CASE STUDIES: SWALE EFFECTIVENESS

BY: MARTY WANIELISTA AND ERIC LIVINGSTON

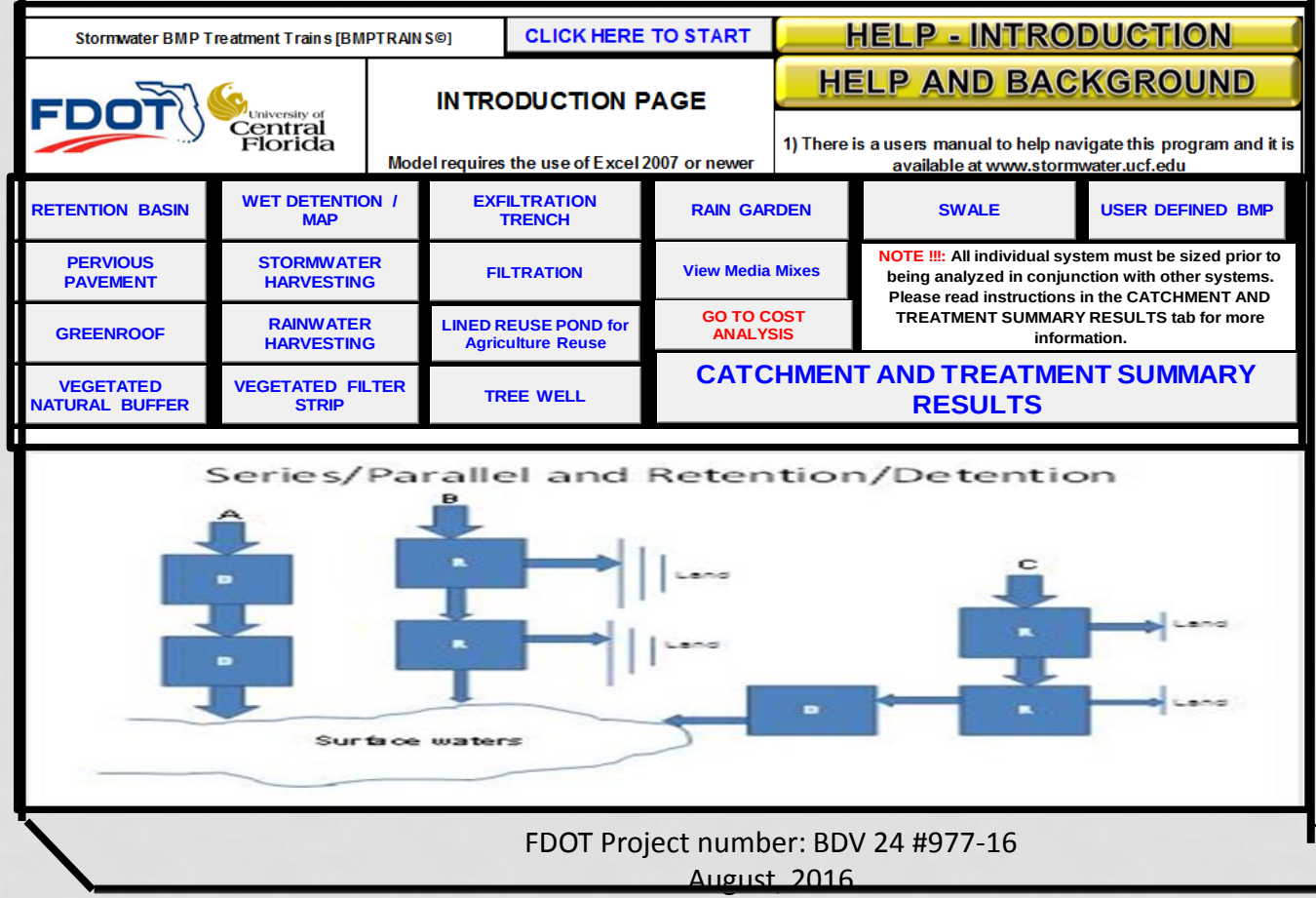
August, 2016
Escambia County

ACKNOWLEDGEMENTS

- The Low Impact Design BMP workshops were presented on August 24 and 25, 2016 at the Escambia County Central Office Complex in Pensacola.
- The Escambia County LID BMP Manual and the LID BMP Workshops were funded in part by a Section 319 Nonpoint Source Management Program Implementation grant from the U.S. Environmental Protection Agency through an agreement/contract with the Nonpoint Source Management Section of the Florida Department of Environmental Protection.

