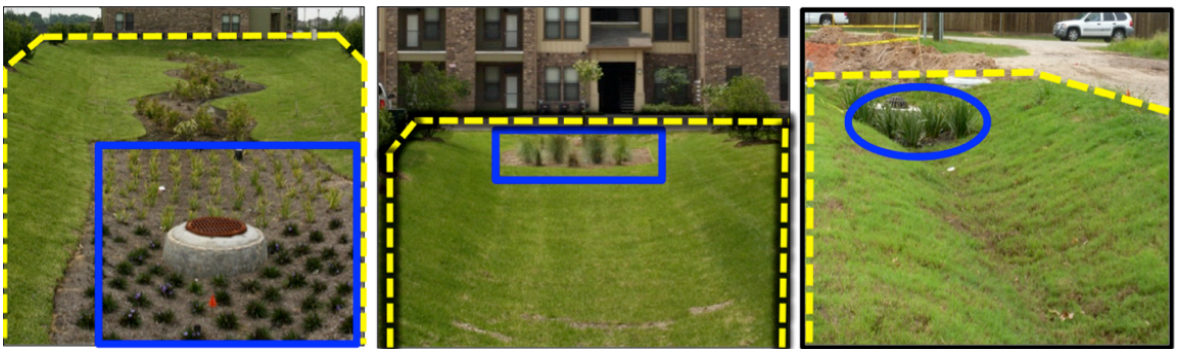


Option #2: Total Area = 280 Sq Ft (8' x 35'), FocalPoint Footprint = 75 Sq Ft (5' x 15')



Option #3: Total Area = 108 Sq Ft (8' x 13.5'), FocalPoint Footprint = 108 Sq Ft (8' x 13.5').

Project examples using this sizing approach.
Blue = FocalPoint, Yellow = Temp Storage



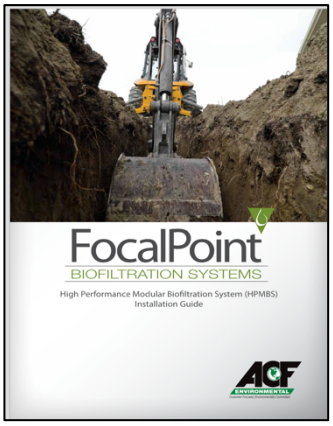
Project examples using this sizing approach. Blue = FocalPoint, Yellow = Temp Storage.

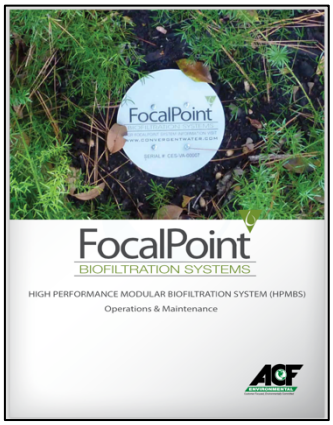
FocalPoint can easily be incorporated into current "Treebox", "Bump-out" and "Bio-swale" designs to overcome inherent deficiencies and limitations. The modular nature of the FocalPoint system components makes it friendly to retrofit designs where existing infrastructure could prohibit larger single unit alternatives.

FocalPoint Maintenance:

Maintenance of the FocalPoint System is simple. Annual removal and replacement of mulch is the main task at hand. This can be performed by public works/maintenance/landscape contractor as part of regular streetscape maintenance or by local arborist/horticulturist. As it is an open system, it is easy to access the entire surface. Any winter sand gets caught by the mulch and can be easily raked out with the mulch. The first year of maintenance is provided at no charge and ACF Environmental can provide training to the identified maintenance party if needed.

Proper installation and maintenance methods are comprehensively presented in the FocalPoint Install and Maintenance Manuals.





What is HydroCAD?

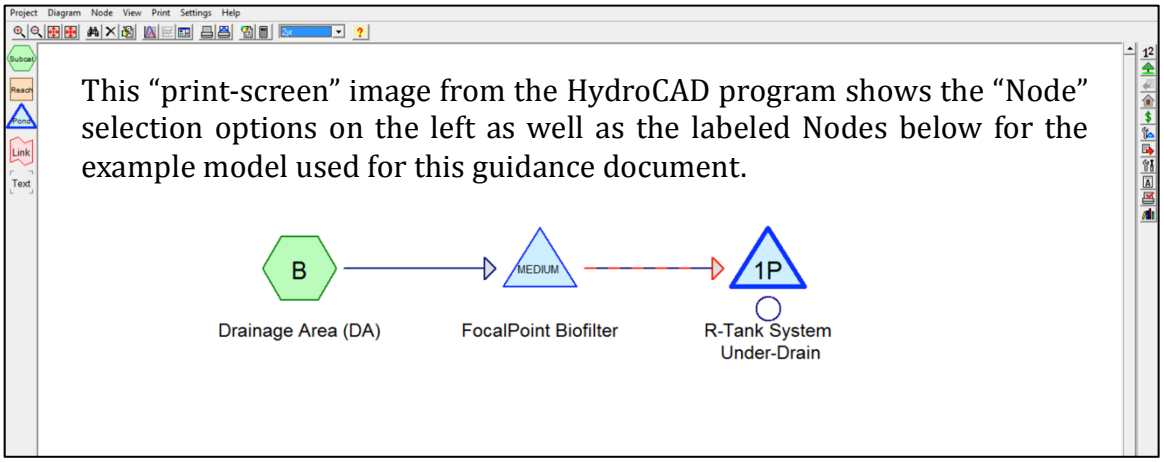
HydroCAD is a Computer Aided Design program for modeling the hydrology and hydraulics of stormwater runoff, commonly referred to as H&H. HydroCAD uses procedures developed by the Soil Conservation Service (now the Natural Resources Conservation Service), plus a wide range of other standard H&H calculations, to produce a fully-intergrated, interactive stormwater modeling system.

HydroCAD is commonly used to generate runoff hydrographs for a given watershed and study their flow through a drainage system consisting of natural and/or artificial components. HydroCAD is a powerful program that provides engineers with the ability to quickly analyze a wide variety of systems and contributing factors. The main scope of the HydroCAD review and guidance in this document will focus on the narrow subject of how the FocalPoint System is sized to treat the Water Quality Volume (WQv) of any given runoff event. The document will also provide some lesser insight into the HydroCAD sizing of the extended R-Tank Storage System as the FocalPoint Modular underdrain starting on page 24).

FocalPoint / HydroCAD Design Components:

There are three basic components (or nodes) of any FocalPoint System HydroCAD model (as illustrated below);

- A Sub-catchment that represents the drainage area (DA) which is used to determine the runoff volume and distribution from any given rain event. The runoff from the sub-catchment then feeds:
- A Pond Node that represents the FocalPoint System constructed filter structure
- A second Pond Node that represents the FocalPoint Underdrain (R-Tank System).



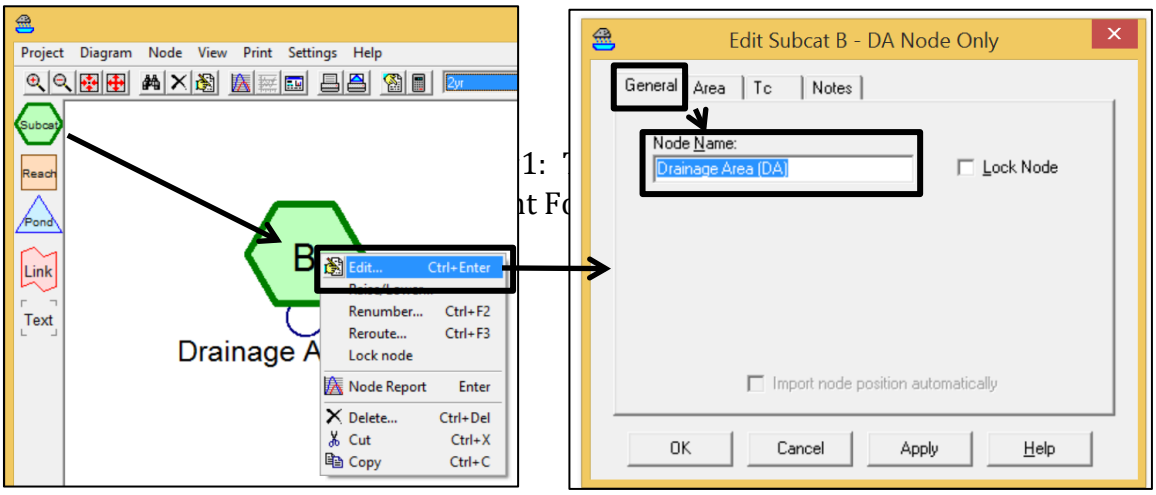
This section of the document will cover the WQv sizing of the FocalPoint HPMBS and surface storage area only, extending the modular underdrain for retention, infiltration or harvesting applications is covered starting on page 24.

The Sizing/model examples following are based on a Drainage Area (DA) of 0.20 acres with a Curve Number (CN) of 98. A 2 year/ 24 Hour Type II design storm distribution is modeled to treat the WQv based on the full volume of a pre-to-post runoff increase **(the following protocol is the same as approach as used in the 1.5 inch runoff volume design used in the scalability example on pages 7 & 8).** These model are basic examples of how the modeling is done, ACF Environmental can provide specific support for individual regulatory needs.

Creating the HydroCAD Drainage Area (DA) Node

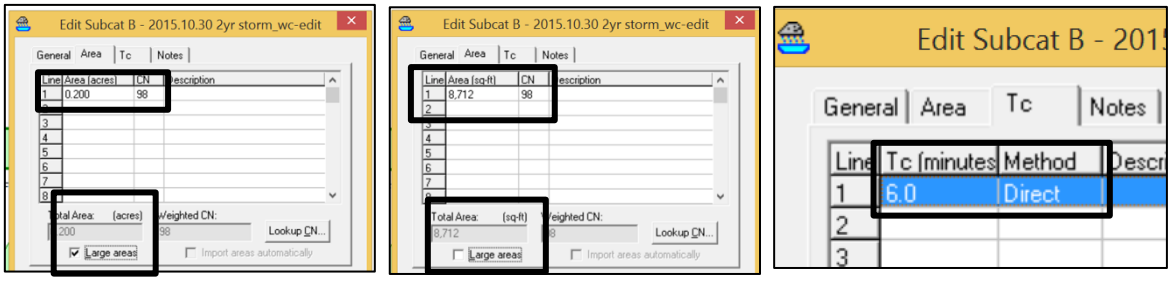
Creating the Drainage Area (DA) Node is a very basic process in HydroCAD and will be illustrated with the use of print screens from the program (as will the entire sizing and review process).

The "Subcat" icon is selected and dragged into the project window, right clicking on the Subcat icon will produce the Subcat pull-down menu, selecting edit will open up the Node window where the it can be labeled in the first "General" tab.

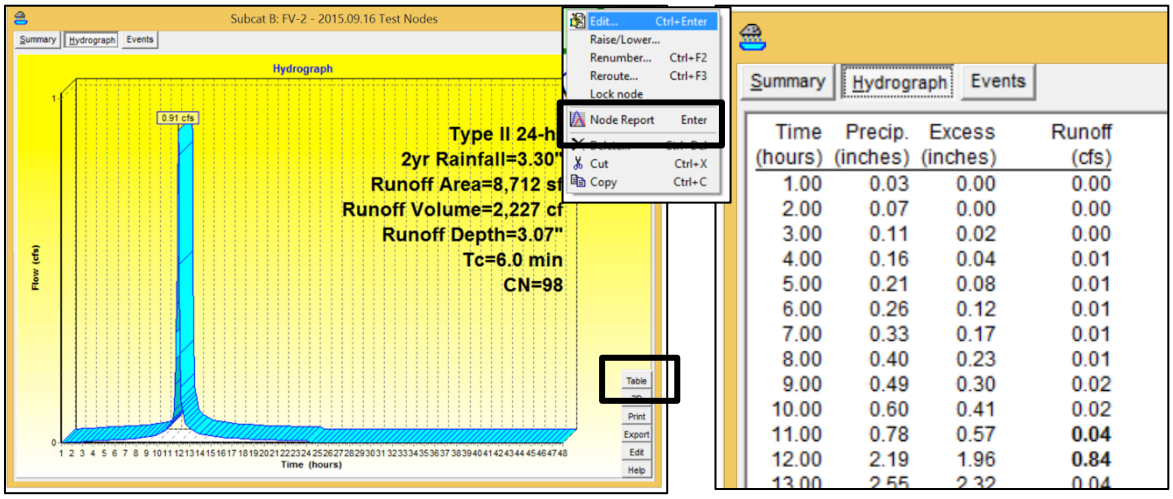


Once the Node is named, the project specific information for the DA can be entered into the "Area" tab. The specific DA can be entered as acres with the "large areas" box checked (below left) or as sq ft with the "large areas" box unchecked (below right).

