

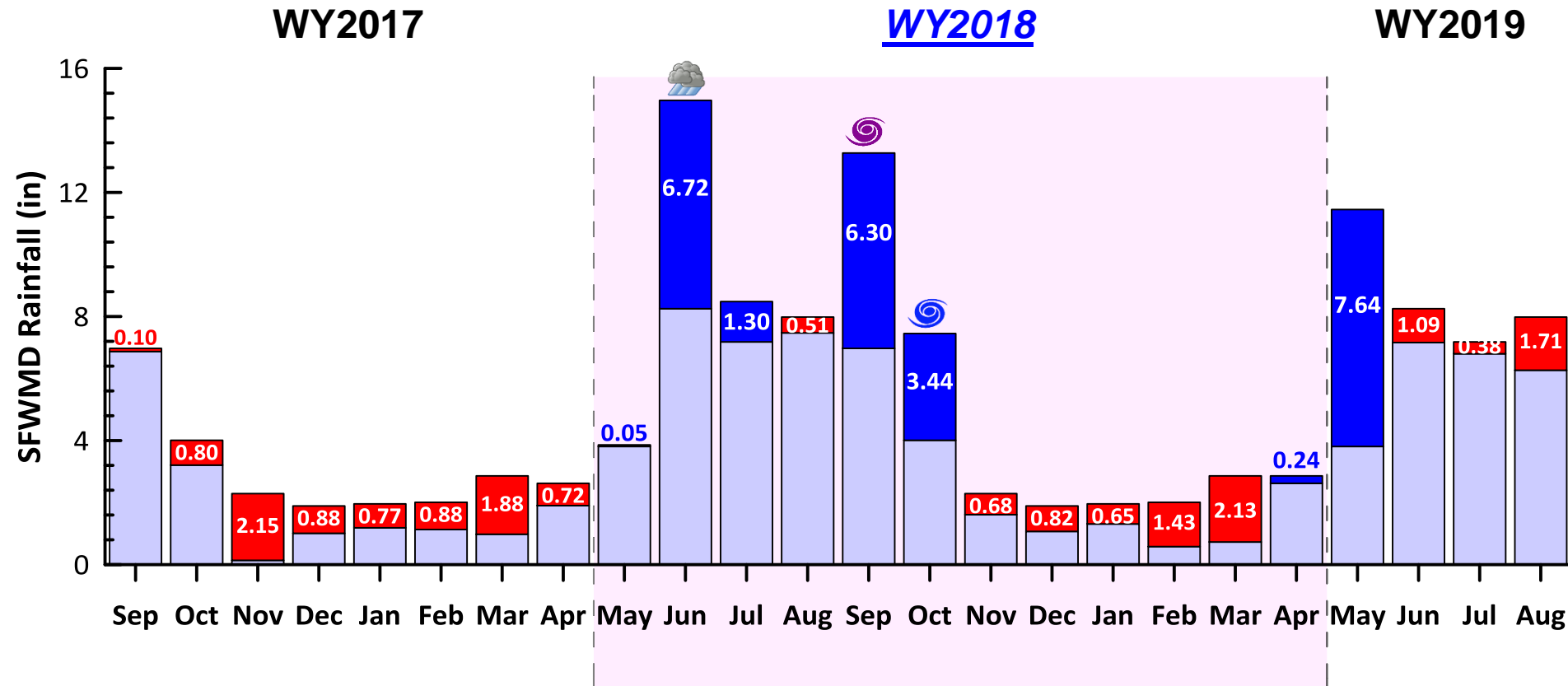
# **Water Years 2014-2018 Southern Everglades Water Quality Overview**

**Water Resources Analysis Coalition  
South Florida Water Management District**

**November 1, 2018**

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

# District-Wide Rainfall Record Setting Water Year 2018



- Extremely dry antecedent conditions prior to the start of WY2018
- WY2018 wet season was the wettest on record since 1932 with 51.5" rain

 Remnant TS Beatriz (June 2017)

 Hurricane Irma (Sep 2017)

 TS Philippe (Oct 2017)



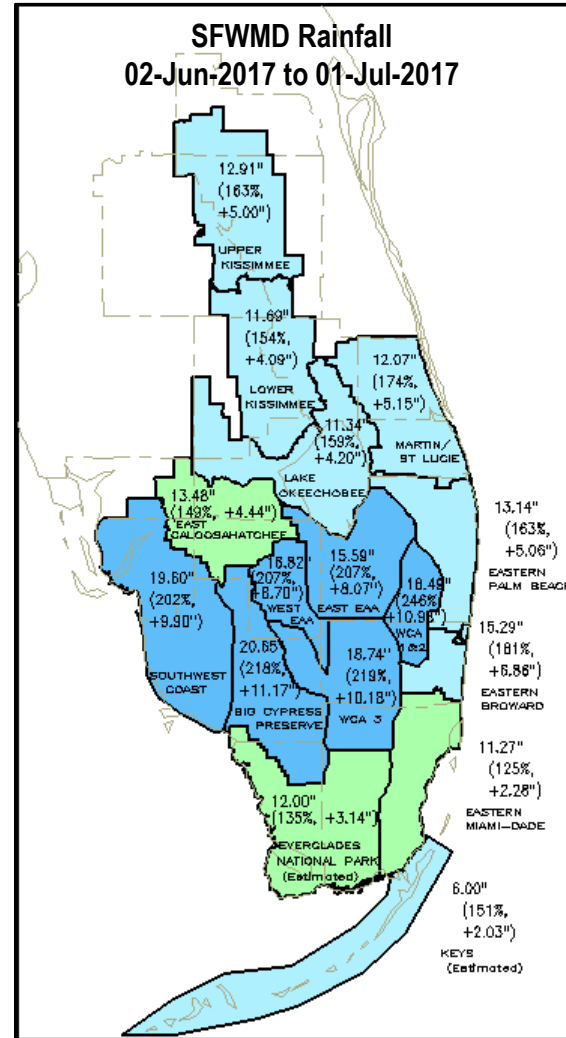
# District-Wide Rainfall

## Rainfall Distribution During Major Rainfall Events

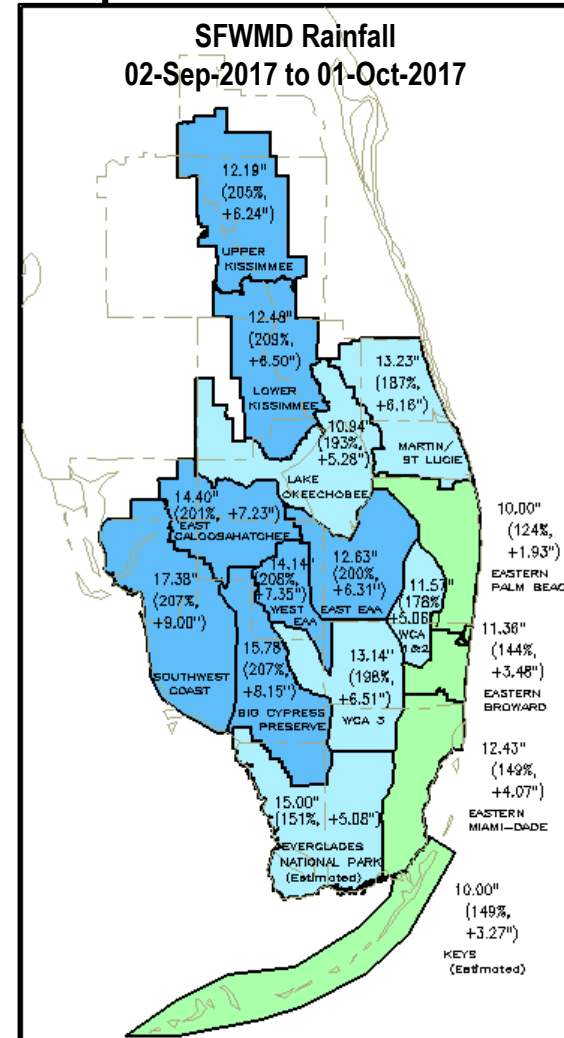
### Events Leading to a Historic Wet Season

- Dry season through May '17 suggested potential drought
- High Water Emergency Order issued Jun '17 resulting from high rainfall for the month
- Jun-Oct wet season rainfall 150% above average (+17.3")

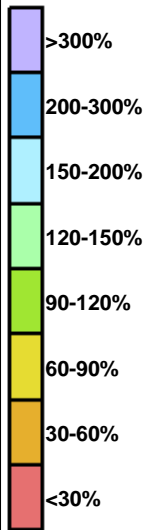
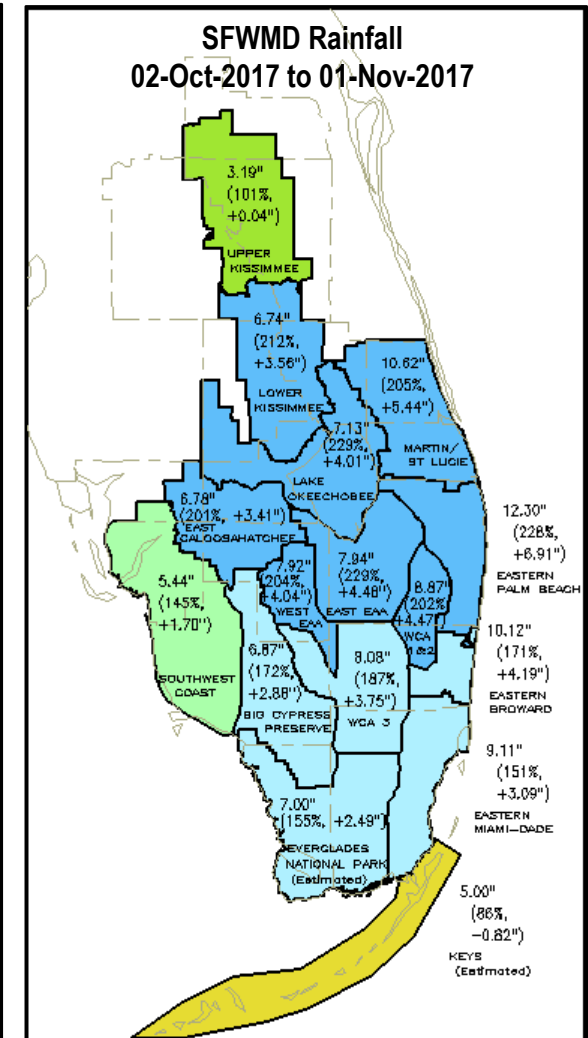
#### June 2017 Rainfall



#### September 2017 Rainfall



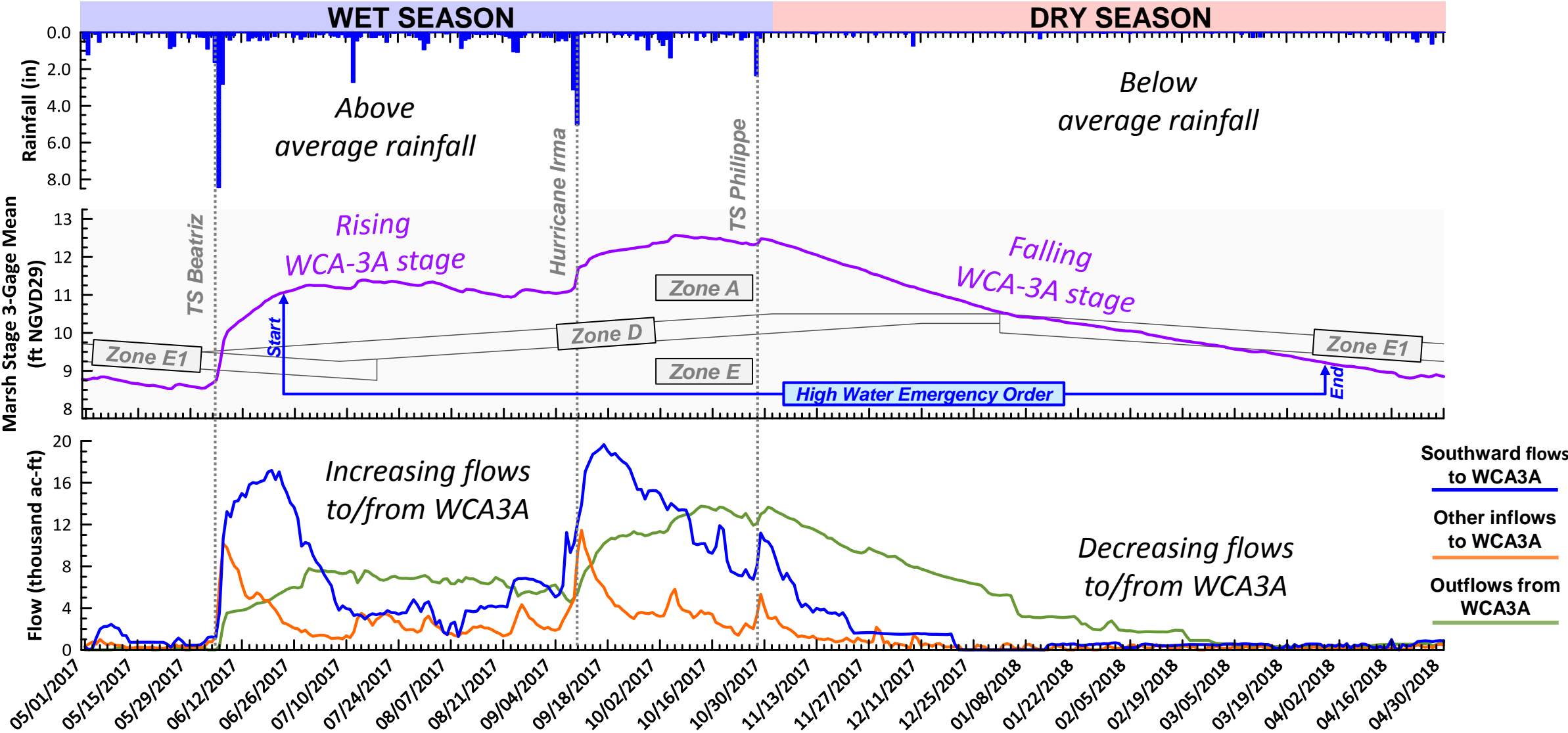
#### October 2017 Rainfall



Measured  
(% of Avg, Diff  
From Avg.)

