Don’t miss the Low Hanging Fruit!
Quantifying water quality treatment for improvements to “grandfathered” roadways with Site Specific Alternative Criteria
Overview of Presentation

- Purpose
- Indian River Lagoon
- NNC and TMDL’s
- Grandfathered Roadways
- Pollutant Load Reduction Computation
Purpose of Training

• To educate on the pollutant load tracking for “grandfathered” roadway development projects

• Properly identify and account for the source and treatment of stormwater pollution

• Make sure we are treating the correct cause of the nutrient impairments in our waters!
Who this applies to?

- MS4 Permit Holders
  - FDOT
  - Municipalities
  - Roadway entities
- Consultants
  - Engineers & Scientists
- Regulatory staff
- Floridians!
Why does this apply to you?

- Important to correctly identify the source of pollution
- **Millions** of dollars are spent each year in Florida to fight stormwater pollution, & protect water resources - $1.4 Billion projected over 15 years
  - $50 million - in 2013 allocated for Springs restoration projects
  - $26.9 million - for Indian River Lagoon in state budget
  - $20 million - Brevard County Muck Dredging Project

- Find the source/cause, treat the problem at the source!

  “It costs $20 to buy a lb. of fertilizer, and $20,000 to clean it up”
Indian River Lagoon

- $3.7 Billion annual economic engine
- Lagoon – shallow estuary separated from ocean by barrier islands
- 156-mile long estuary (~40% of FL east coast)
  - 6 coastal counties in the IRL watershed (Volusia → Palm Beach)
  - One of most biologically diverse estuaries in North America

History of Pollution
- Land development prior to E&S controls and Stormwater treatment
- Agriculture – significant land disturbance from natural lands state
- Legacy load (sediments in waterbodies)
- Until 1990’s – utilities directly discharged more than 50 MGD of sewage to lagoon
- Population boom – doubled in 5-county region over past 30 years
Central Indian River Lagoon TMDL

- Nutrient TMDL adopted for main stem of IRL in March 2009
- Basin Management Action Plan (BMAP) adopted Jan. 2013 – to implement nutrient TMDL’s
- Focus on water quality conditions necessary for seagrass regrowth at historic sea grass water depth limits
  - Based on multi-year composite seagrass coverage
  - **Biological response of seagrass** – most important factor to evaluate success

Continued assessment of seagrass depths to determine if BMAP will be required
- Total Reductions to Date (2015 Progress Report)
  - 44,325 lbs/yr TN
  - 10,934 lbs/yr TP
Central Indian River Lagoon

- Still seeing algal blooms in IRL – as of summer 2016
- Could legacy sediment be a bigger problem than we think? Other factors?
- Make sure we are accurately documenting land based pollutant load reductions so that DEP can better determine where the pollutant load problem is coming from!
- If we are treating the land based stormwater treatment, and still seeing algal blooms = maybe the nutrients already in the water are the problem!
Central Indian River Lagoon

- 2016 Fish kill in NIRL
- Public Involvement
- Social Media Presence
Numeric Nutrient Criteria and TMDLs

http://www.dep.state.fl.us/water/tmdl/final_tmdl.htm
Why are TMDL’s so complex

• Nature did not “go to college”, or attend your regulatory training!

• Legacy sediment
• The Science is ever evolving
  – Models – *HSPF, PLSM, SWIL*
  – Identifying and tracking the source of pollutants is complex
    • Nutrients are chemical compounds that have complex interactions in the environment
    • Carbon, Nitrogen, Phosphorus Cycles
    • External inputs – atmospheric deposition, groundwater
Numeric Nutrient Criteria (NNC)

• F.A.C. 62-302.530(47)(b) states that “in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna.”

• The method for numerically interpreting this NNC, on a site-specific basis, is provided in Rule 62-302.531 (FAC) using a hierarchical process.
Numeric Nutrient Criteria (NNC)

Figure 2.2 The hierarchy for numerically interpreting the NNC

- Nutrient Total Maximum Daily Loads, Site Specific Alternative Criteria, Estuary-specific Criteria, and Water Quality Based Effluent Limitations
  
  - Stressor-Response Relationships (lakes & springs)
  
  - Reference stream-based thresholds combined with biological data (flora and fauna)
  
  - Narrative (wetlands, intermittent streams, South Florida flowing waters)
Grandfather?

- What is a “grandfathered” road anyway?