Both options are shown below, the sq ft option will be used for this document. A CN of 98 is selected as these examples are based on the drainage from a relatively small paved parking lot. Typically six (6) minutes is entered for the Time of Concentration (min. in most States) under the "Tc" Tab to finalize the creation of the DA Node.



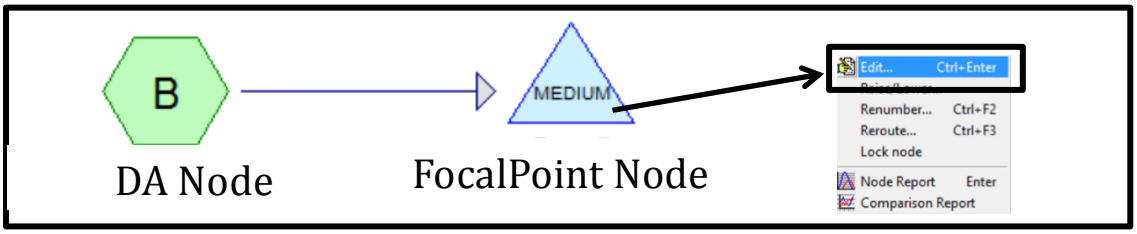
The DA Node will calculate the runoff volume and distribution as represented in the hydrograph (below left) and report form (below right). The Hydrograph window can be accessed by selecting “Node Report” from the DA Node pull-down menu and the “table” button will toggle between the Hydrograph and Tables representations.



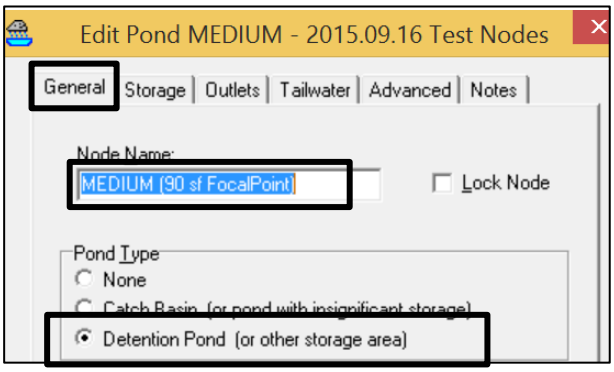
The runoff volume and distribution from the DA Node will be incorporated into all subsequent calculations in the HydroCAD file.

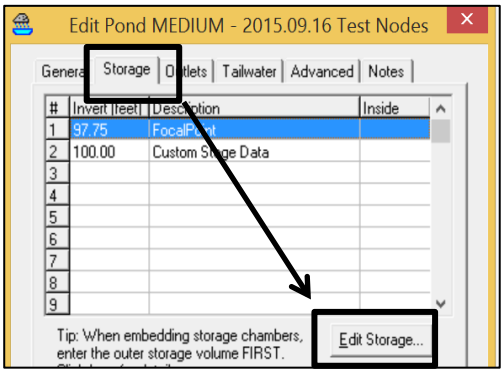
Creating the FocalPoint HPMBS (FP) Node

As shown earlier, the FocalPoint is represented as a ”Pond” Node when designed in HydroCAD (A blue triangle is the HydroCAD pond icon). The FocalPoint filter is built by right-clicking on the Node pull-down menu and selecting “edit”.

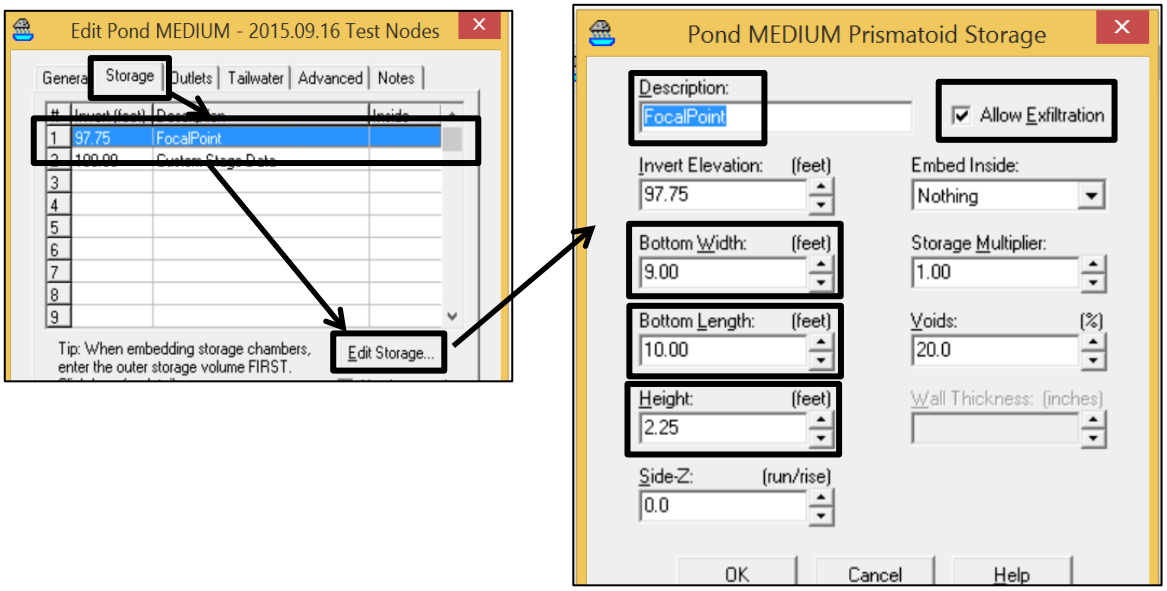


First the FocalPoint Node is named in the “General” tab and designated as a “Detention Pond” (below left). The FocalPoint HPMBS profile is built by selecting the “Edit Storage” button in the “Storage” tab window.

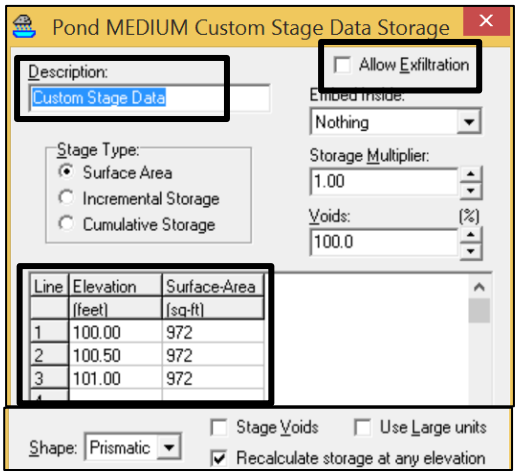




Next, set the elevations and dimensions of the FocalPoint HPMBS. Using an example of 100 as the top of the FP elevation, the invert elevation is set at 97.75 based on the standard 2.25 ft Mulch/Media/Separation Layer profile depth (right). Note that the "Allow Exfiltration" box is checked when building the FocalPoint Node.

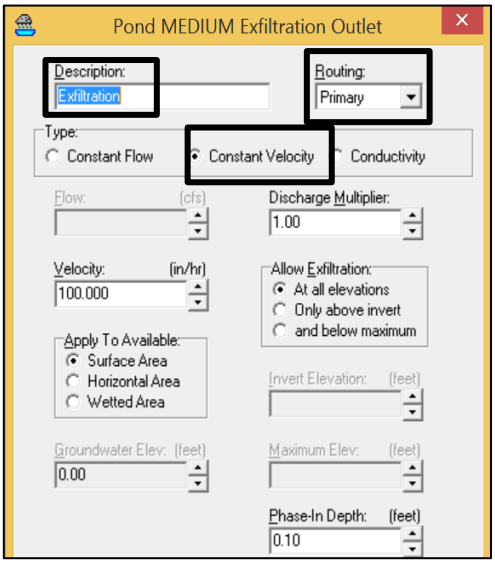


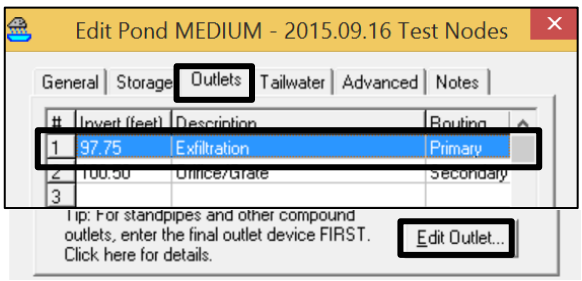
A 90 sq ft FocalPoint footprint is being built. The iterative sizing process can start with a fixed FocalPoint footprint but generally is started with a fix storage footprint (right).

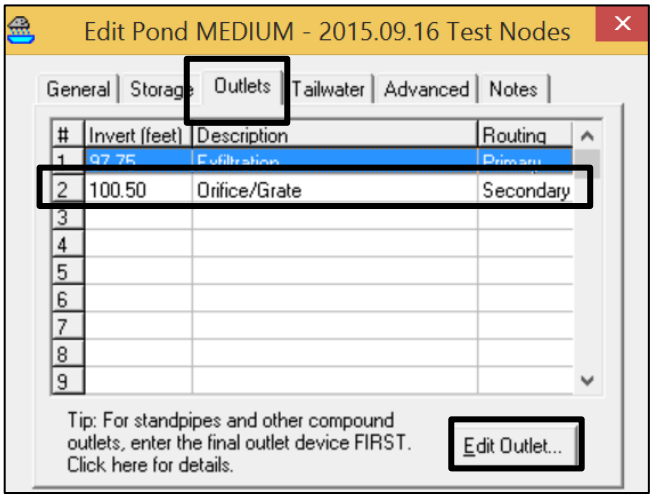


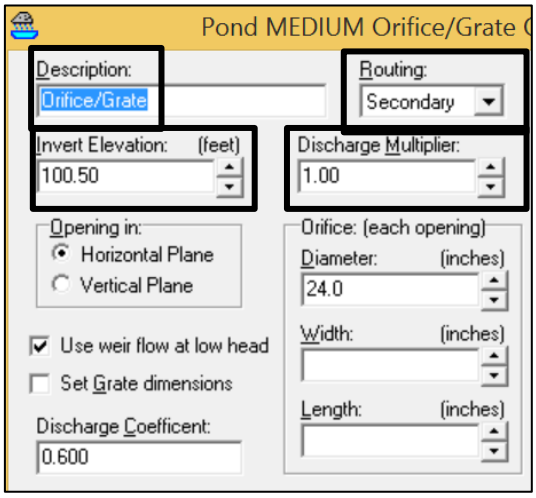
Next the surface storage (Custom Stage Storage) elevations and square footage is set; 972 sq ft is used for all storage elevations. The 100.00 is the top of the FocalPoint, the 100.50 is the bypass elevation and the 101.00 represents the top of the surface storage – note that the "Allow Exfiltration" box is NOT checked for storage.

The FocalPoint exfiltration is set as the primary outlet, at 100 Inches per hours "Constant Velocity" over the surface area, at all elevation with a phase-in depth of 0.10ft. (below and below right),



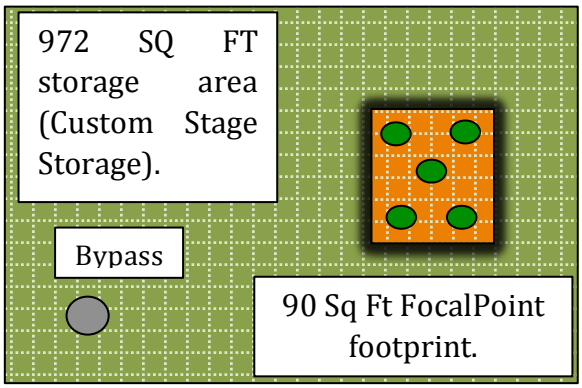




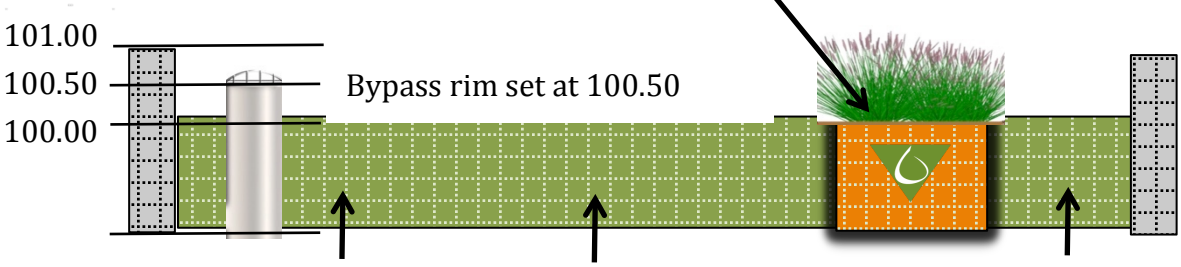


The last step of building the FocalPoint Node is to set the bypass outlet; In this case it is designed as an Orifice / Grate, Secondary discharge at 100.50 – Horizontal Plane, 24" diameter pipe.