# Rainfall, Water Elevations, and Flows for WCA-3A

## Rainfall Driving Stages and Flows



# Phosphorus in the Everglades Watershed WY2014 to WY2018

## Current Condition

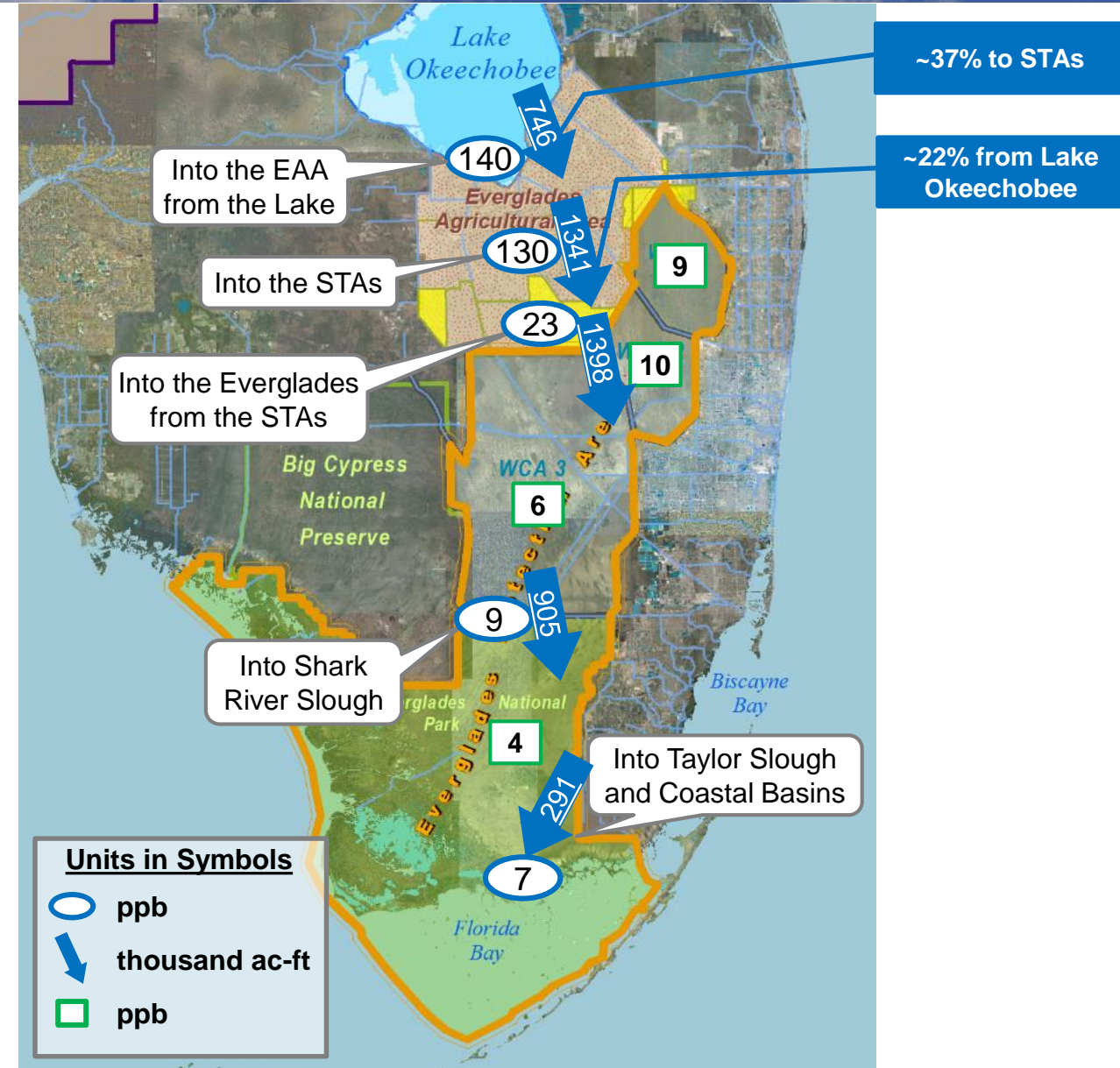
○ Flow-weighted mean TP concentrations in discharge decreasing from North to South

↓ Average Annual Flow Volume

□ Water Conservation Areas and Everglades National Park marshes at or below 10 ppb

- Overall average of “Impacted” and “Unimpacted” for State P-Rule network

**90% of Everglades Protection Area is below or at 10 ppb**





# Federal Consent Decree and State Phosphorus Requirements

## **Federal Consent Decree**

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### **Limited Areas**

- Water Conservation Area – 1  
(Loxahatchee National Wildlife Refuge)
- Everglades National Park

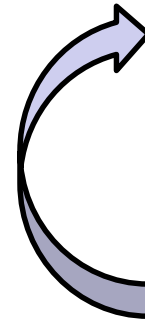
## **State Everglades Forever Act**

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*Ch. 373.4592, F.S.*

### ■ **Expanded Areas**

- Water Conservation Area – 1  
(Loxahatchee National Wildlife Refuge)
- Everglades National Park
- Water Conservation Area – 2
- Water Conservation Area – 3



Everglades Protection Area (EPA)

**Areas Targeted for Phosphorus Reductions**

# Federal Consent Decree and State Phosphorus Requirements

## **Federal Consent Decree**

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### ■ Remedies Imposed

- Best Management Practices (BMPs)
  - Everglades Agricultural Area (EAA) -original area
- Stormwater Treatment Areas (STAs)
  - EAA – original 40K acres
- Everglades research and monitoring program to support establishment of phosphorus numeric criterion for Water Conservation Areas (WCAs)

## **State Everglades Forever Act** *Ch. 373.4592, F.S.*

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### ■ State Law Imposed

- BMPs
  - EAA Rule - original and expanded
  - C-139 Rule
- STAs
  - EAA and C139 - original 40K acres and improvements via Long-Term Plan
  - Restoration Strategies - STAs > 64K acres and Flow Equalization Basins > 115K acre-feet storage
- Establish phosphorus numeric criterion
- Additional projects for Quantity-Timing-Distribution (QTD)

## **Phosphorus Control Programs**

# Federal Consent Decree and State Phosphorus Requirements

## Federal Consent Decree

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### ■ Tracking response to Remedies

- BMP: EAA 25% Reduction
- Loxahatchee National Wildlife Refuge
  - Monthly Level varies as GM, corrected for marsh stage
- Everglades National Park
  - Annual inflow limit varies for Shark River Slough as FWM, corrected for inflow volume
  - Annual inflow limit fixed for Taylor Slough & Coastal Basins

*GM: Geometric Mean (geomean)*

*FWM: Flow Weighted mean*

*NPDES: National Pollutant Discharge Effluent System*

*WQBEL: Water Quality Based Effluent Limit*

## State Everglades Forever Act

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*Ch. 373.4592, F.S.*

### ■ Tracking response to State Law

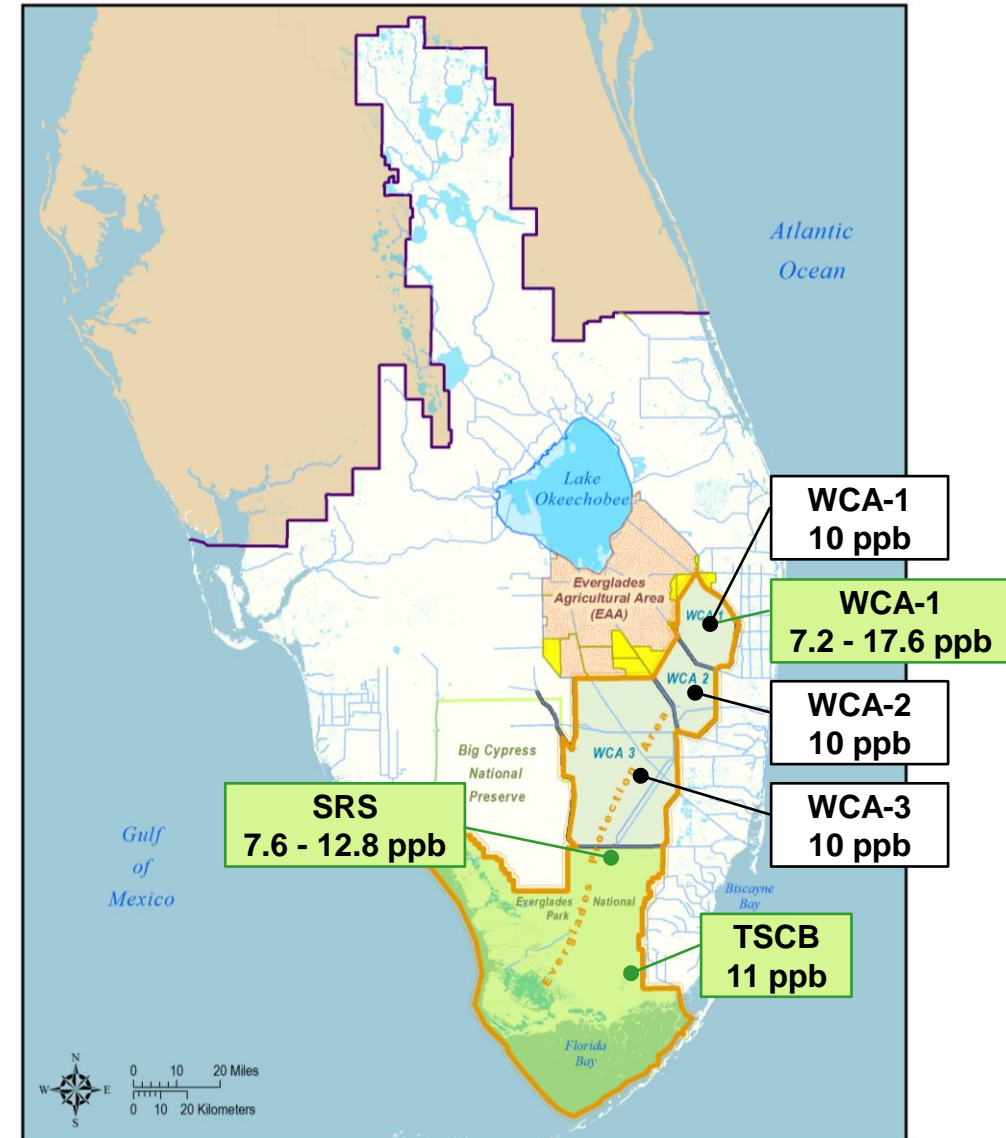
- BMP: EAA 25% Reduction, C139 Historic
- WCA-1 (Refuge), WCA-2, WCA-3
  - Total Phosphorus Rule, networks in all WCAs
- Everglades National Park
  - Inflow limits same as Consent Decree for Shark River Slough & Taylor Slough and Coastal Basins
  - Total Phosphorus Rule – Default criterion if Consent Decree no longer applicable
- STAs
  - NPDES WQBEL

