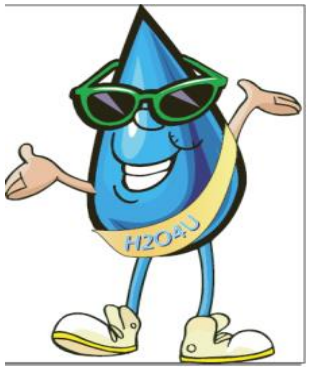
Pinellas County Stormwater Management Manual Training Workshop

SMALL COMMERCIAL AREA CASE STUDY



PRE

Figure 2.1-I – Pre-2013 Redevelopment Project

POST (ACTUAL)

Figure 2.1-III – Post-2013 Redevelopment Project

Table 2.1.a Small Commercial Site Information with Retention BMP Options							
Land Uses	Site Size (Acres)	Impervious Area	Directly Connected Imp Area (DCIA)	Non-DCIA Pervious Area	Soil Types	SHGWT	Stormwater System? Type?
Existing: Light Industrial	1.79	1.66 acres 93% impervious	1.66 acres Project %DCIA = 93%	0.13 acres CN=80	HSG B	3' below land	None
Proposed: High Intensity Commercial	1.79	1.66 acres 93% impervious	1.66 acres Project % DCIA = 93%	0.13 acres CN=80	HSG B		BMP Train

WHICH IS THE APPROPRIATE PERFORMANCE STANDARD?

Post = 90% of Pre vs. 55% N and 80% P reduction

Post = 90% of Pre discharges 7.85kg of N and 1.71kg of P.
This is only 52% removal for N and 26% for P.

HOWEVER, this level of treatment requires 1.61 feet of retention in the 0.13 ac. retention area and only 1.0 feet of storage is available.

GENERAL SITE INFORMATION: V 8.5	GO TO INTRODUCTION PAGE	3/25/2017	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: small commercial

HELP Rainfall

VIEW ZONE MAP

Meteorological Zone (Please use zone map): CLICK ON CELL BELOW TO SELECT — Zone 4

Mean Annual Rainfall (Please use rainfall map): 51.00 Inches

VIEW MEAN ANNUAL RAINFALL MAP

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

Treatment efficiency (N, P) (ex 80 70 (no decimal points) use only for specified removal efficiency): 55 80 %

GO TO WATERSHED CHARACTERISTICS

Select the STORMWATER TREATMENT ANALYSIS Button below to begin analyzing the effectiveness of Best Management Practices.

Model documentation and example problems.

STORMWATER TREATMENT ANALYSIS

Systems available for analysis:

Retention Basin with option for calculating effluent concentration
Wet Detention
Exfiltration Trench
Pervious Pavement
Stormwater Harvesting
Biofiltration
Greenroof
Rainwater Harvesting
Managed Aquatic Plants Detention
Vegetated Natural Buffer
Vegetated Filter Strip
Swale
Rain Garden
Tree Well
Lined reuse pond
User Defined BMP

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.

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

WATERSHED CHARACTERISTICS V 8.0

GO TO STORMWATER TREATMENT ANALYSIS

Blue Numbers =	Input data
Red Numbers =	Calculated

HELP - LAND USES/EMC

SELECT CATCHMENT CONFIGURATION

CLICK ON CELL BELOW TO SELECT CONFIGURATION

A - Single Catchment

VIEW CATCHMENT CONFIGURATION

CATCHMENT NO.1 CHARACTERISTICS:

	CLICK ON CELL BELOW TO SELECT
Pre-development land use:	Light Industrial: TN=1.200 TP=0.260
with default EMCs	CLICK ON CELL BELOW TO SELECT
Post-development land use:	High-Intensity Commercial: TN=2.40 TP=0.345
with default EMCs	

VIEW AVERAGE ANNUAL RUNOFF "C" Factor

VIEW EMC & FLUCCS

OVERWRITE DEFAULT CONCENTRATIONS USING:

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

USE DEFAULT CONCENTRATIONS

Total pre-development catchment area:	1.79	AC
Total post-development catchment or BMP analysis area:	1.79	AC
Pre-development Non DCIA CN:	80.00	
Pre-development DCIA percentage:	93.00	%
Post-development Non DCIA CN:	80.00	
Post-development DCIA percentage:	93.00	%
Estimated BMP Area (No loading from this area)	0.13	AC

Average annual pre runoff volume:	5.891	ac-ft/year
Average annual post runoff volume (note no BMP area):	5.463	ac-ft/year
Pre-development Annual Mass Loading - **Nitrogen:**	8.719	kg/year
Pre-development Annual Mass Loading - **Phosphorus:**	1.889	kg/year
Post-development Annual Mass Loading - **Nitrogen:**	16.171	kg/year
Post-development Annual Mass Loading - **Phosphorus:**	2.325	kg/year

RETENTION BASIN IN EXISTING DEVELOPMENT

Required retention depth over the watershed to meet required efficiency:	1.460	1.460	1.460	1.460	in
Required water quality retention volume:	0.202	0.000	0.000	0.000	ac-ft

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

Retention volume based on retention depth and Total area - BMP area	0.075	0.000	0.000	0.000	ac-ft
Provided retention depth (0.1-3.99 inches over the watershed)	0.540				in
Provided treatment efficiency (**Nitrogen**):	46.398	0.000	0.000	0.000	%
Provided treatment efficiency (**Phosphorus**):	46.398	0.000	0.000	0.000	%
Remaining treatment efficiency (**Nitrogen**):	16.047	55.000	55.000	55.000	%
Remaining treatment efficiency (**Phosphorus**):	60.822	79.000	79.000	79.000	%
Remaining retention depth needed:	0.920	1.460	1.460	1.460	in

One half inch of retention alone only provides 46% removal efficiency.

CATCHMENTS AND TREATMENT SURFACE DISCHARGE SUMMARY V 8.5

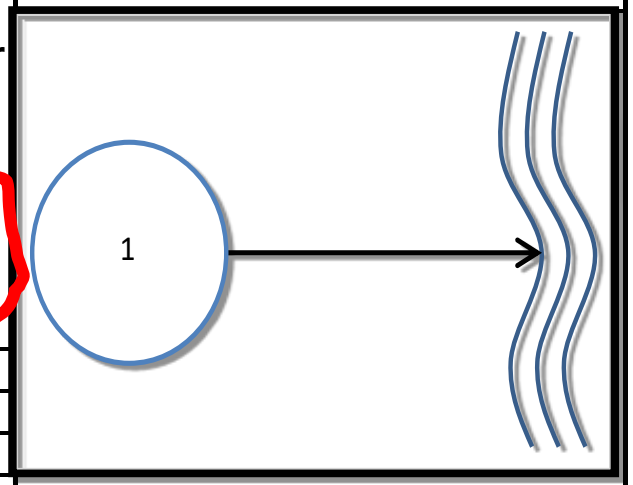
CALCULATION METHODS:

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

PROJECT TITLE	small commercial	Optional Identification		
	gas station	Catchment 2	Catchment 3	Catchment 4
BMP Name	Retention Basin			
BMP Name				
BMP Name				

Surface Water Discharge Summary Performance of Entire Watershed

Catchment Configuration	A - Single Catchment	Treatment Objectives or Target for	3/25/2017
Nitrogen Pre Load (kg/yr)	8.72		BMPTRAINS MODEL
Phosphorus Pre Load (kg/yr)	1.89		
Nitrogen Post Load (kg/yr)	16.17		
Phosphorus Post Load (kg/yr)	2.32		
Target Load Reduction (N) %	55		
Target Load Reduction (P) %	80		
Target Discharge Load, N (kg/yr)	7.28		
Target Discharge Load, P (kg/yr)	0.46		
Provided Overall Efficiency, N (%):	46	TN NOT MET	
Provided Overall Efficiency, P (%):	46	TP NOT MET	
Discharged Load, N (kg/yr & lb/yr):	8.67	19.09	
Discharged Load, P (kg/yr & lb/yr):	1.25	2.74	
Load Removed, N (kg/yr & lb/yr):	7.50	16.53	
Load Removed, P (kg/yr & lb/yr):	1.08	2.38	



ALTERNATE PROJECT DESIGN

POSSIBLE BMPs:

Retention

Biofiltration

Pervious Pavement

Interceptor Trees

Tree Wells

Rain Gardens

(Note other potential rain garden areas exist on site.)