Right and Below are plan and cross section views of the FocalPoint system Node built:



100" hr / 200 ft day Exfiltration from FocalPoint footprint.



No Exfiltration from Surface Storage (Custom Stage Storage.

The final FocalPoint system Nodes are sized based on the Water Quality Volume (WQv), the runoff distribution of that WQv, the treatment rate of the FocalPoint media, and the available temporary surface storage. Whether it is an entire event design or first flush design the bypass elevation is set to determine if the full WQv is being treated prior to any bypass of the system.

That being the case, the only outlet to have flow running through it should be the FocalPoint or Primary as it was labeled in the Node. If the is any flow in the bypass or Secondary then the system has NOT treated all of the WQv and either a bigger storage area or larger FocalPoint footprint must be built until the secondary outlet is not activated.

The HydroCAD Iterative Design Process (Full Event Volume)

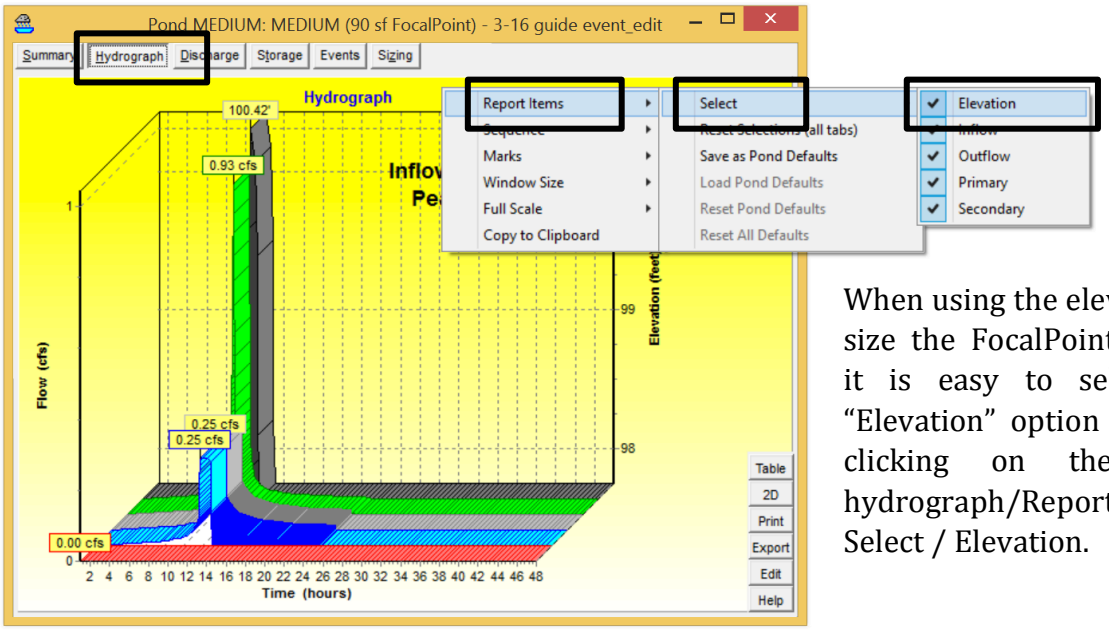
Generally speaking, HydroCAD design of FocalPoint is an iterative process that begins with some estimated sizing that is then fine tuned for the final result. ACF Environmental does provide the use of the "ACF FP & RT Calculator" to provide an easy tool for preliminary budget and sizing calculations. The initial run of the sample site characteristics in the ACF Calculator provided a result of a 107 sq ft FocalPoint footprint inside of the 972 sq ft surface storage area. (See screen shot of ACF Calculator below)

FocalPoint BIOFILTRATION SYSTEMS

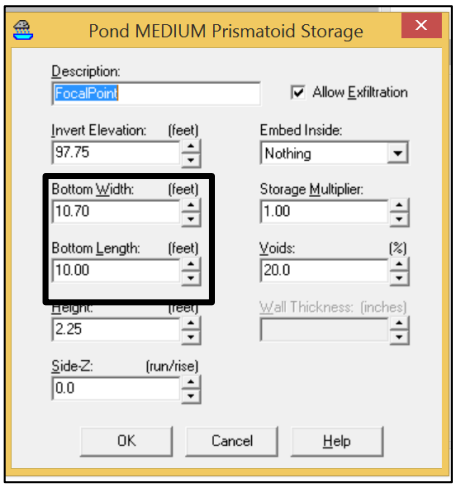
FOCALPOINT DESIGN WORKSHEET

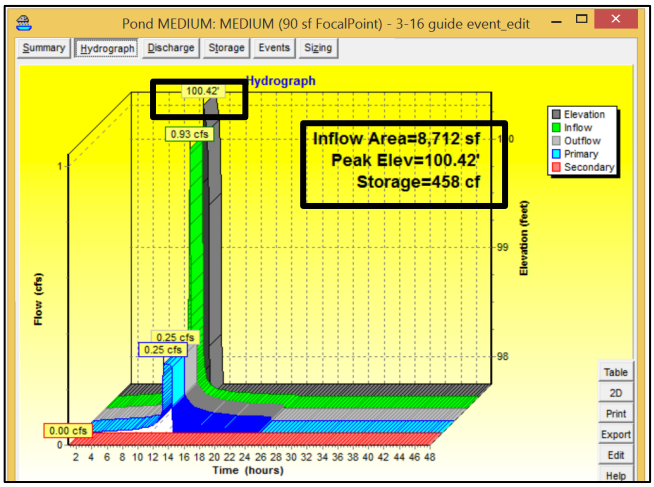
Step 3 - Design Information			**Directions**
3.1 - Water Quality Volume (WQv)	2,227	ft³	Computed Water Quality Volume from previous Sheet
3.2 - Design Event	2,227	ft³	Computed Design Event volume from previous sheet
3.3 - Is FocalPoint used?	Yes		Enter "Yes" if FocalPoint used. Enter "No" if runoff flows directly into R-Tank and proceed to R-Tank Design worksheet
Step 4 - FocalPoint Configuration			
4.1 - FocalPoint Factor of Safety	1.0		Enter optional factor-of-safety
4.2 - FocalPoint bed area	107	ft²	Enter target FocalPoint footprint, (20 ft² min.)
4.3 - Storage volume above FocalPoint provided	486	ft³	Enter available surface storage volume (10 ft³ min.)
4.4 - Desired treatment time	48	hours	Drawdown time from start of storm event (Select 24 or 48 hrs)
4.5 - Water Quality Volume treated prior to bypass?	Yes		If Yes = WQv has been treated. If No = larger FocalPoint bed (Step 4.2) and/or surface storage volume (Step 4.3) required
4.6 - FocalPoint drains within desired time?	Yes		If Yes = drawdown time goal has been met. If No = larger FocalPoint bed (Step 4.2) required
4.7 - Routing for WQv or Design Event	To R-Tank		Select from toggle: "Offsite" to disregard flow, "To R-Tank" to store for retention / detention, harvesting, or infiltration (proceed to R-Tank Design worksheet)
Step 5 - Evaluation of Design			
5.1 - Volume treated prior to bypass	No Overflow	ft³	Result = Volume ft3 treated prior to bypass
5.2 - Total volume treated	2,227	ft³	Result = Total Volume ft3 treated
5.3 - Total volume bypassed	0	ft³	Result = Total Volume assumed to bypass (Step 4.7)

(To obtain the ACF FP & RT Calculator, please contact Rob Woodman at 207-272-4431, rwoodman@acfenv.com or Warren Cohn at 888-856-4505, wcohn@acfenv.com .

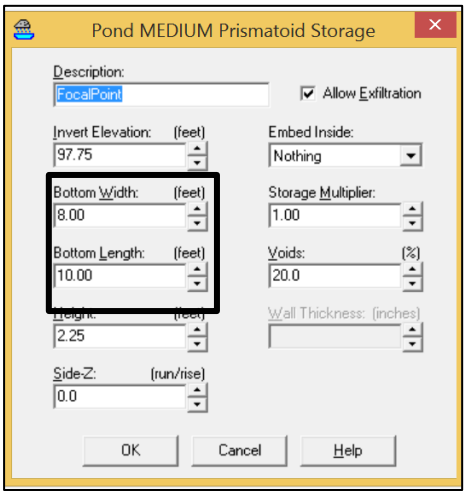


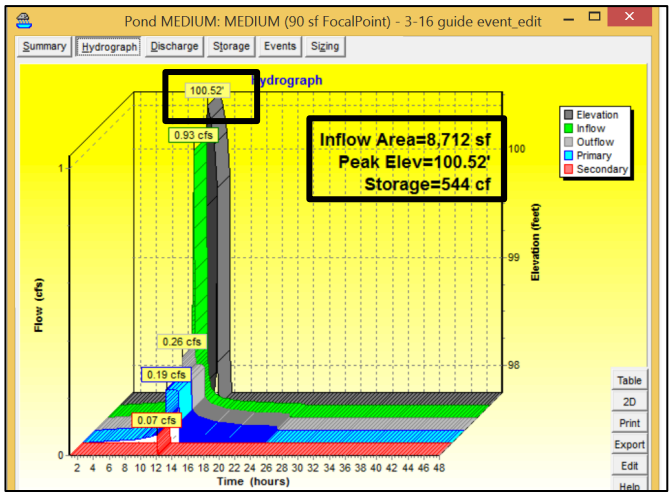
When using the elevation to size the FocalPoint system it is easy to select the "Elevation" option by right clicking on the Node hydrograph/Report Items/ Select / Elevation.



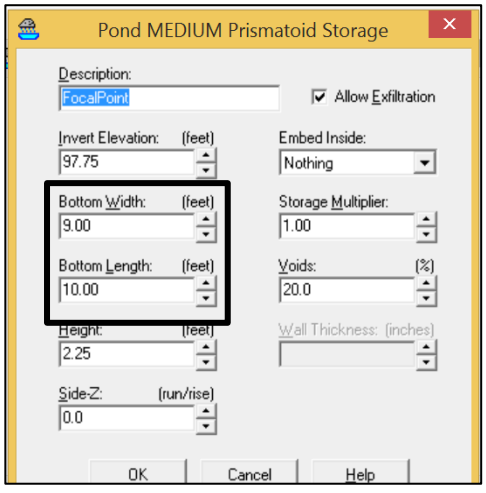


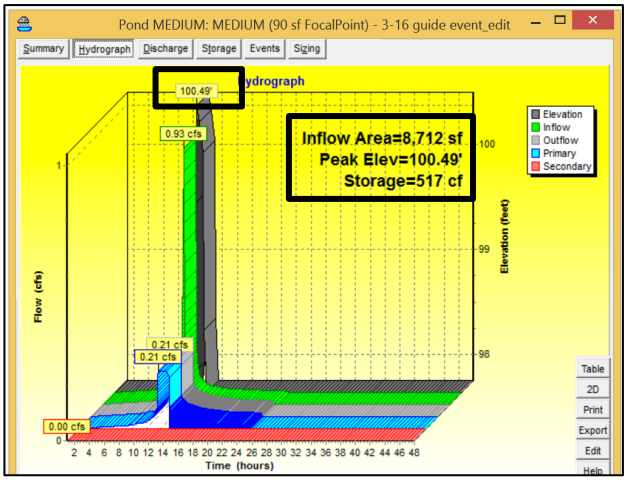
First Iteration: Using the 107 sf FocalPoint from the ACF RT & FP Calculator the highest elevation in the storage area is only 100.42, below the bypass elevation. The FocalPoint is too large so another iteration of the design is run.





Second Iteration: The 107 sf FocalPoint was too small so the FocalPoint footprint is resized to 80 sf. The highest elevation in the storage area is 100.52, above the bypass elevation. The FocalPoint is too small so another iteration of the design is run.