User's Manual for the BMPTRAINS Model

Marty Wanielista, Harvey Harper, Eric Livingston, Mike Hardin, Przemyslaw Kuzlo.
and Ikiensinma Gogo-Abite



FDOT Project number: BDV 24 #977-16
August, 2016

BMPTRAINS

Available from: www.stormwater.ucf.edu

What's New

BMPTRAINS Stormwater Best Management Practices Analysis Model (Version 8) Registration, Model, and User's Manual

To be released before Nov of 2016

NAVIGATING the BMP Nutrient Model BMPTRAINS

INTRODUCTION PAGE

Model requires the use of Excel 2007 or newer

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.

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.

HELP AND BACKGROUND

1) There is a users manual to help navigate this program and it is available at www.stormwater.ucf.edu

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.

3) This spreadsheet has incorporated ERROR MESSAGE WINDOWS. Your analysis is not valid unless ALL ERROR MESSAGE WINDOWS are clear.

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.

5) Click on the button located on the top of this window titled CLICK HERE TO START to begin the analysis.

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.

The authors of this program were Marty Wanielista, Mike Hardin, Harvey Harper, Eric Livingston, Christopher Kuzlo, Colin Miller, and Ikiensinma Gogo-Abite.
The trial version 8.0 updates of this program were done by Marty Wanielista and Mike Hardin.
This is trial version 8.0 of the program, updated on August 1, 2016. Comments are appreciated.

HELP - HYDROGRAPH AND LEGACY PROGRAMS

SMADA ONLINE

NOTE: the HELP button on a page will take you to information related to that page

PROBLEM INFORMATION

- Project location is Liberty County
- Single catchment to be examined
  - Area of 1.1 acres
  - Specified removal efficiency of 80%
- A swale is to be used

CATCHMENT SUMMARY

		Catchment
Predevelopment Conditions	Land use	Agricultural-pasture
	Curve Number	80
	%DCIA	0
Postdevelopment Conditions	Land use	Highway
	non-DCIA Curve Number	85
	%DCIA	50
	BMP Area [acre]	0.1

BMP DESIGN

- Catchment will use 0.1 acre swale
  - Top width = 10 ft
  - Bottom width = 0 ft (so triangular)
  - Length (swale and highway) = 871 ft
  - Highway width = 20 ft
  - Average width of pervious area = 40 ft
  - Swale slope = 0.001
  - Manning's n = 0.05
  - Soil infiltration rate = 5 in/hr
  - Swale side slope = 5
  - There is no swale block but there is a concentration reduction due to low slope

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ZONE MAP | DESIGNATED METEOROLOGICAL REGIONS (ZONES) IN FLORIDA

GENERAL SITE INFORMATION: | GO TO INTRODUCTION PAGE

Blue Numbers = Input data
Red Numbers = Calculated or Carryover

STEP 1: Select the appropriate Meteorological Zone, input the appropriate Mean Annual Rainfall amount and select the type of analysis

NAME OF PROJECT: Example Problem 1

VIEW ZONE MAP

Meteorological Zone (Please use zone map): CLICK ON CELL BELOW TO SELECT — Z

Mean Annual Rainfall (Please use rainfall map): 60.00 Inch

VIEW MEAN ANNUAL RAINFALL MAP

Type of analysis: CLICK ON CELL BELOW TO SELECT — Specified removal efficiency

GO TO WATERSHED CHARACTERISTICS

Treatment efficiency (N, P) (leave empty if net improvement or BMP analysis is used): 80.00 80.00 %

STEP 2: Select the STORMWATER TREATMENT ANALYSIS to begin analyzing Best Management Practices.

Model documentation and example problems.

STORMWATER TREATMENT ANALYSIS

There is a user's manual for the BMPTRAINS model. It can be downloaded from www.stormwater.ucf.edu. The results from the example problems shown in the manual however may not reflect current model results due to ongoing updates of the model.

