Comprehensive Watershed Evaluation, Planning and Management

Evolution of Water Quality BMP
Accountability & Effectiveness

29TH Annual Environmental Permitting Summer School
Florida Chamber Foundation

July 9, 2015

Mark W. Ellard, PE, CFM, D.WRE
Watershed Management

- Stormwater Management
- Water Quality
- Flood Risk
- Ecological
- Water Supply
- Erosion Control

Clean Water Act
NPDES
Section 404 Wetlands
TMDL/NNC
FEMA Floodplains
Water Quality

• Best Management Practices (BMPs)
  – Accountability
  – Effectiveness
  – Enhancements
  – Monitoring
Best Management Practice = BMP

- Term originated circa 1972 with the Clean Water Act
- EPA's Common Definition with Regard to Stormwater:
  - A BMP is a technique, process, activity, or structure used to reduce the pollutant content of a storm water discharge.
  - BMPs include simple nonstructural methods, such as good housekeeping and preventive maintenance. BMPs may also include structural modifications, such as the installation of bioretention measures. BMPs are most effective when used in combination with each other, and customized to meet the specific needs (drainage, materials, activities, etc.) of a given operation. The focus of EPA's general permits is on preventive BMPs, which limit the release of pollutants into storm water discharges. BMPs can also function as treatment controls.
Accountability
Design of wet detention ponds for treating stormwater runoff in the State of Florida is dictated by rules established by the Florida Department of Environmental Protection (FDEP) and the State’s Water Management Districts.


Chapter 62-25.025 stipulates that no discharge from a stormwater management facility shall cause or contribute to a violation of water quality standards in waters of the state.

However, Chapter 62-25.025 also states that the design standards provided may not result in compliance with Chapter 62-302 – “Surface Water Quality Standards”.

Accountability
• The rules provide for a “presumption” of compliance with water quality standards. Chapter 62-40.432(2)(a) conveys that if BMPs such as wet detention ponds are designed and built according to established design and performance criteria, then there is a “rebuttal presumption” that they are assumed to treat stormwater runoff to the extent that the discharges will comply with state water quality standards.

• The performance criteria for stormwater management systems is, according to Chapter 62-40.432(2)(a)1&2, to achieve at least 80% reduction in annual pollutant loads that would cause or contribute to violations of water quality standards, or 95% reduction in the case of discharges to designated Outstanding Florida Waters.

• No actual sampling of effluent from BMPs is required by the State rules to verify the BMPs are meeting the presumed performance criteria.
Accountability

Proverbial Black Box

Pollutants In

BMP

Presumed Percent Reduction

80% Less Pollutants Out ??
Better BMP Selection

- Site-Specific Evaluation Required

- Single BMP (i.e., wet pond) will not do the trick

- Treatment Train Encouraged

- Dry Retention Volumes Determined by Site-Specific Rainfall (by zone), Curve Number, and Percent DCIA

- Wet Detention Volumes Determined by Residence Time

- Opens toolbox to other BMPs
  - Green Infrastructure (GI)
  - Low Impact Development (LID)
Accountability

Open Tool Box

BMPs, Treatment Train, GI, LID, Etc.

Pollutants In

Pollutant Reduction Based on Better Characterization & Monitoring

More Accurate Accounting of Pollutants Reduction
• Numeric Nutrient Criteria
  – Concentration vs. Loads
  – BMP Solutions....
    • Will Require More Creativity
    • Will Require More Innovative Science
    • Will Require Thorough Characterization of Water Bodies
    • Need for Enhanced Effectiveness
    • Increased Need for Confirmation Monitoring
  – For now use TMDL load reduction allocations...
Effectiveness
• Issues with Estimating Pollutant Loads
  – All pollutant models are estimates
    • Approximations of land use, soils, EMC characteristics
  – Over estimation of annualized runoff (underestimation of current attenuation) leads to over estimation of loads
  – Failure to consider other non-runoff load impacts
    • Baseflow can sometimes exceed runoff inputs on annualized basis
    • Upstream Treatment (swales, ditches, etc.)
### Effectiveness