## Phosphorus Inflows and Marsh Levels



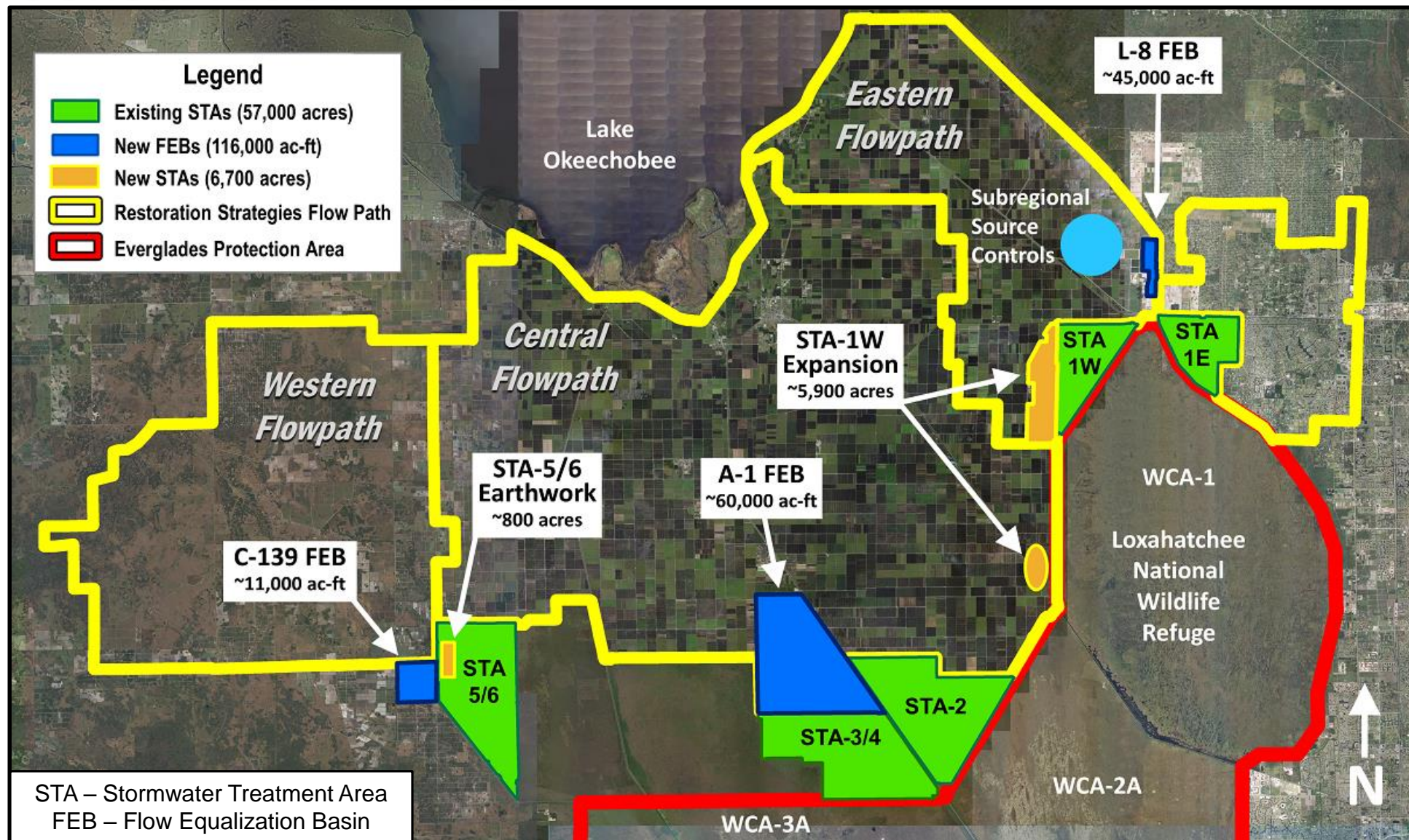
# Overview of Phosphorus Mandates

- **EAA Stormwater Runoff**
  - Consent Decree Appendix E, 25% TP reduction from baseline
  - State Everglades Forever Act and BMP rule (40E-63)
- **STA Discharges to EPA**
  - Original 50 ppb expectation
  - Federal NPDES WQBEL
- **EPA Downstream Marshes**
  - **WCA-1 (Refuge)**
    - Consent Decree Appendix B and State Phosphorus Rule
  - **WCA-2 and WCA-3**
    - State Phosphorus Rule (Consent Decree inapplicable)
  - **Everglades National Park**
    - Consent Decree Appendix A
      - Shark River Slough (SRS)
      - Taylor Slough/Costal Basins (TSCB)(State Phosphorus Rule adopts)