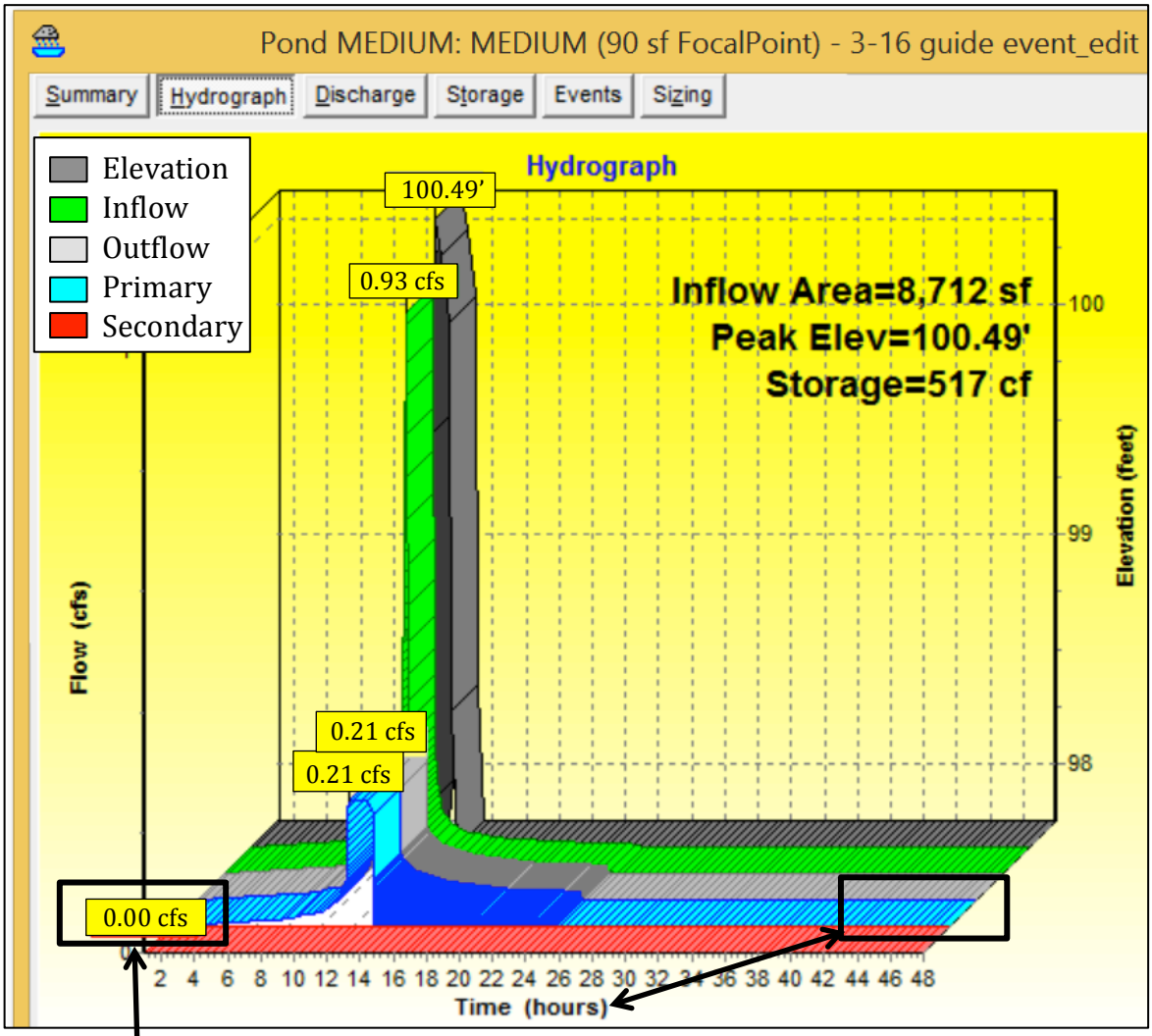
Final Iteration: The FocalPoint footprint is resized to 90 sq ft. The highest elevation in the storage area is 100.49, within the minimum tolerance to represent an optimum usage of the storage area and a proper design.

Reviewing and Evaluating a Focaalpoint HydroCAD Design:

Both the HydroCAD Report Summary and the FP Node hydrograph can be used to determine if the FocalPoint is sized correctly, as follows:

Factor #1. WQv Treatment: The bypass for the FocalPoint is designed as the secondary discharge and set at the top elevation of the WQv in the storage area. If there is no flow in the secondary discharge the system is sized correctly.

Factor #2 WQv ratio to FocalPoint footprint: Confirm the ratio of the temporary storage to FocalPoint footprint. Ratio is correct at no flow in either discharge after 48 total hours from beginning of storm event.



Factor #1. WQv Treatment: The bypass for the FocalPoint system, represented by the red hydrograph curve, shows no flow so all of the WQv is passing through the FocalPoint Filter.

Factor #2 WQv ratio to FocalPoint footprint: The bypass discharge shows flow at 48 hours so the ratio of runoff the FocalPoint Filter is correct.

The HydroCAD summary report provides the same guidance as the hydrograph in terms of evaluating the FocalPoint footprint sizing in treating the entire WQv.

#1. WQv Treatment: The bypass for the FocalPoint system, represented by the "Secondary" discharge line, shows no flow so all of the WQv is passing through the FocalPoint Filter.

2015.10.30 2yr storm *Type II 24-hr 2yr Rainfall=3.30"*
Prepared by Microsoft Printed 11/2/2015
HydroCAD® 10.00-14 s/n 08994 © 2015 HydroCAD Software Solutions LLC Page 12

Summary for Pond MEDIUM: MEDIUM (90 sf FocalPoint)

Inflow Area = 8,712 sf,100.00% Impervious, Inflow Depth = 3.07" for 2yr event
Inflow = 0.93 cfs @ 11.97 hrs, Volume= 2,227 cf
Outflow = 0.21 cfs @ 11.70 hrs, Volume= 2,227 cf, Atten= 78%, Lag= 0.0 min
Primary = 0.21 cfs @ 11.70 hrs, Volume= 2,227 cf
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 100.49' @ 12.12 hrs Surf.Area= 90 sf Storage= 519 cf

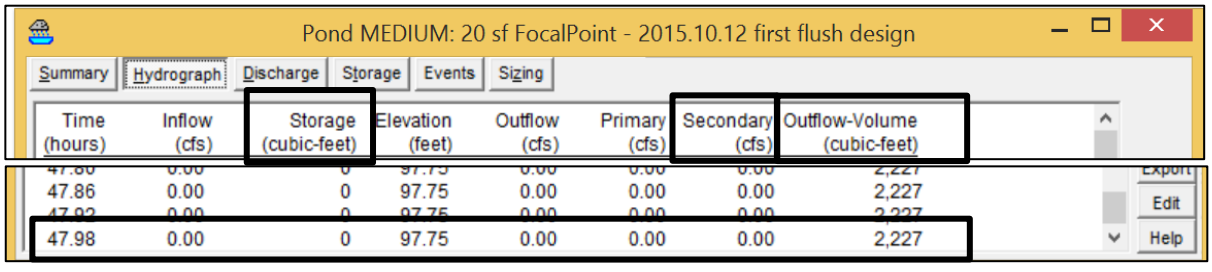
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 11.0 min (762.8 - 751.8)

Volume	Invert	Avail.Storage	Storage Description
#1	97.75'	41 cf	**9.00'W x 10.00'L x 2.25'H FocalPoint** 203 cf Overall x 20.0% Voids
#2	100.00'	972 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) -Impervious
		1,013 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
100.00	972	0	0
100.50	972	486	486
101.00	972	486	972

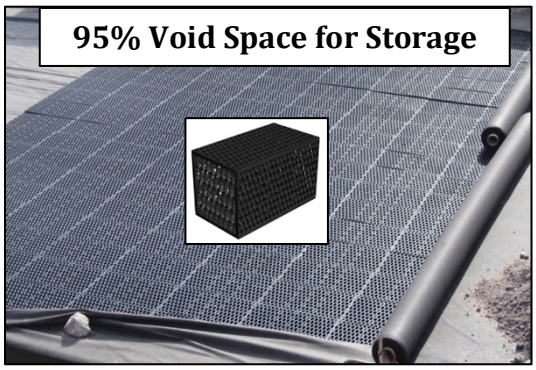
Device	Routing	Invert	Outlet Devices
#1	Primary	97.75'	**100.000 in/hr Exfiltration over Surface area** Phase-In= 0.10'
#2	Secondary	100.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Factor #2 WQv ratio to FocalPoint footprint: The tabular hydrograph will provide guidance as to the ratio of runoff to the FocalPoint footprint. If neither the primary nor the bypass discharge show any flow at 48 hours the ratio of runoff to the FocalPoint Filter is correct. Please note that the 48 hours drainage requirement is the maximum ratio per the manufacturers recommendations. Shorter drainage times may be used for design and evaluated using the same basic approach.

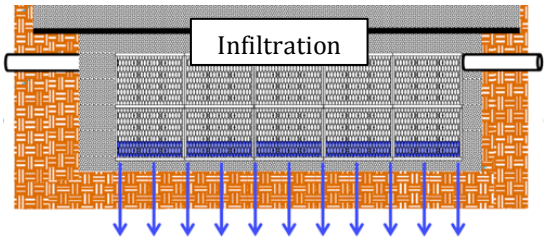


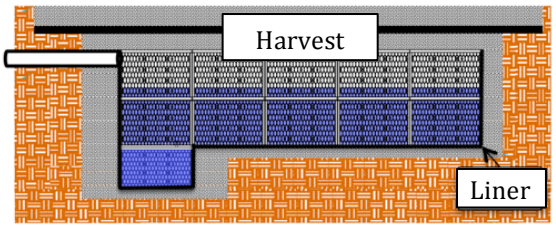
Introduction to the FocalPoint Underdrain / R-Tank System

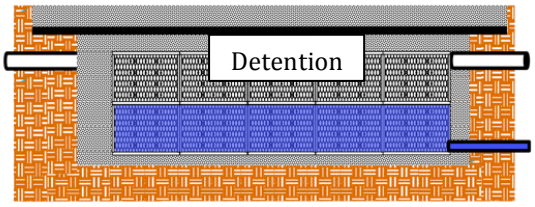
The R-Tank stormwater system provides modular underground storage of stormwater. The system is an alternative to stormwater basins and a more efficient (95% void space in module), space saving alternative to other underground systems for detention (SWM), infiltration (SWM/LID/GI), recycling stormwater (GI) or combination applications

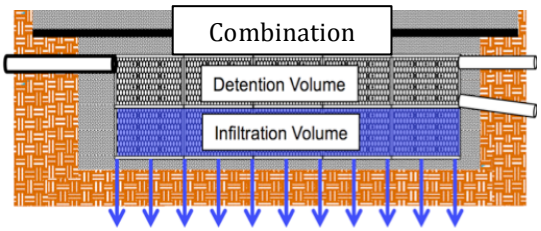


During a rain event fills the R-Tank, stormwater can flow into the drainage system, infiltrate into the ground, or be reused. The system is an alternative to stormwater basins and a more efficient, space saving alternative to other underground systems for detention, infiltration, and recycling stormwater.

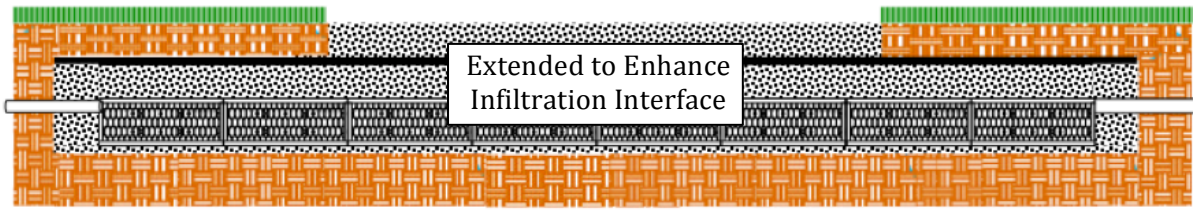








When used for infiltration, the low profile aspect of the R-Tank System can provide a large footprint of shallow infiltration to enhance the total infiltration rate separately from the limits of space availability at the surface. This same approach can also solve problems dealing with high ground water levels, high bedrock elevations or shallow utility obstacles.

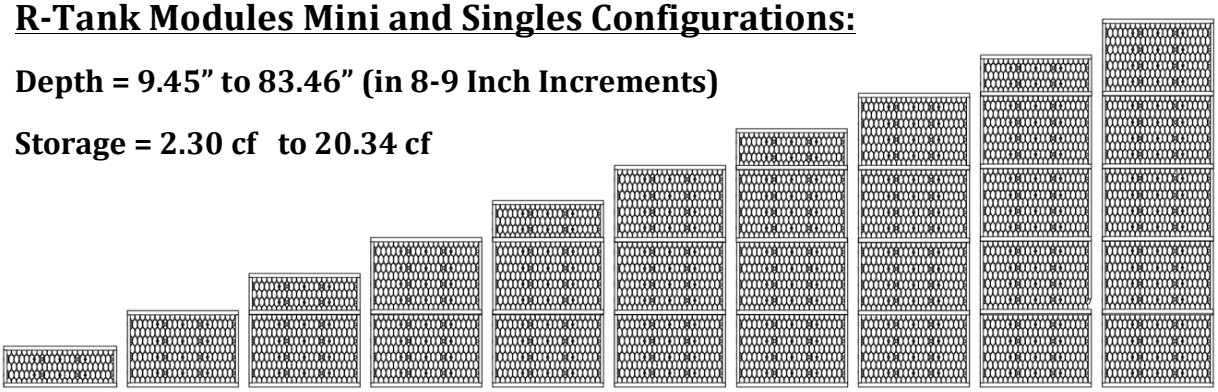


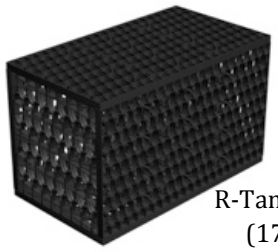
Modular Versatility Depth: R-Tank modules can be assembled to a variety of heights from 2 inches to just under 7 feet. This rigid system can be placed beneath a variety of surfaces including: Parking Lots, Streets and Access Roads, Driveways (H20 & HS25), Landscaping, Athletic Fields/Playgrounds, Swales and Channels.

