Past & Present Water Quality Conditions in the South Florida Water Management District

November 5, 2015
(Revised 12/23/15)

Stuart Van Horn, P.E. – Chief, Water Quality Bureau
Information Source

- Annual Report published by May 1st
  - Florida Department of Environmental Protection
  - South Florida Water Management District
- Details a Year of Accomplishments in Restoration, Science and Engineering
  - Southern Everglades (Vol. I – Ch.’s 3, 4, 5, 6)
  - Lake Okeechobee Watershed (Vol. I - Ch. 8)
  - Kissimmee Watershed (Vol. I - Ch. 9)
  - Coastal Watersheds and Estuaries (Vol. I - Ch. 10)
- DRAFT Report available at:
  [www.sfwmd.gov/sfer](http://www.sfwmd.gov/sfer)
  Water Year 2015 (May 1, 2014 – April 30, 2015)
Past & Present Total Phosphorus Conditions

- Southern Everglades
  - Everglades Protection Area
  - Everglades Agricultural Area

- Northern Everglades
  - Kissimmee and Lake Okeechobee Watershed
  - St Lucie River Watershed
  - Caloosahatchee River Watershed

- Summary
Southern Everglades
Water Quality Improvement in Total Phosphorus (TP) Concentrations in the Water Conservation Areas (WCAs)

Significant decrease in TP inflow to WCAs as a result of the 1994 “Everglades Forever Act” requiring:

- On-Farm Best Management Practices (BMPs)
- Stormwater Treatment Areas (STAs)
- Comprehensive research program to optimize both BMP and STA performance

NOTE:
TP values represent the 5-year average of annual geometric means at each station.
Southern Everglades
TP Concentration Improvement in the Loxahatchee Refuge (WCA-1)

WY1979-1983
All sites > 10 ppb

Mean of CA1-3 to CA1-16: 20.4 ppb

WY2011-2015
Most sites < 10 ppb

Mean of LOX3 to LOX16: 6.9 ppb

NOTE:
TP values represent the 5-year average of annual geometric means at each station.
Southern Everglades
TP Concentration Improvement in WCA-2A

WY1979-1983
71% of sites > 10 ppb

WY2011-2015
All sites significantly improved
31% of sites > 10 ppb

Mean of all 21 stations: 32.8 ppb
Mean of all 16 P-Rule stations: 9.9 ppb

NOTE:
TP values represent the 5-year average of annual geometric means at each station.
Southern Everglades
TP Concentration Improvement in WCA-3

WY1979-1983
~50% of stations > 10 ppb

WY2011-2015
Only two stations > 10 ppb

Mean of all stations (CA3-1 to CA3-21): 14.5 ppb

Mean of all 18 P-Rule stations: 6.2 ppb

NOTE:
TP values represent the 5-year average of annual geometric means at each station
Southern Everglades
TP Concentration Improvement in Everglades National Park (ENP)

**WY1986-1990**
Most stations ≥ 5 ppb

**WY2011-2015**
Most stations ≤ 5 ppb

- TP concentrations at sites in the ENP have consistently remained below 10 ppb.

**NOTE:**
TP values represent the 5-year average of annual geometric means at each station.

Mean of all 7 stations: 7.2 ppb
Mean of all 13 P-Rule stations: 3.6 ppb
The argument in 1988 was that cattails were expanding 5 acres per day and ultimately would take over the entire Southern Everglades.

Over the last 20 years there has been little expansion of cattail areas in WCA-2A.

The cattails are there primarily due to high phosphorus soils. Physical removal is a management option being actively studied.

Loxahatchee National Wildlife Refuge

Applicable TP Criteria

- Federal Consent Decree (Appendix B)
  - 14 station TP geometric mean (long-term goal ~7 ppb)
    - Long-term compliance level varies (7.2-17.5 ppb) dependent on water level
    - Tested monthly

- State TP Rule
  - 18 Unimpacted station TP geometric mean
  - 6 Impacted station TP geometric mean
    - Long-term compliance limit (10 ppb)
    - Tested annually and on 5-year basis
Southern Everglades Exceedances in the Everglades (Loxahatchee Refuge)

Federal Consent Decree (Appendix B)
- Actual 14-station geometric downward trend:
  1999 geometric mean ~ 10 ppb
  2015 geometric mean ~ 7 ppb
- Monthly TP averages for 5-yrs (Oct 2010-Sep 2015):
  ~ 95% of months below level by 3.7 ppb
  ~ 5% of months above level by 0.4 ppb