Systems available for analysis:
Retention Basin with option for calculating effluent concentration
Wet Detention
Exfiltration Trench
Pervious Pavement
Stormwater Harvesting
Underdrain Biofiltration
Greenroof
Rainwater Harvesting
Floating Island with Wet Detention
Vegetated Natural Buffer
Vegetated Filter Strip
Swale
Rain Garden
User Defined BMP

RESET INPUT FOR STORMWATER TREATMENT ANALYSIS

METHODOLOGY FOR CALCULATING REQUIRED TREATMENT EFFICIENCY

METHODOLOGY FOR RETENTION SYSTEMS

METHODOLOGY FOR WET DETENTION SYSTEMS

METHODOLOGY FOR GREENROOF SYSTEMS

METHODOLOGY FOR WATER HARVESTING SYSTEMS

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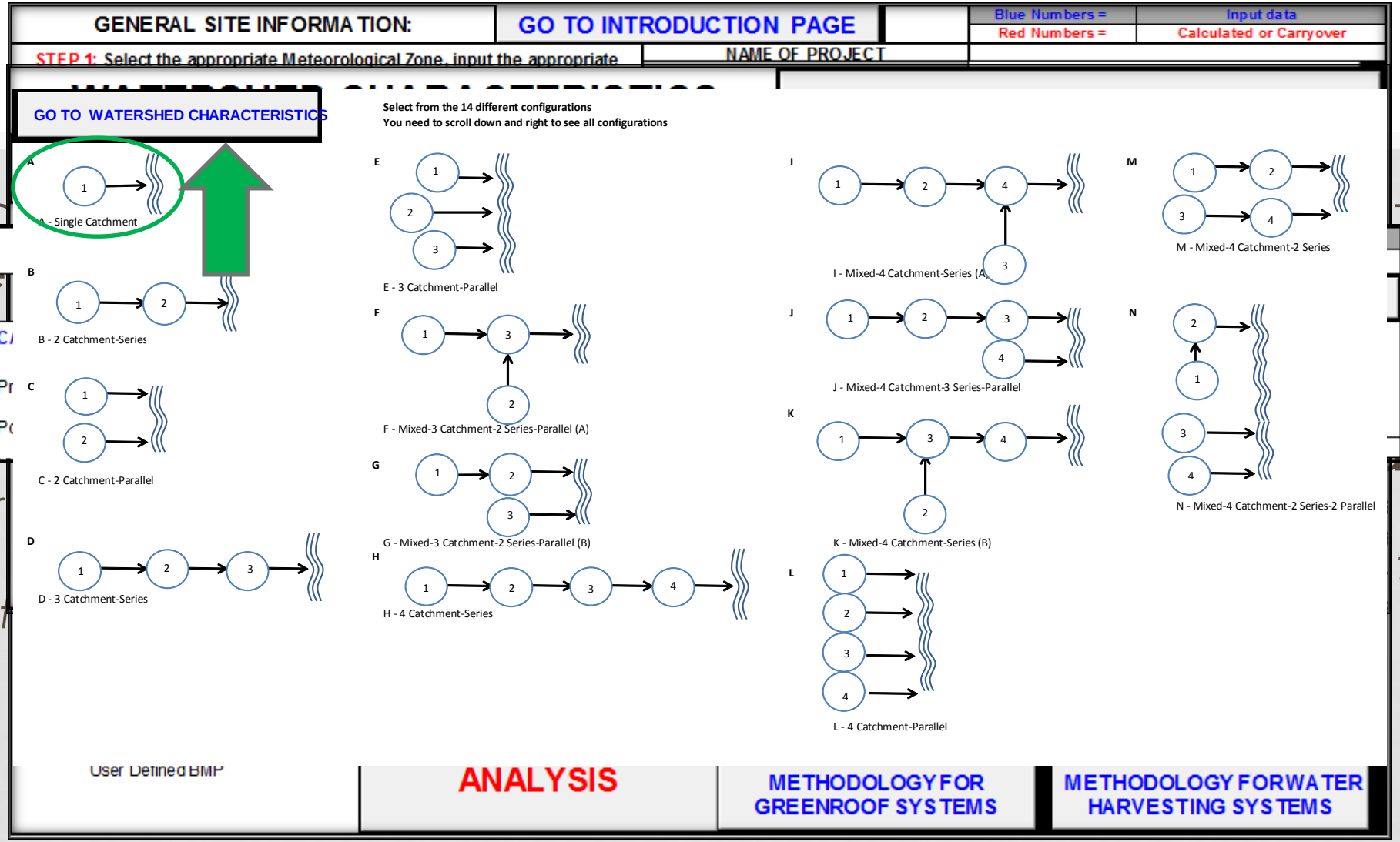