R-Tank Modules Mini and Singles Configurations:

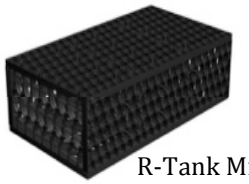
Depth = 9.45" to 83.46" (in 8-9 Inch Increments)

Storage = 2.30 cf to 20.34 cf



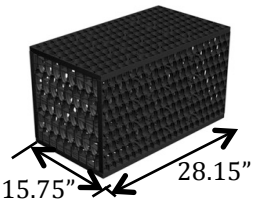


R-Tank Single
(17.32")

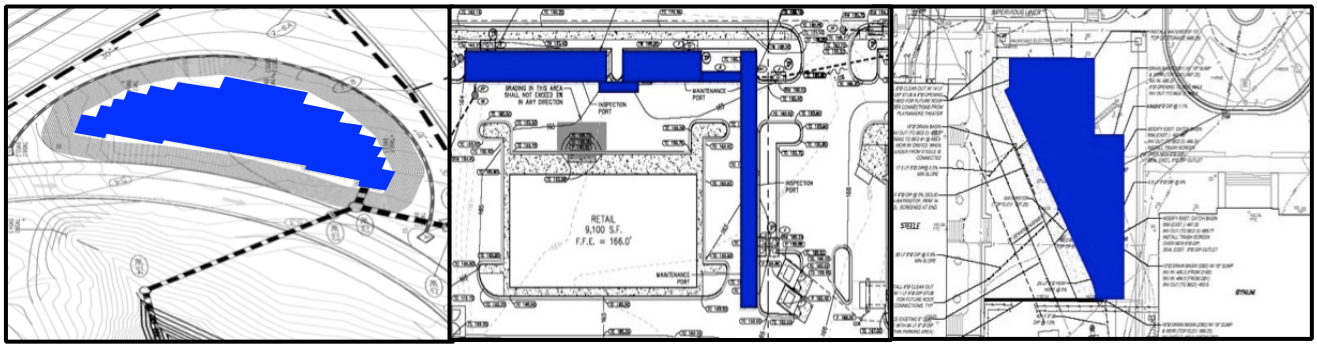


R-Tank Mini
(9.45")

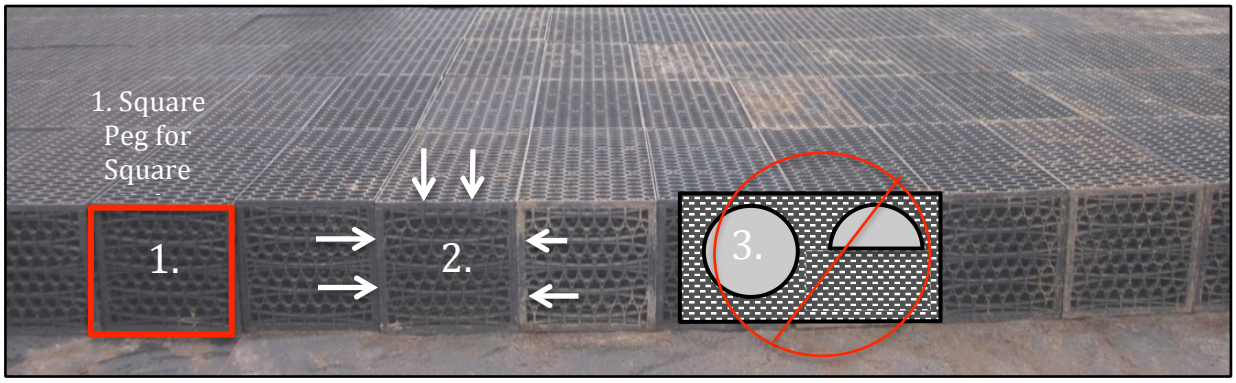
R-Tank XD 2" Panels
(92% Void) can be
utilized from 2" to 10'



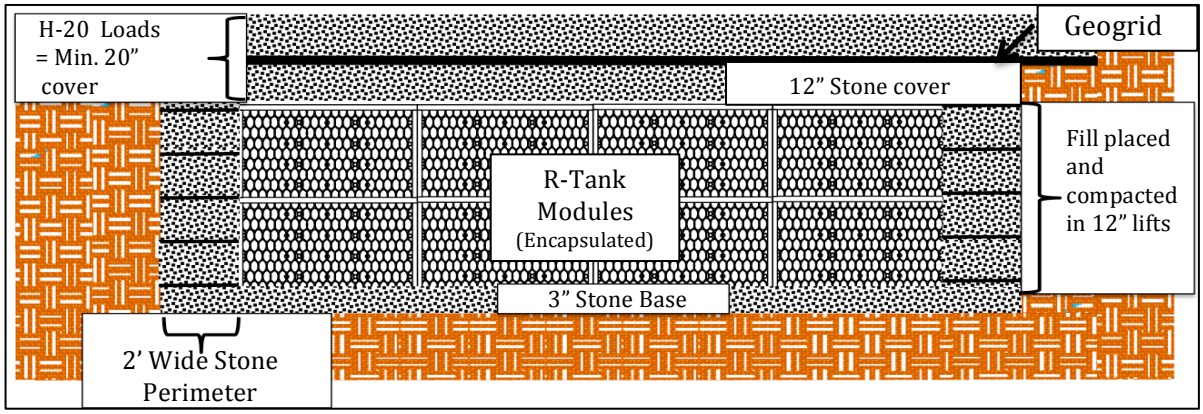
Modular Versatility – Layout Arrangement: The R-Tank module's 3.08 sq ft footprint can easily adapt to complex and irregular application footprints, as illustrated below.



R-Tank Modules ship as unassembled panels, providing significant cost savings. ACF provides an assembled R-Tank option so that contractors have cost certainty. Once assembled, all sizes of modules are individual units that can be easily handled and placed.



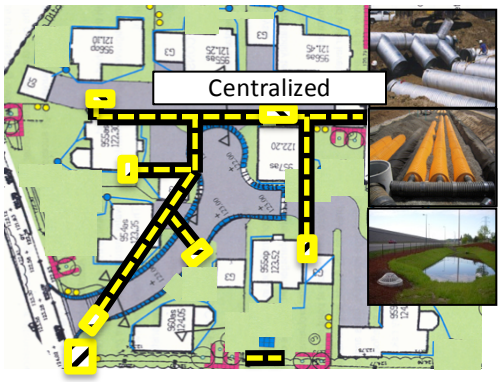
1. R-Tank is a "square peg for a square hole" making engineering computations and sizing simple. ACF R-Tank is included in the "Chamber Wizard" within HydroCAD.
2. R-Tank provides stability for lateral and vertical pressures.
3. R-Tank eliminates low void space and compaction issues associated with pipe and chamber systems.



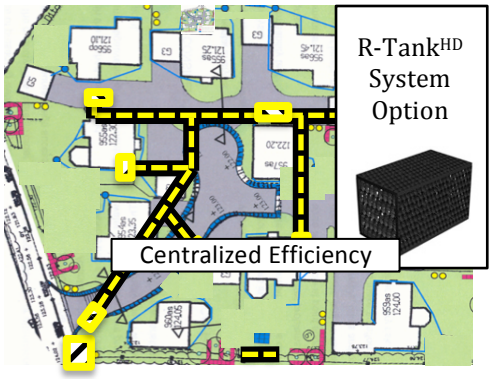
The typical section for the R-Tank^{HD} (Heavy Duty) system consists of a compacted subgrade (un-compacted for infiltration) and the minimum cover and fill as represented to the right. R-Tank^{HD} can accommodate a maximum of 7 feet of cover over the modules. Note: R-Tank^{SD} (super duty) is available for cover up to 10 foot over modules.

Pipe connections to R-Tank are easily facilitated by using a prefabricated "Pipe Boot"; horizontal, vertical, fabric or liner. Another option is to connect directly to a catch basin/drain. Both options eliminate the cost and complexity of header systems required for pipe or arch chambers systems.

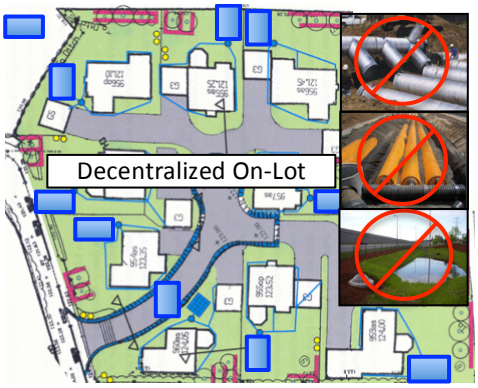
The R-Tank system does not require costly and project specific manifolds, instead it only requires easy connections to convey the runoff in and out of the system. This benefit is perfect when the intent is to implement a decentralized GI/LID application. The ability to eliminate costly conveyance infrastructure can have a significant effect on the global cost of your PCSM approach.



Traditional SWM using infrastructure to collect and convey run-off to centralized systems.

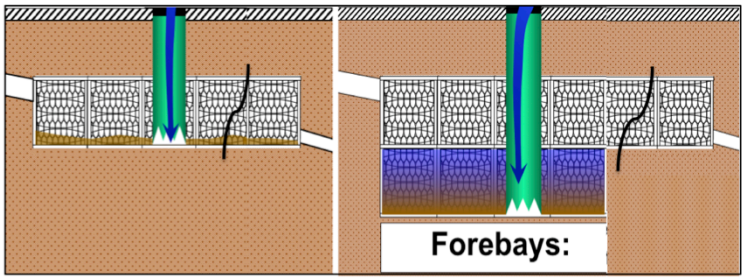


R-Tank HD can enhance traditional SWM by providing a more efficient 95% void space storage while eliminating the manifolds.



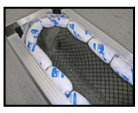
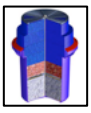
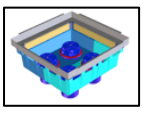
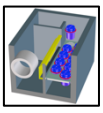
Progressive LID and GI approach: Managing run-off at its source with small on-lot R-Tank HD systems

In reference to maintenance, cleanout or flushing of the R-Tank system is facilitated by observation -maintenance ports. Sometimes a "Forebay" approach can be effective.

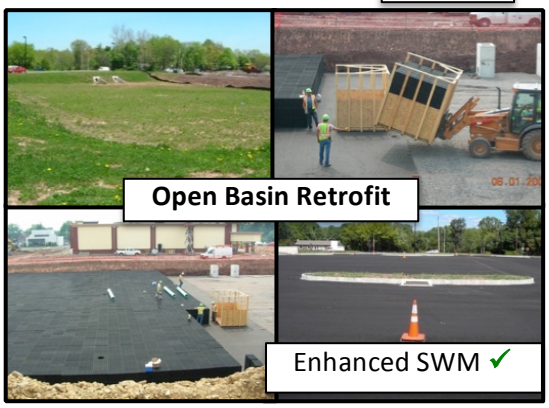


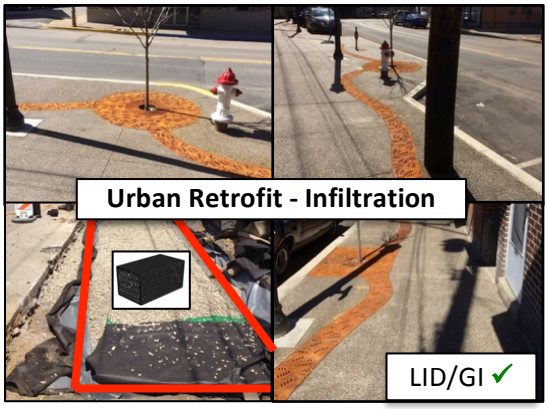
While pretreatment is not required in most states, it is **imperative** for the long term sustainability of all underground systems, especially for infiltration systems. To protect the R-Tank system from trash, debris and sediment, per many state's requirements or recommendations, ACF provides several pretreatment options upstream of the R-Tank system, both **mechanical** and **biological**, as follows: Trash Guard Plus, Fabco Connector Pipe Screen, StormSack, StormBasin and StormSafe, FocalPoint BioFiltration.