Central and North Indian River Lagoon (IRL) Basin Management Action Plans (BMAPs)  
Best Management Practice (BMP) Efficiencies (August 2010)

<table>
<thead>
<tr>
<th>Standard Best Management Practices (BMPs)</th>
<th>TP % Reduction</th>
<th>TN % Reduction</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retention BMPs (includes basins, exfiltration trenches, etc.)</td>
<td>Based on percent reduction from appropriate table in Appendix F using project’s percent directly connected impervious area (DCIA), non-DCIA curve number (CN), and rainfall zone</td>
<td>Based on percent reduction from appropriate table in Appendix F using project’s percent DCIA, non-DCIA CN, and rainfall zone</td>
<td>Appendix F Draft Stormwater Treatment Applicant’s Handbook (Florida Department of Environmental Protection)</td>
</tr>
<tr>
<td>Wet detention ponds</td>
<td>Reduction from Figure 13.2 given the project’s residence time, which is based on the flow from the model</td>
<td>Reduction from Figure 13.3 given the project’s residence time, which is based on the flow from the model</td>
<td>Figures 13.2 and 13.3 in Draft Stormwater Treatment Applicant’s Handbook</td>
</tr>
<tr>
<td>BMP treatment trains using a combination of BMPs</td>
<td>Use BMP Treatment Train (TT) equation: BMP TT Efficiency = Eff1 +((1-Eff1)*Eff2)</td>
<td>Use BMP Treatment Train (TT) equation: BMP TT Efficiency = Eff1 +((1-Eff1)*Eff2)</td>
<td>Draft Stormwater Treatment Applicant’s Handbook</td>
</tr>
<tr>
<td>Baffle box</td>
<td>2.3</td>
<td>0.5</td>
<td>Final Report Contract S0236 Effectiveness of Baffle Boxes</td>
</tr>
<tr>
<td>Nutrient baffle box (2nd generation)</td>
<td>15.5</td>
<td>19.05</td>
<td>Final Report Contract S0236 Effectiveness of Baffle Boxes</td>
</tr>
<tr>
<td>Catch basin inserts/inlet filters</td>
<td>Evaluated on a case-by case basis</td>
<td>Evaluated on a case-by case basis</td>
<td>Case-by-case</td>
</tr>
<tr>
<td>Grass swales with swale blocks or raised culverts</td>
<td>Use retention BMPs above</td>
<td>Use retention BMPs above</td>
<td>Draft Stormwater Treatment Applicant’s Handbook</td>
</tr>
<tr>
<td>Grass swales without swale blocks or raised culverts</td>
<td>50% of value for grass swales with swale blocks or raised culverts</td>
<td>50% of value for grass swales with swale blocks or raised culverts</td>
<td>Draft Stormwater Treatment Applicant’s Handbook</td>
</tr>
<tr>
<td>Alum injection</td>
<td>90</td>
<td>50</td>
<td>Evaluation of Harper data</td>
</tr>
</tbody>
</table>

Note: The Draft Stormwater Treatment Applicant’s Handbook is located at: [http://www.dep.state.fl.us/water/wetlands/erp/rules/stormwater/docs/ah_rule_draft_031710.pdf](http://www.dep.state.fl.us/water/wetlands/erp/rules/stormwater/docs/ah_rule_draft_031710.pdf)
## Effectiveness

### Central and North Indian River Lagoon (IRL) Basin Management Action Plans (BMAPs)  
**Best Management Practice (BMP) Efficiencies (August 2010)**