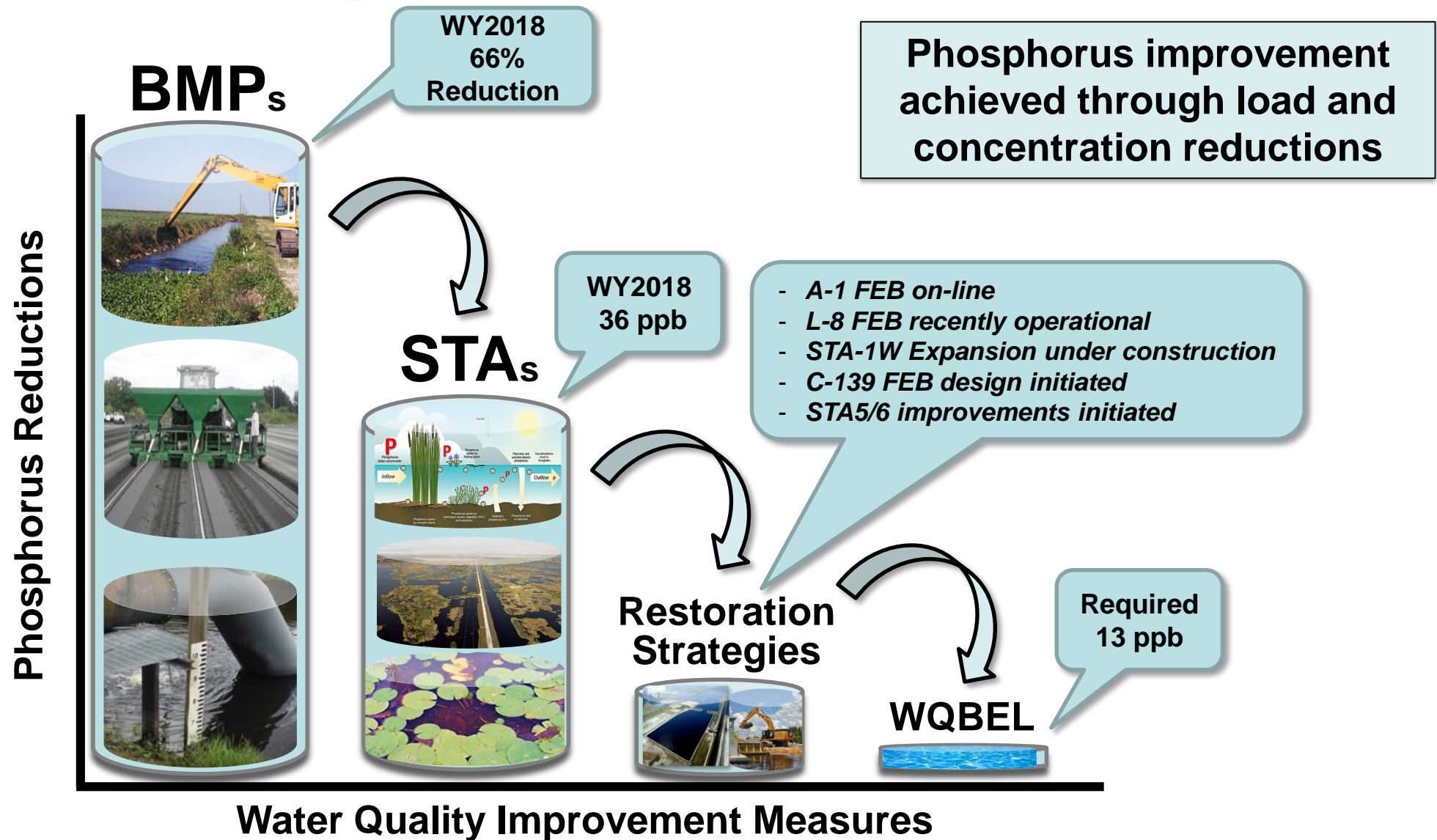


# Phosphorus Controls Upstream of Water Conservation Areas



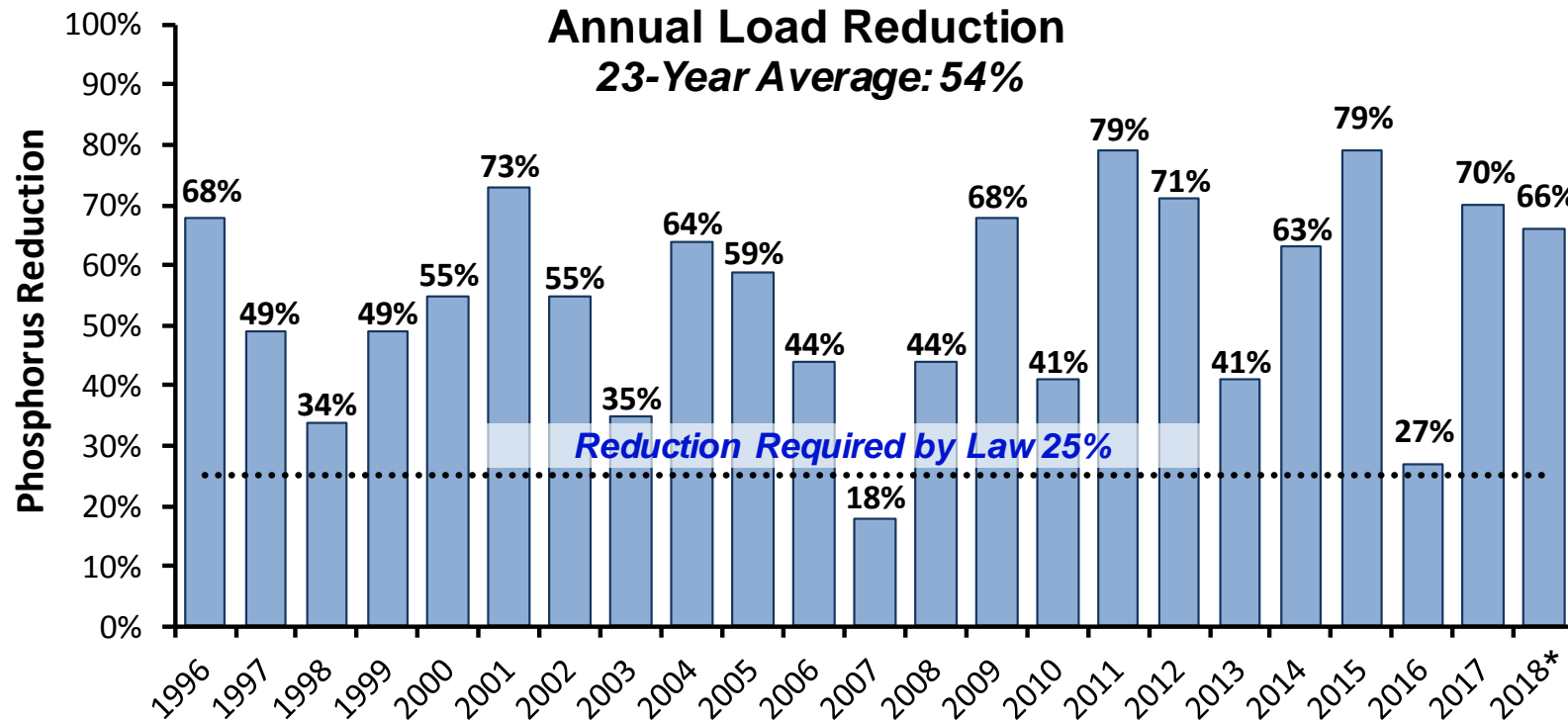


# "Treatment Train" Approach to Reduce Phosphorus since Everglades Forever Act



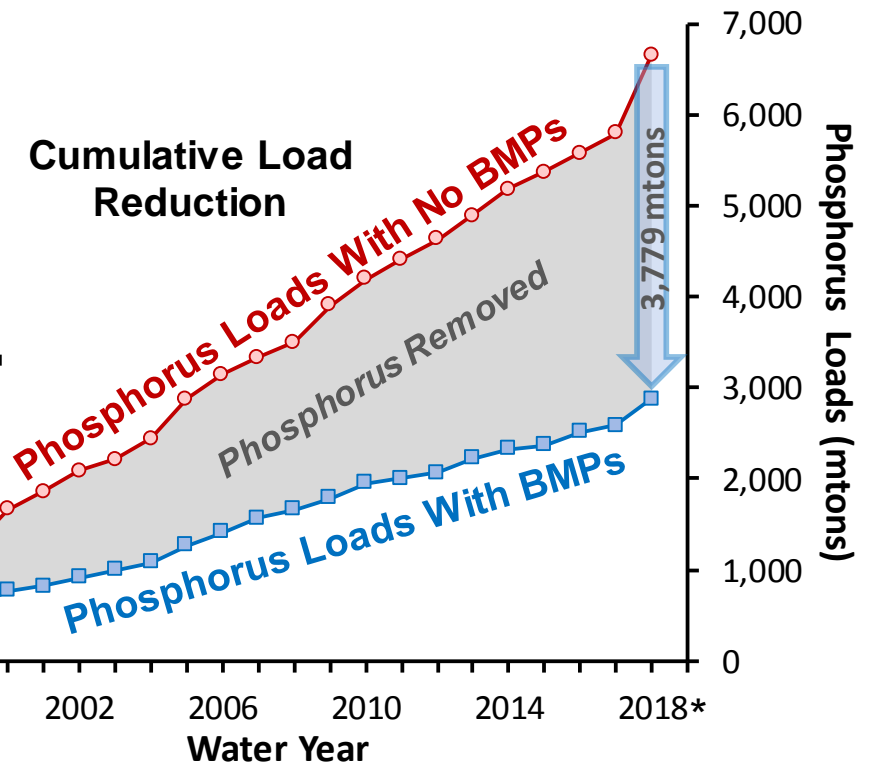


# Everglades Agricultural Area Phosphorus Load Reduction Achieved with BMPs



**Best Management Practices  
prevented 3,779 metric tons of  
phosphorus from leaving the EAA**

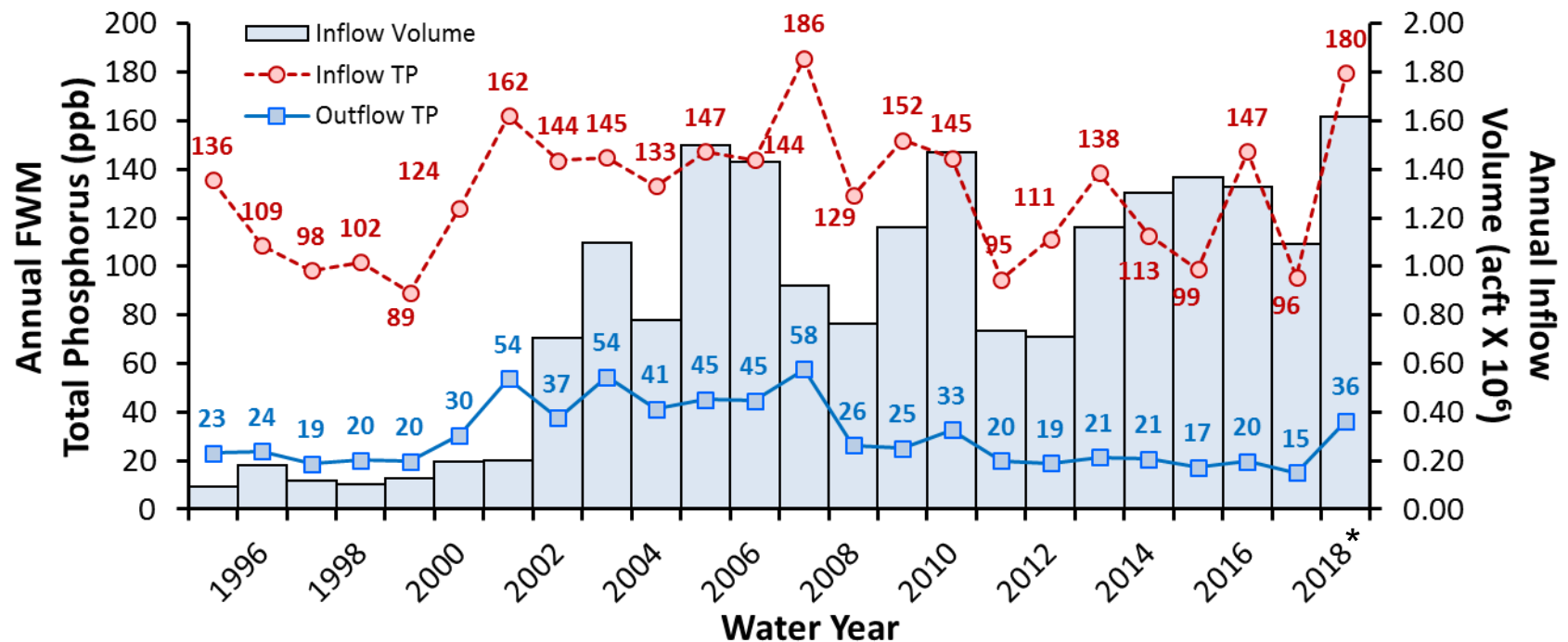
*mtons – metric tons = 1,000 kilograms*



\*WY2018 Extraordinarily Wet Year

# Everglades Stormwater Treatment Areas Phosphorus Concentration & Load Reductions

Annual Concentration Trend



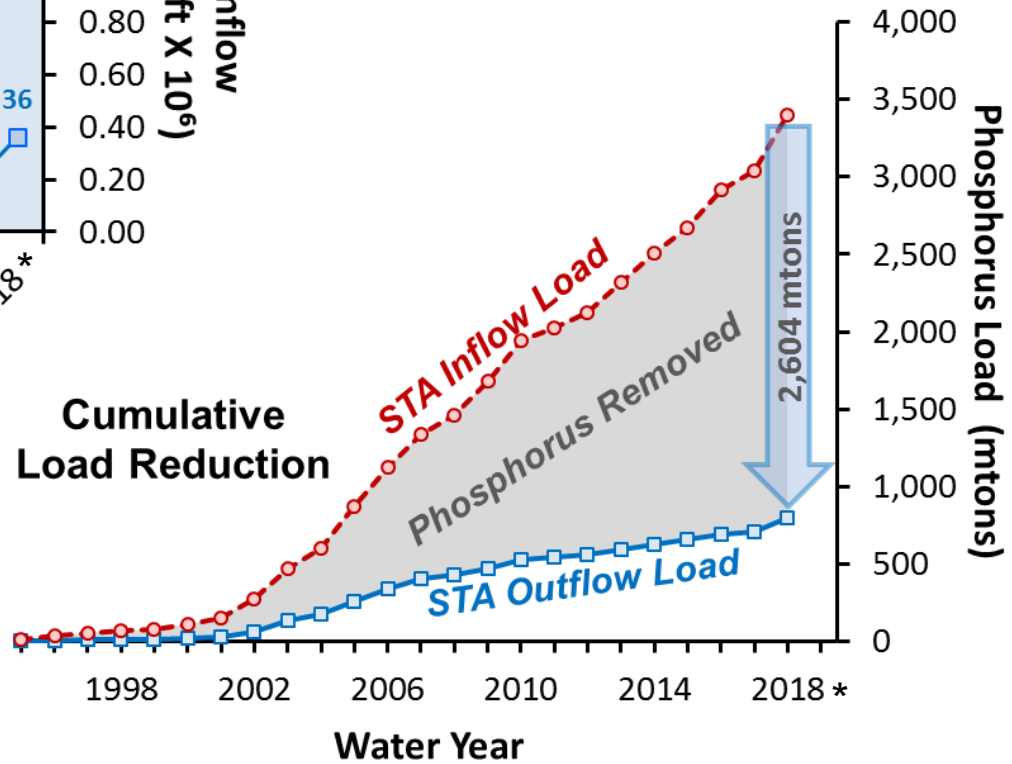
STA Outflow FWM TP for Last Five Water Years (ppb)

	2014	2015	2016	2017	2018*
STA-1E	41	21	19	20	47
STA-1W	24	19	36	23	39
STA-2	19	16	18	14	38
STA-3/4	14	15	12	11	12
STA-5/6	23	32	29	18	74
All	21	17	20	15	36

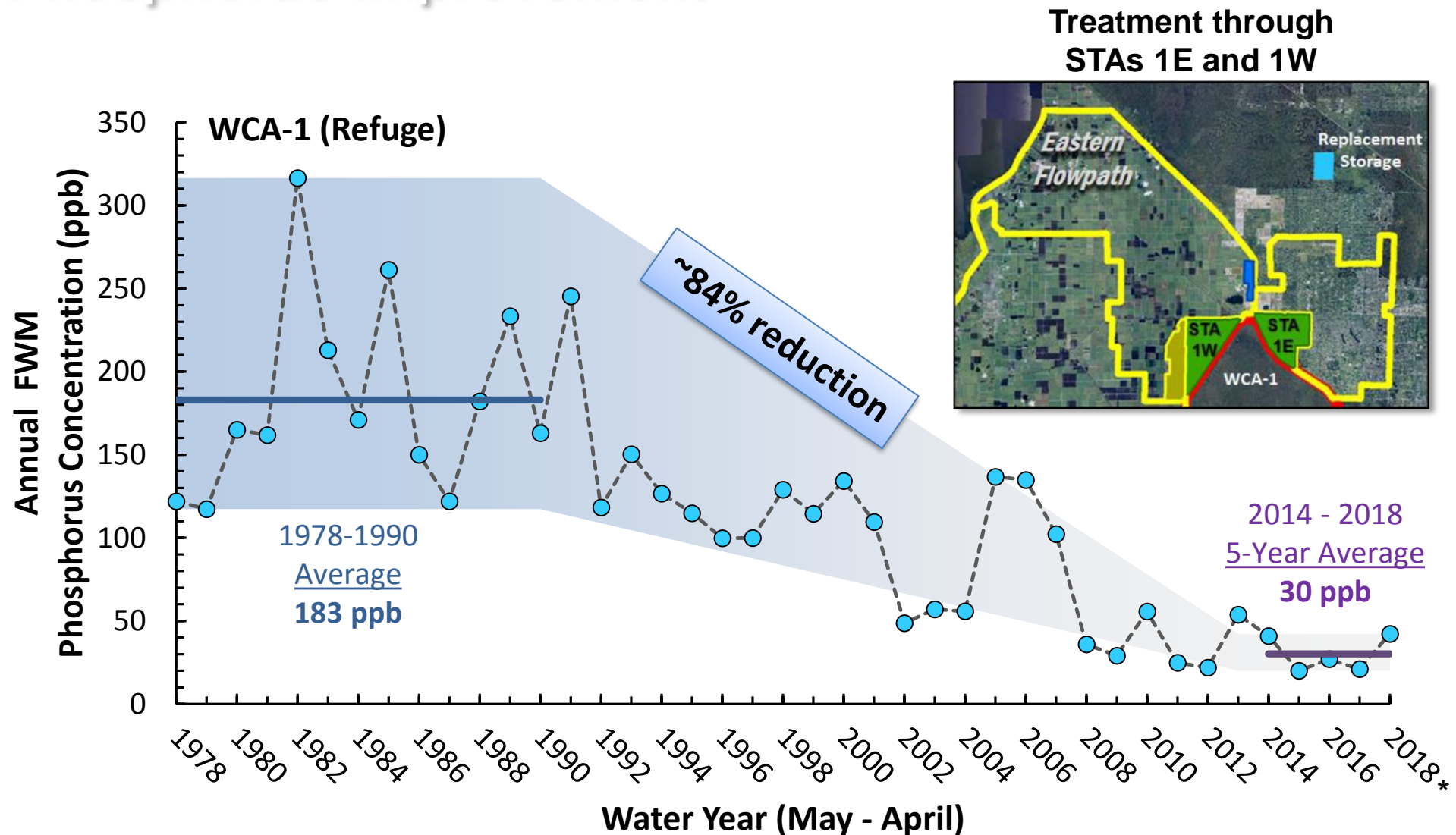
**Stormwater Treatment Areas prevented 2,604 metric tons of phosphorus from entering the Water Conservation Areas**