PROBLEM SOLUTION

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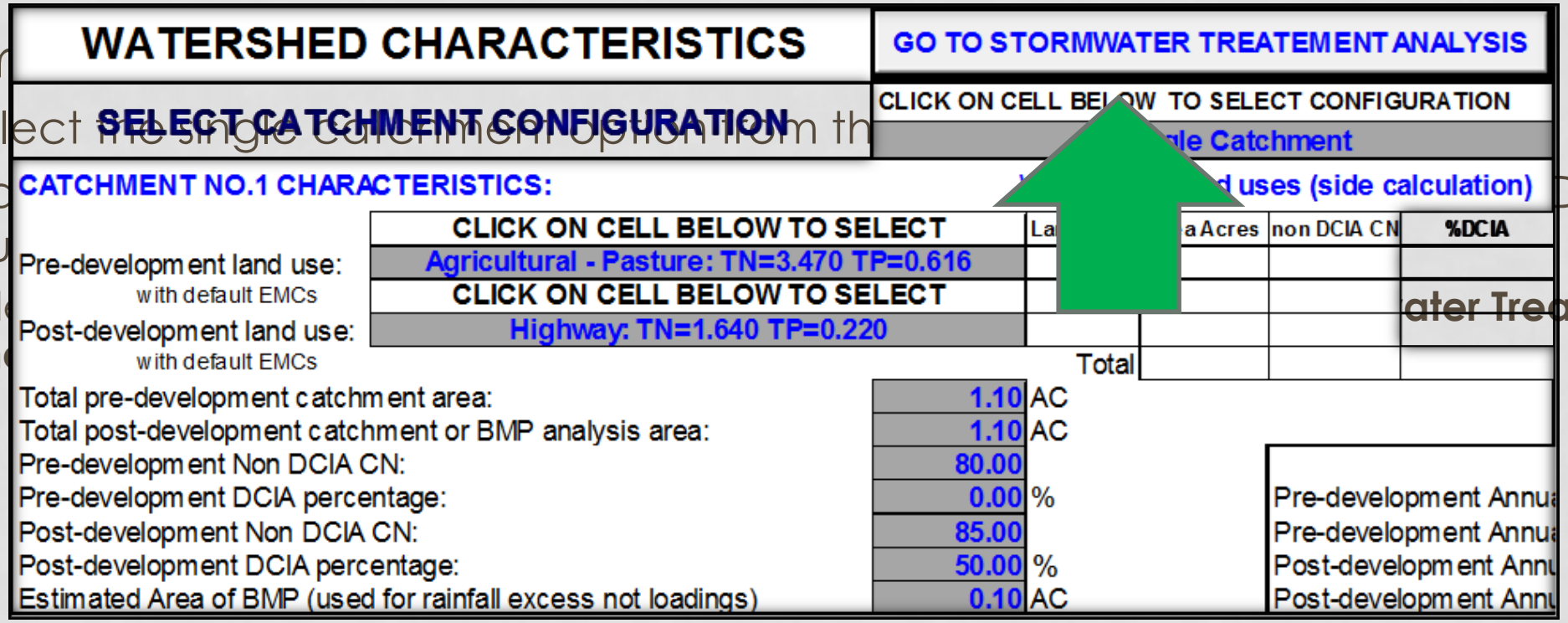
  - Select the single catchment option from th
  - Inc DCIA Cu
  - Sel ater Treatment **An**



WATERSHED CHARACTERISTICS	GO TO STORMWATER TREATEMENT ANALYSIS
SELECT CATCHMENT CONFIGURATION	CLICK ON CELL BELOW TO SELECT CONFIGURATION
	le Catchment

CATCHMENT NO.1 CHARACTERISTICS: d uses (side calculation)

	CLICK ON CELL BELOW TO SELECT	La	a Acres	non DCIA CN	%DCIA
Pre-development land use: with default EMCs	Agricultural - Pasture: TN=3.470 TP=0.616				
	CLICK ON CELL BELOW TO SELECT				
Post-development land use: with default EMCs	Highway: TN=1.640 TP=0.220				
		Total			

Total pre-development catchment area:	1.10	AC	
Total post-development catchment or BMP analysis area:	1.10	AC	
Pre-development Non DCIA CN:	80.00		
Pre-development DCIA percentage:	0.00	%	Pre-development Annua
Post-development Non DCIA CN:	85.00		Pre-development Annua
Post-development DCIA percentage:	50.00	%	Post-development Annu
Estimated Area of BMP (used for rainfall excess not loadings)	0.10	AC	Post-development Annu

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STORMWATER TREATMENT ANALYSIS:	GO TO GENERAL SITE INFORMATION PAGE	Blue Numbers =	Input data

