



Complex Configuration Example

By: Mike Hardin, PhD, PE, CFM

BMPTRAINS Model Training Course

5/17/2016

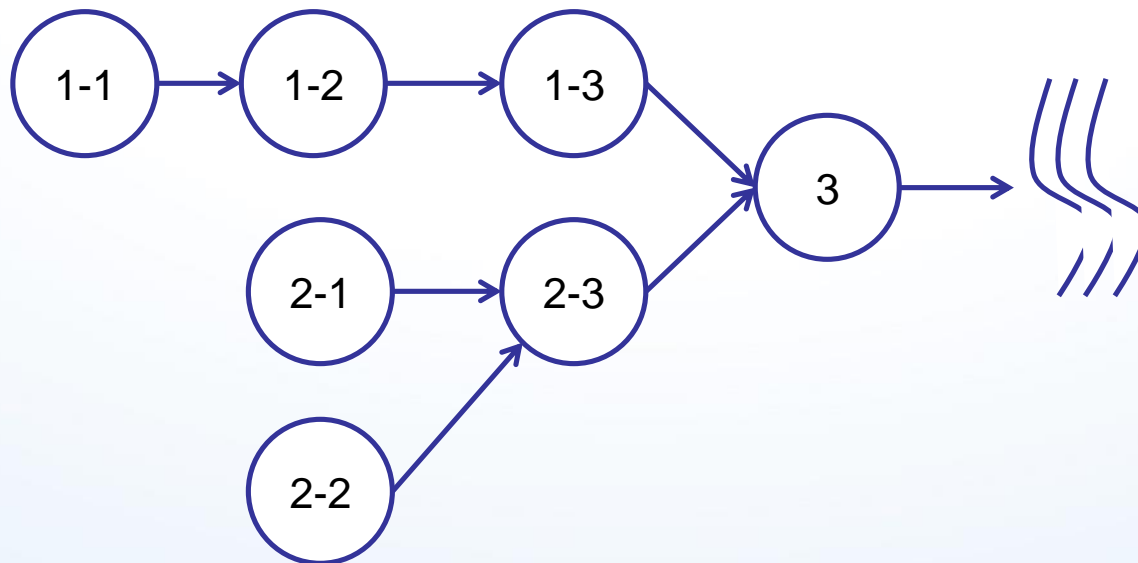


**UNIVERSITY OF
CENTRAL FLORIDA**
STORMWATER MANAGEMENT ACADEMY

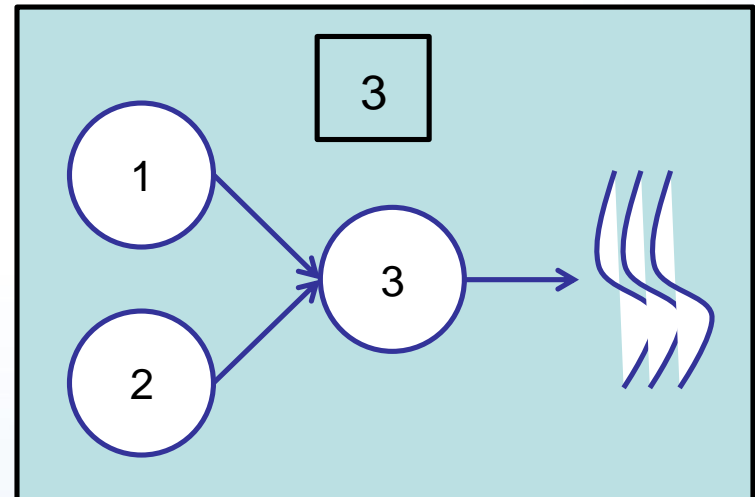
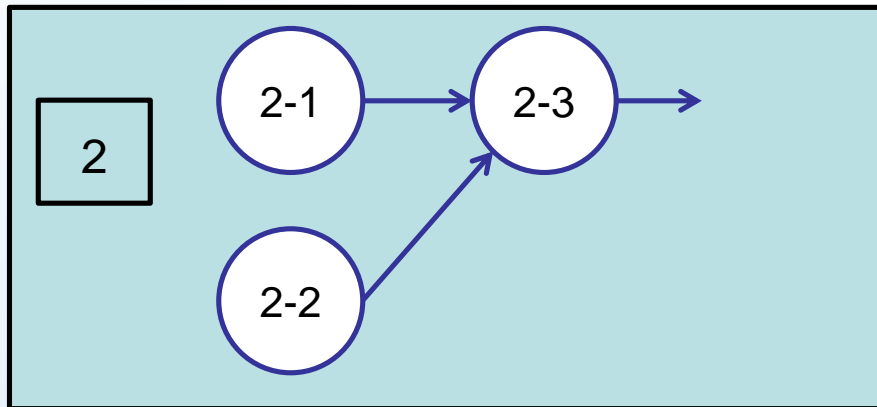
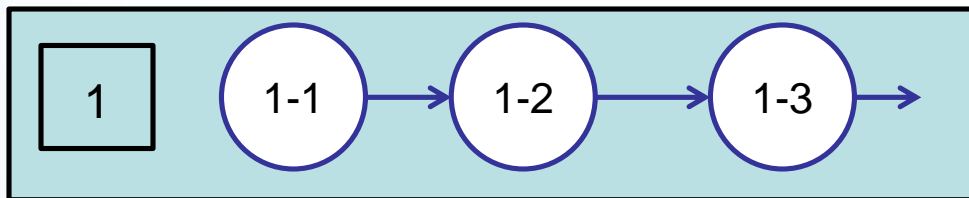
Geosyntec.com

engineers | scientists | innovators

- Project based on question from consultant
- Multiple catchments (7 catchments mixed configuration)


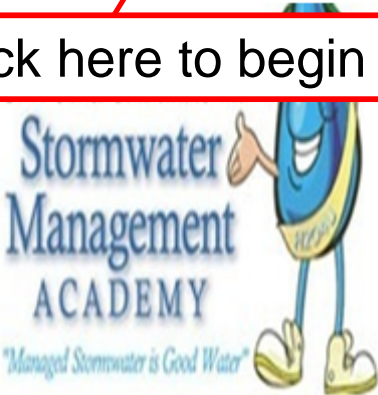


- BMPTRAINS Model allows for 4
- Need to simplify
 - Break into three model runs



- Problem background
- Will assume in Orlando
- Pre-development condition is pasture
- Post development condition is single family residential

Catchment	Area [acres]	Pre-CN	Post-CN	Post %DCIA	Treatment
1-1	12	78	80	35	0.75 in retention
1-2	10	78	80	50	1 ac pond 21 day residence time
1-3	10	78	80	50	1 ac pond 21 day residence time
2-1	15	78	80	45	0.5 in retention
2-2	13	78	80	40	0.5 in retention
2-3	22	78	80	35	0.5 in retention
3	30	78	80	30	0.5 in retention