Pervious pavement 0.50 ac.

Rain garden 0.10 ac.

Retention 1.19 ac.

WATERSHED CHARACTERISTICS V 8.0

GO TO STORMWATER TREATMENT ANALYSIS

Blue Numbers = Input data

Red Numbers = Calculated

HELP - LAND USES/EMC

SELECT CATCHMENT CONFIGURATION

CLICK ON CELL BELOW TO SELECT CONFIGURATION

F - Mixed-3 Catchment-2 Series-Parallel (A)

VIEW CATCHMENT CONFIGURATION

CATCHMENT NO.1 CHARACTERISTICS:

VIEW AVERAGE ANNUAL RUNOFF "C" Factor

VIEW EMC & FLUCCS

Pre-development land use: with default EMCs	CLICK ON CELL BELOW TO SELECT: Light Industrial: TN=1.200 TP=0.260	
Post-development land use: with default EMCs	CLICK ON CELL BELOW TO SELECT: High-Intensity Commercial: TN=2.40 TP=0.345	
Total pre-development catchment area:	0.50	AC
Total post-development catchment or BMP analysis area:	0.50	AC
Pre-development Non DCIA CN:	80.00	
Pre-development DCIA percentage:	93.00	%
Post-development Non DCIA CN:	80.00	
Post-development DCIA percentage:	100.00	%
Estimated BMP Area (No loading from this area)		AC

OVERWRITE DEFAULT CONCENTRATIONS USING:

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

USE DEFAULT CONCENTRATIONS

Average annual pre runoff volume:	1.646	ac-ft/year
Average annual post runoff volume (note no BMP area):	1.749	ac-ft/year
Pre-development Annual Mass Loading - **Nitrogen:**	2.435	kg/year
Pre-development Annual Mass Loading - **Phosphorus:**	0.528	kg/year
Post-development Annual Mass Loading - **Nitrogen:**	5.176	kg/year
Post-development Annual Mass Loading - **Phosphorus:**	0.744	kg/year

CATCHMENT NO.2 CHARACTERISTICS:

Pre-development land use: with default EMCs	CLICK ON CELL BELOW TO SELECT: Light Industrial: TN=1.200 TP=0.260	
Post-development land use: with default EMCs	CLICK ON CELL BELOW TO SELECT: High-Intensity Commercial: TN=2.40 TP=0.345	
Total pre-development catchment area:	0.10	AC
Total post-development catchment or BMP analysis area:	0.10	AC
Pre-development Non DCIA CN:	80.00	
Pre-development DCIA percentage:	93.00	%
Post-development Non DCIA CN:	80.00	
Post-development DCIA percentage:	100.00	%
Estimated BMP Area (No loading from this area)	0.01	AC

OVERWRITE DEFAULT CONCENTRATIONS:

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

USE DEFAULT CONCENTRATIONS

Average annual pre runoff volume:	0.329	ac-ft/year
Average annual post runoff volume (note no BMP area):	0.315	ac-ft/year
Pre-development Annual Mass Loading - **Nitrogen:**	0.487	kg/year
Pre-development Annual Mass Loading - **Phosphorus:**	0.106	kg/year
Post-development Annual Mass Loading - **Nitrogen:**	0.932	kg/year
Post-development Annual Mass Loading - **Phosphorus:**	0.134	kg/year

CATCHMENT NO.3 CHARACTERISTICS:

Pre-development land use: with default EMCs	CLICK ON CELL BELOW TO SELECT: Light Industrial: TN=1.200 TP=0.260	
Post-development land use: with default EMCs	CLICK ON CELL BELOW TO SELECT: High-Intensity Commercial: TN=2.40 TP=0.345	
Total pre-development catchment area:	1.19	AC
Total post-development catchment or BMP analysis area:	1.19	AC
Pre-development Non DCIA CN:	80.00	
Pre-development DCIA percentage:	93.00	%
Post-development Non DCIA CN:	80.00	
Post-development DCIA percentage:	93.00	%
Estimated BMP Area (no loading from this area)	0.13	AC