<table>
<thead>
<tr>
<th>Standard Best Management Practices (BMPs)</th>
<th>TP % Reduction</th>
<th>TN % Reduction</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street sweeping</td>
<td>Determine pounds of materials removed and multiply by values to be provided by the Florida Stormwater Association (FSA) University of Florida (UF) municipal separate storm sewer system (MS4) BMP project</td>
<td>Determine pounds of materials removed and multiply by values to be provided by FSA UF MS4 BMP project</td>
<td>Final Report of FSA UF MS4 BMP Project</td>
</tr>
<tr>
<td>Floating islands</td>
<td>20</td>
<td>20</td>
<td>Chapter 14 Draft Stormwater Treatment Applicant’s Handbook</td>
</tr>
<tr>
<td>Stormceptor</td>
<td>13</td>
<td>2</td>
<td>Final Report Contract S0095 Sanford Stormceptor project</td>
</tr>
<tr>
<td>Continuous deflective separation (CDS) units</td>
<td>10</td>
<td>Not applicable</td>
<td>Final Report Contract WM793 Broadway Outfall Project</td>
</tr>
</tbody>
</table>

**Note:** The Draft Stormwater Treatment Applicant’s Handbook is located at: [http://www.dep.state.fl.us/water/wetlands/erp/rules/stormwater/docs/ah_rule_draft_031710.pdf](http://www.dep.state.fl.us/water/wetlands/erp/rules/stormwater/docs/ah_rule_draft_031710.pdf)
Effectiveness

Wet Detention Removal Efficiency

Total Phosphorus

Removal Efficiency (%)

Detention Time, $t_d$ (days)

Percent Removal = $40.15 + 6.366 \cdot \ln(t_d) + 0.214 \cdot (\ln(t_d))^2$

$R^2 = 0.8941$

Source: Draft Stormwater Quality Applicant’s Handbook, DEP & WMDs, 2010:
http://www.dep.state.fl.us/water/wetlands/erp/rules/stormwater/docs/ah_rule_draft_031710.pdf
Effectiveness

Wet Detention Removal Efficiency

Total Nitrogen

\[\text{Efficiency} = \frac{44.72 \cdot t_d}{5.46 + t_d}\]

\[R^2 = 0.808\]

Source: Draft Stormwater Quality Applicant’s Handbook, DEP & WMDs, 2010:
http://www.dep.state.fl.us/water/wetlands/erp/rules/stormwater/docs/ah_rule_draft_031710.pdf
Effectiveness

• Issues with Percent Removal vs. Concentrations
  – Percent removal varies depending on influent concentration
  – Higher percent removals achieved with higher influent concentrations
  – Lower influent concentrations may approach irreducible levels
  – BMPs with high percent removal can still have unacceptable effluent concentrations
  – BMPs with low percent removals can still meet receiving water numeric targets depending on influent concentration
Better results with only 50% removal. It all depends on the input.

• Volume & Total Load
  – Volume Reduction Also Important in Addition to Treatment (Physical, Biological, Chemical) in BMPs
    • Addresses Increase in Runoff Volume from Urbanized Areas
    • Reduce Downstream Impacts such as Streambank Erosion, Channel Deformation, Habitat Impacts, etc.
  – Simply Comparing IN vs. OUT Concentration Does Not Properly Account for Relative Impact of Volume Reduction
  – Should Evaluate BMPs Based on Overall Load Reduction
    • BMP Treatment, and
    • Volume Reduction
BMP Pollutant Reduction but **No** Volume Reduction

In this example, the BMP removes 50 kg or 50% of the "total load" of this pollutant. It does not reduce the volume of stormwater discharged.

In this example, the BMP removes 75 kg or 75% of the “total load” of this pollutant. The “true” performance of this BMP is only apparent when we factor in the impact of volume reduction and calculate the total load of the pollutant.
Effectiveness

International BMP Database
(www.bmpdatabase.org)
Effectiveness

Figure 4. Box Plots of Influent/Effluent Total Phosphorus Concentrations by BMP Type.

Figure 3. Box Plot Key
- Possible outlier (> 1.5 IQRs from Q3)
- Q3 + 1.5 IQRs
- 95% Confidence Interval
- Inter-quartile range
  IQR = Q3 - Q1
- Q1 - 1.5 IQRs

Instream NNC
Lake NNC (clear lake)
Figure 7. Box Plots of Influent/Effluent Total Nitrogen Concentrations by BMP Type.