Stormwater BMP Treatment Trains [BMPTRAINS@]		CLICK HERE TO START	HELP - INTRODUCTION
		INTRODUCTION PAGE	HELP AND BACKGROUND
<p>Model requires the use of Excel 2007 or newer</p>		<div style="border: 2px solid red; padding: 5px; display: inline-block;"> <p>Click here to begin</p> </div> 	<p>1) There is a users manual to help navigate this program and it is available at www.stormwater.ucf.edu</p>
<p>This program is compiled from stormwater management publications and deliberations during a two year review of the stormwater rule in the State of Florida. Input from the members of the Florida Department of Environmental Protection Stormwater Review Technical Advisory Committee and the staff and consultants from the State Water Management Districts is appreciated.</p>			<p>2) This spreadsheet is best viewed at 1280 BY 1080 PIXELS screen resolution. If the maximum resolution of your computer screen is lower than 1280 BY 1080 PIXELS you can adjust the view in the Excel VIEW menu by zooming out to value smaller than 100 PERCENT.</p>
<p>The State Department of Transportation provided guidance and resources to compile this program. The Stormwater Management Academy is responsible for the content of this program.</p>			<p>3) This spreadsheet has incorporated ERROR MESSAGE WINDOWS. Your analysis is not valid unless ALL ERROR MESSAGE WINDOWS are clear.</p>
			<p>4) PRINTING INSTRUCTIONS: Many options. One is to print the page to MICROSOFT OFFICE DOCUMENT IMAGE WRITER (typically the default) or ADOBE PDF, save the page as an image document, then print the document you saved.</p>
			<p>5) Click on the button located on the top of this window titled CLICK HERE TO START to begin the analysis.</p>
<p>Disclaimer: These workbooks were created to assist in the analysis of Best Management Practice calculations. All users are responsible for validating the accuracy of the internal calculations. If improvements are noted within this model, please e-mail Marty Wanielista, Ph.D., P.E. at martin.wanielista@ucf.edu with specific information so that revisions can be made.</p>			
<p>The authors of this program were Christopher Kuzlo, Marty Wanielista, Mike Hardin, and Ikiensinma Gogo-Abite. This is version 7.7 of the program, updated on November 18, 2015. Comments are appreciated.</p>			
		<p>HELP - HYDROGRAPH AND LEGACY PROGRAMS</p>	
		<p>SMADA ONLINE</p>	

GENERAL SITE INFORMATION: V 7.7		GO TO INTRODUCTION PAGE	Blue Numbers = Input data Red Numbers = Calculated or Carryover
Select the appropriate Meteorological Zone, input the appropriate Mean Annual Rainfall amount and select the type of analysis		NAME OF PROJECT Complex Configuration Ex	HELP
Meteorological Zone (Please use zone map): <input type="text" value="Zone 2"/>		<input type="button" value="CLICK ON CELL BELOW TO SELECT"/>	VIEW ZONE MAP
Mean Annual Rainfall (Please use rainfall map): <input type="text" value="50.00"/> Inches		<input type="button" value="CLICK ON CELL BELOW TO SELECT"/>	VIEW MEAN ANNUAL RAINFALL MAP
Type of analysis: Treatment efficiency (N, P) (leave empty if net improvement or BMP analysis is used):		<input type="text" value="Net improvement"/>	GO TO WATERSHED CHARACTERISTICS
Select the STORMWATER TREATMENT ANALYSIS button below to be used.		documentation and example problems.	
STORMWATER TREATMENT ANALYSIS		There is a user's manual for the BMP from www.stormwater.ucf.edu. The shown in the manual however may ongoing update	
Systems available for analysis: Retention Basin with option for calculating effluent concentration Wet Detention Exfiltration Trench Pervious Pavement		downloaded problems due to	
Model Reset		RESET INPUT FOR STORMWATER TREATMENT ANALYSIS	
Swale Rain Garden Tree Well Lined reuse pond User Defined BMP		METHODOLOGY FOR CALCULATING REQUIRED TREATMENT EFFICIENCY	
		METHODOLOGY FOR RETENTION SYSTEMS	METHODOLOGY FOR WET DETENTION SYSTEMS
		METHODOLOGY FOR GREENROOF SYSTEMS	METHODOLOGY FOR WATER HARVESTING SYSTEMS

Input data

State Maps for zone and rainfall

Next worksheet

Model Reset

Next worksheet

Site configuration

Input data

Loading data

WATERSHED 7.7 **GO TO STORMWATER TREATMENT ANALYSIS** Blue Numbers = Input data Red Numbers = Calculated **HELP - LAND USES/EMC**

SELECT CATCHMENT **CLICK ON CELL BELOW TO SELECT CONFIGURATION** **VIEW CATCHMENT CONFIGURATION**

CATCHMENT NO.1 **CLICK ON CELL BELOW TO SELECT** **D - 3 Catchment-Series** **VIEW AVERAGE ANNUAL RUNOFF "C" Factor** **OVERWRITE DEFAULT CONCENTRATIONS USING:**

Pre-development land use: **Agricultural - Pasture: TN=3.510TP=0.686** **CLICK ON CELL BELOW TO SELECT** **PRE:** mg/L **POST:** mg/L
with default EMCs
Post-development land use: **Single-Family: TN=2.070 TP=0.327** **CLICK ON CELL BELOW TO SELECT** **EMC(N):** mg/L **EMC(P):** mg/L

VIEW EMC & FLUCCS **USE DEFAULT CONCENTRATIONS**

Total pre-development catchment area:	12.00	AC
Total post-development catchment or BMP analysis area:	12.00	AC
Pre-development Non DCIA CN:	78.00	
Pre-development DCIA percentage:	0.00	%
Post-development Non DCIA CN:	80.00	
Post-development DCIA percentage:	35.00	%
Estimated BMPArea (No loading from this area)		AC

Average annual pre runoff volume: 4.910 ac-ft/year
Average annual post runoff volume (note no BMP area): 17.750 ac-ft/year
Pre-development Annual Mass Loading - Nitrogen: 21.254 kg/year
Pre-development Annual Mass Loading - Phosphorus: 4.154 kg/year
Post-development Annual Mass Loading - Nitrogen: 45.313 kg/year
Post-development Annual Mass Loading - Phosphorus: 7.158 kg/year

CATCHMENT NO.2 CHARACTERISTICS: **CLICK ON CELL BELOW TO SELECT** **CLICK ON CELL BELOW TO SELECT** **OVERWRITE DEFAULT CONCENTRATIONS:**

Pre-development land use: **Agricultural - Pasture: TN=3.510TP=0.686** **CLICK ON CELL BELOW TO SELECT** **PRE:** mg/L **POST:** mg/L
with default EMCs
Post-development land use: **Single-Family: TN=2.070 TP=0.327** **CLICK ON CELL BELOW TO SELECT** **EMC(N):** mg/L **EMC(P):** mg/L

USE DEFAULT CONCENTRATIONS

Total pre-development catchment area:	10.00	AC
Total post-development catchment or BMP analysis area:	10.00	AC
Pre-development Non DCIA CN:	78.00	
Pre-development DCIA percentage:	0.00	%
Post-development Non DCIA CN:	80.00	
Post-development DCIA percentage:	50.00	%
Estimated BMPArea (No loading from this area)	1.00	AC

Pre-development Annual Mass Loading - Nitrogen: 17.712 kg/year
Pre-development Annual Mass Loading - Phosphorus: 3.462 kg/year
Post-development Annual Mass Loading - Nitrogen: 44.037 kg/year
Post-development Annual Mass Loading - Phosphorus: 6.957 kg/year

CATCHMENT NO.3 CHARACTERISTICS: **CLICK ON CELL BELOW TO SELECT** **CLICK ON CELL BELOW TO SELECT** **OVERWRITE DEFAULT CONCENTRATIONS:**

Pre-development land use: **Agricultural - Pasture: TN=3.510TP=0.686** **CLICK ON CELL BELOW TO SELECT** **PRE:** mg/L **POST:** mg/L
with default EMCs
Post-development land use: **Single-Family: TN=2.070 TP=0.327** **CLICK ON CELL BELOW TO SELECT** **EMC(N):** mg/L **EMC(P):** mg/L

USE DEFAULT CONCENTRATIONS

Total pre-development catchment area:	10.00	AC
Total post-development catchment or BMP analysis area:	10.00	AC
Pre-development Non DCIA CN:	78.00	
Pre-development DCIA percentage:	0.00	%
Post-development Non DCIA CN:	80.00	
Post-development DCIA percentage:	50.00	%
Estimated BMPArea (no loading from this area)	1.00	AC

Average annual pre runoff volume: 4.092 ac-ft/year
Average annual post runoff volume (note no BMP area): 17.250 ac-ft/year
Pre-development Annual Mass Loading - Nitrogen: 17.712 kg/year
Pre-development Annual Mass Loading - Phosphorus: 3.462 kg/year
Post-development Annual Mass Loading - Nitrogen: 44.037 kg/year
Post-development Annual Mass Loading - Phosphorus: 6.957 kg/year