OVERWRITE DEFAULT CONCENTRATIONS:

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

USE DEFAULT CONCENTRATIONS

Average annual pre runoff volume:	3.917	ac-ft/year
Average annual post runoff volume (note no BMP area):	3.489	ac-ft/year
Pre-development Annual Mass Loading - **Nitrogen:**	5.796	kg/year
Pre-development Annual Mass Loading - **Phosphorus:**	1.256	kg/year
Post-development Annual Mass Loading - **Nitrogen:**	10.326	kg/year
Post-development Annual Mass Loading - **Phosphorus:**	1.484	kg/year

PERVIOUS PAVEMENT:	V 8.0	small commercial Manual 3 BMP	Blue Numbers =	Input data
			Red Numbers =	Calculated or Carryover

CONTRIBUTING WATERSHED AND PERVIOUS PAVEMENT CHARACTERISTICS:

GO TO STORMWATER TREATMENT ANALYSIS

Pervious Pavement Section Storage Calculator (S')

VIEW TYPICAL PERVIOUS PAVEMENT SYSTEM SCHEMATIC

Catchment 1

Layer	Thickness (in):	Void Space (%):	Storage (in):
Concrete Pervious Pavement	6.00	25.00	1.500
Other Perv. Pvmt. (see note below)			
#57 rock	6.00	21.00	1.260
#89 pea rock	2.00	25.00	0.500
#4 rock		24.00	
Recycled (crushed) concrete		21.00	
BOLD & GOLD™		9.00	
Other Sub Base (see note below)			

Note: There are loadings from this BMP area needing treatment.

	Catchment 1	Catchment 2	Catchment3	Catchment 4	
Contributing catchment area:	0.500	0.100	1.190	0.000	ac
Required treatment efficiency (**Nitrogen**):	55.000	55.000	55.000	55.000	%
Required treatment efficiency (**Phosphorus**):	79.000	79.000	79.000	79.000	%
Storage provided in specified pervious pavement system:	3.260	0.000	0.000	0.000	in
Area of the pervious pavement system:	0.500				ac
Provided retention over the contributing catchment area:	3.260	0.000	0.000	0.000	in
Provided treatment efficiency (**Nitrogen**):	94.712	0.000	0.000	0.000	%
Provided treatment efficiency (**Phosphorus**):	94.712	0.000	0.000	0.000	%

(Note: Entire catchment area is pervious pavement.)

RAIN GARDEN / DEPRESSION STORAGE

3/25/2017 V 8.5

These are depressed areas in a landscape for the storage of runoff water.

Loadings from BMP area are contained by the BMP, thus no BMP area load.	front	middle	back	Catchment 4	
Contributing catchment area:	0.500	0.090	1.060	0.000	ac
Required treatment efficiency (**Nitrogen**):	55.000	55.000	55.000	55.000	%
Required treatment efficiency (**Phosphorus**):	80.000	80.000	80.000	80.000	%
Provided retention depth for hydraulic capture efficiency (see below):	0.000	3.061	0.000	0.000	in
Provided retention volume for hydraulic capture efficiency:	0.000	0.023	0.000	0.000	ac-ft
Is this a retention or detention system?		Retention			
Select media mix — View Media Mixes					
Provided treatment efficiency (**Nitrogen**):	0.000	93.992	0.000	0.000	
Provided treatment efficiency (**Phosphorus**):	0.000	93.992	0.000	0.000	
Volume Storage Input data					
Sustainable void space fraction		0.20			
Media volume CF =		2000			
Water above media in CF =		600			
Thus volume storage CF=	0	1000	0	0	
Used for retention depth above in row 10 & volume storage (inches) =	0.000	3.061	0.000	0.000	