Instream NNC

Lake NNC (clear lake)
Enhanced BMP Practices
What is Low Impact Development (LID) ?

- Low Impact Development (LID) is an approach to land development that works with nature to manage stormwater as close to its source as possible.

- EPA Definition (Coffman, 2000)

  - **LID is a site design strategy with a goal of maintaining or replicating the predevelopment hydrologic regime through the use of design techniques to create a functionally equivalent hydrologic landscape.**
What is Green Infrastructure (GI)?

- **EPA Definition** ([http://water.epa.gov/infrastructure/greeninfrastructure/gi_what.cfm](http://water.epa.gov/infrastructure/greeninfrastructure/gi_what.cfm))

  - Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems that mimic nature by soaking up and storing water.
Benefits of GI / LID

Focus on *stormwater* as a resource

- **Pollutant Treatment** (water quality)
- **Volume Reduction** (attenuation)
- **Land Utilization**
GI / LID Stormwater Practices:

- Pervious pavement
- Bioretention Areas/
  Bioswales
- Rain Gardens
- Planter Box
- Tree Box Filters
- Stormwater Harvesting –
  Cisterns
- Curb Cuts & Inverted
  Medians
Challenges of GI / LID

- Effective integration with traditional practices
- Lack of familiarity by city/county engineers
- Lack of familiarity by regional permitting authorities
- Lack of familiarity of local contractors
- Lack of experience with maintenance procedures
Cost Impacts of GI/LID:

• Capital Costs
  – Reduced infrastructure (↓)
  – Potentially smaller ponds (↓)
  – More vegetation/plantings (↑)
  – Contractor certifications (↑)

• Maintenance Costs
  – Training/certifications for personnel (↑)
  – Replace typical landscaping – offset overall BMP maintenance area (↓)
  – Infiltration/media testing (↑)
Concept Plans Comparison

• Purpose
  – Show LID techniques can accommodate equivalent density/intensity development as traditional methods;
  – Provide alternatives to structural stormwater facilities;
  – Provide additional opportunities for infiltration; and
  – Illustrate that water quality, water quantity, and nutrient loading criteria can be met or exceeded using LID practices.

• Project Site (29.09 acres): portion of Hamlin PD
  – Commercial:  - Grocery store – 54,000 sq. ft.
    - Bank (Outparcel) – 4,500 sq. ft.
    - Retail – 4,500 sq. ft.
  – Residential:  - 168 MF units (7 buildings at 24 units/building)
Comparison Results

– The LID Concept provides the same commercial and residential sq. ft. and parking
– LID Utilizes 25.31 acres of the original 29.09 acres – a reduction of 3.78 acres (13%).
– The LID concept plan meets or exceeds the Traditional concept plan in all stormwater management criteria.

Table 1: Comparison of Traditional and LID Results

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Traditional</th>
<th>LID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment Volume (^1)</td>
<td>4.40 ac-ft</td>
<td>5.83 ac-ft</td>
</tr>
<tr>
<td>Volume to Ponds (^2)</td>
<td>17.7 ac-ft</td>
<td>11.7 ac-ft</td>
</tr>
<tr>
<td>Site Discharge Rate (^3)</td>
<td>8.46 cfs</td>
<td>8.05 cfs</td>
</tr>
<tr>
<td>Pollutant Loading Removal</td>
<td>95.95%</td>
<td>96.69%</td>
</tr>
<tr>
<td>Outflow Mass Loading</td>
<td>1.19 kg/yr</td>
<td>0.86 kg/yr</td>
</tr>
</tbody>
</table>

(1): Treatment Volume is controlled by the retention depth needed for nutrient removal
(2): Total Inflow volume for the 25yr/24hr (Orange) storm event to Ponds 100/100L and 200/200L
(3): Peak Discharge to Lk Hancock for the 25yr/24hr (Orange) storm event
## Enhanced BMP Practices