FWM – flow weighted mean  
 ppb – parts per billion; acft – acre feet  
 mtons – metric tons = 1,000 kilograms

\*WY2018 Extraordinarily Wet Year



# Water Conservation Area 1 (Refuge) Inflow Phosphorus Improvement



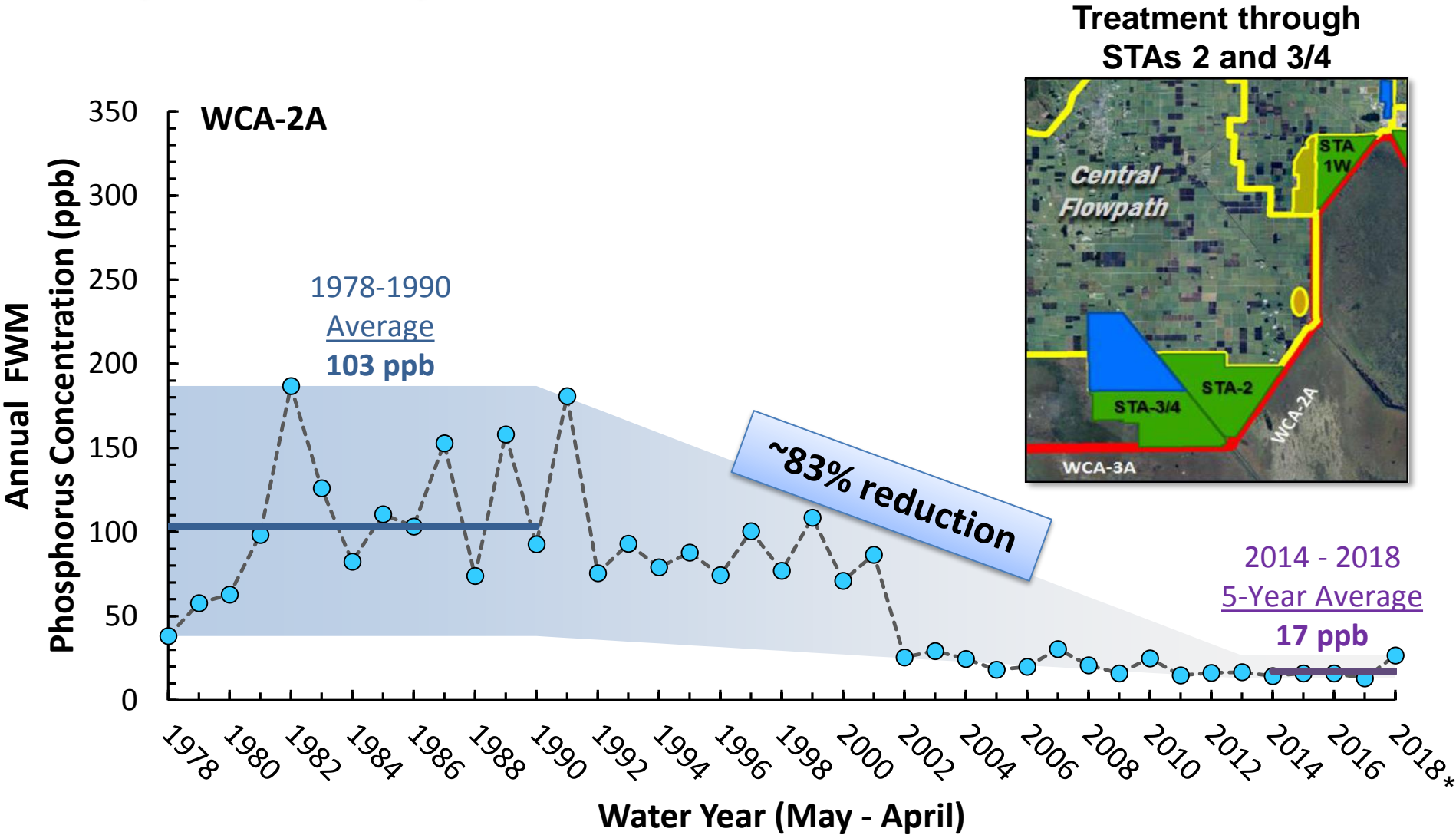
FWM – flow weighted mean  
ppb – parts per billion

\*WY2018 Extraordinarily Wet Year



# Water Conservation Area 2A

## Inflow Phosphorus Improvement

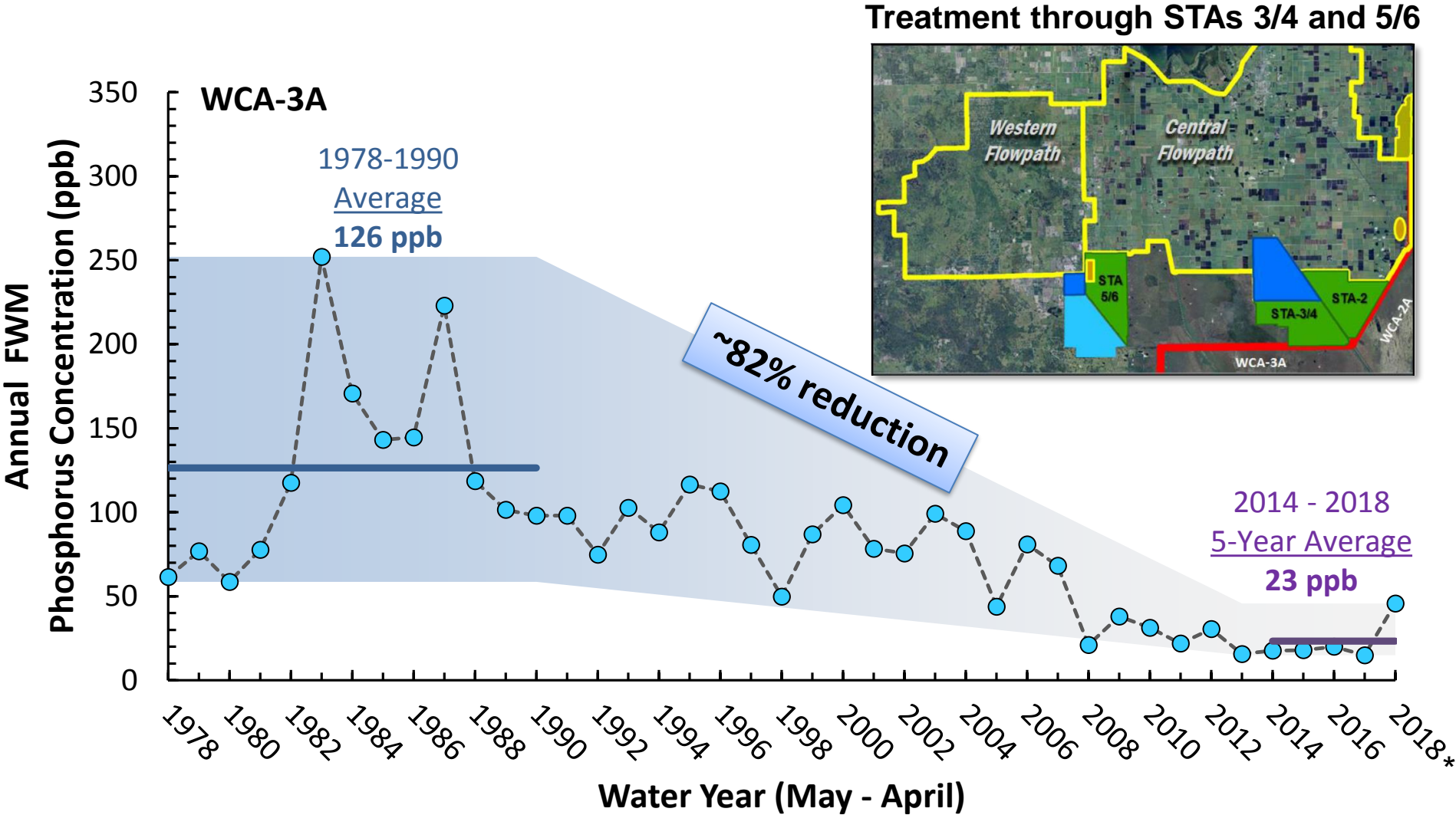


FWM – flow weighted mean  
ppb – parts per billion

\*WY2018 Extraordinarily Wet Year

# Water Conservation Area 3A

## Inflow Phosphorus Improvement



FWM – flow weighted mean  
ppb – parts per billion

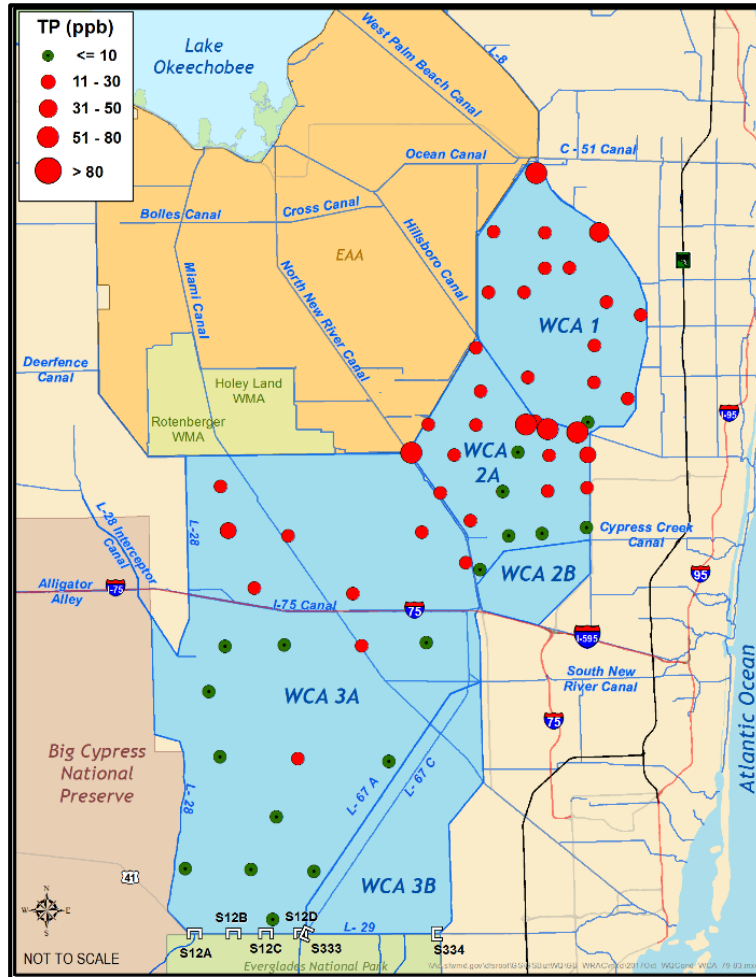
\*WY2018 Extraordinarily Wet Year

# SOUTH FLORIDA WATER MANAGEMENT DISTRICT

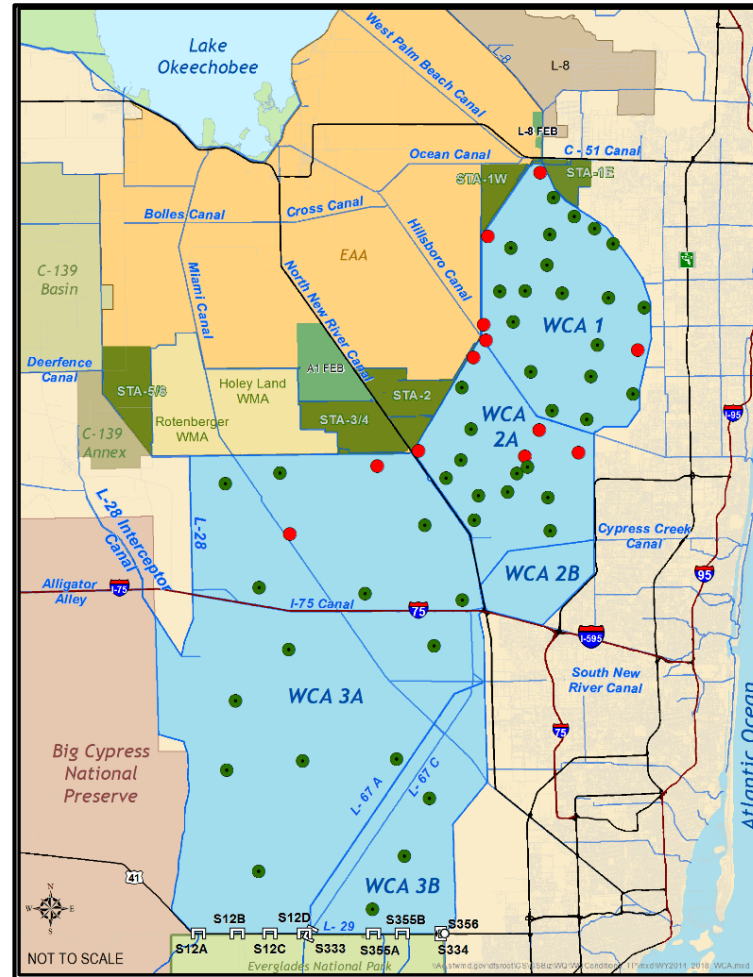
## Water Conservation Areas Marsh Phosphorus Trends and Mandates