HIGHWAY SWALE

Blue Numbers =	Input data
Red Numbers =	Calculated or Carryover

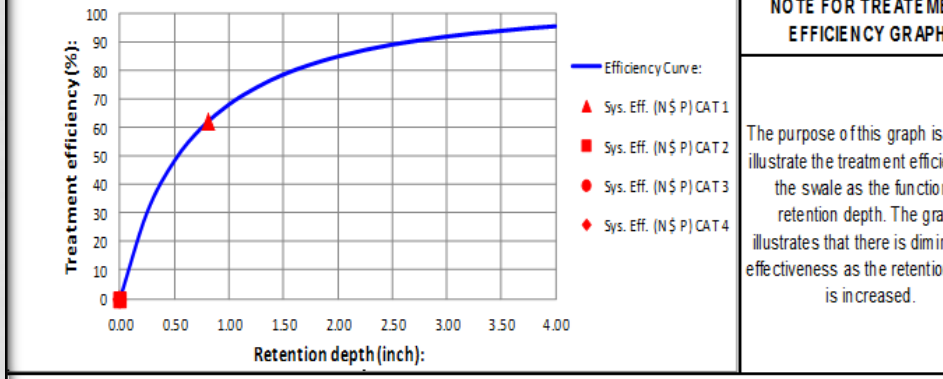
SWALE SERVING CONTRIBUTING CATCHMENT:	Example Problem1

GO TO STORMWATER TREATMENT ANALYSIS

	Catchment 1	Catchment 2	Catchment3	Catchment 4	
Contributing catchment area:	1.000	0.000	0.000	0.000	ac
Required treatment efficiency (**Nitrogen**):	80.000	80.000	80.000	80.000	%
Required treatment efficiency (**Phosphorus**):	80.000	80.000	80.000	80.000	%
Swale top width calculated for flood conditions:	10.00				ft
Swale bottom width (0 for triangular section):	0.00				ft
Swale length:	871.00				ft
Highway length:	871.00				ft
Highway width (including shoulder):	20.00				ft
Average width of the pervious area to include swale width:	40.00				ft
Highway contributing catchment area:	43550.00	0.00	0.00	0.00	ft^2
Swale slope (ft drop/ft length):	0.001				
Manning's N:	0.050				
Soil infiltration rate (in/hr):	5.000				
Side slope of swale (horizontal ft/vertical ft):	5.000				
Infiltrated storage depth (in):	0.811	0.000	0.000	0.000	in
Height of the swale block:					ft
Length of the berm upstream of crest:					ft
Volume of swale block:	0.000	0.000	0.000	0.000	in
Total volume:	0.811	0.000	0.000	0.000	in
Provided treatment efficiency (**Nitrogen**):	61.890	0.000	0.000	0.000	%
Provided treatment efficiency (**Phosphorus**):	61.890	0.000	0.000	0.000	%

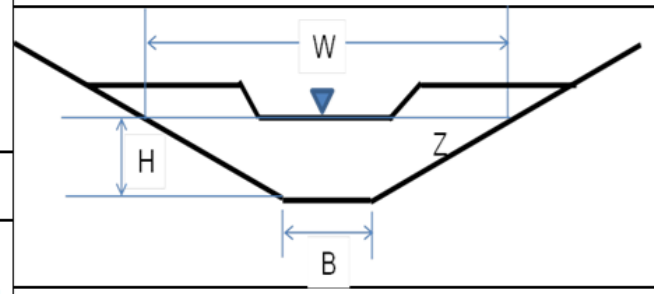
	Catchment 1	Catchment 2	Catchment3	Catchment 4	
Concentration reduction?	Yes				
Provided treatment efficiencies are:					
Nitrogen efficiency	…23	0.000	0.000	0.000	
Phosphorus efficiency	…88	0.000	0.000	0.000	
Required remaining treatment efficiency of a non re… BMP, such as wet detention in series with swale. Use for sizing of non retention … in series with swale.					
Remaining treatment efficiency needed (**Nitrogen**):	…29	80.000	80.000	80.000	%
Required pre-treatment efficiency (**Phosphorus**):	…524	80.000	80.000	80.000	%

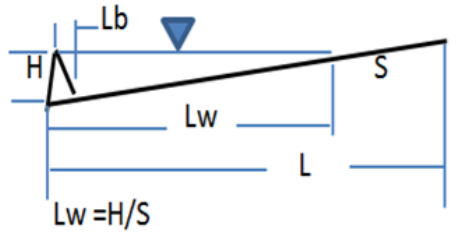
ERROR MESSAGE WINDOW FOR SWALE:



NOTE FOR TREATEMENT EFFICIENCY GRAPH:

The purpose of this graph is to help illustrate the treatment efficiency of the swale as the function of retention depth. The graph illustrates that there is diminishing effectiveness as the retention depth is increased.