Monthly 14-Station Geometric Mean TP Concentrations Deviation from Long-term Levels (LTL) in ppb (October 2010 – September 2015)

<table>
<thead>
<tr>
<th>Number of Months</th>
<th>Minimum Difference</th>
<th>Maximum Difference</th>
<th>Average Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Compliance (below level)</td>
<td>53</td>
<td>-0.2</td>
<td>-9.4</td>
</tr>
<tr>
<td>Excursion (above level)</td>
<td>3</td>
<td>0.2</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Exceedance Event TP Differences in ppb

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Long-term Level</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008 Nov</td>
<td>7.4</td>
<td>7.2</td>
<td>0.2</td>
</tr>
<tr>
<td>2009 Jun</td>
<td>13.2</td>
<td>12.1</td>
<td>1.1</td>
</tr>
<tr>
<td>2014 Oct</td>
<td>7.9</td>
<td>7.2</td>
<td>0.7</td>
</tr>
<tr>
<td>2015 Jan</td>
<td>8.1</td>
<td>7.9</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Note: The laboratory margin of error is +/- 2 ppb

Note: Two monthly Excursions in 12-month period result in an Exceedance of long-term compliance level.
State TP Rule (WY2015)

- **Unimpacted 18-stations**
  - All 4 parts of compliance test met
  - Average geometric mean ~ 7 ppb

- **Impacted 6-stations**
  - 4 stations met annual individual test
  - Average geometric mean ~15 ppb

### TP Rule 4-part Compliance Test

<table>
<thead>
<tr>
<th>Criterion Provision</th>
<th>Applied to</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-year Average Geometric Mean</td>
<td>All Stations GM</td>
<td>≤ 10 ppb</td>
</tr>
<tr>
<td>3 of 5 years</td>
<td>All Stations GM</td>
<td>≤ 10 ppb</td>
</tr>
<tr>
<td>Annual</td>
<td>All Stations GM</td>
<td>≤ 11 ppb</td>
</tr>
<tr>
<td>Annual</td>
<td>Individual</td>
<td>≤ 15 ppb</td>
</tr>
</tbody>
</table>

*Note: Test is applied to Impacted and Unimpacted sites separately*
Federal Consent Decree (Appendix A)

Exceedance Event TP Differences in ppb

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Long-term Limit</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>10.6</td>
<td>10.2</td>
<td>0.4</td>
</tr>
<tr>
<td>2012</td>
<td>8.9</td>
<td>8.8</td>
<td>0.1</td>
</tr>
<tr>
<td>2014</td>
<td>10.8</td>
<td>9.7</td>
<td>1.1</td>
</tr>
</tbody>
</table>

ENP - Shark River Slough

1978-1990 Average: 14.2 ppb

Base Period

~40% concentration reduction

Interim Limit

Long-term Limit

FWMC – flow weighted mean concentration

Note: The laboratory margin of error is +/- 2 ppb
Everglades Agricultural Area
Everglades Construction and Restoration Strategies Projects

Source: Figure 5A-1 Key Projects for the Restoration Strategies Regional Water Quality Plan (Draft 2016 SFER)
State Law requires a long-term geometric mean of 10 µg/L or ppb TP for the Everglades Protection Area (EPA).

EAA phosphorus concentration during the base condition (1979 – 1988) was 173 µg/L.
Everglades Agricultural Area
Best Management Practices (BMP) Success

20-Year Average: 56% Reduction

Reduction Required by Law 25%
BMPs prevented 3,000 metric tons of phosphorus from entering STAs.
Everglades Agricultural Area
Reductions in Phosphorus since EFA

Current (WY2011 - 2015)

- BMP Reductions
- STA Reductions
- Projected Restoration Strategies Reductions
- Restoration Standard in the EPA
Current Condition

- Flow-weighted mean TP concentrations decrease from North to South
- Everglades Stormwater Treatment Areas (STA’s) treat runoff from additional areas beyond the EAA
2007: Northern Everglades and Estuaries Protection Program (NEEPP) – Expands Northern Everglades to include River/Estuary Watersheds

- NEEPP also expands the focus beyond water quality to water quantity and habitat restoration

- Three key goals of NEEPP:
  1) Achieve Total Maximum Daily Loads (TMDLs)
  2) Maintain lake levels with desirable range
  3) Maintain desirable salinity balance in estuaries

- Watershed Protection Plans are the basis for the state’s Basin Management Action Plans (BMAPs) (adopted in 2012 Caloosahatchee, 2013 St. Lucie, 2014 Lake Okeechobee)
Surface Inflow to Lake Okeechobee historically varies over a wide range (0.5 to 5.0 million ac-ft per year)
Northern Everglades Lake Okeechobee Inflow
WY2011-WY2015
Phosphorus