- An existing roadway – in this case: one that is being redeveloped, repaved, or widened
  - AND it must be a roadway that was constructed prior to State Stormwater Management permitting requirements

- Pollutant Load Screening Model - FDEP
PLSM Model

- Grandfathered roadways are accounted for in the pollutant loading calculations of the PLSM model – have already been included in the Waste Load Allocation (WLA)
- So if we are improving water quality that affects the WLA = we are reducing pollutant load towards our BMAP
Sources of Pollutants from Roadways

1. **Street Pavement**
   - Aggregate material, binder, fillers, surface substances (0.05-0.1 in/yr of pavement surface worn away)

2. **Motor Vehicles**
   - Fluids, lubricants, particles from tires or brake lining, exhaust, emissions collected on roadway surface, corrosion products, vehicle parts, etc.
   - Asbestos; many heavy metals including lead, zinc, and copper
   - Organics, nutrients, & suspended solids which have become attached to the vehicle surface or underside

3. **Land Surface**
   - Depends on surface cover of Right-of-Way, and amount of traffic

4. **Litter**

5. **Chemicals used for roadway maintenance**
   - Fertilizers, pesticides & herbicides
Sources of Pollutants from Roadways

Sediments!

• Sand, silt, clay and organic matter with a particle size larger than dissolved molecules or ions

• **Sediment is the largest contributor by volume to nonpoint source pollution in the United States!**

• Suspended matter is generated primarily through erosion processes during rain events

• Pollutants such as nutrients (Nitrogen & Phosphorus) attached to sediment particles
Sources of Pollutants from Roadways

Nutrients

- Enter runoff through sources such as fertilizers, plant matter (grass clippings), detergents, washing fluids, soil leaching, animal wastes

- May be present as either dissolved ions or in particulate form

- In general:
  - About 40-50% of nitrogen and phosphorus in runoff is in a dissolved form; While 50-60% exists in a particulate form
  - Dissolved forms of Nitrogen include ammonia, nitrite/nitrate (NO$_x$) – available to plants & algae
  - Orthophosphorus (orthophosphate, SRP) is the common dissolved form of Phosphorus available to plants & algae
Typical Stormwater Treatment for Roadways

- Wet Detention Basins
- Retention Basins
- Exfiltration (French drains)
- Baffle Boxes
- Grassed Swales
- Street Sweeping
- Litter Pickup
- Fertilizer Cessation
Pollutant Load Reduction Computation

- Accounting procedure to document pollutant load reduction – “grandfathered” roadways being re-developed

- Calculate how many pounds of pollutant load reduction is provided vs. pollutant load reduction required

- Essentially how much treatment is provided “above and beyond” permitting requirements
Pollutant Load Reduction Computation

• Review Water Management District permit and water quality based stormwater requirements

• Determine if original roadway lanes were constructed prior to water quality permitting requirements (i.e. these roadway lanes would be “grandfathered” in regard to stormwater quality treatment for the WLA in the PLSM)

• In the PLSM model, land use from the year 2000 was used, and therefore these roadways have been modeled as impervious, and are included in the Waste Load Allocation (WLA); Ch. 62-304.520 F.A.C. – so when the roadway is re-developed this load (existing pavement) is already accounted for as going into the CIRL
Grey - Existing “grandfathered” roadway lanes, no treatment required, BUT already accounted for in Waste Load Allocation in PLSM model. AND therefore this pollutant load reduction can be quantified and used towards the BMAP and PLRG.

Black – new roadway lanes (widening project), Require stormwater treatment for new development permit criteria, and are counted as “untreated” in PLSM model.
Pollutant Load Reduction Computation – Example 4 lanes to 6 lane widening project

STEPS:
1. Identify that project meets requirements of “grandfathered” condition
   a) Developed prior to ERP stormwater requirements (1995)
   b) Provides treatment “above and beyond” permit requirements
   c) Must be re-developed after the year 2000 (cut-off)
2. Define treated acres draining to BMP’s – based on Engineer’s design
3. Clip GIS based PLSM load – to determine pollutant load
4. Calculate Pollutant load from GIS PLSM model data
5. Determine treatment area efficiencies provided, using BMP Efficiencies Table
6. Quantify treatment area efficiency “above and beyond” requirements for new lanes (existing lanes, all treatment is above and beyond)
7. Multiply Pollutant loads (both TN and TP, respectively) by the calculated treatment efficiency provided → Yields the Pollutant Load Reduction Value for both TN and TP, respectively
Pollutant Load Reduction Computation

STEP 4:
Calculate Pollutant load from GIS PLSM model data

The calculations for the PLSM model are as follows for each polygon:

1. Determine the appropriate EMC value for TN and TP. Examine GRID_CODE (Column I), which contains either a 1 or a 0. When GRID_CODE contains a 0, the polygon is “treated,” and the EMC values are calculated:
   a. EMC TN (Column J) = 0.7 * TN_MG_L (Column G)
   b. EMC TP (Column K) = 0.5 * TP_MG_L (Column H)
   c. Otherwise, the EMC TN = TN_MG_L, and the EMC TP = TP_MG_L

2. Calculate the annual runoff:
   a. Multiply the AVG_ANNUAL (rainfall, inches) (Column F)* C (Annual runoff coefficient, unitless) (Column E)* ACRES (polygon area in acres) (Column C).
   b. Convert the result to cubic meters per year.
   c. Round the annual runoff (cubic meters per year) to the nearest integer.