### Cost Comparison Results with Land Savings (Preliminary)

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>LID Cost</th>
<th>Traditional Cost</th>
<th>LID Description</th>
<th>Traditional Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement</td>
<td>$ 741,323.67</td>
<td>$ 586,532.87</td>
<td>Pervious Pavement, Pervious Asphalt, and Pavers</td>
<td>Asphalt and Concrete Sidewalk</td>
</tr>
<tr>
<td>Bioretention Swale</td>
<td>$ 645,387.05</td>
<td>$ 290,941.07</td>
<td>Bioretention Swale</td>
<td>Landscaping</td>
</tr>
<tr>
<td>Raingarden</td>
<td>$ 408,062.24</td>
<td>$ 104,400.34</td>
<td>Raingarden</td>
<td>Landscaping</td>
</tr>
<tr>
<td>Planter Box</td>
<td>$ 47,296.75</td>
<td>$ 9,645.40</td>
<td>Planter Box</td>
<td>Landscaping</td>
</tr>
<tr>
<td>Tree Box Filter</td>
<td>$ 128,730.00</td>
<td>$ 6,307.27</td>
<td>Tree Box Filter</td>
<td>Landscaping</td>
</tr>
<tr>
<td>Curbing and Medians</td>
<td>$ 86,326.45</td>
<td>$ 86,886.83</td>
<td>Valley Gutter, Type D curb, and Pavement</td>
<td>Type D Curb and Pavement</td>
</tr>
<tr>
<td>Stormwater Harvesting</td>
<td>$ 212,621.14</td>
<td>N/A</td>
<td>Stormwater Harvesting</td>
<td>No item correlates</td>
</tr>
<tr>
<td>Primary Storm System</td>
<td>$ 398,769.82</td>
<td>$ 818,139.65</td>
<td>Two Dry Retention Ponds</td>
<td>Two Dry Retention Ponds and One Wet Detention Pond</td>
</tr>
<tr>
<td>Secondary Storm System</td>
<td>$ 354,529.42</td>
<td>$ 644,946.81</td>
<td>36-inch Pipe, Manhole, DBI C, 36-Inch MES</td>
<td>12-inch &amp; 36-inch Pipe, DBI C, 36-Inch MES</td>
</tr>
<tr>
<td>Undeveloped Land</td>
<td>N/A</td>
<td>$ 849,000.00</td>
<td>No item correlates</td>
<td>$200k/acre multi-family; $250k/acre retail</td>
</tr>
<tr>
<td><strong>Totals:</strong></td>
<td>$ 3,023,047</td>
<td>$ 3,396,800</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Maintenance Costs Projections

- Project maintenance costs for each of the LID practices:
  - frequency
  - inspection activity
  - maintenance activity
  - labor/equipment/materials
  - costs of similar traditional stormwater management activities

- Compare example project data
- Compare to national data
**Enhanced BMP Practices**

### Example 10-Year Maintenance Cost Projection

**Table PP-2 - Pervious Pavement Projected 10-Year Maintenance Costs**

*LID Practice Maintenance Cost Projection*  
*Orange County, Florida*

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Year</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Monthly Trash and Debris Removal</td>
<td>$300</td>
<td>$309</td>
</tr>
<tr>
<td>Triannual Minor Inspection, Cleaning, and</td>
<td>$405</td>
<td>$417</td>
</tr>
<tr>
<td>Restoration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Inspection and Maintenance</td>
<td>$208</td>
<td>$214</td>
</tr>
<tr>
<td>Annual Compliance Report</td>
<td>$300</td>
<td>$309</td>
</tr>
<tr>
<td><strong>Total 10 Year Maintenance Cost:</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
- *Costs are projected to the specific year from 2013 (year 1) dollars using a base inflation rate of 3%.*
- **Refer to Table PP-1 for annual maintenance cost assumptions.**

Green shading indicates cell can be manually edited.  
Purple shading indicates cell result of formula calculation and should not be manually edited.
## Traditional vs. LID Maintenance Cost