Northern watershed contributes ~ 90% of flow and TP load

**LAKE ISTOKPOGA**
13% Water; 6% TP Load
- TP Load: 26 mt
- TP FWMC: 75 ppb

**INDIAN PRAIRIE**
13% Water; 19% TP Load
- TP Load: 78 mt
- TP FWMC: 232 ppb

**FISHEATING CREEK**
9% Water; 11% TP Load
- TP Load: 43 mt
- TP FWMC: 181 ppb

**WEST LAKE O.**
2% Water; 2% TP Load
- TP Load: 8 mt
- TP FWMC: 146 ppb

**UPPER KISSIMMEE**
34% Water; 15% TP Load
- TP Load: 62 mt
- TP FWMC: 69 ppb

**LOWER KISSIMMEE**
16% Water; 19% TP Load
- TP Load: 75 mt
- TP FWMC: 174 ppb

**TC-NS**
6% Water; 19% TP Load
- TP Load: 77 mt
- TP FWMC: 456 ppb

**EAST LAKE O.**
4% Water; 4% TP Load
- TP Load: 16 mt
- TP FWMC: 154 ppb

**SOUTH LAKE O.**
3% Water; 4% TP Load
- TP Load: 15 mt
- TP FWMC: 220 ppb

North Lake Okeechobee
TMDL: 140 mt
Target Conc. 40 ppb
Note: Inflows modeled and estimated from Tidal Basins entire period and Ten Mile Creek prior to WY2006.
Local Basin Runoff accounted for about 79% of flow and 87% of TP load to Estuary.
Caloosahatchee Estuary Annual Inflows (WY1979-2015)

Note: Inflows modeled and estimated from Tidal Basin.
Northern Everglades
Caloosahatchee Estuary Inflows WY2011-15
Phosphorus

Local Basin Runoff accounted for about 69% of flow and 77% of TP load to Estuary

**C-43 AND S-4 BASINS TO ESTUARY**
48% Water; 62% P Load

<table>
<thead>
<tr>
<th>TP Load</th>
<th>TP FWMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>147 mt</td>
<td>148 ppb</td>
</tr>
</tbody>
</table>

**TIDAL BASIN (ESTIMATED)**
21% Water; 15% P Load

<table>
<thead>
<tr>
<th>TP Load</th>
<th>TP FWMC</th>
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</thead>
<tbody>
<tr>
<td>36 mt</td>
<td>83 ppb</td>
</tr>
</tbody>
</table>

**LAKE OKEECHOBEE**
31% Water; 23% P Load

<table>
<thead>
<tr>
<th>TP Load</th>
<th>TP FWMC</th>
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<tbody>
<tr>
<td>54 mt</td>
<td>85 ppb</td>
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</tbody>
</table>

Notes: Coastal Basin runoff (west of Shell Point) is not included as Estuary contribution
Tidal Basin runoff flow modeled and TP estimated from representative data
Summary

- **Southern Everglades**: >95% of area currently meets the 10 ppb water quality standard.
  - **EAA**: Need to fully implement “Restoration Strategies Plan” to achieve 100% compliance with the 10 ppb standard.
  - **Everglades Protection Area**: Fulfill goal of completing Modified Water Delivery Plan and CEPP Plan to help achieve TP standards and to improve the timing and distribution of water flow.

- **Northern Everglades**: Basin Management Action Plans (BMAPs) are overarching water quality restoration plans. Improving water quality and providing storage are key for restoration.
  - **Lake Okeechobee**: Inflows from the north (2.64 million acres or 4,131 square miles) contribute majority (~90 percent) of Lake inflows. Significant storage volumes north of lake are necessary to achieve healthier lake levels and reduce harmful discharges to estuaries.
  - **St Lucie Estuary**: Complete Indian River Lagoon and C-44 projects to reduce high TP discharges from local basin to estuary. At present, St Lucie watershed runoff has one of the highest TP concentrations in SFWMD’s 16 county area, and reductions are needed to help restore estuary.
  - **Caloosahatchee Estuary**: Complete C-43, Lake Hicpochee, Boma, and Nicodemus Slough projects, as well as other local projects, to provide storage and reduce TP discharges from local runoff to help restore estuary.
Governor Scott’s Plan

At a Glance

- Governor Scott has proposed a dedicated source of funding for Everglades restoration over the next 20 years.
  