DRAFT

**WY1979-1983**  
*High TP in WCAs*



**WY2014-2018**  
*Majority of area below  
10 parts per billion (ppb)*



**All WCAs**  
TP Rule 4-part Compliance Test

Long-Term Criteria	Applied to	Test
5-year Average	All Stations GM	$\leq 10$ ppb
3 of 5 years	All Stations GM	$\leq 10$ ppb
Annual	All Stations GM	$\leq 11$ ppb
Annual	Individual GM	$\leq 15$ ppb

Note: Test is applied to **Impacted** and **Unimpacted** sites separately

**WCA-1 (Refuge)**  
Consent Decree, Appendix B

### Long-term Level

- TP concentration varies with stage (inverse relationship)
- Level range 7.2 - 17.6 ppb
- No more than 1 in 12 months can exceed Level

TP values represent the 5-year average of annual geometric means at each station  
ppb – parts per billion

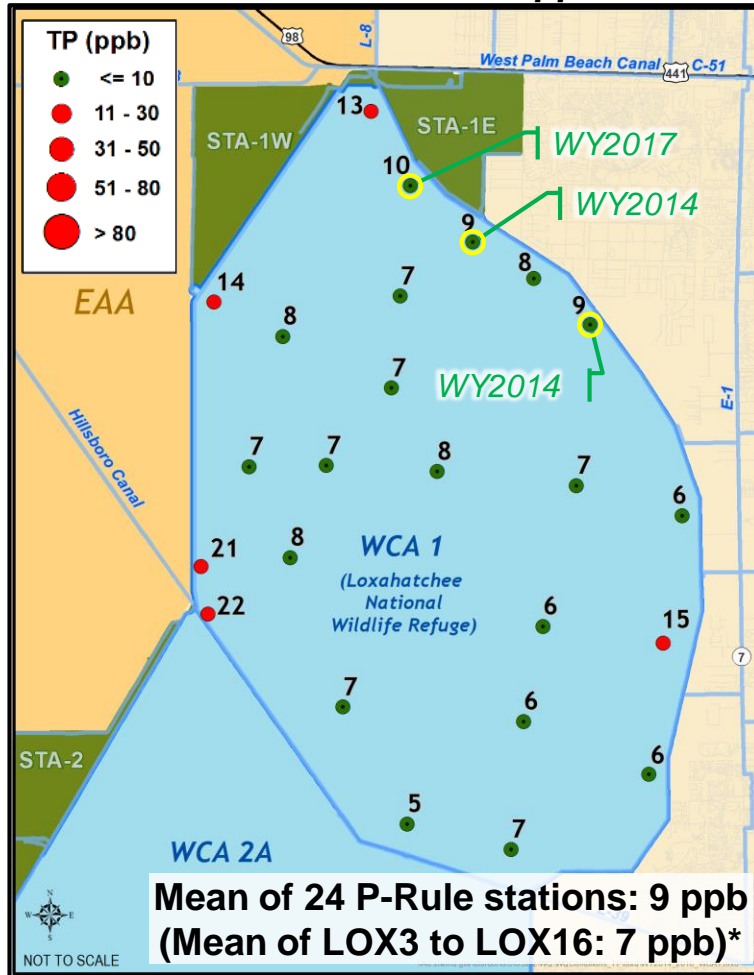


# Water Conservation Area 1 (Refuge)

## Marsh Phosphorus Improvement

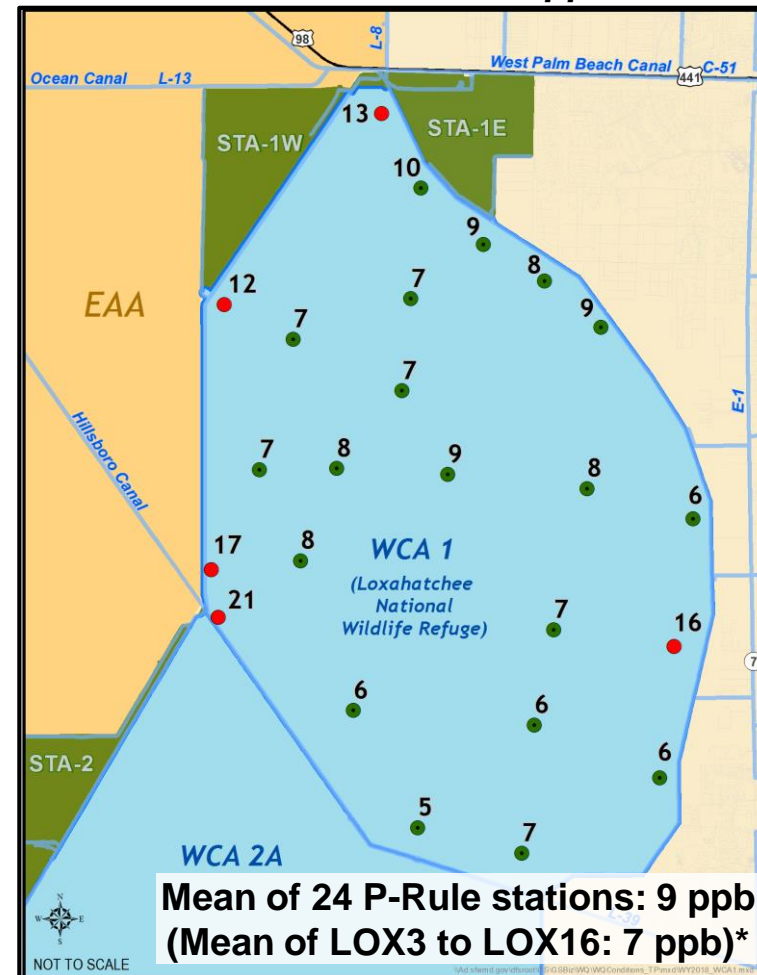
**WY2014-2018**

79% of stations  $\leq 10$  ppb



**WY2018**

79% of stations  $\leq 10$  ppb



**Historic WY1979-83**

6% of stations  $\leq 10$  ppb  
Mean of 16 stations: 25 ppb

**Water Year 2018**

19 Unimpacted stations

(originally 16)

- All 4 parts of compliance test met
- Average geometric mean 7 ppb

5 Impacted stations

(originally 8)

- 2 stations met individual test
- Average geometric mean 16 ppb

- TP values represent the average of annual geometric means at each station
- ppb – parts per billion

WY site transitioned from Impacted to Unimpacted

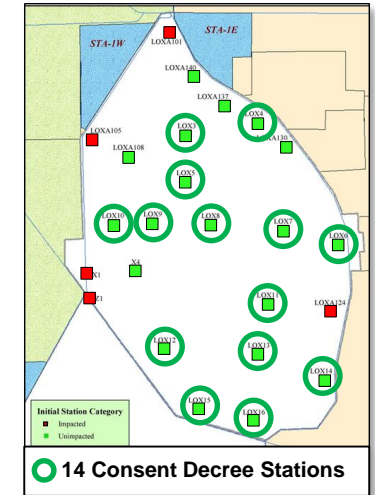
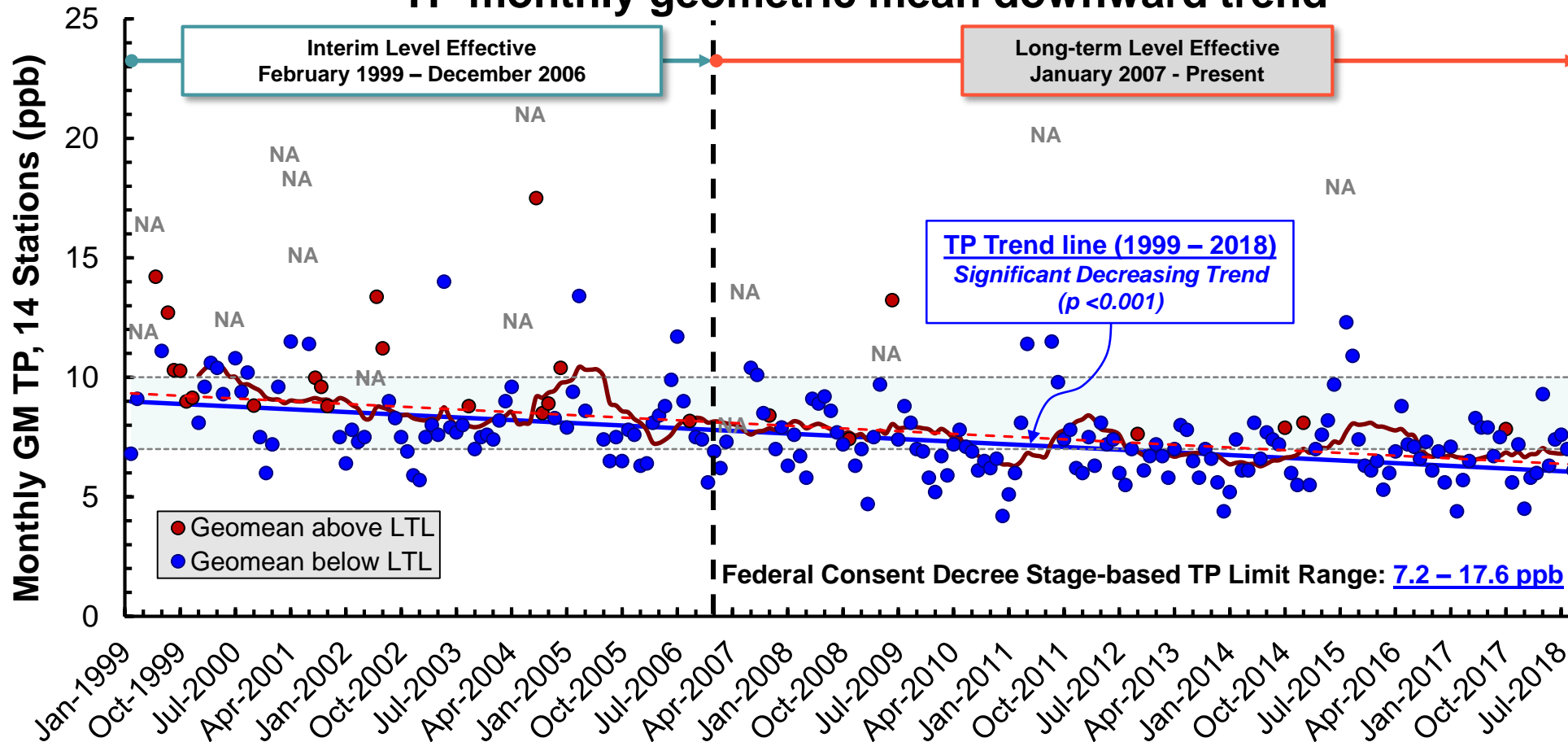
**State Phosphorus Rule**