CATCHMENT NO.4 CHARACTERISTICS: **CLICK ON CELL BELOW TO SELECT** **CLICK ON CELL BELOW TO SELECT** **OVERWRITE DEFAULT CONCENTRATIONS:**

Pre-development land use: **CLICK ON CELL BELOW TO SELECT** **PRE:** mg/L **POST:** mg/L
with default EMCs
Post-development land use: **CLICK ON CELL BELOW TO SELECT** **EMC(N):** mg/L **EMC(P):** mg/L

USE DEFAULT CONCENTRATIONS

Total pre-development catchment area:		AC
Total post-development catchment or BMP analysis area:		AC

Average annual pre runoff volume: ac-ft/year

- What if multiple land uses within a single catchment?
- The new EMC should be determined using a flow weighted average

- Can use CN and A

$$EMC_{Comp} = \frac{\sum EMC * CN * A}{\sum CN * A}$$

- This gives a better representation of the true EMC that a BMP will receive
 - Runoff generation differences
 - Imperviousness
 - Area
- Use overwrite default concentration feature and enter EMC value

STORMWATER TREATMENT ANALYSIS:		V 7.7	GO TO GENERAL SITE INFORMATION PAGE		Blue Numbers =	Input data
					Red Numbers =	Calculated
If not done, specify pre- and post-development watershed characteristics.						
GO TO WATERSHED CHARACTERISTICS						
<p><u>Total Required Treatment Efficiency:</u></p> <p>Required Treatment Eff (Nitrogen): 57.509 %</p> <p>Required Treatment Eff (Phosphorus): 47.430 %</p>						
<div style="border: 1px solid red; padding: 5px; display: inline-block;">Treatment Objectives</div>			<div style="border: 1px solid red; padding: 5px; display: inline-block; text-align: center;">BMP Worksheets</div>			
			<div style="border: 1px solid red; padding: 5px; display: inline-block; text-align: center;">Site configuration</div>			
Select one of the BMPs below to analyze efficiency or review the summary data.						
RETENTION BASIN	WET DETENTION	EXFILTRATION TRENCH	RAIN GARDEN	SWALE	USER DEFINED BMP	
PERVIOUS PAVEMENT	STORMWATER HARVESTING	FILTRATION including Up-Flow Filters	LINED REUSE POND & UNDERDRAIN INPUT	<div style="border: 1px solid red; padding: 5px; display: inline-block;">Results worksheet</div> <p>TREATMENT SUMMARY RESULTS tab for more information.</p>		
GREENROOF	RAINWATER HARVESTING	MANAGED AQUATIC PLANTS				
VEGETATED NATURAL BUFFER	VEGETATED FILTER STRIP	TREE WELL	CATCHMENT AND TREATMENT SUMMARY RESULTS			

RETENTION BASIN:

V 7.7

RETENTION BASIN SERVING:

Complex Configuration Ex 3

Loadings from BMP area are contained by the BMP, thus no BMP area load.

Watershed area cotributing to basin:

Required Treatment Eff (**Nitrogen**):

Required Tre

Required ret

Required wa

Catchment 1	Catchment 2	Catchment 3	Catchment 4	
12.000	9.000	9.000	0.000	ac
53.095	59.779	59.779		%
41.969	50.239	50.239		%
0.383	0.463	0.463	0.000	in
0.383	0.348	0.348	0.000	ac-ft

Treatment volume

RETENTION

RETENTION SYSTEMS (if there is a need for additional removal efficiencies in a series of BMPs):

Retention volume based on retention depth and total area

Provided retention depth (0.1-3.99 inches over the watershed)

Provided treatment efficiency (**Nitrogen**):

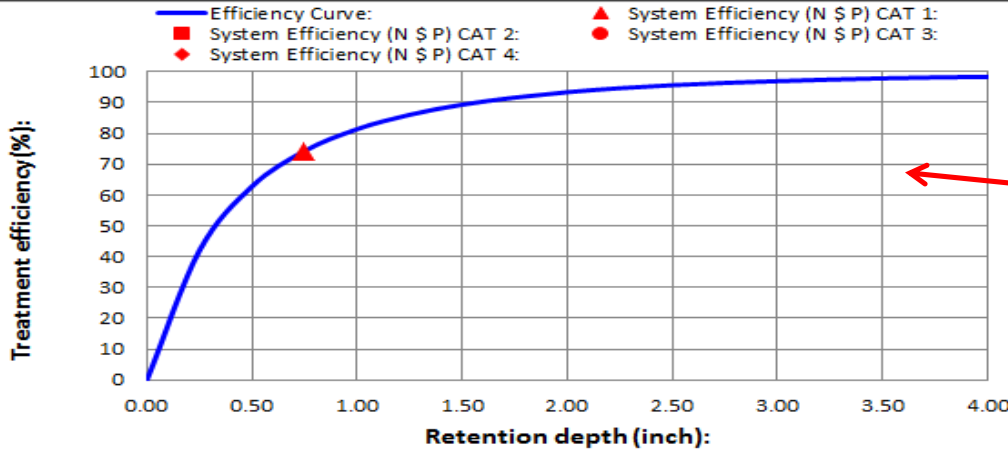
Provided treatment efficiency (**Phosphorus**):

Remaining treatment efficiency (**Nitrogen**):

Remaining treatment efficiency (**Phosphorus**):

Remaining retention depth needed:

0.750	0.000	0.000	0.000	ac-ft
0.750				in
74.320	0.000	0.000	0.000	%
74.320	0.000	0.000	0.000	%
0.000	59.779	59.779		%
0.000	50.239	50.239		%
0.000	0.463	0.463	0.000	in



NOTE FOR TREATMENT EFFICIENCY GRAPH:

Treatment curve

This graph helps illustrate the treatment efficiency function of retention depth for a catchment. The graph illustrates that as the retention depth is increased, thus increases in "treatment trains" and catchment volume should be considered. NOTE: the retention volume can not exceed 3.99 inches to be within the range of data used to determine effectiveness.

HELP - EXAMPLE PROBLEM 3

[View Media Mixes](#)

Use only down flow media mix before water enters the ground, specify type

Nitrogen mass reduction in groundwater discharge (%)

Phosphorus mass reduction in groundwater discharge (%)

Catchment 1	Catchment 2	Catchment 3	Catchment 4

WET DETENTION:

V 7.7

WET DETENTION POND SERVING:

Complex Configuration Ex 3

Loadings from BMP area are contained by the BMP, thus no BMP area load.

Total pre-development catchment area:

Total post-development catchment area:

Average annual residence time (between 1 and 500 days):

Littoral Zone or other improvements used?