<table>
<thead>
<tr>
<th>Maintenance Scenario</th>
<th>Design Practice Size</th>
<th>Estimated Annual Maintenance (2013 Dollars)</th>
<th>Estimated 10-Year Maintenance (3% inflation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pervious Pavement</td>
<td>36792 sf</td>
<td>$1,333</td>
<td>$15,278</td>
</tr>
<tr>
<td>Bioretention</td>
<td>73846 sf</td>
<td>$11,367</td>
<td>$130,311</td>
</tr>
<tr>
<td>Rain Garden</td>
<td>26498 sf</td>
<td>$5,877</td>
<td>$67,377</td>
</tr>
<tr>
<td>Planter Box</td>
<td>2448 sf</td>
<td>$1,804</td>
<td>$20,684</td>
</tr>
<tr>
<td>Tree Box Filter</td>
<td>10 boxes</td>
<td>$1,586</td>
<td>$18,722</td>
</tr>
<tr>
<td>Curb Cuts / Inverted Medians</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Stormwater Harvesting (w/ Cisterns)</td>
<td>134528 gal</td>
<td>$9,120</td>
<td>$104,548</td>
</tr>
<tr>
<td>Dry Retention Pond</td>
<td>92522 sf</td>
<td>$11,303</td>
<td>$133,462</td>
</tr>
<tr>
<td><strong>Totals:</strong></td>
<td></td>
<td><strong>$42,390</strong></td>
<td><strong>$490,382</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maintenance Scenario</th>
<th>Design Practice Size</th>
<th>Estimated Annual Maintenance (2013 Dollars)</th>
<th>Estimated 10-Year Maintenance (3% inflation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Retention Pond</td>
<td>132,675 sf</td>
<td>$15,880</td>
<td>$187,512</td>
</tr>
<tr>
<td>Landscaped Area</td>
<td>30,546 sf</td>
<td>$5,889</td>
<td>$69,542</td>
</tr>
<tr>
<td>Swale</td>
<td>73,843 sf</td>
<td>$8,779</td>
<td>$103,663</td>
</tr>
<tr>
<td>Wet Detention Pond</td>
<td>63,319 sf</td>
<td>$4,451</td>
<td>$49,095</td>
</tr>
<tr>
<td><strong>Totals:</strong></td>
<td></td>
<td><strong>$34,999</strong></td>
<td><strong>$409,812</strong></td>
</tr>
</tbody>
</table>
Monitoring
• Importance of Monitoring
  – Establish Baseline
  – Compare influent to effluent concentrations
  – Account for Volume Reduction
  – Confirm pollutant loading estimates
  – Compare effluent concentrations to receiving water standards (numeric nutrient criteria)
  – Long Term Monitoring Ideal – the More Data the Better
Example of Traditional vs. Possible Enhanced BMP Monitoring with Treatment Trains

Traditional Monitoring
1 BMP

Traditional Monitoring
2 BMPs

Enhanced Monitoring
BMP Treatment Trains

Adapted from: Urban Stormwater BMP Performance Monitoring, Geosyntec/WWE, 2009
Monitoring
Monitoring

- Impact of not Monitoring
  - Rely on presumptive performance
  - Actual concentrations not quantified
  - Irreducible Concentrations not identified
  - Actual Mass Loadings not quantified
  - Other Load Sources not Accounted for (baseflow, septic, industrial, etc.)
  - Numeric Limits not Addressed
• Significant Cost
  – Accurately Project Receiving Water Requirements
  – Accurately Project Long Term Needs
  – Allocate Budget During Design Estimates
  – Outside Funding
    • Research Grants
    • Academic Partnerships
Thank You!

