BMPTRAINS MODEL:
A TRAINING WORKSHOP

BY: MARTY WANIELISTA, HARVEY HARPER AND MIKE HARDIN.
PURPOSE OF TRAINING IS TO:

- Understand the theory essential for estimating annual nutrient mass removal.
- Understand the basis of removal for 15 Stormwater Best Management Practices.
- Define input data required for the BMPTRAINS program.
- Use BMPTRAINS for the selection of stormwater best management practices.

Credit and thanks to: Mike Hardin, Dr. Harvey Harper, Dr. Ikiensinma Gogo-Abite and Chris Kuzlo
BMPTRAINS: an EXCEL based model for sizing BMPs and estimating annual removal effectiveness.

It’s name is derived from the analysis of stormwater BMPs in series.

The model is used to evaluate Best Management Practice Treatment options for Removal on an Annual basis by those Interested in Nutrients in Stormwater.

Available from: www.stormwater.ucf.edu
<table>
<thead>
<tr>
<th>Literature Review</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jordan/Falls Lake Stormwater Nutrient Load Accounting Model</td>
<td>2</td>
</tr>
<tr>
<td>BMP SELECT Model</td>
<td>3</td>
</tr>
<tr>
<td>EPA Clinton River Site Evaluation Tool (SET) and National Stormwater Calculator</td>
<td>5</td>
</tr>
<tr>
<td>Virginia Runoff Reduction Method Worksheet</td>
<td>7</td>
</tr>
<tr>
<td>Department of Environmental Services (DES) Pollutant Loading Spreadsheet Model</td>
<td>9</td>
</tr>
<tr>
<td>Stormwater Best Management Practice Design Workbook</td>
<td>11</td>
</tr>
<tr>
<td>Stormwater Management and Design Aid (SMADA)</td>
<td>12</td>
</tr>
</tbody>
</table>
NAVIGATING the BMP Nutrient Model  BMPTRAINS

INTRODUCTION PAGE

Model requires the use of Excel 2007 or newer

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: 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.

EXCEL BASED

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.

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 Christopher Kuzlo, Marty Wanielista, Mike Hardin, and Ikensinma Gogo-Abite. This is version 7.4 of the program, updated on September 5, 2014. Comments are appreciated.

NOTE: the HELP button on a page will take you to information related to that page.
RAINFALL AND TYPE OF EFFECTIVENESS ANALYSIS

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

**Meteorological Zone (Please use zone map):**
- Zone 2

**Mean Annual Rainfall (Please use rainfall map):**
- 50.00 Inches

**Type of analysis:**
- Specified removal efficiency

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

**BMP, Net Efficiency:**
- 80.00

**Annual Effectiveness:**

**Buttons For:**
- View Zone Maps
- View Mean Annual Rainfall Map
RAINFALL DISTRIBUTIONS

- Rainfall distributions are regionally different.
## WATERSHEDS

### CATCHMENT INPUTS

<table>
<thead>
<tr>
<th>Land use Area Acres</th>
<th>non DCIA CN</th>
<th>%DCIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-development land use: with default EMCs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-development land use: with default EMCs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total pre-development catchment area:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total post-development catchment or BMP analysis area:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-development Non DCIA CN:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-development DCIA percentage:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-development Non DCIA CN:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-development DCIA percentage:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated Area of BMP (used for rainfall excess not loadings)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### WATERSHED CHARACTERISTICS

<table>
<thead>
<tr>
<th>Land use</th>
<th>Area Acres</th>
<th>non DCIA CN</th>
<th>%DCIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-Family: TN=2.230 TP=0.520</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highway: TN=1.640 TP=0.220</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### GO TO STORMWATER TREATMENT ANALYSIS

Click on cell below to select configuration.
WATERSHEDS

CATCHMENT CONFIGURATIONS

<table>
<thead>
<tr>
<th>Series</th>
<th>Parallel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 → 2 → 3</td>
<td>1 → 2 → 3 → 4</td>
</tr>
</tbody>
</table>

**Up to 3 BMPs in Each catchment**

**Up to 14 configurations**
# EMC Default Values

**As of June 3, 2013**

<table>
<thead>
<tr>
<th>Land Use Category</th>
<th>Event Mean Concentration (mg/l)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Total Nitrogen</strong></td>
<td><strong>Total Phosphorus</strong></td>
<td></td>
</tr>
<tr>
<td>Low-Density Residential¹</td>
<td>1.51</td>
<td>0.178</td>
<td></td>
</tr>
<tr>
<td>Single-Family</td>
<td>1.87</td>
<td>0.301</td>
<td></td>
</tr>
<tr>
<td>Multi-Family</td>
<td>2.1</td>
<td>0.497</td>
<td></td>
</tr>
<tr>
<td>Low-Intensity Commercial</td>
<td>1.07</td>
<td>0.179</td>
<td></td>
</tr>
<tr>
<td>High-Intensity Commercial</td>
<td>2.2</td>
<td>0.248</td>
<td></td>
</tr>
<tr>
<td>Light Industrial</td>
<td>1.19</td>
<td>0.213</td>
<td></td>
</tr>
<tr>
<td>Highway</td>
<td>1.37</td>
<td>0.167</td>
<td></td>
</tr>
<tr>
<td>Agricultural - Pasture</td>
<td>3.3</td>
<td>0.621</td>
<td></td>
</tr>
<tr>
<td>Agricultural - Citrus</td>
<td>2.07</td>
<td>0.152</td>
<td></td>
</tr>
<tr>
<td>Agricultural - Row Crops</td>
<td>2.46</td>
<td>0.489</td>
<td></td>
</tr>
<tr>
<td>Agricultural - General Agriculture²</td>
<td>2.79</td>
<td>0.431</td>
<td></td>
</tr>
<tr>
<td>Undeveloped</td>
<td>1.15</td>
<td>0.055</td>
<td></td>
</tr>
<tr>
<td>Mining / Extractive</td>
<td>1.18</td>
<td>0.15</td>
<td></td>
</tr>
</tbody>
</table>

