WELCOME

Robert Shuford
Lead Scientist
Ecosystem Restoration

21st Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins

February 26, 2024

AGENDA

1. Welcome and Introduction Robert Shuford, Ecosystem Restoration Bureau	**9:00**
2. System Conditions Robert Shuford, Ecosystem Restoration Bureau	**9:05**
3. Everglades Stormwater Treatment Areas (STA) Performance Update Jake Dombrowski, Applied Sciences Bureau	**9:25**
4. STA Vegetation Management and Enhancement Eric Crawford, Land Resources Bureau	**9:45**
5. Restoration Strategies: Stormwater Treatment Area (STA) Science Plan Update & Highlights Tom James, Ph.D, Applied Sciences Bureau	**10:05**
6. Restoration Strategies: Design and Construction Update Alexis San-Miguel, Engineering and Construction Bureau	**10:25**
7. Southern Everglades Nutrient Source Control Program Update Youchoa Wang, Ph.D, P.E, Everglades and Estuaries Protection Programs Bureau	**10:45**
8. Public Use on SFWMD Stormwater Treatment Areas Dan Cotter, Land Resources Bureau	**11:05**
9. Public Comment	**11:25**

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

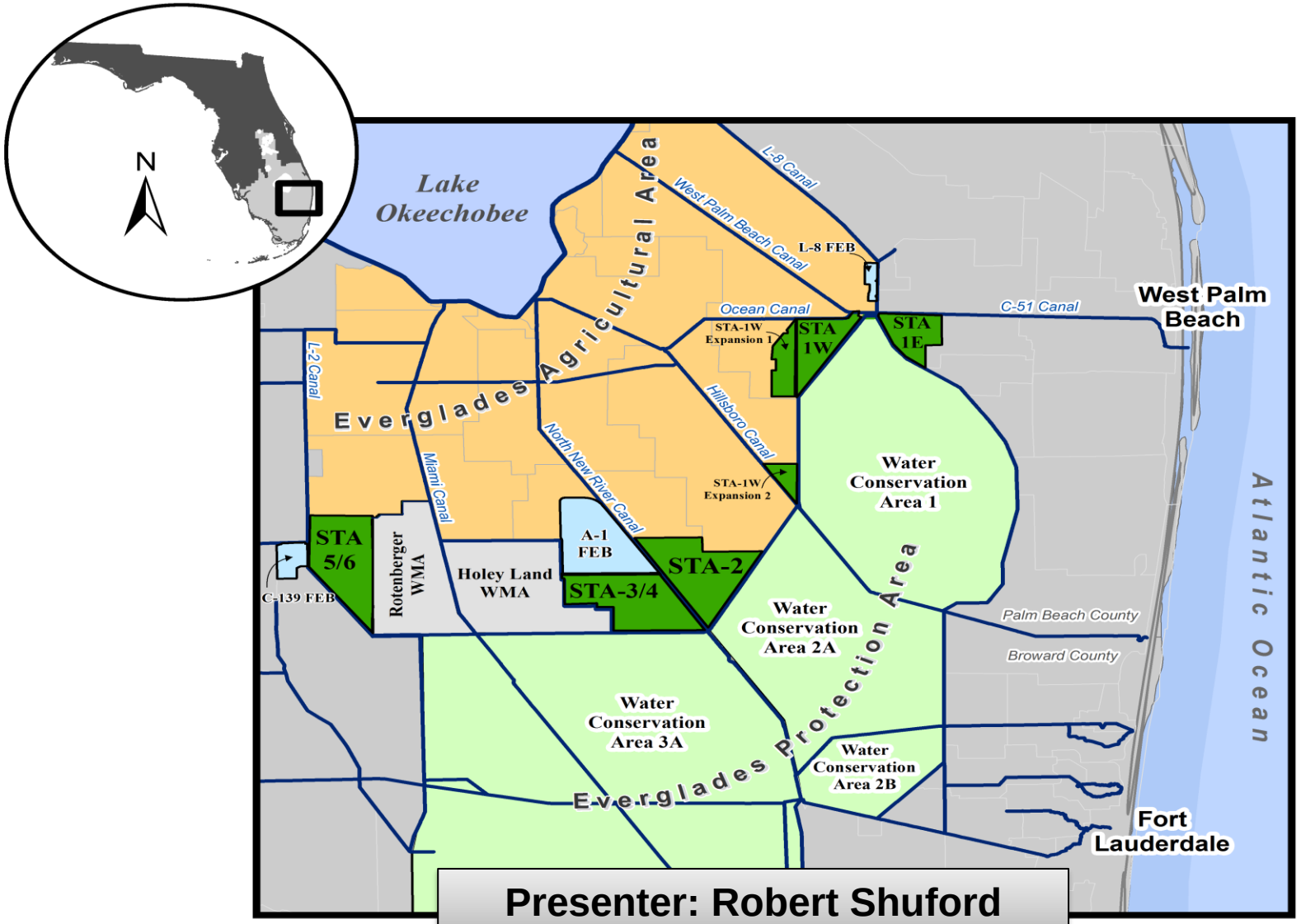
SYSTEM CONDITIONS

Robert Shuford
Lead Scientist
Ecosystem Restoration

21st Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins

February 26, 2024

RESTORATION STRATEGIES



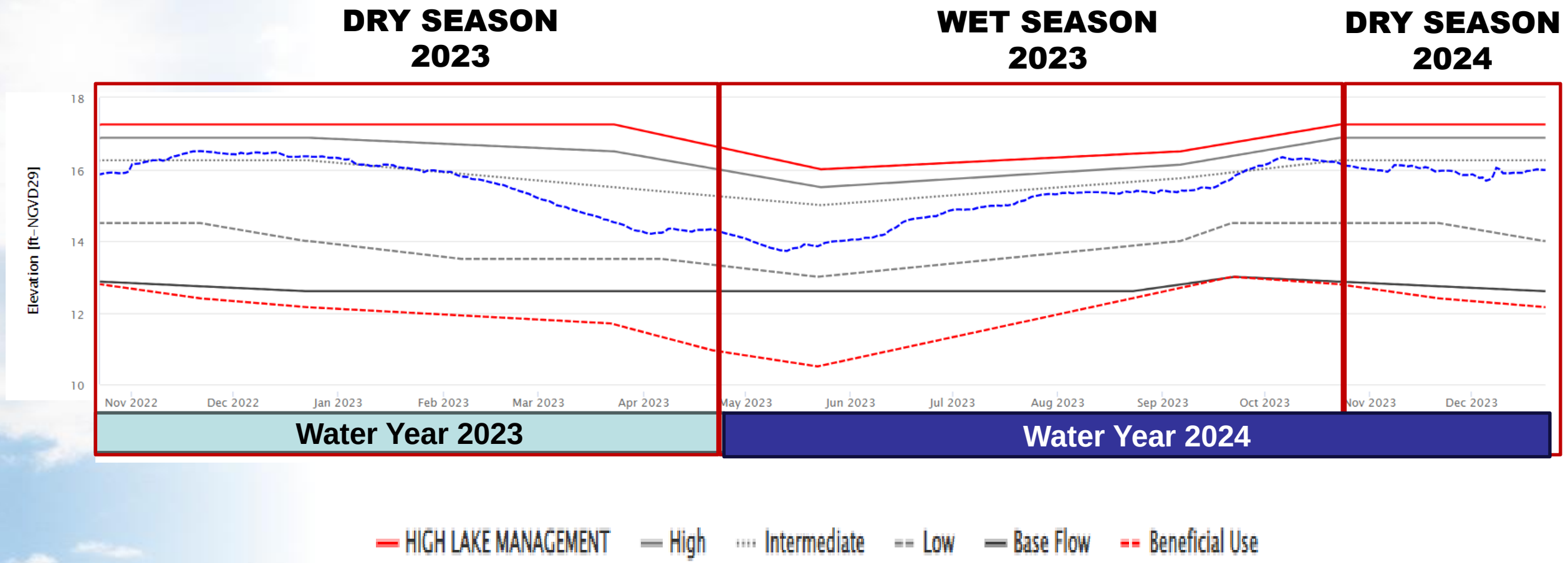
STAs = 62,000 acres
FEBs = 116,000 ac-ft

Presenter: Robert Shuford

WATER YEAR 2024
(May 1, 2023 – April 30, 2024)