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CATCHMENTS AND TREATMENT SUMMARY RESULTS

CALCULATION METHODS:

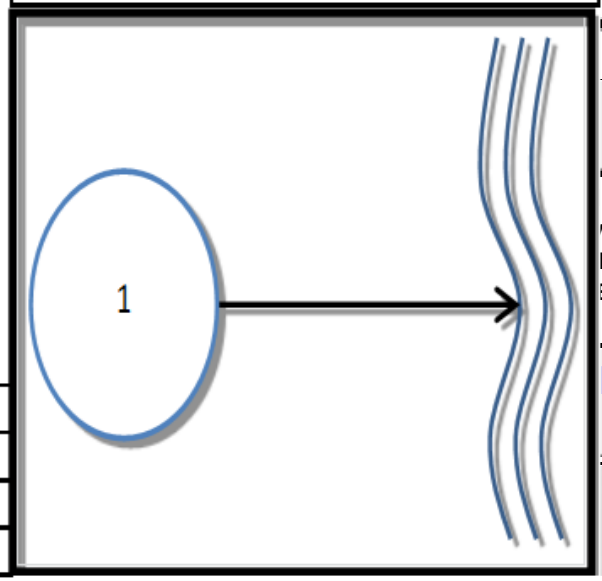
1. The effectiveness of each BMP in a single catchment is converted to an equivalent capture volume.
2. Certain BMP treatment train combinations have not been evaluated and in practice they are at this time not used, an example is a greenroof following a tree well.
3. If multiple BMPs are used in a single catchment and one of them is detention, then it is assumed to be last in series.

PROJECT TITLE	Example Problem 1	Optional Identification		
	Catchment 1:	Catchment 2:	Catchment 3:	Catchment 4:
BMP1	Swale			
BMP2				
BMP3				
Catchment Configuration	A - Single Catchment			

Summary Performance			
Catchment Nitrogen Pre Load	3.81		
Catchment Phosphorus Pre Load	0.68		
Catchment Nitrogen Post Load	5.41		
Catchment Phosphorus Post Load	0.73		
Target Load Reduction (N) %	80		
Target Load Reduction (P) %	80		
Target Discharge Load, N (kg/yr)	1.08		
Target Discharge Load, P (kg/yr)	0.15		
Provided Overall Efficiency, N (%):	73		
Provided Overall Efficiency, P (%):	68		
Discharged Load, N (kg/yr & lb/yr):	1.44	3.18	
Discharged Load, P (kg/yr & lb/yr):	0.23	0.51	
Load Removed, N (kg/yr & lb/yr):	3.97	8.74	
Load Removed, P (kg/yr & lb/yr):	0.49	1.09	

7/16/2013

BMPTRAINS MODEL



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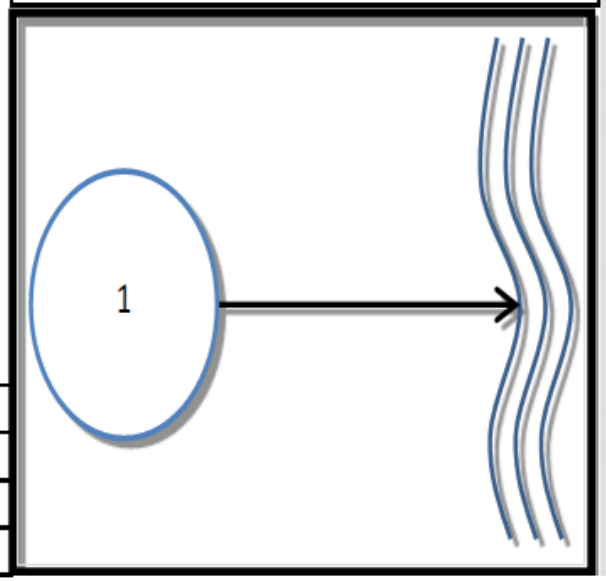
7/16/2013

BMPTRAINS MODEL



SOME OBSERVATIONS

Easy to use model allows you to easily try different designs and evaluate them

Can evaluate swale designs

15 BMPs to choose from with the ability to use several different configurations

- Series
- Parallel
- Combination

Summary sheet allows for quick and easy evaluation of design

QUESTIONS, REMARKS AND DISCUSSION

THANK YOU!