\* Federal Consent Decree Appendix B

WY2018 Extraordinarily Wet Year

# Water Conservation Area 1 (Refuge) Marsh Phosphorus Improvement

## 14-station Refuge marsh network TP monthly geometric mean downward trend



1999 (Feb-Dec)  
geometric mean  
> 10 ppb



2018 (Jan-Sep)  
geometric mean  
< 7 ppb

NA = Stage < 15.42 ft

Includes Provisional Data July-September 2018

**Federal Consent Decree, Appendix B**

# Water Conservation Area 1 (Refuge)

## Marsh Phosphorus Improvement

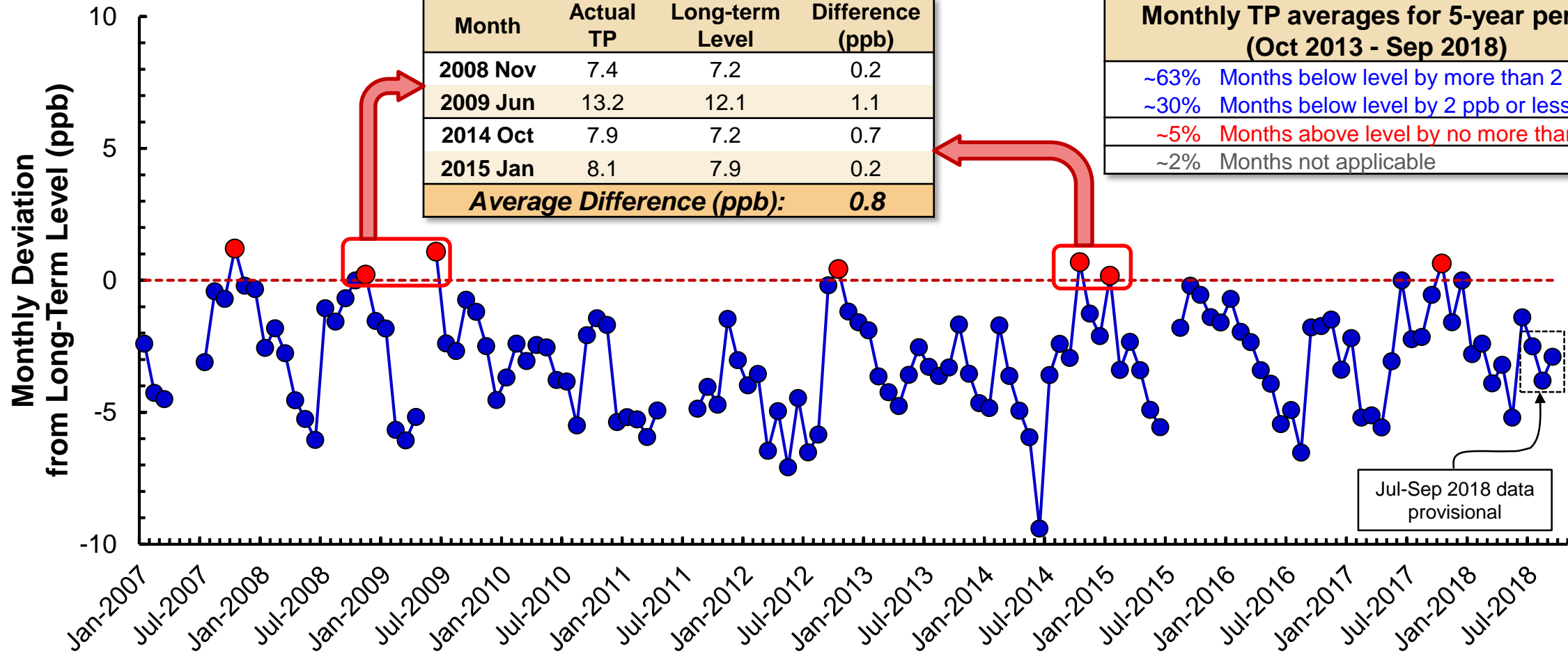
DRAFT

### Exceedance\* Event TP Differences

Month	Actual TP	Long-term Level	Difference (ppb)
2008 Nov	7.4	7.2	0.2
2009 Jun	13.2	12.1	1.1
2014 Oct	7.9	7.2	0.7
2015 Jan	8.1	7.9	0.2
<b>Average Difference (ppb):</b>			<b>0.8</b>

### Monthly TP averages for 5-year period (Oct 2013 - Sep 2018)

~63%	Months below level by more than 2 ppb
~30%	Months below level by 2 ppb or less
~5%	Months above level by no more than 1.1 ppb
~2%	Months not applicable



\*Note: Two monthly Excursions in 12-month period result in an Exceedance of long-term compliance level.

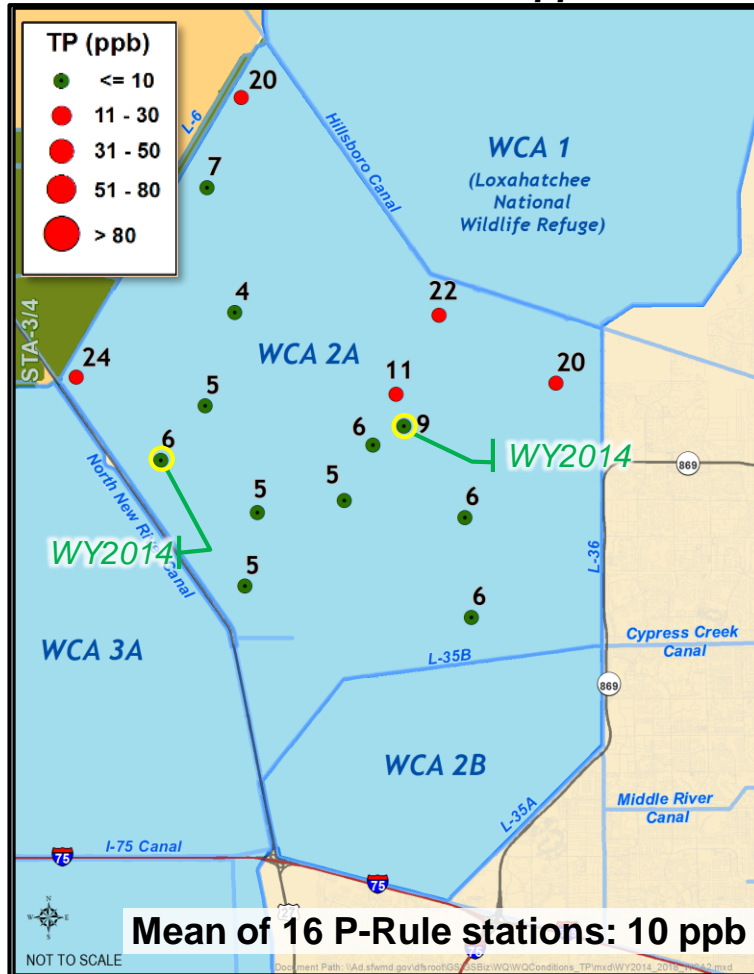
Federal Consent Decree, Appendix B



# Water Conservation Area 2 Marsh Phosphorus Improvement

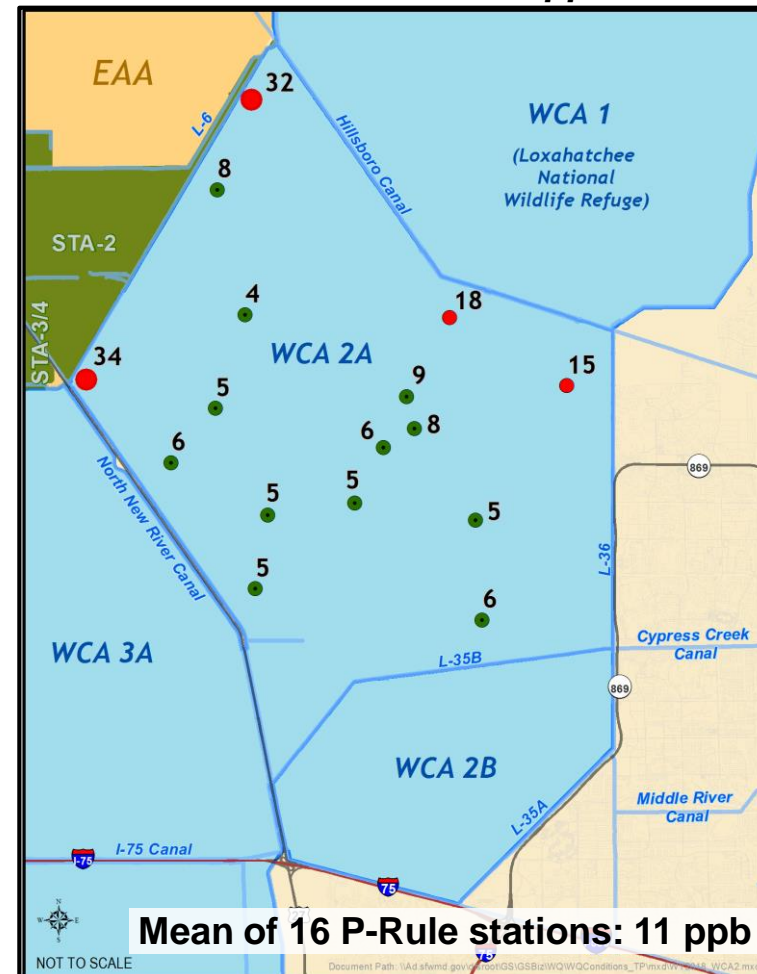
**WY2014-2018**

69% of stations  $\leq 10$  ppb



**WY2018**

75% of stations  $\leq 10$  ppb



**Historic WY1979-83**

29% of stations  $\leq 10$  ppb  
Mean of 21 stations: 33 ppb

**Water Year 2018**

11 Unimpacted stations

(originally 9)

- All 4 parts of compliance test met
- Average geometric mean 6 ppb

5 Impacted stations

(originally 7)

- 1 station met individual test
- Average geometric mean 22 ppb

- TP values represent the average of annual geometric means at each station
- ppb – parts per billion

WY site transitioned from Impacted to Unimpacted

**State Phosphorus Rule**

WY2018 Extraordinarily Wet Year

DRAFT<sup>22</sup>

**89% of stations  $\leq 10$  ppb**



**83% of stations  $\leq 10$  ppb**



WY2018 Extraordinarily Wet Year

55% of stations  $\leq 10$  ppb  
Mean of 21 stations: 15 ppb

### 15 Unimpacted stations

- All 4 parts of compliance test met
- Average geometric mean 5 ppb

(originally 5)

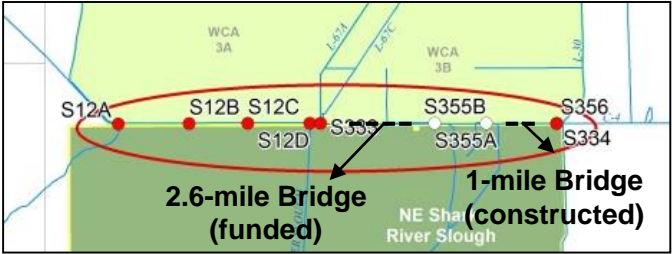
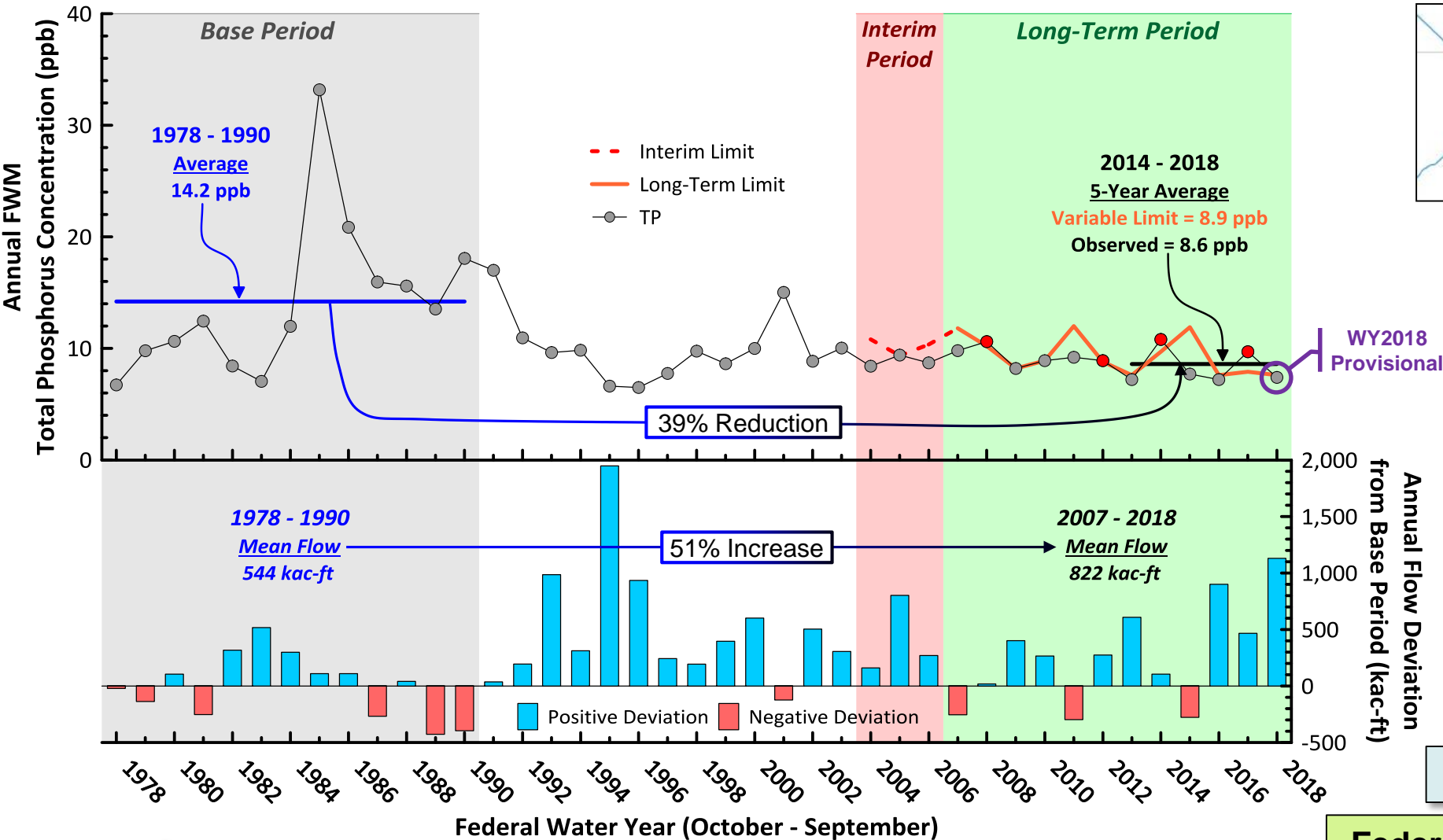
- Average geometric mean 17 ppb