Littoral Zone or other improvement efficiency credit:

Total Nitrogen removal efficiency provided:

Total Phosphorus removal efficiency provided:

Total Nitrogen removal efficiency provided:

Total Phosphorus removal efficiency provided:

Is the wet detention sufficient:

Average annual runoff volume into the pond:

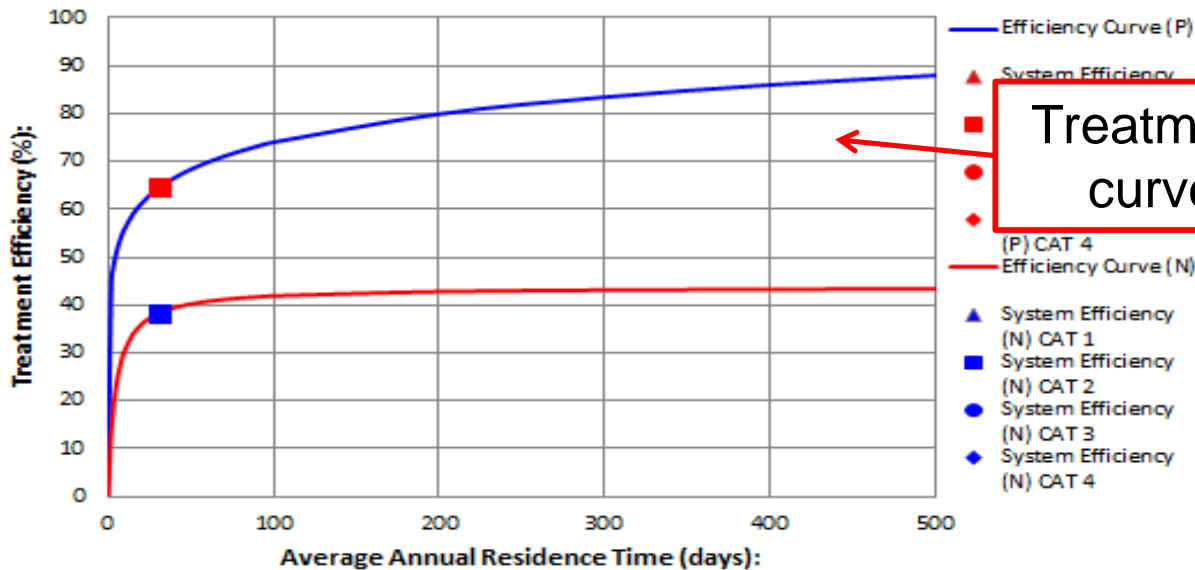
Catchment 1	Catchment 2	Catchment 3	Catchment 4	
12.000	10.000	10.000	0.000	ac
12.000	9.000	9.000	0.000	ac
	31.50	31.50		days
				%
	26.322	26.322		%
	13.448	13.448		%
	38.409	38.409		%
	64.649	64.649		%
	YES	YES		
17.750	17.250	17.250		ac-ft/yr

Retention Time

To Achieve the Treatment Efficiency Shown in the Graph Below, the Following Must Hold

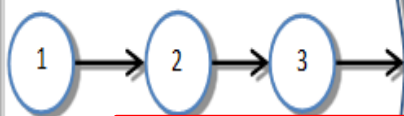
Minimum Pond Permanent Pool Volume:

	1.489	1.489		ac-ft
--	-------	-------	--	-------



NOTE FOR TREATMENT EFFICIENCY GRAPH:

The purpose of the treatment efficiency graphs is to help determine the treatment efficiency of the wet detention system as the function of average annual residence time (and permanent pool volume). The graph illustrates that there is a point of diminished return as the permanent pool volume is substantially increased. The lines are produced from the conditions of catchment one, thus other catchments are shown with the data points.

CATCHMENTS AND TREATMENT SUMMARY RESULTS				V 7.7	Blue Numbers = Red Numbers =	Input data Calculated or Carryover
CALCULATION METHODS: 1. The effectiveness of each BMP in a series is based on the flow volume. 2. Certain BMP treatment train combinations have not been evaluated and in practice they are at this time not used, an example is a greenroof following a tree well. 3. Wet detention is last when used in a single catchment with other BMPs, except when followed by filtration					GO TO STORMWATER TREATMENT ANALYSIS GO TO WATERSHED CHARACTERISTICS	
PROJECT TITLE Complex Configuration Ex 2 Options Identification						
	Catchment 1:	Catchment 2:	Catchment 3:	Catchment 4:	Thank you for using this BMPTRAINS model. NOTE: Multiple BMPs in a single catchment are treated as in series for calculation purposes. If the BMPs are not in series use multiple catchments. There can be a maximum of 3 BMPs in a single catchment.	
BMP Name	Retention Basin	Wet Detention	Wet Detention			
BMP Name						
BMP Name						
Summary Performance of Entire Watershed					GO TO GENERAL SITE INFORMATION PAGE HELP - SERIES HELP - 3 CATCHMENTS	
Catchment Configuration	D - 3 Catchment-Series		1/27/2016			
Nitrogen Pre Load (kg/yr)	56.68		Treatment Objectives or Target MET 			
Phosphorus Pre Load (kg/yr)	11.08					
Nitrogen Post Load (kg/yr)	133.39					
Phosphorus Post Load (kg/yr)	21.07					
Target Load Reduction (N) %	57.5					
Target Load Reduction (P) %	47.4					
Target Discharge Load, N (kg/yr)	56.68					
Target Discharge Load, P (kg/yr)	11.08					
Provided Overall Efficiency, N (%)	57.6					
Provided Overall Efficiency, P (%)	68.5					
Discharged Load, N (kg/yr & lb/yr):	56.57	124.61	Make note of for later			
Discharged Load, P (kg/yr & lb/yr):	6.63	14.61				
Load Removed, N (kg/yr & lb/yr):	76.81	169.19				
Load Removed, P (kg/yr & lb/yr):	14.44	31.80				

BMPs used

Summary of Results

Make note of for later

Provided Overall Efficiency, N (%): 57.6
 Provided Overall Efficiency, P (%): 68.5

GENERAL SITE INFORMATION: V 7.7		GO TO INTRODUCTION PAGE	Blue Numbers = Input data Red Numbers = Calculated or Carryover				
Select the appropriate Meteorological Zone, input the appropriate Mean Annual Rainfall amount and select the type of analysis		NAME OF PROJECT Complex Configuration Ex	HELP VIEW ZONE MAP VIEW MEAN ANNUAL RAINFALL MAP GO TO WATERSHED CHARACTERISTICS				
Meteorological Zone (Please use zone map):	<input type="text" value="Zone 2"/> <small>CLICK ON CELL BELOW TO SELECT</small>	<input type="text" value="50.00"/> Inches					
Mean Annual Rainfall (Please use rainfall map):	<input type="text" value="Net improvement"/> <small>CLICK ON CELL BELOW TO SELECT</small>						
Type of analysis: Treatment efficiency (N, P) (leave empty if net improvement or BMP analysis is used):	<input type="text"/> %						
Select the STORMWATER TREATMENT ANALYSIS...	Input data	State Maps for zone and rainfall	Next worksheet				
STORMWATER TREATMENT ANALYSIS Systems available for analysis: Retention Basin with option for calculating effluent concentration Wet Detention Exfiltration Trench Pervious Pavement	Model Reset	RESET INPUT FOR STORMWATER TREATMENT ANALYSIS	There is a user's manual for the BMP... from www.stormwater.ucf.edu. The... shown in the manual however may... ongoing update				
Swale Rain Garden Tree Well Lined reuse pond User Defined BMP			METHODOLOGY FOR CALCULATING REQUIRED TREATMENT EFFICIENCY <table border="1"> <tr> <td>METHODOLOGY FOR RETENTION SYSTEMS</td> <td>METHODOLOGY FOR WET DETENTION SYSTEMS</td> </tr> <tr> <td>METHODOLOGY FOR GREENROOF SYSTEMS</td> <td>METHODOLOGY FOR WATER HARVESTING SYSTEMS</td> </tr> </table>	METHODOLOGY FOR RETENTION SYSTEMS	METHODOLOGY FOR WET DETENTION SYSTEMS	METHODOLOGY FOR GREENROOF SYSTEMS	METHODOLOGY FOR WATER HARVESTING SYSTEMS
METHODOLOGY FOR RETENTION SYSTEMS	METHODOLOGY FOR WET DETENTION SYSTEMS						
METHODOLOGY FOR GREENROOF SYSTEMS	METHODOLOGY FOR WATER HARVESTING SYSTEMS						

The screenshot shows a software interface for watershed analysis, divided into four catchment sections. Red callout boxes with arrows highlight key areas:

- Next worksheet:** Points to the 'WATERSHED' tab and the 'GO TO STORMWATER TREATMENT ANALYSIS' button.
- Site configuration:** Points to the 'VIEW AVERAGE ANNUAL RUNOFF "C" Factor' button.
- Input data:** Points to the 'CLICK ON CELL BELOW TO SELECT' buttons for land use configuration.
- Loading data:** Points to the 'OVERWRITE DEFAULT CONCENTRATIONS USING:' section, specifically the 'PRE:' and 'POST:' input fields for EMC(N) and EMC(P).