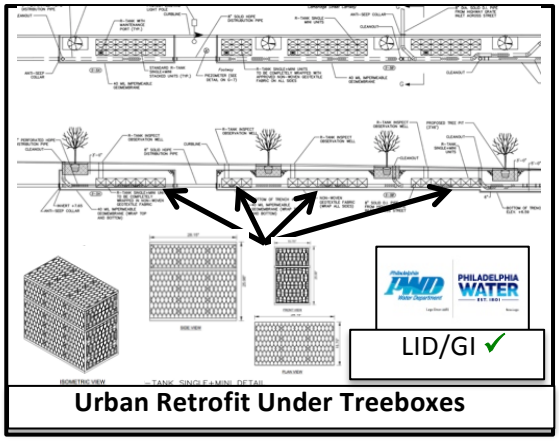



Example R-Tank Projects:







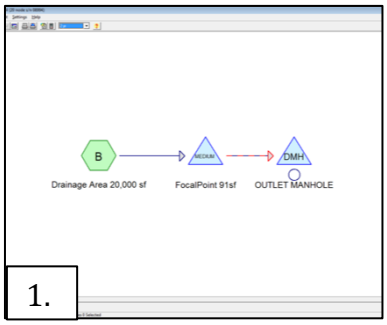
R-Tank System: Sizing the FocalPoint Extended Underdrain Using HydroCAD.

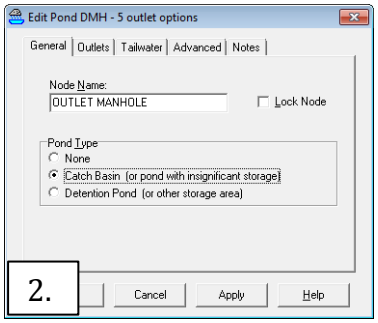
The R-Tank Modular Storage System is a stand alone system as well as the extended underdrain of the FocalPoint BioFiltration system. In either situation the R-Tank will be created and sized as a separate Node from the FocalPoint or any other treatment system upstream from the R-Tank. There are five basic and common applications for the R-Tank Modular Storage System.

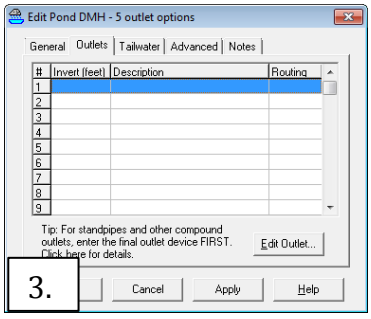
R-Tank "Treat and Release" Design and Sizing

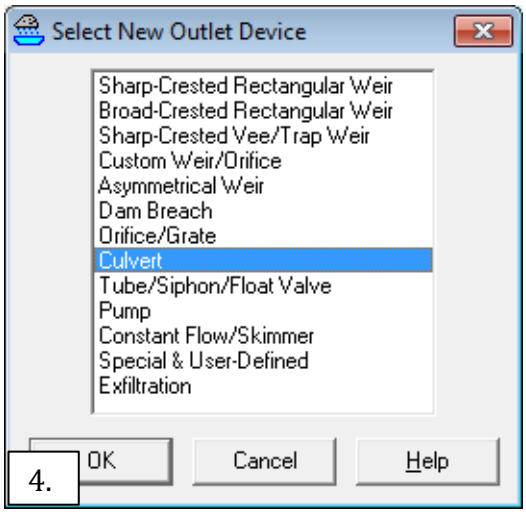
When designing a R-Tank System for a situation where there is a water quality component but not a volume control component needed from a regulatory need, the system will be designed in a "Treat & Release" manner.

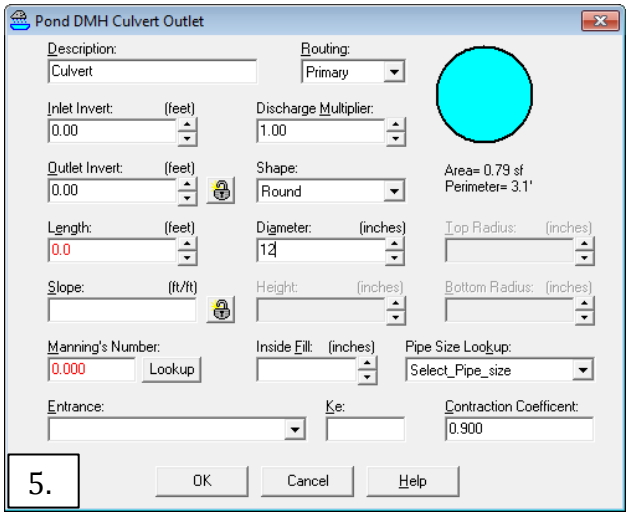
1. First the HydroCAD Node downstream from the treatment is created. The Node is designated DMH (Drain Manhole) for this example.
2. The Node is designated as a "Catch Basin".
3. The "Outlet" is designed by selecting the "Edit Outlet" button…
4. Where "Culvert is selected in the "Select New Outlet Device" window.
5. The appropriate selections are then made in the "Pond DMH Culvert Outlet" design window.







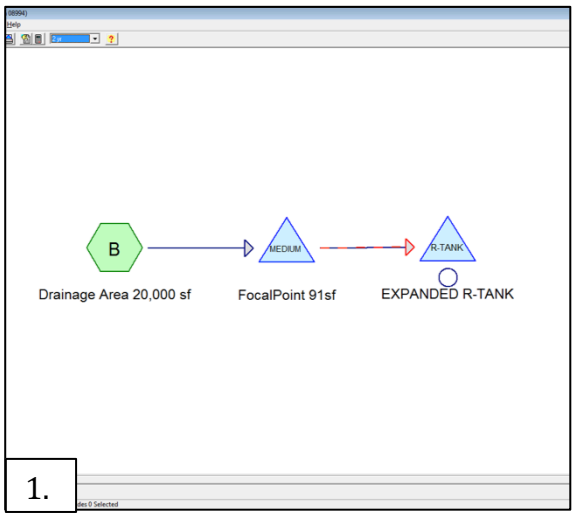




R-Tank Infiltration (Only) Design and Sizing

When designing a R-Tank System for a situation where the water discharge from the R-Tank will be "exfiltration", the system will be designed in a "Infiltration" manner.

1. First the HydroCAD Node downstream from the treatment is created. The Node is designated R-Tank – EXPANDED R-TANK for this example.
2. The Node is designated as a "Detention Pond".
3. The "Storage" is designed by selecting the "Storage" button…
4. Where "Chamber Wizard" is selected in the "Select New Storage Type" window.
5. The appropriate R-Tank selections are then made in the "R-Tank Chamber Wizard " design window options.
6. The R-Tank Chamber Wizard will construct the R-Tank storage per the input.
7. The Wizard will create both the R-Tank Modules as well as the required stone perimeter back fill.
8. & 9. The "Outlet" Tab will allow for "Exfiltration" to be selected as the "New Outlet device"
10. The established exfiltration rate is applied to the surface area.



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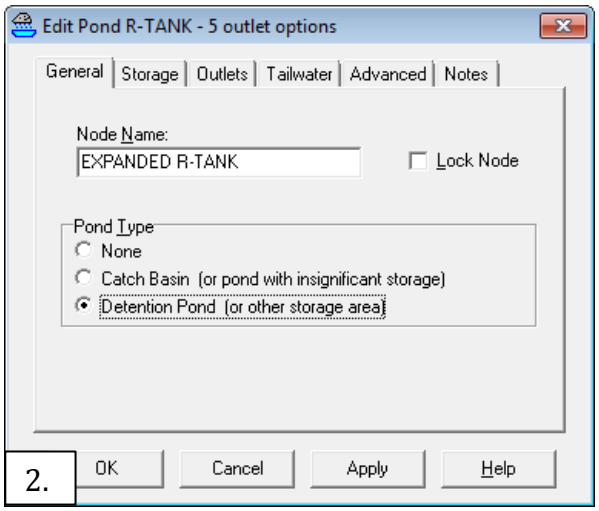

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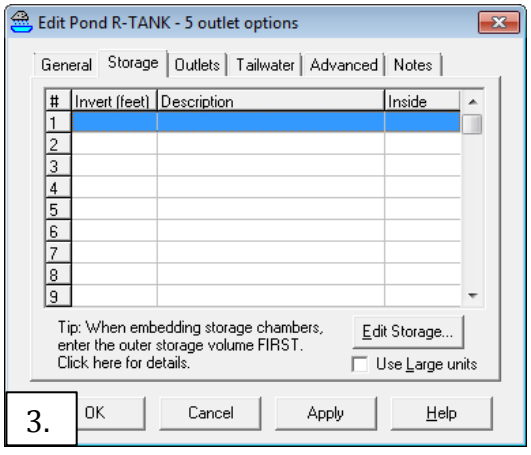

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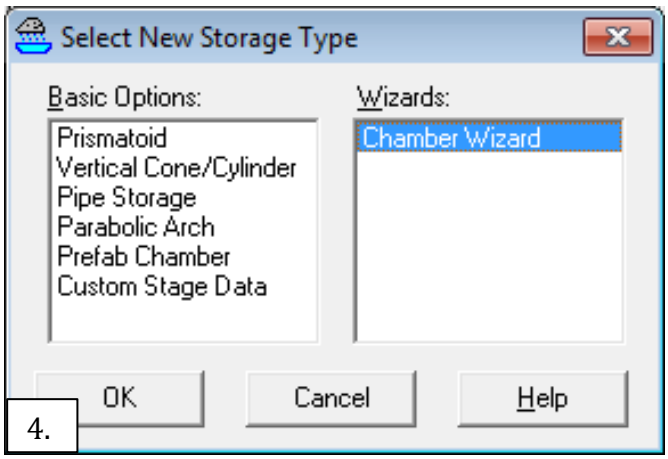

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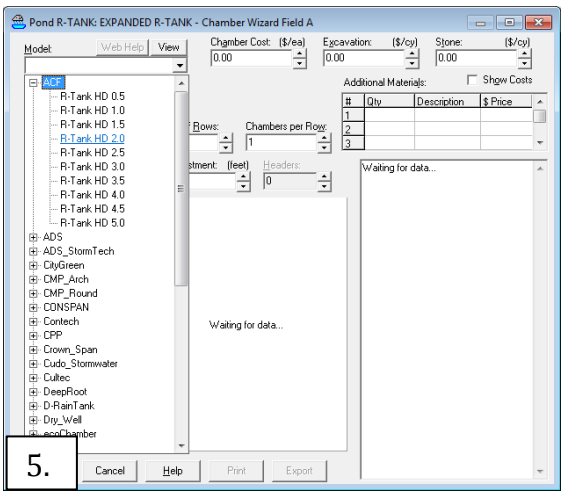
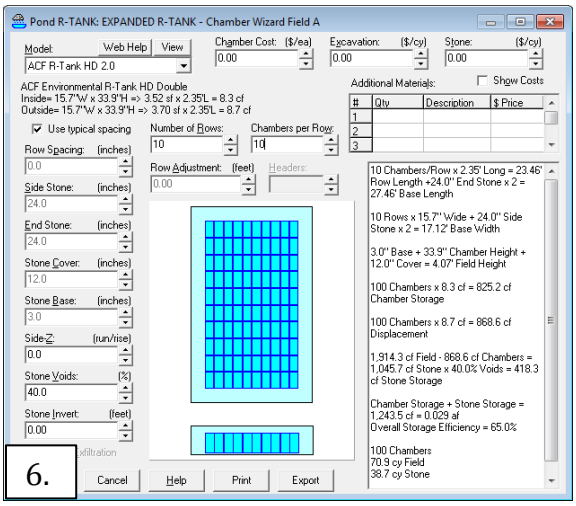
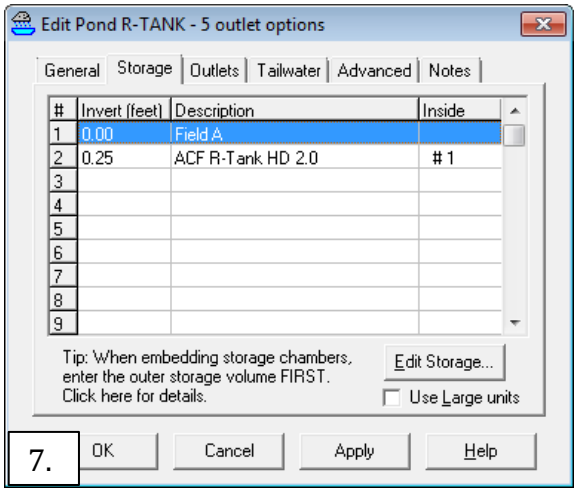
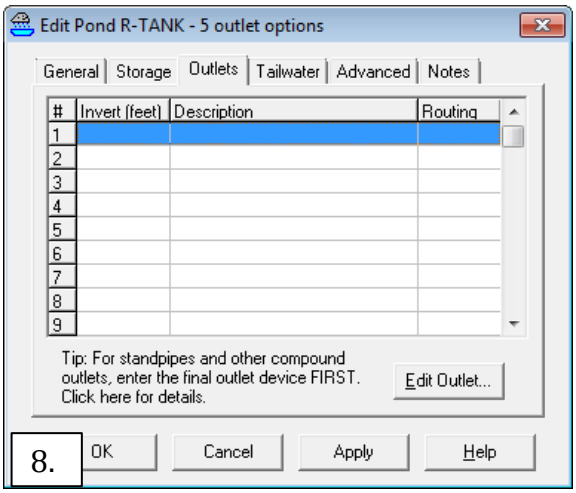
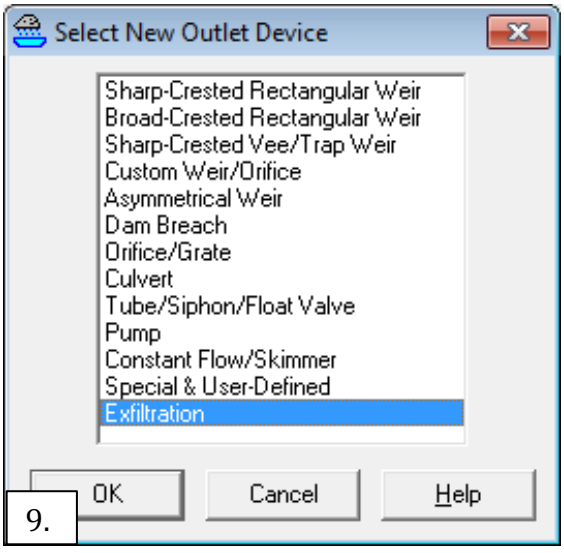
R-Tank Infiltration (Only) Design and Sizing (continued)