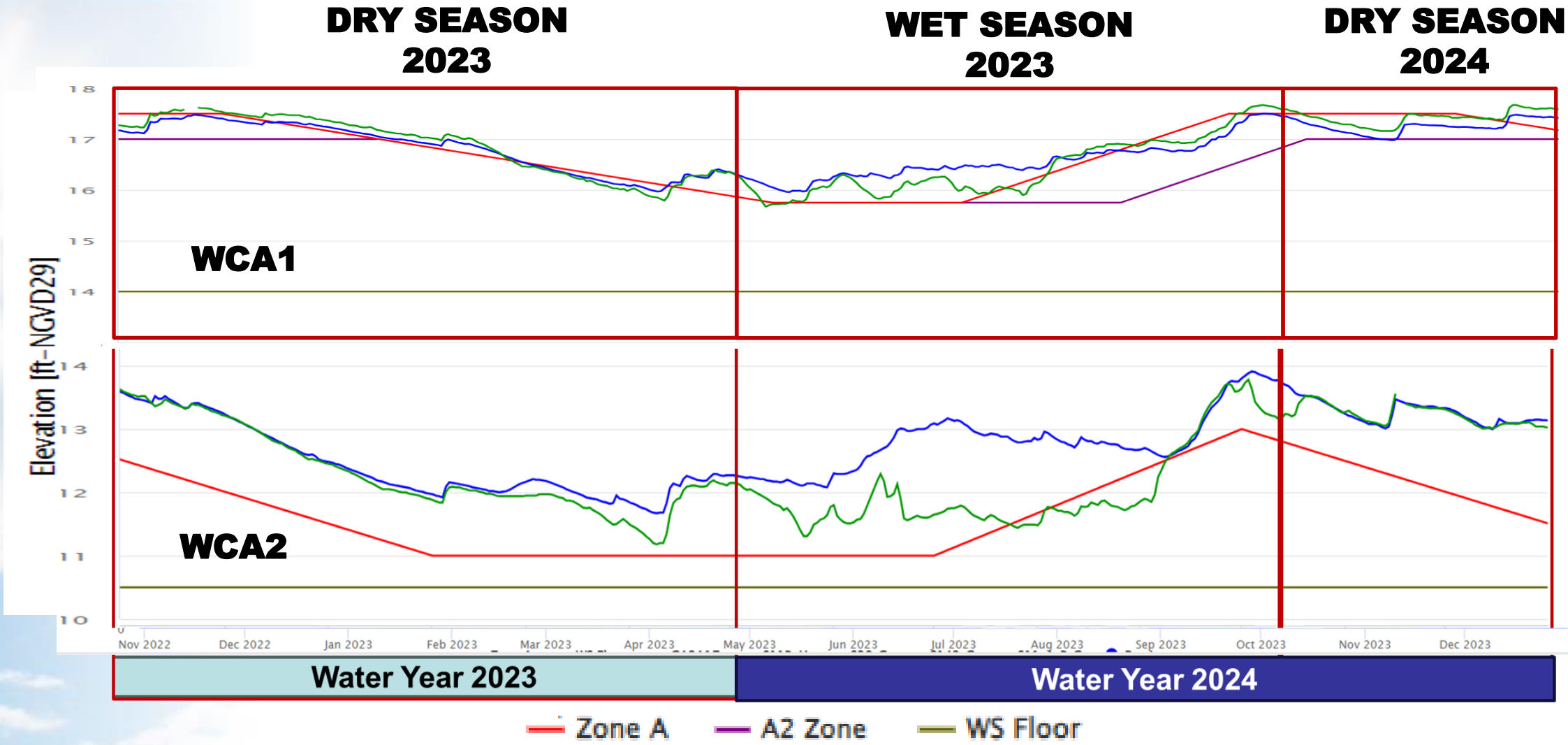
Presenter: Robert Shuford

LAKE OKEECHOBEE



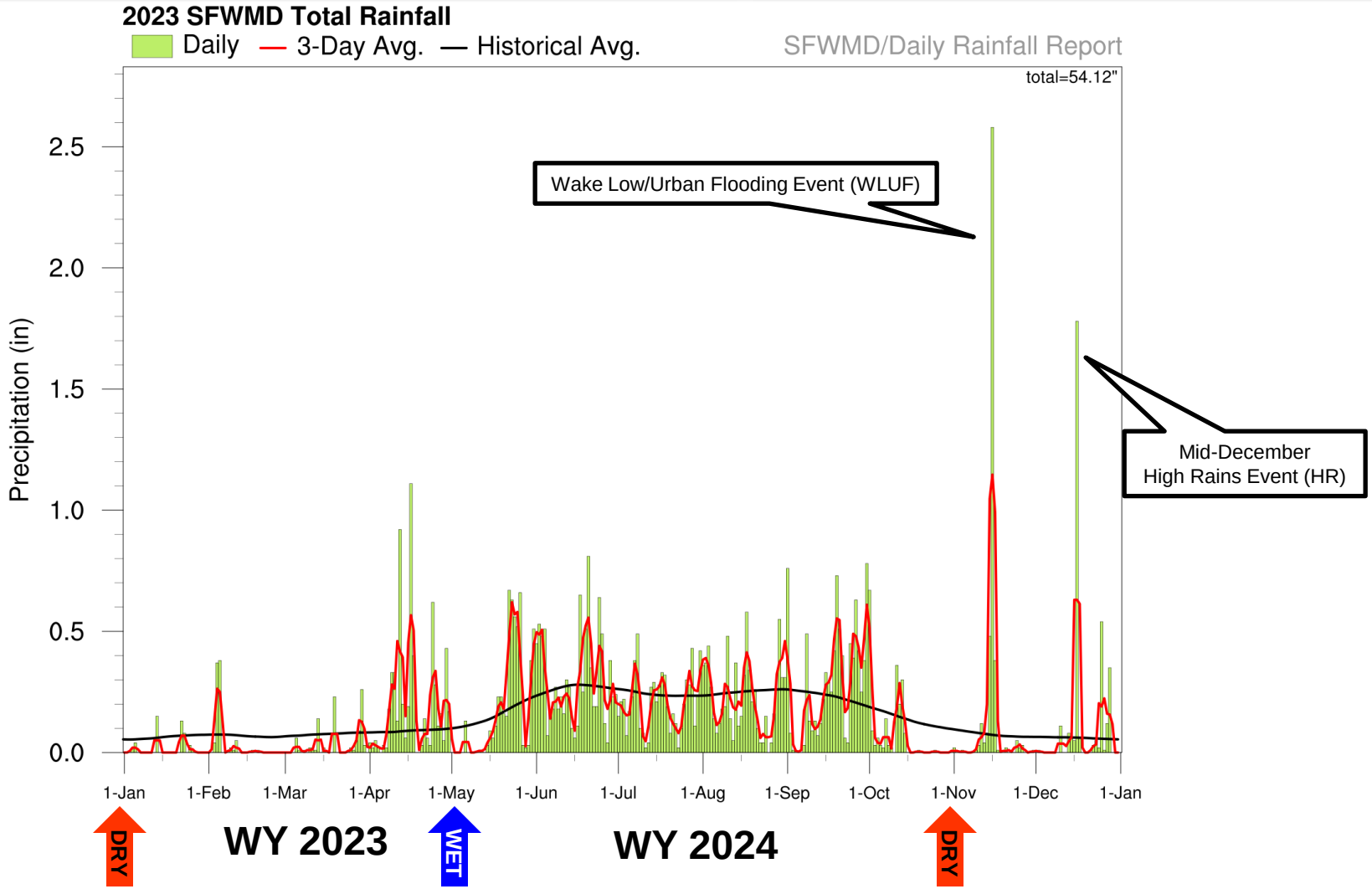