1. Average of single-family and undeveloped loading rates
2. Mean of pasture, citrus, and row crop land uses
METHODOLOGIES: Effectiveness based on annual removals

GENERAL SITE INFORMATION: GO TO INTRODUCTION PAGE

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

- Meteorological Zone:
  - Zone 1
  - Zone 2

- Mean Annual Rainfall:
  - 50.50 Inches

- Type of analysis:
  - Specified removal efficiency

Treatment efficiency (leave empty if not improvement analysis is used): 80.00%

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

STORMWATER TREATMENT ANALYSIS

- Systems available for analysis:
  - Retention Basin
  - Wet Detention
  - Exfiltration Trench
  - Permeable Pavement
  - Stormwater Harvesting
  - Underdrain Filtration
  - Greenroof
  - Rainwater Harvesting
  - Floating Island with Wet Detention
  - Vegetated Natural Buffer
  - Vegetated Filter Strip
  - Swale
  - Rain Garden

METHODOLOGY FOR CALCULATING REQUIRED TREATMENT EFFICIENCY

METHODOLOGY FOR RETENTION SYSTEMS

METHODOLOGY FOR WET DETENTION SYSTEMS

METHODOLOGY FOR STORMWATER AND RAINWATER HARVESTING

METHODOLOGY FOR GREENROOF SYSTEMS

RESET INPUT FOR SINGLE SYSTEM TABS
Most Rainfall Data are hourly based and for 30 years, up to 2005. There are regional differences affecting treatment efficiency.
Example Demonstration Retention in Series

Retention depth over the watershed area is 1.43 inches for the watershed conditions and rainfall zone.

MAXIMUM retention for all events in a year

Treatment efficiency (%): Retention depth (inch)
BUT not sufficient area for one retention basin
But may use 3 BMPs for each catchment in Series in one Watershed

NOTE: This is the effectiveness curve if pervious pave is only used.
Retention depth over the area is 0.60 inches
For a pervious pavement with reservoir.
Example 3 BMPs in Series in one Watershed

2nd BMP in series is exfiltration @ 0.5 inch treatment

NOTE: This is the effectiveness curve if exfiltration is only used. Retention depth over the equivalent impervious area is 0.50 inches for an exfiltration system.
Annual effectiveness is **not** the sum of the two efficiencies (50+40= 90%) It is however the annual effectiveness at 1.1 inch retention or 70%.

NOTE: order of retention BMPs has no affect on the removal.
BMP TREATMENT TRAIN CREDITS
WHEN THREE EFFICIENCIES ARE IN SERIES

Pervious Pavement 50% effective (0.6 inch)
Exfiltration 40% Effective (0.5 inch)
Wet detention 33.3% Effective (16 hours retention)

TP LOAD = 100

\[ M = 100 \left[ 1 - \{(1\cdot 0.5)(1\cdot 0.4)(1\cdot 0.33)\}\right] = 100\left[ 1 - 0.20\right] = 80 \% \text{ removed} \]

NOT  50+40+33.3=123.3%

NOTES  1. Example flow diagram for this problem only.
2. There was no input or additional catchment flow between BMPs
# 15 BMPS AND ONE USER DEFINED

## STEP 2: Select one of the systems below to analyze efficiency.

<table>
<thead>
<tr>
<th>RETENTION BASIN</th>
<th>WET DETENTION</th>
<th>EXFILTRATION TRENCH</th>
<th>RAIN (BIO) GARDEN</th>
<th>SWALE</th>
<th>USER DEFINED BMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERVIOUS PAVEMENT</td>
<td>STORMWATER HARVESTING</td>
<td>FILTRATION including BIOFILTRATION</td>
<td>LINED REUSE POND &amp; UNDERDRAIN INPUT</td>
<td>NOTE !!!: All individual system must be sized prior to being analyzed in conjunction with other systems. Please read instructions in the MULTIPLE WATERSHEDS AND TREATMENT SYSTEMS ANALYSIS tab for more information.</td>
<td></td>
</tr>
<tr>
<td>GREENROOF</td>
<td>RAINWATER HARVESTING</td>
<td>FLOATING ISLANDS WITH WET DETENTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VEGETATED NATURAL BUFFER</td>
<td>VEGETATED FILTER STRIP</td>
<td>VEGETATED AREA Example tree well</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CATCHMENT AND TREATMENT SUMMARY RESULTS
1. BMPTRAINS model is used to size treatment systems based on an average annual effectiveness. It is available at no cost to the users.
2. The average annual effectiveness is site specific incorporating rainfall conditions, impervious cover, soil conditions, type of land use, and type of BMP.
3. BMPs can be analyzed in either series or parallel structure. The estimates stay “true” to the underlying rainfall and catchment conditions.
QUESTIONS, REMARKS AND DISCUSSION

THANK YOU!