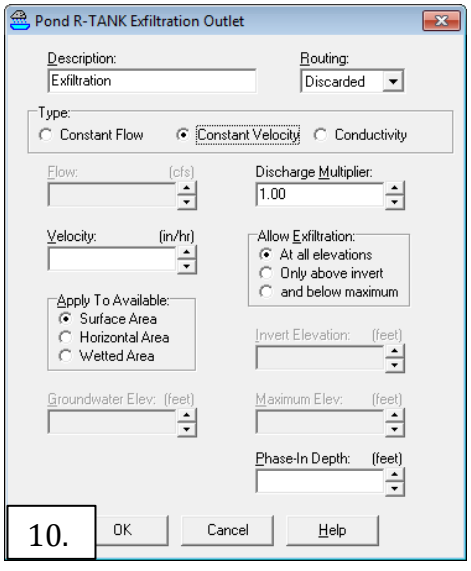








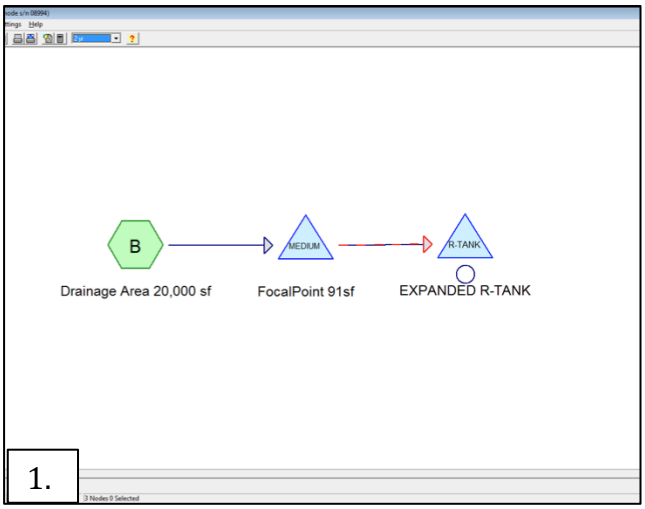




R-Tank Harvest Only Design and Sizing

When designing a R-Tank System for a situation where the goal is to capture the runoff for beneficial re-use, the system will be designed in a "Harvest Only" manner.

1. First the HydroCAD Node downstream from the treatment is created. The Node is designated R-Tank – EXPANDED R-TANK for this example.
2. The Node is designated as a "Detention Pond".
3. The "Storage" is designed by selecting the "Storage" then "Edit Storage" tabs.
4. "Chamber Wizard" is selected in the "Select New Storage Type" window.
5. The appropriate R-Tank selections are then made in the "R-Tank Chamber Wizard " design window options.
6. The R-Tank Chamber Wizard will construct the R-Tank storage per the input.
7. The Wizard will create both the R-Tank Modules as well as the required stone perimeter back fill.
8. There is no outlet designated from the R-Tank, perhaps just a spillway or broadcrested weir at the top of the R-Tank System.



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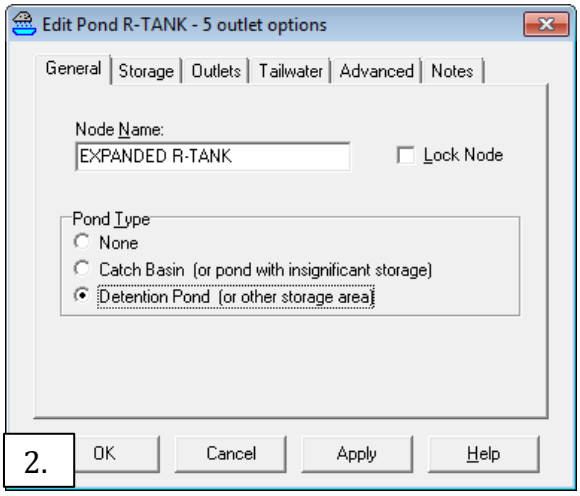

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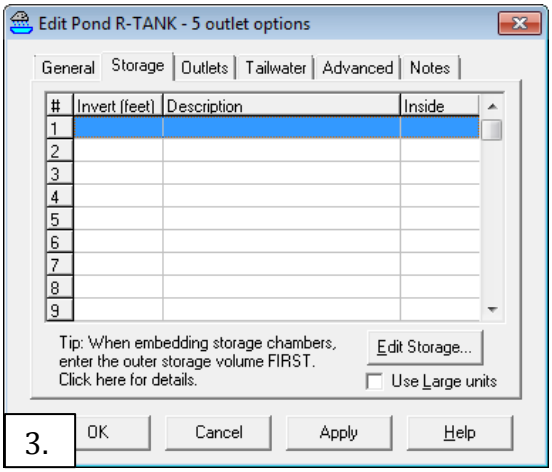

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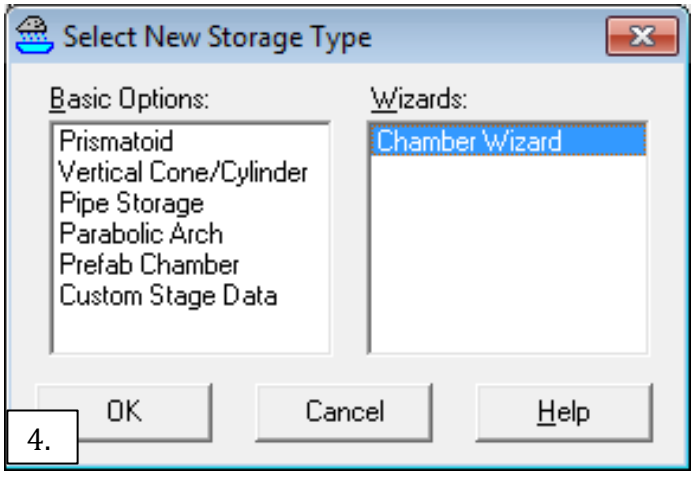
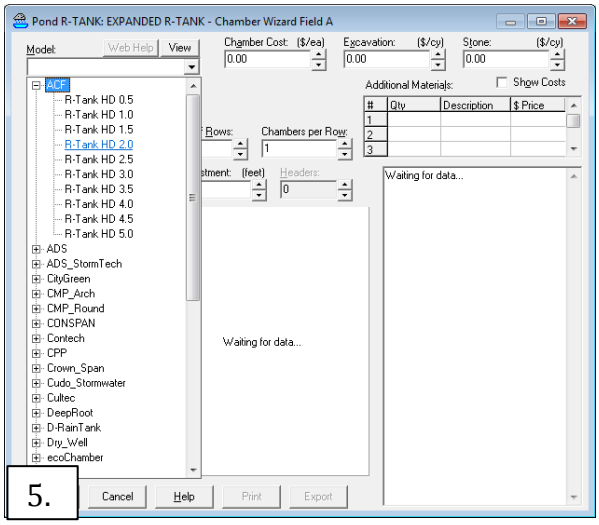
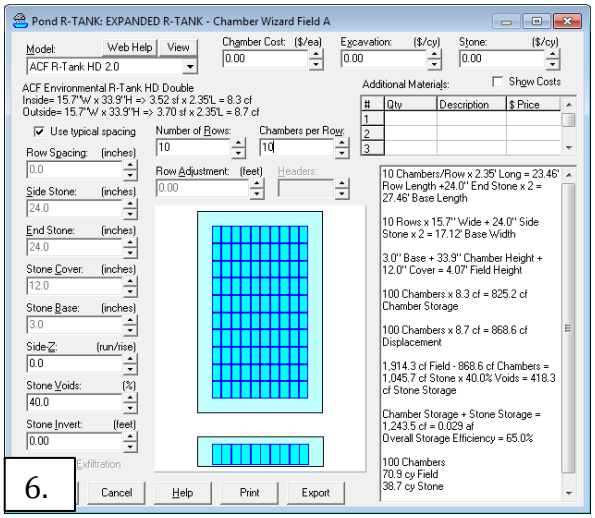
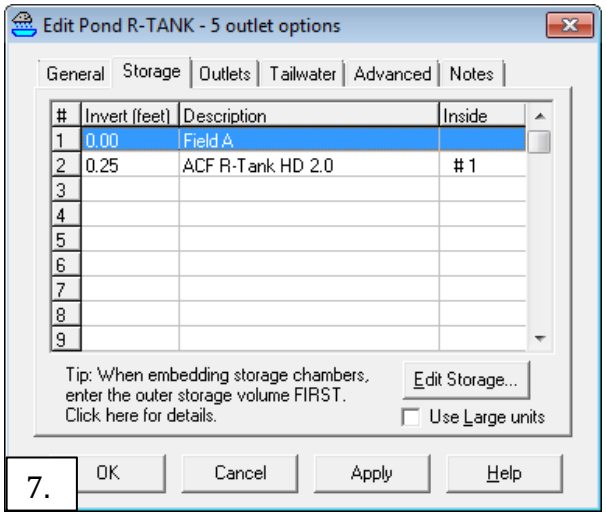


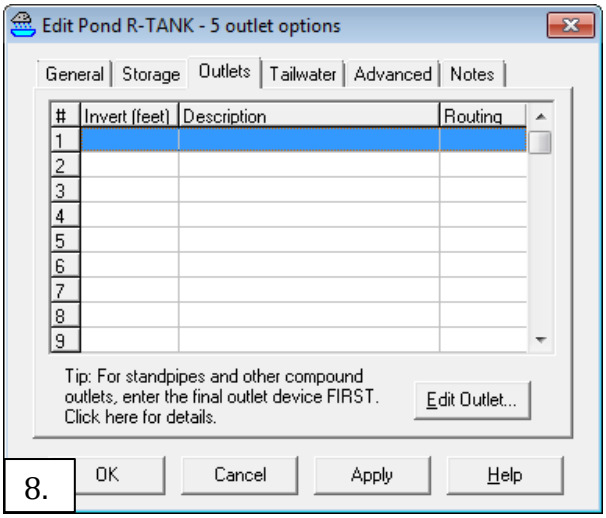
4.

R-Tank Harvest Only Design and Sizing





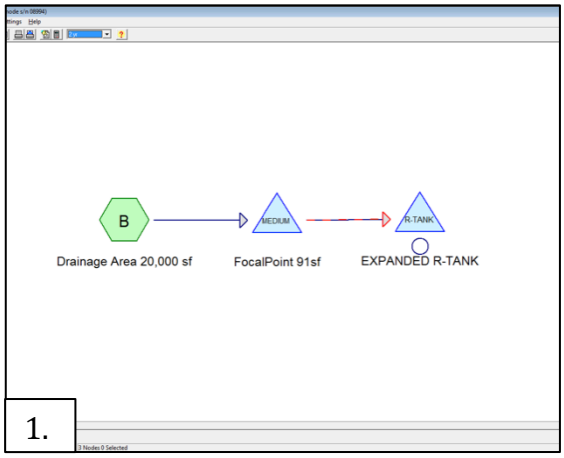




R-Tank Detention Design and Sizing

When designing a R-Tank System for a situation where the requirement is to store and then slowly release the runoff at a predetermined rate, the system will be designed in a "Detention" manner.

1. First the HydroCAD Node downstream from the treatment is created. The Node is designated R-Tank – EXPANDED R-TANK for this example.
2. The Node is designated as a "Detention Pond".
3. The "Storage" is designed by selecting the "Storage" button…
4. Where "Chamber Wizard" is selected in the "Select New Storage Type" window.
5. The appropriate R-Tank selections are then made in the "R-Tank Chamber Wizard " design window options.
6. The R-Tank Chamber Wizard will construct the R-Tank storage per the input.
7. The Wizard will create both the R-Tank Modules as well as the required stone perimeter back fill.
8. & 9. The "Outlet" Tab will allow for "Orifice/Grate" to be selected as the "New Outlet device"
10. 11. And 12. The Orifice/Grate setting are established per standard engineering .