WATERSHED V 7.7

SELECT CATCHMENT | **GO TO STORMWATER TREATMENT ANALYSIS** | Blue Numbers = Input data | Red Numbers = Calculated | HELP - LAND USES/EMC

CATCHMENT NO.1

Pre-development land use: **Agricultural - Pasture: TN=3.510TP=0.686**
with default EMCs
CLICK ON CELL BELOW TO SELECT

Post-development land use: **Single-Family: TN=2.070 TP=0.327**
with default EMCs

Total pre-development catchment area: 15.00 AC
Total post-development catchment or BMP analysis area: 15.00 AC
Pre-development Non DCIA CN: 78.00
Pre-development DCIA percentage: 0.00 %
Post-development Non DCIA CN: 80.00
Post-development DCIA percentage: 45.00 %
Estimated BMP Area (No loading from this area): AC

VIEW AVERAGE ANNUAL RUNOFF "C" Factor

OVERWRITE DEFAULT CONCENTRATIONS USING:

PRE: mg/L | POST: mg/L
EMC(N): mg/L | EMC(P): mg/L

USE DEFAULT CONCENTRATIONS

Average annual pre runoff volume: 6.138 ac-ft/year
Average annual post runoff volume (note no BMP area): 26.563 ac-ft/year
Pre-development Annual Mass Loading - Nitrogen: 26.568 kg/year
Pre-development Annual Mass Loading - Phosphorus: 5.192 kg/year
Post-development Annual Mass Loading - Nitrogen: 67.810 kg/year
Post-development Annual Mass Loading - Phosphorus: 10.712 kg/year

CATCHMENT NO.2 CHARACTERISTICS:

Pre-development land use: **Agricultural - Pasture: TN=3.510TP=0.686**
with default EMCs
CLICK ON CELL BELOW TO SELECT

Post-development land use: **Single-Family: TN=2.070 TP=0.327**
with default EMCs

Total pre-development catchment area: 13.00 AC
Total post-development catchment or BMP analysis area: 13.00 AC
Pre-development Non DCIA CN: 78.00
Pre-development DCIA percentage: 0.00 %
Post-development Non DCIA CN: 80.00
Post-development DCIA percentage: 40.00 %
Estimated BMP Area (No loading from this area): AC

OVERWRITE DEFAULT CONCENTRATIONS USING:

PRE: mg/L | POST: mg/L
EMC(N): mg/L | EMC(P): mg/L

USE DEFAULT CONCENTRATIONS

Average annual pre runoff volume: 5.319 ac-ft/year
Average annual post runoff volume (note no BMP area): 21.125 ac-ft/year
Pre-development Annual Mass Loading - Nitrogen: 23.025 kg/year
Pre-development Annual Mass Loading - Phosphorus: 4.500 kg/year
Post-development Annual Mass Loading - Nitrogen: 53.929 kg/year
Post-development Annual Mass Loading - Phosphorus: 8.519 kg/year

CATCHMENT NO.3 CHARACTERISTICS:

Pre-development land use: **Agricultural - Pasture: TN=3.510TP=0.686**
with default EMCs
CLICK ON CELL BELOW TO SELECT

Post-development land use: **Single-Family: TN=2.070 TP=0.327**
with default EMCs

Total pre-development catchment area: 22.00 AC
Total post-development catchment or BMP analysis area: 22.00 AC
Pre-development Non DCIA CN: 78.00
Pre-development DCIA percentage: 0.00 %
Post-development Non DCIA CN: 80.00
Post-development DCIA percentage: 35.00 %
Estimated BMP Area (no loading from this area): AC

OVERWRITE DEFAULT CONCENTRATIONS USING:

PRE: mg/L | POST: mg/L
EMC(N): mg/L | EMC(P): mg/L

USE DEFAULT CONCENTRATIONS

Average annual pre runoff volume: 9.002 ac-ft/year
Average annual post runoff volume (note no BMP area): 32.542 ac-ft/year
Pre-development Annual Mass Loading - Nitrogen: 38.966 kg/year
Pre-development Annual Mass Loading - Phosphorus: 7.616 kg/year
Post-development Annual Mass Loading - Nitrogen: 83.074 kg/year
Post-development Annual Mass Loading - Phosphorus: 13.123 kg/year

CATCHMENT NO.4 CHARACTERISTICS:

Pre-development land use: **Agricultural - Pasture: TN=3.510TP=0.686**
with default EMCs
CLICK ON CELL BELOW TO SELECT

Post-development land use: **Single-Family: TN=2.070 TP=0.327**
with default EMCs

Total pre-development catchment area: AC
Total post-development catchment or BMP analysis area: AC
Pre-development Non DCIA CN: %
Pre-development DCIA percentage: %

OVERWRITE DEFAULT CONCENTRATIONS USING:

PRE: mg/L | POST: mg/L
EMC(N): mg/L | EMC(P): mg/L

USE DEFAULT CONCENTRATIONS

Average annual pre runoff volume: ac-ft/year
Average annual post runoff volume (note no BMP area): ac-ft/year
Pre-development Annual Mass Loading - Nitrogen: kg/year

STORMWATER TREATMENT ANALYSIS:		V 7.7	GO TO GENERAL SITE INFORMATION PAGE		Blue Numbers =	Input data
					Red Numbers =	Calculated
If not done, specify pre- and post-development watershed characteristics.						
GO TO WATERSHED CHARACTERISTICS						
<p><u>Total Required Treatment Efficiency:</u></p> <p>Required Treatment Eff (Nitrogen): 56.761 %</p> <p>Required Treatment Eff (Phosphorus): 46.505 %</p>			<p>Treatment Objectives (points to the efficiency values)</p> <p>BMP Worksheets (points to the BMP selection table)</p> <p>Site configuration (points to the site diagram)</p>			
Select one of the BMPs below to analyze efficiency or review the summary data.						
RETENTION BASIN	WET DETENTION	EXFILTRATION TRENCH	RAIN GARDEN	SWALE	USER DEFINED BMP	
PERVIOUS PAVEMENT	STORMWATER HARVESTING	FILTRATION including Up-Flow Filters	LINED REUSE POND & UNDERDRAIN INPUT	<p>Results worksheet (points to the summary results)</p> <p>Please read instructions in the CATCHMENT AND TREATMENT SUMMARY RESULTS tab for more information.</p>		
GREENROOF	RAINWATER HARVESTING	MANAGED AQUATIC PLANTS	<p>CATCHMENT AND TREATMENT SUMMARY RESULTS</p>			
VEGETATED NATURAL BUFFER	VEGETATED FILTER STRIP	TREE WELL				

RETENTION BASIN:

V 7.7

RETENTION BASIN SERVING:

Complex Configuration Ex 2

Loadings from BMP area are contained by the BMP, thus no BMP area load.