  *The Governor’s plan includes $5 billion in state funding and $4 billion in anticipated matching funds from the federal government.*

- The plan will continue the momentum of Florida’s job growth and provide for steady and consistent progress on Everglades restoration.

- Implementation of the Governor’s plan will deliver these critical benefits to the Everglades ecosystem:

  *Capture and store 1 million acre-feet (330 billion gallons) of fresh water, which will significantly decrease the frequency and intensity of harmful freshwater discharges to the northern estuaries.*

  *Reduce phosphorus loads to Lake Okeechobee, Caloosahatchee Estuary, St Lucie Estuary and the Everglades by 252 metric tons per year.*
Discussion
The following revisions were made to this presentation to address comments received at the November 5, 2015, WRAC meeting:

- Minor editorial changes not listed here
- Southern Everglades Exceedances in the Everglades (Loxahatchee Refuge) original slide 10 split into new slides 10, 11, and 12.
  - Refuge Map and Applicable TP Criteria overview (Federal Consent Decree and State TP Rule)
  - Federal Consent Decree – added data to quantify deviation from Long-term Level (criteria)
  - State TP Rule – added 2015 geo-means and 4-part compliance test table
- Southern Everglades Exceedances in the Everglades (Shark River Slough)
  - Added Table of 2008, 2012 and 2014 Exceedance Event TP Differences
- Northern Everglades – Re-ordered inflow volume charts before TP inflow maps
- St Lucie and Caloosahatchee – updated annual inflow charts
  - Added estimated tidal basin inflows to estuaries and corrected C-23 missing data prior to 1996
  - Added pie chart of period-of-record inflow volume percentages by basin
Supplemental Nitrogen Information

- The following three slides representing 5-year average levels of total nitrogen within the Northern Everglades watersheds are provided in response to WRAC member comments on November 5, 2015.

- These slides are to be incorporated to a presentation at a future WRAC meeting.
Northern Everglades Lake Okeechobee Inflow

LAKE ISTOKPOGA
13% Water; 13% TN Load
 TN Load | TN FWMC
530 mt   | 1.54 ppm

INDIAN PRAIRIE
13% Water; 18% TN Load
 TN Load | TN FWMC
728 mt   | 2.16 ppm

FISHEATING CREEK
9% Water; 10% TN Load
 TN Load | TN FWMC
401 mt   | 1.71 ppm

WEST LAKE O.
2% Water; 2% TN Load
 TN Load | TN FWMC
89 mt    | 1.61 ppm

UPPER KISSIMMEE
34% Water; 25% TN Load
 TN Load | TN FWMC
1,048 mt | 1.16 ppm

LOWER KISSIMMEE
16% Water; 13% TN Load
 TN Load | TN FWMC
554 mt   | 1.29 ppm

TC-NS
6% Water; 8% TN Load
 TN Load | TN FWMC
329 mt   | 1.94 ppm

EAST LAKE O.
4% Water; 5% TN Load
 TN Load | TN FWMC
198 mt   | 1.90 ppm

SOUTH LAKE O.
3% Water; 6% TN Load
 TN Load | TN FWMC
265 mt   | 3.80 ppm

Northern watershed contributes:
~ 91% of flow and
~ 87% TN load

Northern Everglades Lake Okeechobee Inflow

WY2011-WY2015 Nitrogen

Lake Okeechobee
Northern watershed contributes:
~ 91% of flow and
~ 87% TN load
Local Basin Runoff accounted for about 79% of flow and 79% of TN load to Estuary.
Local Basin Runoff accounted for about 69% of flow and 68% of TN load to Estuary.

**TIDAL BASIN (ESTIMATED)**
21% Water; 20% TN Load

<table>
<thead>
<tr>
<th>TN Load</th>
<th>TN FWMC</th>
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</thead>
<tbody>
<tr>
<td>568 mt</td>
<td>1.29 ppm</td>
</tr>
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</table>

**C-43 AND S-4 BASINS TO ESTUARY**
48% Water; 48% TN Load

<table>
<thead>
<tr>
<th>TN Load</th>
<th>TN FWMC</th>
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<tr>
<td>1,342 mt</td>
<td>1.35 ppm</td>
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</table>

**LAKE OKEECHOBEE**
31% Water; 32% TN Load

<table>
<thead>
<tr>
<th>TN Load</th>
<th>TN FWMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>874 mt</td>
<td>1.36 ppm</td>
</tr>
</tbody>
</table>

Note: Coastal Basin runoff (west of Shell Point) is not included as Estuary contribution.