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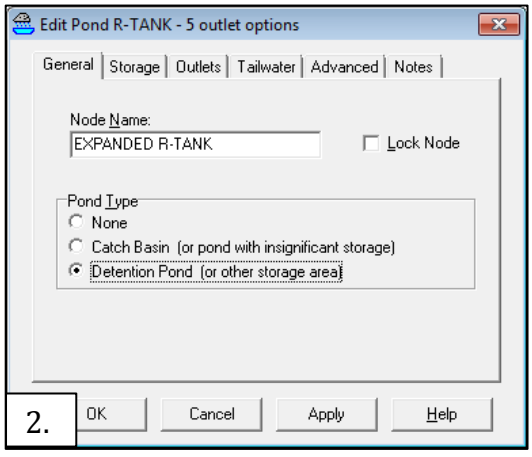

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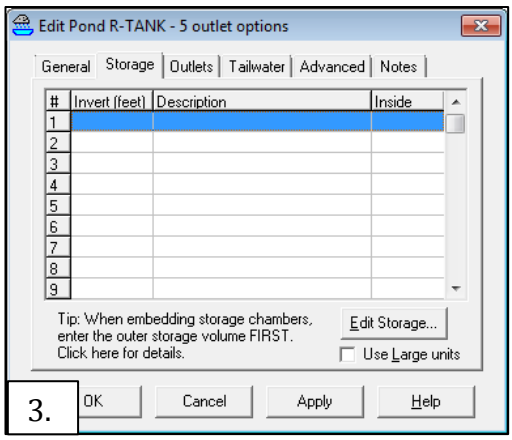

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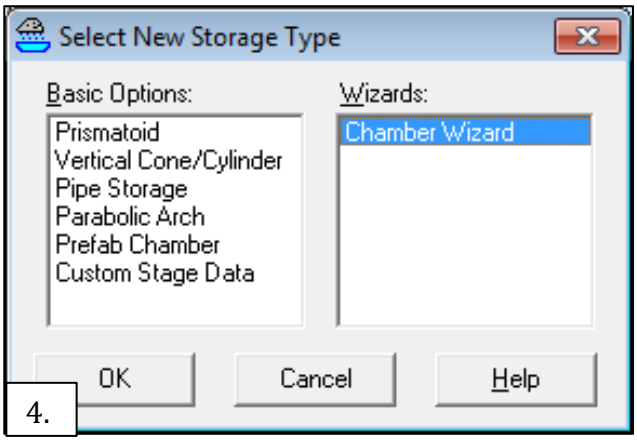
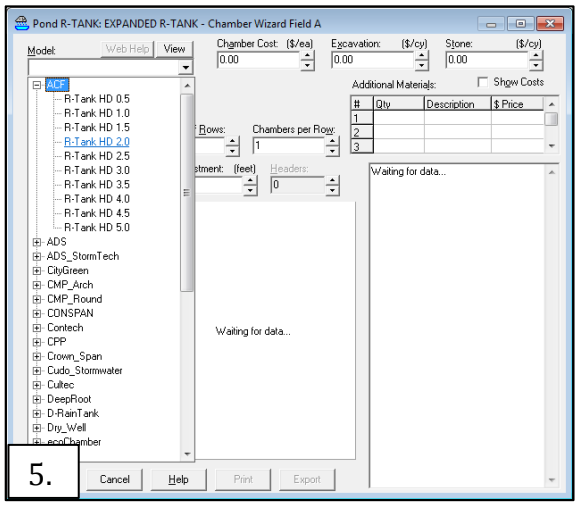
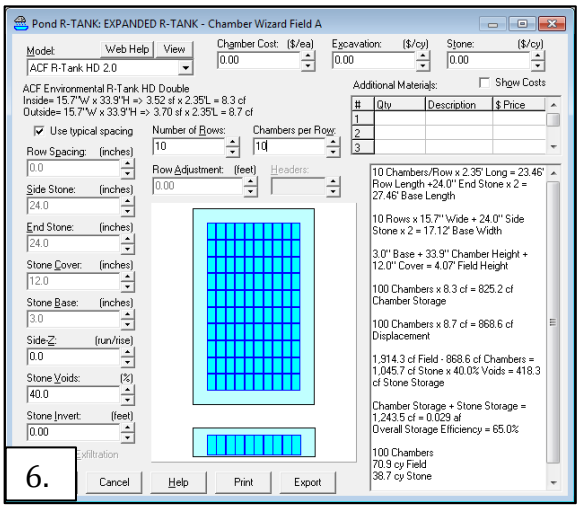
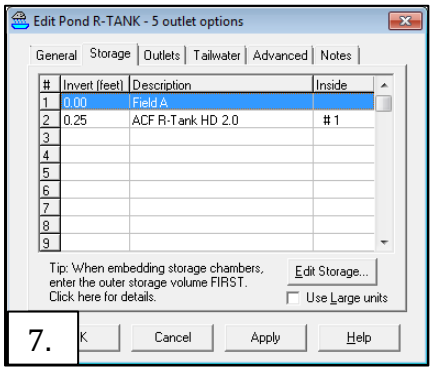


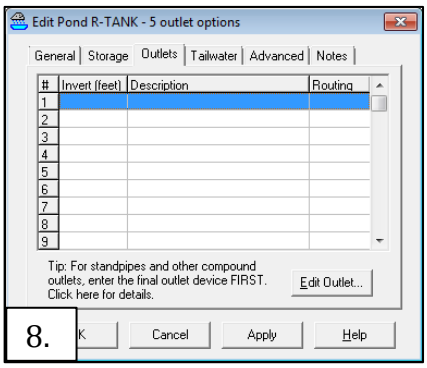
4.

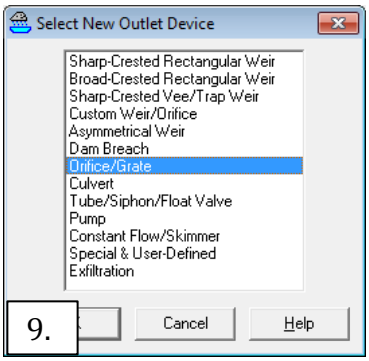
R-Tank Detention Design and Sizing

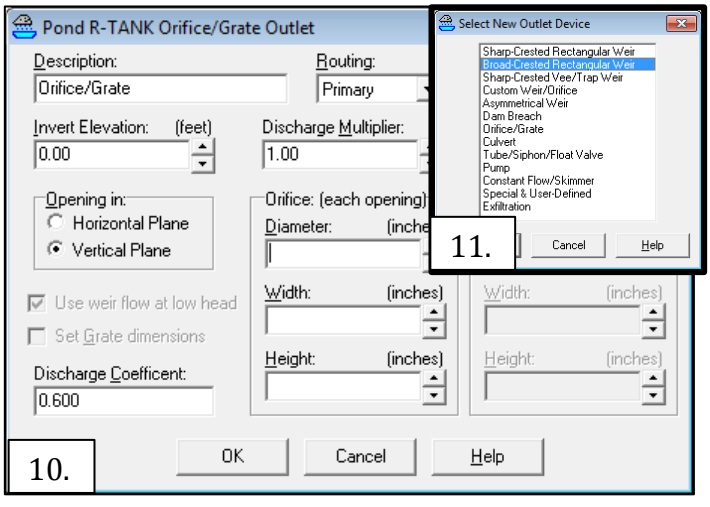


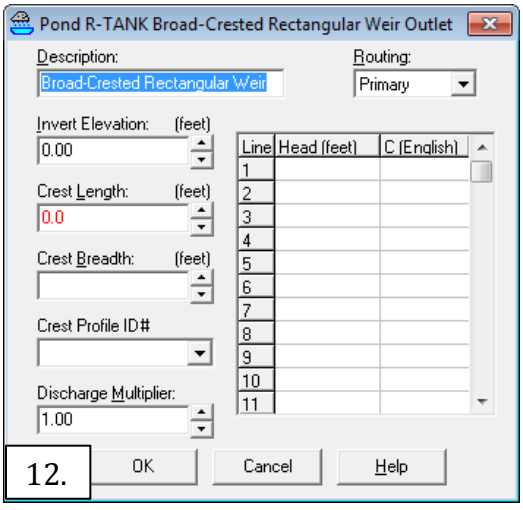








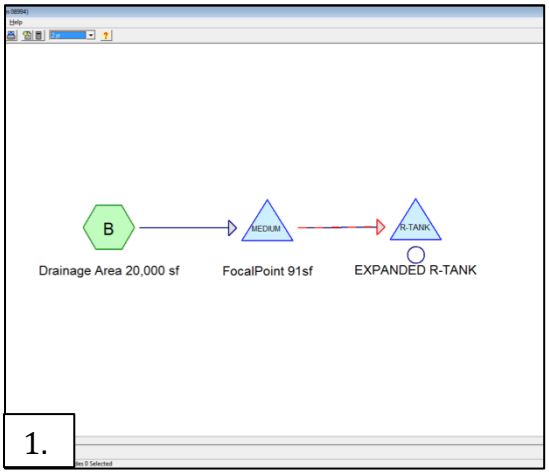




R-Tank Infiltration and Detention Design and Sizing

When designing a R-Tank System for a situation where the requirement is to store and then slowly release the runoff at a predetermined rate, the system will be designed in a "Detention" manner.

1. First the HydroCAD Node downstream from the treatment is created. The Node is designated R-Tank – EXPANDED R-TANK for this example.
2. The Node is designated as a "Detention Pond".
3. The "Storage" is designed by selecting the "Storage" button.
4. Where "Chamber Wizard" is selected in the "Select New Storage Type" window.
5. The appropriate R-Tank selections are then made in the "R-Tank Chamber Wizard " design window options.
6. The R-Tank Chamber Wizard will construct the R-Tank storage per the input.
7. The Wizard will create both the R-Tank Modules as well as the required stone perimeter back fill.
8. & 9. The "Outlet" Tab will allow for "Orifice/Grate" to be selected as the "New Outlet device"
10. 11. And 12. The Orifice/Grate setting are established per standard engineering.



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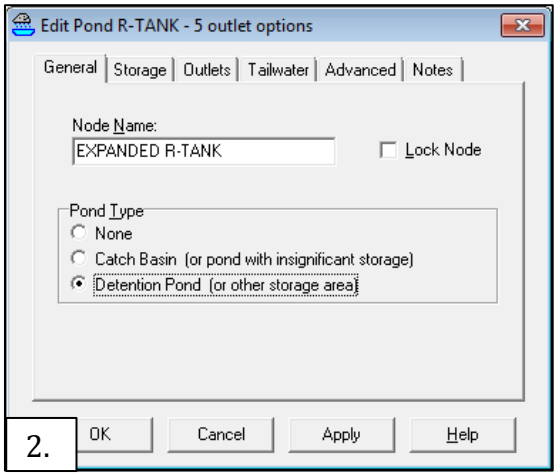

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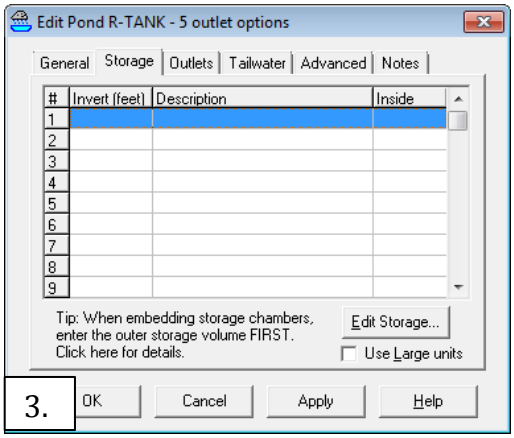

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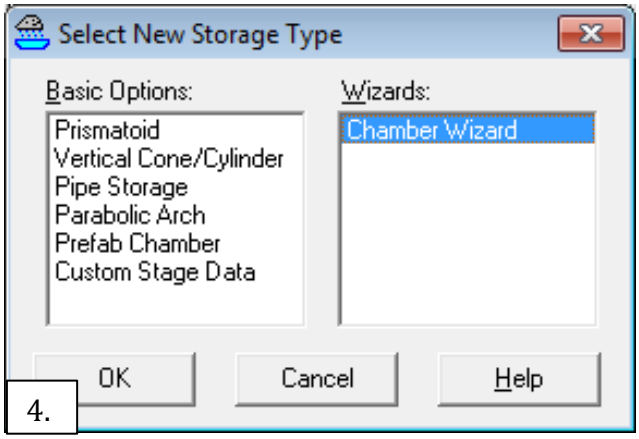

4.

R-Tank Infiltration and Detention Design and Sizing (Continued)