Watershed area cotributing to basin:

Required Treatment Eff (Nitrogen):

Required Treatment Eff (Phosphorus):

Required retention depth:

Required water volume:

	Catchment 1	Catchment 2	Catchment 3	Catchment 4	
Watershed area cotributing to basin:	15.000	13.000	22.000	0.000	ac
Required Treatment Eff (Nitrogen):	60.820	57.304	53.095		%
Required Treatment Eff (Phosphorus):	51.527	47.177	41.969		%
Required retention depth:	0.457	0.414	0.363	0.000	in
Required water volume:	0.572	0.449	0.665	0.000	ac-ft

Treatment volume

RETENTION SYSTEMS (if there is a need for additional removal efficiencies in a series of BMPs):

Retention volume based on retention depth and total area

Provided retention depth (0.1-3.99 inches over the watershed)

Provided treatment efficiency (Nitrogen):

Provided treatment efficiency (Phosphorus):

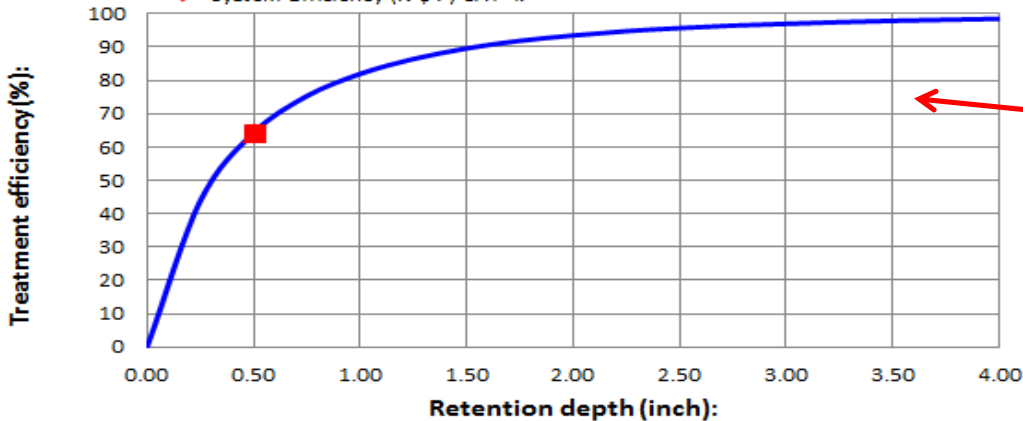
Remaining treatment efficiency (Nitrogen):

Remaining treatment efficiency (Phosphorus):

Remaining retention depth needed:

	Catchment 1	Catchment 2	Catchment 3	Catchment 4	
Retention volume based on retention depth and total area	0.625	0.542	0.917	0.000	ac-ft
Provided retention depth (0.1-3.99 inches over the watershed)	0.500	0.500	0.500		in
Provided treatment efficiency (Nitrogen):	64.296	64.296	64.296	0.000	%
Provided treatment efficiency (Phosphorus):	64.296	64.296	64.296	0.000	%
Remaining treatment efficiency (Nitrogen):	0.000	0.000	0.000		%
Remaining treatment efficiency (Phosphorus):	0.000	0.000	0.000		%
Remaining retention depth needed:	0.000	0.000	0.000	0.000	in

- Efficiency Curve:
- System Efficiency (N \$ P) CAT 2:
- ◆ System Efficiency (N \$ P) CAT 4:
- ▲ System Efficiency (N \$ P) CAT 1:
- System Efficiency (N \$ P) CAT 3:



NOTE FOR TREATMENT EFFICIENCY GRAPH:

The graph helps illustrate the treatment efficiency as a function of retention depth for a catchment. The graph illustrates that as the retention depth is increased, thus the effectiveness in "treatment trains" and compensatory treatment should be considered. NOTE: the retention volume can not exceed 3.99 inches to be within the range of data used to determine effectiveness.

HELP - EXAMPLE PROBLEM 3

[View Media Mixes](#)

Use only down flow media mix before water enters the ground, specify type

Nitrogen mass reduction in groundwater discharge (%)

Phosphorus mass reduction in groundwater discharge (%)

Catchment 1	Catchment 2	Catchment 3	Catchment 4

CATCHMENTS AND TREATMENT SUMMARY RESULTS					V 7.7	Blue Numbers = Red Numbers =	Input data Calculated or Carryover		
CALCULATION METHODS: 1. The effectiveness of each BMP in a single catchment is converted to an equivalent capture volume. 2. Certain BMP treatment train combinations have not been evaluated and in practice they are at this time not used, an example is a greenroof following a tree well. 3. Wet detention is last when used in a single catchment with other BMPs, except when followed by filtration					<p>BMPs used</p>			<p>GO TO STORMWATER TREATMENT ANALYSIS</p>	
<p>PROJECT TITLE Complex Configuration Ex 2 Optional Identification</p>								<p>GO TO WATERSHED CHARACTERISTICS</p>	
<p>Catchment 1: Catchment 2: Catchment 3: Catchment 4:</p>					<p>Thank you for using this BMPTRAINS model.</p>				
<p>BMP Name Retention Basin Retention Basin Retention Basin</p>					<p>NOTE: Multiple BMPs in a single catchment are treated as in series for calculation purposes. If the BMPs are not in series use multiple catchments. There can be a maximum of 3 BMPs in a single catchment.</p>				
<p>BMP Name</p>									
<p>BMP Name</p>									
<p>Summary Performance of Entire Watershed</p>					<p>Summary of Results</p>				
<p>Catchment Configuration F - Mixed-3 Catchment-2 Series-Parallel (A)</p>					<p>1/27/2016</p>				
<p>Nitrogen Pre Load (kg/yr) 88.56</p>					<p>BMPTRAINS MODEL</p>				
<p>Phosphorus Pre Load (kg/yr) 17.31</p>									
<p>Nitrogen Post Load (kg/yr) 204.81</p>									
<p>Phosphorus Post Load (kg/yr) 32.35</p>									
<p>Target Load Reduction (N) % 56.8</p>									
<p>Target Load Reduction (P) % 46.5</p>									
<p>Target Discharge Load, N (kg/yr) 88.56</p>									
<p>Target Discharge Load, P (kg/yr) 17.31</p>									
<p>Provided Overall Efficiency, N (%) 68.4</p>									
<p>Provided Overall Efficiency, P (%) 68.4</p>									
<p>Discharged Load, N (kg/yr & lb/yr): 64.79 142.70</p>									
<p>Discharged Load, P (kg/yr & lb/yr): 10.23 22.54</p>									
<p>Load Removed, N (kg/yr & lb/yr): 140.03 308.42</p>									
<p>Load Removed, P (kg/yr & lb/yr): 22.12 48.72</p>									
<p>Treatment Objectives or Target MET</p>					<p>Make note of for later</p>				
<p>GO TO GENERAL SITE INFORMATION PAGE</p>					<p>HELP - SERIES</p>				
<p>HELP - 3 CATCHMENTS</p>					<p>HELP - 3 CATCHMENTS</p>				

GENERAL SITE INFORMATION: V 7.7		GO TO INTRODUCTION PAGE	Blue Numbers = Input data Red Numbers = Calculated or Carryover
<p>Select the appropriate Meteorological Zone, input the appropriate Mean Annual Rainfall amount and select the type of analysis</p>		NAME OF PROJECT Complex Configuration Ex 3	HELP
<p>Meteorological Zone (Please use zone map):</p> <p>Mean Annual Rainfall (Please use rainfall map):</p> <p>Type of analysis:</p> <p>Treatment efficiency (N, P) (leave empty if net improvement or BMP analysis is ...):</p>		<p>CLICK ON CELL BELOW TO SELECT</p> <p>Zone 2</p> <p>50.00 Inches</p> <p>CLICK ON CELL BELOW TO SELECT</p> <p>Net improvement</p>	<p>VIEW ZONE MAP</p> <p>VIEW MEAN ANNUAL RAINFALL MAP</p> <p>GO TO WATERSHED CHARACTERISTICS</p>
<p>Select the STORMWATER TREATMENT PRACTICES button below to begin the analysis of the selected practices.</p>		<p>Input data</p> <p>State Maps for zone and rainfall</p>	<p>Next worksheet</p>
<p>STORMWATER TREATMENT ANALYSIS</p> <p>Systems available for analysis:</p> <ul style="list-style-type: none"> Retention Basin with option for calculating effluent concentration Rainwater Harvesting Managed Aquatic Plants Detention Vegetated Natural Buffer Vegetated Filter Strip Swale Rain Garden Tree Well Lined reuse pond User Defined BMP 		<p>RESET INPUT FOR STORMWATER TREATMENT ANALYSIS</p>	<p>There is a user's manual for the BMP from www.stormwater.ucf.edu. The manual is shown in the manual however may be subject to ongoing updates.</p> <p>Next worksheet</p>
		<p>METHODOLOGY FOR CALCULATING REQUIRED TREATMENT EFFICIENCY</p> <p>METHODOLOGY FOR RETENTION SYSTEMS</p> <p>METHODOLOGY FOR WET DETENTION SYSTEMS</p> <p>METHODOLOGY FOR GREENROOF SYSTEMS</p> <p>METHODOLOGY FOR WATER HARVESTING SYSTEMS</p>	