Mark W. Ellard, PE, CFM, D.WRE
Associate, Water Resources

Geosyntec Consultants
1511 East State Road 434, Suite 1005
Winter Springs, Florida 32708
Phone: 407-321-7030
www.geosyntec.com
Sustainability
• Pond Sustainability Study
  – Paradigm of traditional BMP maintenance
  – Millions spent annually on mowing, spraying, etc.
  – Can sustainability save money?
  – What if grass replaced with vegetation requiring no/little maintenance?
  – Can Pond Functionality be Maintained?
  – Public Acceptance?
Sustainable Pond Maintenance

• Over 1600 stormwater ponds maintained
  – Wet and Dry
  – Varying Soil Types
  – Varying Landuses
  – Varying Demographics

• Choose Example Ponds to Evaluate Concept and Estimate Benefit-Cost
Typical Orange County Stormwater Ponds

Dry Retention Pond

Wet Detention Pond
Typical Vegetated Stormwater Ponds

Dry Pond

Wet Pond
Sustainable Pond Maintenance
# Sustainable Pond Maintenance

## Summary of Benefit Cost Analysis of Concept Ponds – 10 Year Projection

<table>
<thead>
<tr>
<th>Pond ID</th>
<th>Total Acreage (GIS)</th>
<th>Total Planting Acres</th>
<th>Wet or Dry</th>
<th>Irregular or Uniform Shape</th>
<th>Soil Type</th>
<th>MSTU or Non-MSTU</th>
<th>Slope 4:1?</th>
<th>Adjacent Residential?</th>
<th>Total Estimated Cost of Vegetative Plantings Concept</th>
<th>Scenario 1 Avoided Maintenance Cost Only</th>
<th>Scenario 2 Avoided Maintenance Cost with Environmental Factors Included</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0063</td>
<td>8.62</td>
<td>7.40</td>
<td>Dry</td>
<td>Uniform</td>
<td>Poorly Drained</td>
<td>Non-MSTU</td>
<td>No</td>
<td>Yes</td>
<td>$82,290</td>
<td>$62,084</td>
<td>$85,424</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-$20,206</td>
<td>0.75</td>
</tr>
<tr>
<td>6407</td>
<td>1.13</td>
<td>0.53</td>
<td>Wet</td>
<td>Irregular</td>
<td>Poorly Drained</td>
<td>MSTU</td>
<td>No</td>
<td>Yes</td>
<td>$14,659</td>
<td>$26,152</td>
<td>$46,571</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$11,493</td>
<td>1.78</td>
</tr>
<tr>
<td>6709</td>
<td>0.76</td>
<td>0.68</td>
<td>Dry</td>
<td>Uniform</td>
<td>Moderately Well Drained</td>
<td>MSTU</td>
<td>No</td>
<td>Yes</td>
<td>$15,410</td>
<td>$17,237</td>
<td>$35,278</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$1,827</td>
<td>1.12</td>
</tr>
<tr>
<td>6942</td>
<td>2.39</td>
<td>1.18</td>
<td>Wet</td>
<td>Uniform</td>
<td>Somewhat Poorly Drained</td>
<td>Non-MSTU</td>
<td>No</td>
<td>Yes</td>
<td>$21,275</td>
<td>$24,146</td>
<td>$58,563</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$2,871</td>
<td>1.13</td>
</tr>
<tr>
<td>7157</td>
<td>41.78</td>
<td>21.29</td>
<td>Wet</td>
<td>Uniform</td>
<td>Poorly Drained</td>
<td>Non-MSTU</td>
<td>No</td>
<td>Yes</td>
<td>$169,925</td>
<td>$308,274</td>
<td>$1,036,899</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$138,349</td>
<td>1.81</td>
</tr>
<tr>
<td>7536</td>
<td>1.68</td>
<td>0.79</td>
<td>Wet</td>
<td>Irregular</td>
<td>Poorly Drained</td>
<td>MSTU</td>
<td>No</td>
<td>Yes</td>
<td>$17,328</td>
<td>$16,525</td>
<td>$39,877</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-$803</td>
<td>0.95</td>
</tr>
</tbody>
</table>

**Notes:**
- *B:C* ratio > 1.0 indicates feasibility of concept.

---

**Environmental Benefits Included:**
- Water Quality Improvement
- Increased Habitat Value
- Increased Tree Canopy (Carbon Sequestering)
Sustainable Pond Maintenance