Presenter: Robert Shuford

WCA SCHEDULES



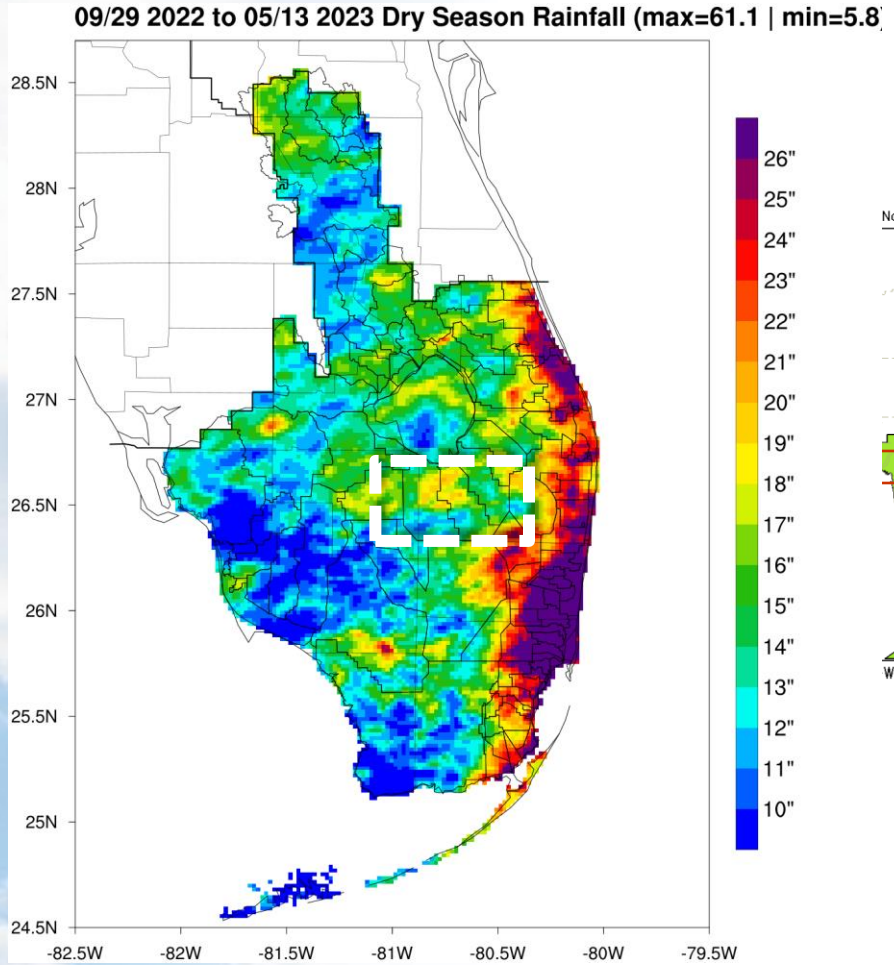
Presenter: Robert Shuford