Next worksheet

WATERSHED V 7.7 **GO TO STORMWATER TREATMENT ANALYSIS**

Blue Numbers = Input data
Red Numbers = Calculated HELP - LAND USES/EMC

SELECT CATCHMENT

CATCHMENT NO.1

Pre-development land use: **Agricultural - Pasture: TN=3.510TP=0.686**
with default EMCs
CLICK ON CELL BELOW TO SELECT

Post-development land use: **Single-Family: TN=2.070 TP=0.327**
with default EMCs

Total pre-development catchment area:	32.00	AC
Total post-development catchment or BMP analysis area:	32.00	AC
Pre-development Non DCIA CN:	78.00	
Pre-development DCIA percentage:	0.00	%
Post-development Non DCIA CN:	80.00	
Post-development DCIA percentage:	44.40	%
Estimated BMP Area (No loading from this area)	2.00	AC

VIEW AVERAGE ANNUAL RUNOFF "C" Factor

VIEW EMC & FLUCCS

VIEW CATCHMENT CONFIGURATION

OVERWRITE DEFAULT CONCENTRATIONS USING:

PRE: _____ mg/L POST: _____ mg/L
EMC(N): _____ mg/L EMC(P): _____ mg/L

USE DEFAULT CONCENTRATIONS

Average annual pre runoff volume:	13.093	ac-ft/year
Pre-development Annual Mass Loading - Nitrogen:	52.600	kg/year
Pre-development Annual Mass Loading - Phosphorus:	11.077	kg/year
Post-development Annual Mass Loading - Nitrogen:	134.280	kg/year
Post-development Annual Mass Loading - Phosphorus:	21.212	kg/year

CATCHMENT NO.2 CHARACTERISTICS:

Pre-development land use: **Agricultural - Pasture: TN=3.510TP=0.686**
with default EMCs
CLICK ON CELL BELOW TO SELECT

Post-development land use: **Single-Family: TN=2.070 TP=0.327**
with default EMCs

Total pre-development catchment area:	50.00	AC
Total post-development catchment or BMP analysis area:	50.00	AC
Pre-development Non DCIA CN:	78.00	
Pre-development DCIA percentage:	0.00	%
Post-development Non DCIA CN:	80.00	
Post-development DCIA percentage:	39.30	%
Estimated BMP Area (No loading from this area)		AC

Sum of Run 1

OVERWRITE DEFAULT CONCENTRATIONS:

PRE: _____ mg/L POST: _____ mg/L
EMC(N): _____ mg/L EMC(P): _____ mg/L

USE DEFAULT CONCENTRATIONS

Average annual post runoff volume (note no BMP area):	20.458	ac-ft/year
Pre-development Annual Mass Loading - Nitrogen:	88.559	kg/year
Pre-development Annual Mass Loading - Phosphorus:	17.308	kg/year
Post-development Annual Mass Loading - Nitrogen:	204.813	kg/year
Post-development Annual Mass Loading - Phosphorus:	32.355	kg/year

CATCHMENT NO.3 CHARACTERISTICS:

Pre-development land use: **Agricultural - Pasture: TN=3.510TP=0.686**
with default EMCs
CLICK ON CELL BELOW TO SELECT

Post-development land use: **Single-Family: TN=2.070 TP=0.327**
with default EMCs

Total pre-development catchment area:	30.00	AC
Total post-development catchment or BMP analysis area:	30.00	AC
Pre-development Non DCIA CN:	78.00	
Pre-development DCIA percentage:	0.00	%
Post-development Non DCIA CN:	80.00	
Post-development DCIA percentage:	30.00	%
Estimated BMP Area (no loading from this area)		AC

Sum of Run 2

OVERWRITE DEFAULT CONCENTRATIONS:

PRE: _____ mg/L POST: _____ mg/L
EMC(N): _____ mg/L EMC(P): _____ mg/L

USE DEFAULT CONCENTRATIONS

Average annual pre runoff volume:	12.275	ac-ft/year
Average annual post runoff volume (note no BMP area):	40.000	ac-ft/year
Pre-development Annual Mass Loading - Nitrogen:	53.135	kg/year
Pre-development Annual Mass Loading - Phosphorus:	10.385	kg/year
Post-development Annual Mass Loading - Nitrogen:	102.114	kg/year
Post-development Annual Mass Loading - Phosphorus:	16.131	kg/year

CATCHMENT NO.4 CHARACTERISTICS:

Pre-development land use: _____
with default EMCs
CLICK ON CELL BELOW TO SELECT

Post-development land use: _____
with default EMCs

Total pre-development catchment area:		AC
Total post-development catchment or BMP analysis area:		AC

Loading data

OVERWRITE DEFAULT CONCENTRATIONS:

PRE: _____ mg/L POST: _____ mg/L
EMC(N): _____ mg/L EMC(P): _____ mg/L

USE DEFAULT CONCENTRATIONS

Average annual pre runoff volume:		ac-ft/year
-----------------------------------	--	------------

STORMWATER TREATMENT ANALYSIS:		V 7.7	GO TO GENERAL SITE INFORMATION PAGE	Blue Numbers =	Input data
				Red Numbers =	Calculated
If not done, specify pre- and post-development watershed characteristics.					
GO TO WATERSHED CHARACTERISTICS					
<p><u>Total Required Treatment Efficiency:</u></p> <p>Required Treatment Eff (Nitrogen): 55.033 %</p> <p>Required Treatment Eff (Phosphorus): 44.367 %</p>			<p>Treatment Objectives (with arrow pointing to the efficiency values)</p>		
			<p>BMP Worksheets (with arrows pointing to the BMP selection table)</p>		
			<p>Site configuration (with arrow pointing to the site diagram)</p>		
Select one of the BMPs below to analyze efficiency or review the summary data.					
RETENTION BASIN	WET DETENTION	EXFILTRATION TRENCH	RAIN GARDEN	SWALE	USER DEFINED BMP
PERVIOUS PAVEMENT	STORMWATER HARVESTING	FILTRATION including Up-Flow Filters	LINED REUSE POND & UNDERDRAIN INPUT	<p>Results worksheet (with arrow pointing to the results section)</p> <p>Please read instructions in the CATCHMENT AND TREATMENT SUMMARY RESULTS tab for more information.</p>	
GREENROOF	RAINWATER HARVESTING	MANAGED AQUATIC PLANTS			
VEGETATED NATURAL BUFFER	VEGETATED FILTER STRIP	TREE WELL	CATCHMENT AND TREATMENT SUMMARY RESULTS		

User Defined BMP

V 7.7

USER DEFINED BMP SERVING:

Complex Configuration Ex 3

Your Name of BMP

Contributing catchment area

Required treatment efficiency (Nitrogen):

Required treatment efficiency (Phosphorus):

Is this a retention or other system*?

If retention

The catchment

Treatment from
Runs 1 and 2

Composite 1	Composite 2			
32.000	50.000	30.000	0.000	ac
57.774	56.761	47.965		%
47.758	46.505	35.622		%
Other	Other			
				in
0.000	0.000	0.000	0.000	ac-ft
57.60	68.40			%
68.50	68.40			%

Provided treatment efficiency (Nitrogen):

Provided treatment efficiency (Phosphorus):

* Examples of other systems are street sweeping, dry detention, chemical treatment, and pre-treatment devices

Enter a short description of BMP below (no more than 200 characters)

Both BMPs are composite BMPs that represent the overall treatment provided in model runs 1 and 2, respectively

Attach a detailed explanation with supporting data to support removal efficiencies.