County-wide Benefit : Cost Ratio Results for Orange County Stormwater Ponds

Positive Benefit : Cost Ratio in 86% of Ponds (99% when considering environmental benefits in addition to just maintenance avoidance)
Potential Countywide Cost Savings Summary – 10 Year Period

<table>
<thead>
<tr>
<th></th>
<th>Lower Bound</th>
<th></th>
<th>1179</th>
<th></th>
<th>Upper Bound</th>
<th></th>
<th>1355</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pond Count</strong></td>
<td></td>
<td></td>
<td>1179</td>
<td></td>
<td></td>
<td></td>
<td>1355</td>
<td></td>
</tr>
<tr>
<td><strong>Expected Benefit Cost</strong></td>
<td>$44,006,795</td>
<td>$21,188,062</td>
<td>$22,818,733</td>
<td>$50,233,061</td>
<td>$23,858,240</td>
<td>$25,743,166</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note that this projected savings based on a County-wide implementation under “steady state” conditions. Actual implementation of a comprehensive program would be expected to be applied over 10+ year period. Pond would require some increased maintenance during early years until vegetation fully established.
Maintenance
BMPs
• **Street Sweeping BMP Optimization**
  
  – Maintenance Related BMPs
    • Street Sweeping
    • Catch Basin / Storm Inlet Cleaning
    • BMP Unit Cleaning (Baffle Boxes, Hydrodynamic Separators, etc.)
  
  – Current Contract just based on frequency and curb miles
  
  – Where to optimize?
Maintenance BMPs: Street Sweeping, Catch Basin/Inlet Cleaning, Baffle Box/Hydrodynamic Separator Units
Quantifying Nutrient Reduction Credit for Maintenance BMPs

Approved for TMDL Pollutant Load Reduction Allocations

Assumed Nutrient Removal Based on Statewide Sampling

The More Material Removed the more Credit

Question – How to Maximize Material Removed?
Maintenance BMPs

Conceptual Benefit-Cost Analysis for Street Sweeping

- Water Quality Benefit
  - Never Ever Swept At All
  - "Maximum Extent Practicable"
  - Sweep Every Mile Every Day

- Cost
  - Number of Sweepers, Frequency of Sweeping, Road Miles Swept, Geography Swept

Programs:
1. Program
2. Program
3. Program
• Data Needs – How to do Better Analysis?
  – Geography - Track Where Street Sweeping Loads Come From
    • GPS Tracking
    • Impaired Waters
  – Frequency Analysis
    • Tree Canopy Coverages
    • Seasonality
  – Micro-manage Analyticals
    • Segregate Based on Particle Size
    • Bulk Density
    • Moisture Content
EXHIBIT 1
CURRENT PROGRAM
STREET SWEEPING
LOCATIONS

CONTRACTED STREET SWEEPING ROADS
DIVISION (Frequency of Sweeping)

- Environmental Protection (Every Week)
- Roads & Drainage (Every 6 Weeks)

5,235 Street Segments
EXHIBIT 2
REALLOCATED PROGRAM
STREET SWEEPING
LOCATIONS

ROADS & DRAINAGE PROGRAM
FREQUENCY RECOMMENDATIONS

Increase in Sweeping Frequency (26 sweeps per year)
No Change in Sweeping Frequency (9 sweeps per year)

CONTRACTED STREET SWEEPING ROADS
DIVISION (Frequency of Sweeping)

Environmental Protection (No Change - Every Week)

263 Street Segments to Increase
• **Cost Impact**
  - Existing Street Sweeping Program = ~$1.9 million Annually
  - Optimized Street Sweeping Program
    • Increase Phosphorus Removal of 28 tons
    • Increase Nitrogen Removal of 97 tons
  - Cost to Remove Nutrients
    • FDEP - Remove 1 ton phosphorus from waterways at $63 million
    • FDEP - Remove 1 ton nitrogen from waterways at $18 million
    • Tampa Bay Nitrogen Management Consortium - $200k per ton Nitrogen
  - Possible Cost Offset ~$19+ million ?