- TP values represent the average of annual geometric means at each station
- *ppb* – parts per billion

 *WY site transitioned from Impacted to Unimpacted*

## State Phosphorus Rule

# Everglades National Park - Shark River Slough Inflow Phosphorus Improvement



## Exceedance Event TP Differences (ppb)

	Actual	Long-term Limit	Difference
2008	10.6	10.2	0.4
2012	8.9	8.8	0.1
2014	10.8	9.7	1.1
2017	9.7	7.9	1.8
Average Difference			0.9

FWM – flow weighted mean  
Note: The laboratory margin of error is ± 2 ppb

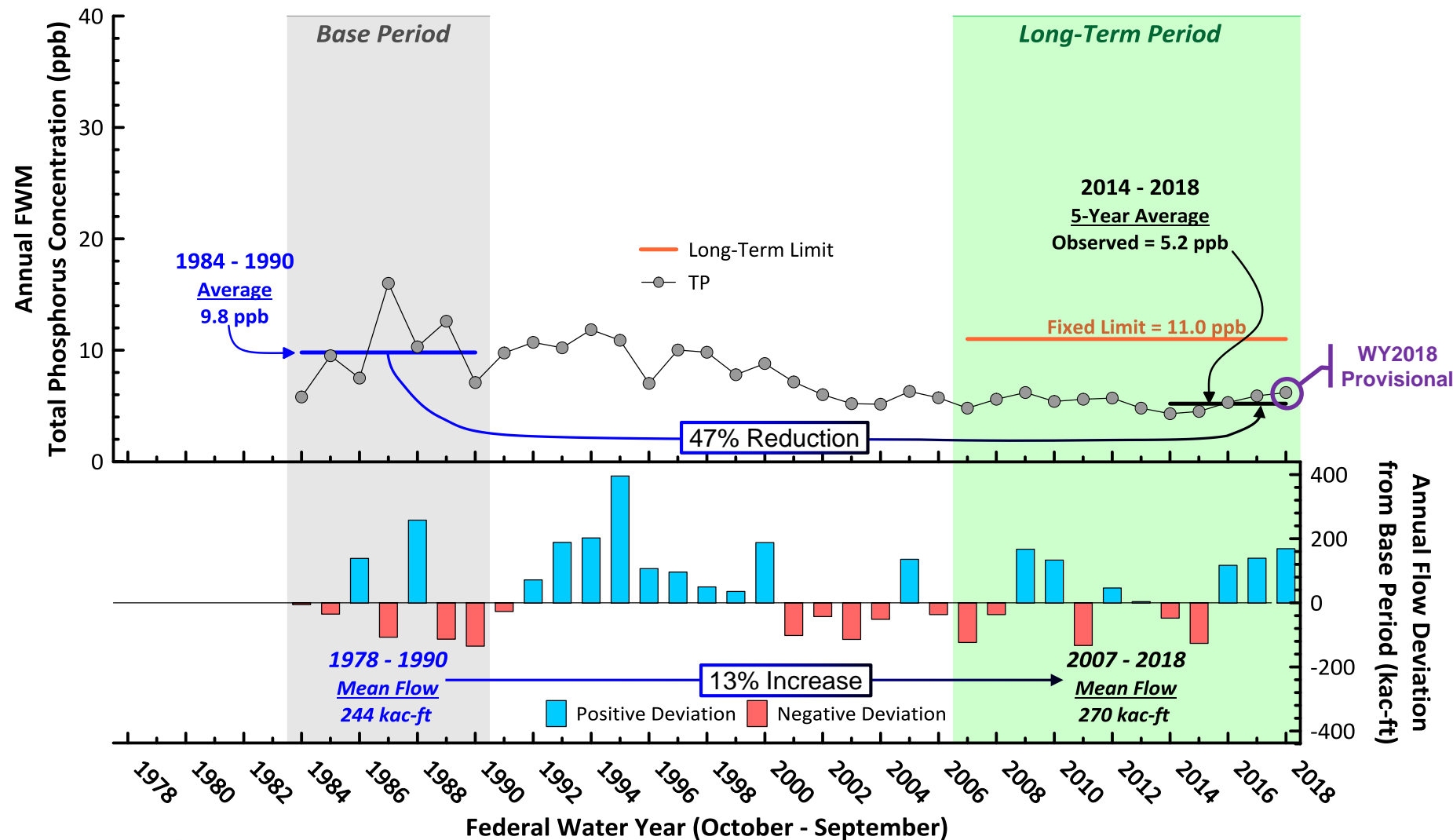
State Phosphorus Rule

Federal Consent Decree, Appendix A



# ENP – Taylor Slough and Coastal Basins

## Inflow Phosphorus Improvement



### Compliance Inflow Sites

- Current:
  - S332D
  - S18C
- Additional Under Consideration:
  - S737
  - G328



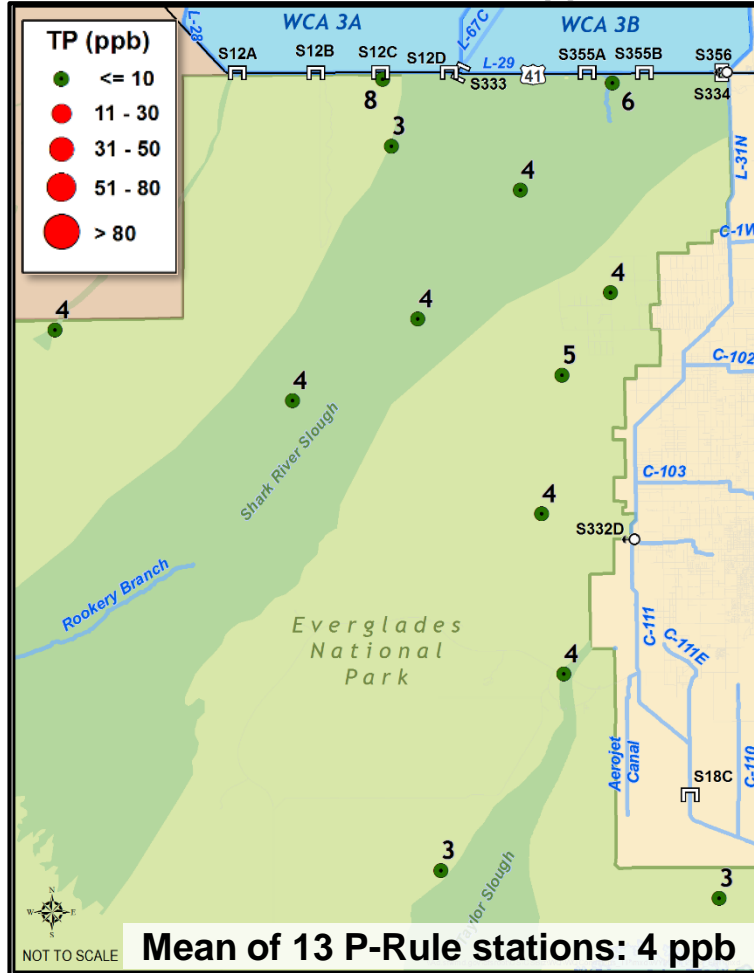
ENP – Everglades National Park  
 FWM – flow-weighted mean

**Federal Consent Decree,  
 Appendix A**

# Everglades National Park Marsh Phosphorus Improvement

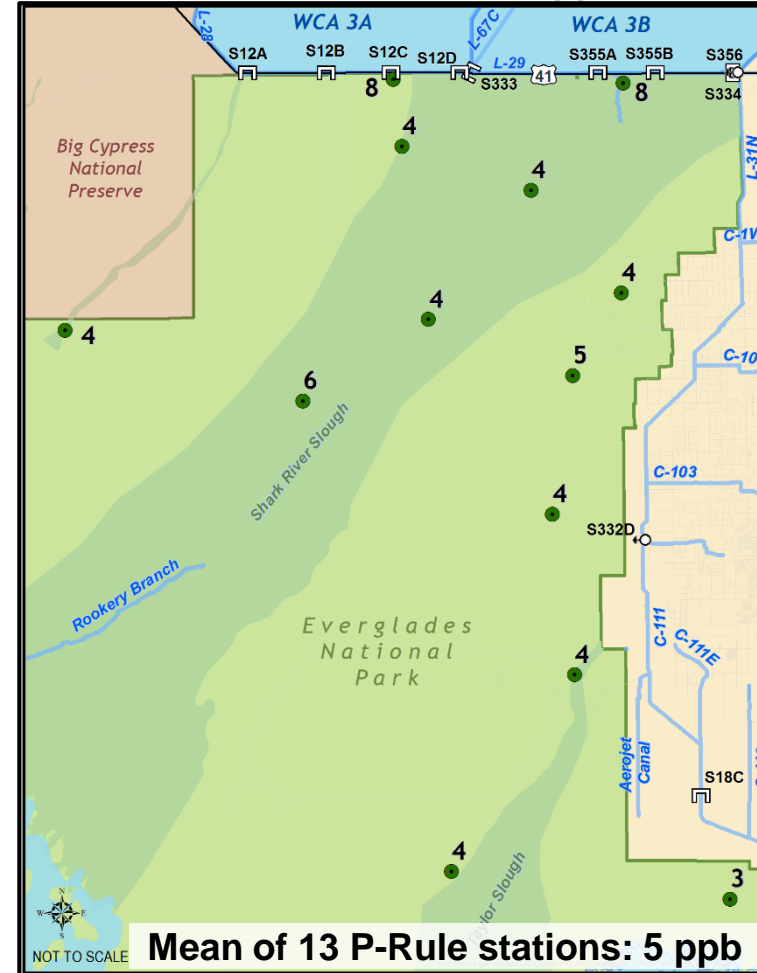
**WY2014-2018**

**100% of stations ≤ 10 ppb**



**WY2018**

**100% of stations ≤ 10 ppb**



**Historic WY1986-90**

86% of stations ≤ 10 ppb

Mean of 7 stations: 7 ppb

**Water Year 2018**

13 Unimpacted stations

(originally 13)

- All 4 parts of compliance test met
- Average geometric mean 5 ppb

No impacted stations

- TP values represent the average of annual geometric means at each station
- ppb – parts per billion

 WY site transitioned from Impacted to Unimpacted

**State Phosphorus Rule  
Default Monitoring  
Network**

WY2018 Extraordinarily Wet Year

# Information Sources



- Annual Report published March 1 each year
  - Florida Department of Environmental Protection
  - South Florida Water Management District
- 2019 Report Details a Year of Accomplishments in Restoration, Science and Engineering for Water Year 2018 (May 1, 2017 – April 30, 2018)
  - Hydrology & Water Management (Volume I – Chapter 2)
  - Southern Everglades (Volume I – Chapters 3A, 3B, 4, 5A, 5B, 5C & 6)
- Draft 2019 Volume 1 available at [www.sfwmd.gov/SFER](http://www.sfwmd.gov/SFER)
- Everglades Technical Oversight Committee [www.sfwmd.gov/TOC](http://www.sfwmd.gov/TOC)
- WRAC November 2017 Presentation [www.sfwmd.gov/WRAC](http://www.sfwmd.gov/WRAC) (Item #7)



# QUESTIONS