Monitoring shall be required when the applicant proposes design criteria not found in this model and does not have specific test data or other data to support the removal claims

RETENTION BASIN:

V 7.7

RETENTION BASIN SERVING:

Complex Configuration Ex 3

Loadings from BMP area are contained by the BMP, thus no BMP area load.

Watershed area contributing to basin:

Required Treatment Eff (**Nitrogen**):

Required Treatment Eff (**Phosphorus**):

Required retention depth (inches) and required efficiency:

Required water quality:

Catchment 1	Catchment 2	Catchment 3	Catchment 4	
30.000	50.000	30.000	0.000	ac
57.774	56.761	47.965		%
47.758	46.505	35.622		%
0.416	0.403	0.295	0.000	in
1.039	1.680	0.737	0.000	ac-ft

Treatment volume

RETENTION BASIN SYSTEMS (if there is a need for additional removal efficiencies in a series of BMPs):

Retention volume based on:

Provided retention depth (0.1-3.99 inches over the watershed)

Provided treatment efficiency (**Nitrogen**):

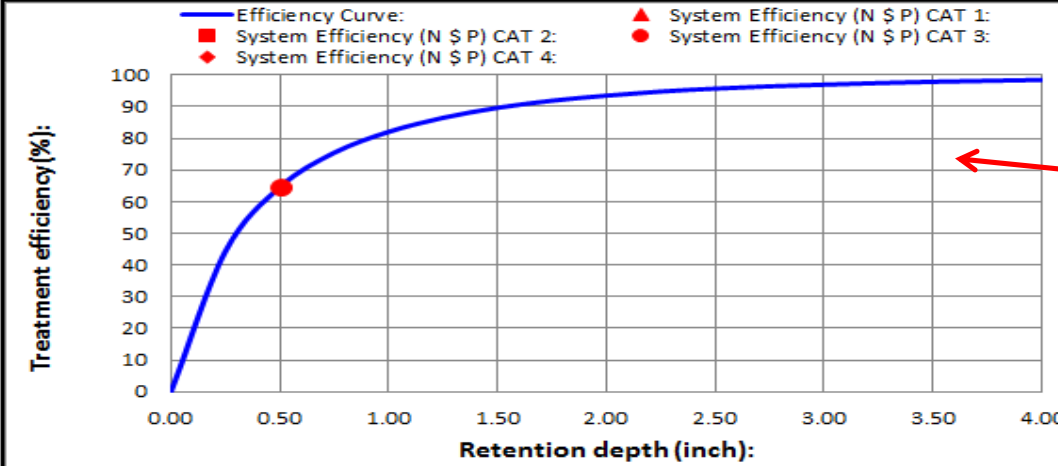
Provided treatment efficiency (**Phosphorus**):

Remaining treatment efficiency (**Nitrogen**):

Remaining treatment efficiency (**Phosphorus**):

Remaining retention depth needed:

0.000	0.000	1.250	0.000	ac-ft
		0.500		in
0.000	0.000	64.619	0.000	%
0.000	0.000	64.619	0.000	%
57.774	56.761	0.000		%
47.758	46.505	0.000		%
0.416	0.403	0.000	0.000	in



NOTE FOR TREATMENT EFFICIENCY GRAPH:

The graph helps illustrate the treatment efficiency as a function of retention depth for a catchment. The graph illustrates that as the retention depth is increased, thus the retention depth is increased. Thus, additional treatment trains and compensatory treatment should be considered. NOTE: the retention volume can not exceed 3.99 inches to be within the range of data used to determine effectiveness.

HELP - EXAMPLE PROBLEM 3

View Media Mixes

Use only down flow media mix before water enters the ground, specify type
 Nitrogen mass reduction in groundwater discharge (%)
 Phosphorus mass reduction in groundwater discharge (%)

Catchment 1	Catchment 2	Catchment 3	Catchment 4

CATCHMENTS AND TREATMENT SUMMARY RESULTS					V 7.7	Blue Numbers = Input data	Red Numbers = Calculated or Carryover																																																			
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<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 15%;">Catchment Configuration</th> <th style="width: 35%;">F - Mixed-3 Catchment-2 Series-Parallel (A)</th> <th style="width: 15%;"></th> <th style="width: 15%;">1/27/2016</th> <th style="width: 20%;"></th> </tr> <tr> <td></td> <td></td> <td rowspan="10" style="text-align: center; vertical-align: middle;"> Treatment Objectives or Target MET </td> <td colspan="2" style="text-align: center;">BMPTRAINS MODEL</td> </tr> <tr> <td>Nitrogen Pre Load (kg/yr)</td> <td style="color: red;">198.37</td> <td colspan="2" rowspan="10" style="text-align: center; vertical-align: middle;"> </td> </tr> <tr> <td>Phosphorus Pre Load (kg/yr)</td> <td style="color: red;">38.77</td> </tr> <tr> <td>Nitrogen Post Load (kg/yr)</td> <td style="color: red;">441.15</td> </tr> <tr> <td>Phosphorus Post Load (kg/yr)</td> <td style="color: red;">69.69</td> </tr> <tr> <td>Target Load Reduction (N) %</td> <td style="color: red;">55.0</td> </tr> <tr> <td>Target Load Reduction (P) %</td> <td style="color: red;">44.4</td> </tr> <tr> <td>Target Discharge Load, N (kg/yr)</td> <td style="color: red;">198.37</td> </tr> <tr> <td>Target Discharge Load, P (kg/yr)</td> <td style="color: red;">38.77</td> </tr> <tr> <td>Provided Overall Efficiency, N (%)</td> <td style="color: red;">68.3</td> </tr> <tr> <td>Provided Overall Efficiency, P (%)</td> <td style="color: red;">71.3</td> </tr> <tr> <td>Discharged Load, N (kg/yr & lb/yr)</td> <td style="color: red;">139.66</td> <td style="color: red;">307.62</td> <td colspan="2"></td> </tr> <tr> <td>Discharged Load, P (kg/yr & lb/yr)</td> <td style="color: red;">19.99</td> <td style="color: red;">44.03</td> <td colspan="2"></td> </tr> <tr> <td>Load Removed, N (kg/yr & lb/yr)</td> <td style="color: red;">301.49</td> <td style="color: red;">664.06</td> <td colspan="2"></td> </tr> <tr> <td>Load Removed, P (kg/yr & lb/yr)</td> <td style="color: red;">49.70</td> <td style="color: red;">109.46</td> <td colspan="2"></td> </tr> </table>					Catchment Configuration	F - Mixed-3 Catchment-2 Series-Parallel (A)		1/27/2016				Treatment Objectives or Target MET	BMPTRAINS MODEL		Nitrogen Pre Load (kg/yr)	198.37			Phosphorus Pre Load (kg/yr)	38.77	Nitrogen Post Load (kg/yr)	441.15	Phosphorus Post Load (kg/yr)	69.69	Target Load Reduction (N) %	55.0	Target Load Reduction (P) %	44.4	Target Discharge Load, N (kg/yr)	198.37	Target Discharge Load, P (kg/yr)	38.77	Provided Overall Efficiency, N (%)	68.3	Provided Overall Efficiency, P (%)	71.3	Discharged Load, N (kg/yr & lb/yr)	139.66	307.62			Discharged Load, P (kg/yr & lb/yr)	19.99	44.03			Load Removed, N (kg/yr & lb/yr)	301.49	664.06			Load Removed, P (kg/yr & lb/yr)	49.70	109.46			GO TO GENERAL SITE INFORMATION PAGE	
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Questions?

Mike Hardin

mhardin@geosyntec.com

(321)244-1464