3. Calculate the nitrogen load:
   a. Multiply the appropriate EMC TN (see step 1.a, mg/L) times the annual runoff (rounded, cubic meters per year) to get the nitrogen load.
   b. Convert the loads to pounds per year.
   c. Round the loads to the nearest integer.

4. Calculate the phosphorus load:
   a. Multiply the appropriate EMC TP (see step 1.b, mg/L) times the annual runoff (rounded, cubic meters per year) to get the phosphorus load.
   b. Convert the loads to pounds per year.
   c. Round the loads to the nearest 0.1 pounds.

5. Sum the loads across polygons.
## Pollutant Load Reduction Computation

### STEP 4:
Calculate Pollutant load from GIS PLSM model data

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<th>LUCODE</th>
<th>HYDRGRP</th>
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<th>LC_HYDR</th>
<th>RO_C</th>
<th>TN_MG_L</th>
<th>TP_MG_L</th>
<th>TSS_MG_L</th>
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<th>GRID CO</th>
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<th>Area (ac)</th>
<th>EMC TN</th>
<th>EMC TP</th>
<th>Annual Runoff (ac-ft)</th>
<th>Annual Runoff (m³)</th>
<th>TN Load (lbs/yr)</th>
<th>TP Load (lbs/yr)</th>
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Pollutant Load Reduction Computation

STEP 5:
Determine treatment area efficiencies provided, using BMP Efficiencies Table for Central Indian River Lagoon
Pollutant Load Reduction Computation

STEP 5:
Determine treatment area efficiencies for: Swale Treatment

STEP 6: Find Treatment efficiency “above and beyond”

| Treated acres: | 152.32 ac |
| Volume         | 21.37 ac-ft | 14.28 ac-ft |

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4 Grandfathered Lanes – treatment provided above & beyond = 90.6%

2 New Lanes – treatment difference (above and beyond requirement) = 12.8%
Pollutant Load Reduction Computation – Example 4 lanes to 6 lane widening project

STEP 7:
Multiply Pollutant loads (both TN and TP, respectively) by the calculated treatment efficiency provided → Yields the Pollutant Load Reduction Value for both TN and TP, respectively

\[ = (TN \text{ Load} \times \% \text{ Eff. Provided Ex. lanes} \times \# \text{of ex. lanes}/\# \text{ of total lanes}) + (TN \text{ Load} \times \% \text{ Eff. Provided New lanes} \times (\# \text{ of new lanes}/\# \text{ of total lanes}) \]

Units
• TN or TP Load = lbs/yr
• % Efficiency Provided = should be in decimal for calculation
Pollutant Load Reduction Computation – Example 4 lanes to 6 lane widening project

STEP 7: Multiply Pollutant loads (both TN and TP, respectively) by the calculated treatment efficiency provided → Yields the Pollutant Load Reduction Value for both TN and TP, respectively

\[ TN = (1578 \text{ lbs/yr } TN \times 0.906 \times \frac{4}{6}) + (1578 \text{ lbs/yr } TN \times 0.128 \times \frac{2}{6}) = 1,020.4 \text{ lbs/yr} \]

\[ TP = (592.4 \text{ lbs/yr } TN \times 0.906 \times \frac{4}{6}) + (592.4 \text{ lbs/yr } TN \times 0.128 \times \frac{2}{6}) = 383.1 \text{ lbs/yr} \]

Units
- TN or TP Load = lbs/yr
- % Efficiency Provided = should be in decimal for calculation
Pollutant Load Reduction Computation – Example 4 lanes to 6 lane widening project

Pollutant Load Reduction from Existing “grandfathered” lanes

\[ TN = \left( (1578 \text{ lbs/yr} \times 0.906 \times \frac{4}{6}) + (1578 \text{ lbs/yr} \times 0.128 \times \frac{2}{6}) \right) = 1,020.4 \text{ lbs/yr} \]

\[ TP = \left( (592.4 \text{ lbs/yr} \times 0.906 \times \frac{4}{6}) + (592.4 \text{ lbs/yr} \times 0.128 \times \frac{2}{6}) \right) = 383.1 \text{ lbs/yr} \]

Pollutant Load Reduction from New lanes “above and beyond” ERP requirements

\[ TN = 953.1 \text{ lbs/yr} \]
\[ TP = 357.8 \text{ lbs/yr} \]

\[ TN = 67.3 \text{ lbs/yr} \]
\[ TP = 25.3 \text{ lbs/yr} \]
Take Home Message

• Are you accounting for your Water Quality activities appropriately?

• Leave no stone unturned

• Know the difference between your permitting requirements – and the TMDL, BMAP, and/or NNC (Waste Load Allocation) requirements = not always the same!

• Know where the load is coming from. So we are addressing the correct sources!
Questions?

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References