RETENTION BASIN: 3/25/2017 V 8.5

RETENTION BASIN SERVING:	small commercial				
Loadings from BMP area are contained by the BMP, thus no BMP area load.	front	middle	back	Catchment 4	
Watershed area cotributing to basin:	0.500	0.090	1.060	0.000	ac
Required Treatment Eff (**Nitrogen**):	55.000	55.000	55.000	55.000	%
Required Treatment Eff (**Phosphorus**):	80.000	80.000	80.000	80.000	%
Required retention depth over the watershed to meet required efficiency:	1.536	1.536	1.536	1.536	in
Required water quality retention volume:	0.064	0.012	0.136	0.000	ac-ft

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

Retention volume based on retention depth and Total area - BMP area	0.000	0.000	0.093	0.000	ac-ft
Provided retention depth (0.1-3.99 inches over the watershed)			1.050		in
Provided treatment efficiency (**Nitrogen**):	0.000	0.000	68.121	0.000	%
Provided treatment efficiency (**Phosphorus**):	0.000	0.000	68.121	0.000	%
Remaining treatment efficiency (**Nitrogen)**:	55.000	55.000	0.000	55.000	%
Remaining treatment efficiency (**Phosphorus)**:	80.000	80.000	37.262	80.000	%
Remaining retention depth needed:	1.536	1.536	0.486	1.536	in

CATCHMENTS AND TREATMENT SURFACE DISCHARGE SUMMARY V 8.5

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

PROJECT TITLE	small commercial	Optional Identification	

	front	middle	back	Catchment 4
BMP Name	Pervious Pavement	Rain Garden	Retention Basin	
BMP Name				
BMP Name				

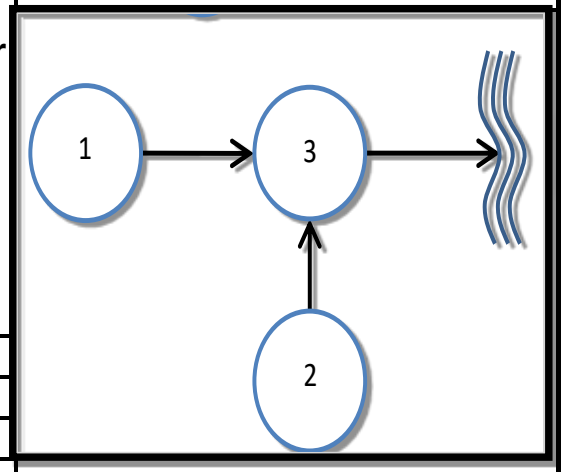
Surface Water Discharge Summary Performance of Entire Watershed

Catchment Configuration	F - Mixed-3 Catchment-2 Series-Parallel (A)		3/25/2017
Nitrogen Pre Load (kg/yr)	8.72		BMPTRAINS MODEL
Phosphorus Pre Load (kg/yr)	1.89		
Nitrogen Post Load (kg/yr)	16.43		
Phosphorus Post Load (kg/yr)	2.36		
Target Load Reduction (N) %	55		
Target Load Reduction (P) %	80		
Target Discharge Load, N (kg/yr)	7.40		
Target Discharge Load, P (kg/yr)	0.47		
Provided Overall Efficiency, N (%):	80		
Provided Overall Efficiency, P (%):	80		
Discharged Load, N (kg/yr & lb/yr):	3.29	7.25	
Discharged Load, P (kg/yr & lb/yr):	0.47	1.04	
Load Removed, N (kg/yr & lb/yr):	13.14	28.95	
Load Removed, P (kg/yr & lb/yr):	1.89	4.16	

Treatment Objectives or Target for

TN MET

TP MET



Seal of Approval

Conclusions

1. BMPTRAINS model is used to evaluate and size treatment systems based on an average annual effectiveness.
2. Can easily evaluate effectiveness and cost of various combinations of BMP treatment trains.
3. The average annual effectiveness is site specific incorporating rainfall conditions, impervious cover, soil conditions, type of land use, and type of LID BMP.
4. LIDs can be analyzed in either series or parallel structure. The estimates stay “true” to the underlying rainfall and catchment conditions.

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QUESTIONS, REMARKS AND DISCUSSION