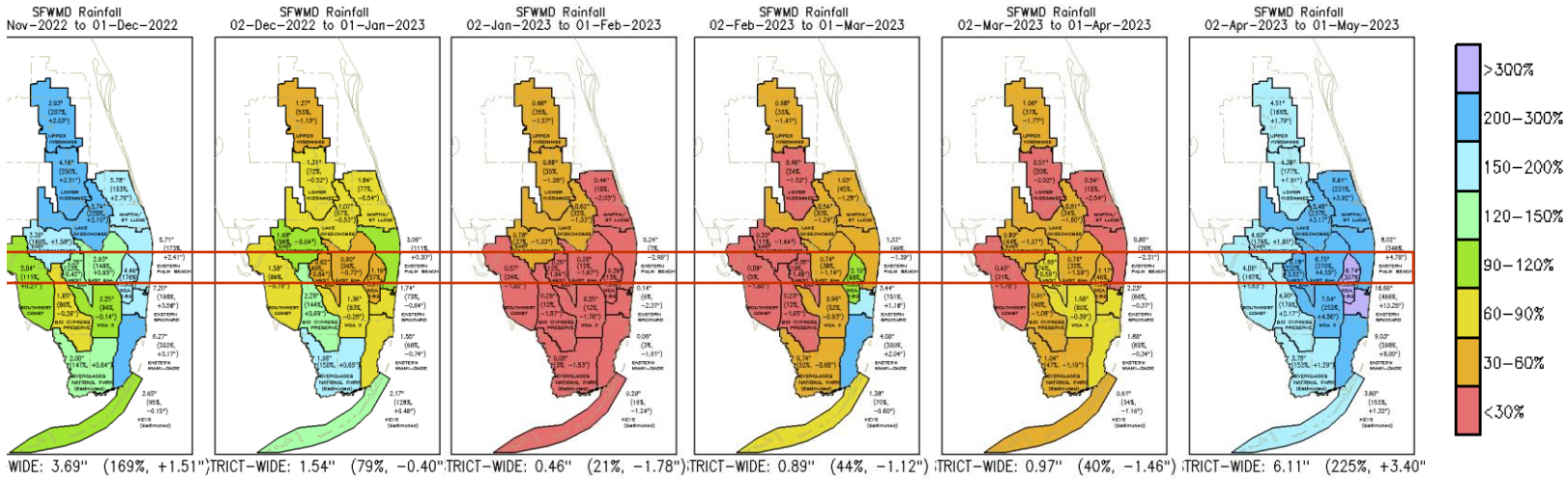
2024 RAIN EVENTS



Presenter: Robert Shuford

DRY SEASON RAINFALL
Water Year 2023

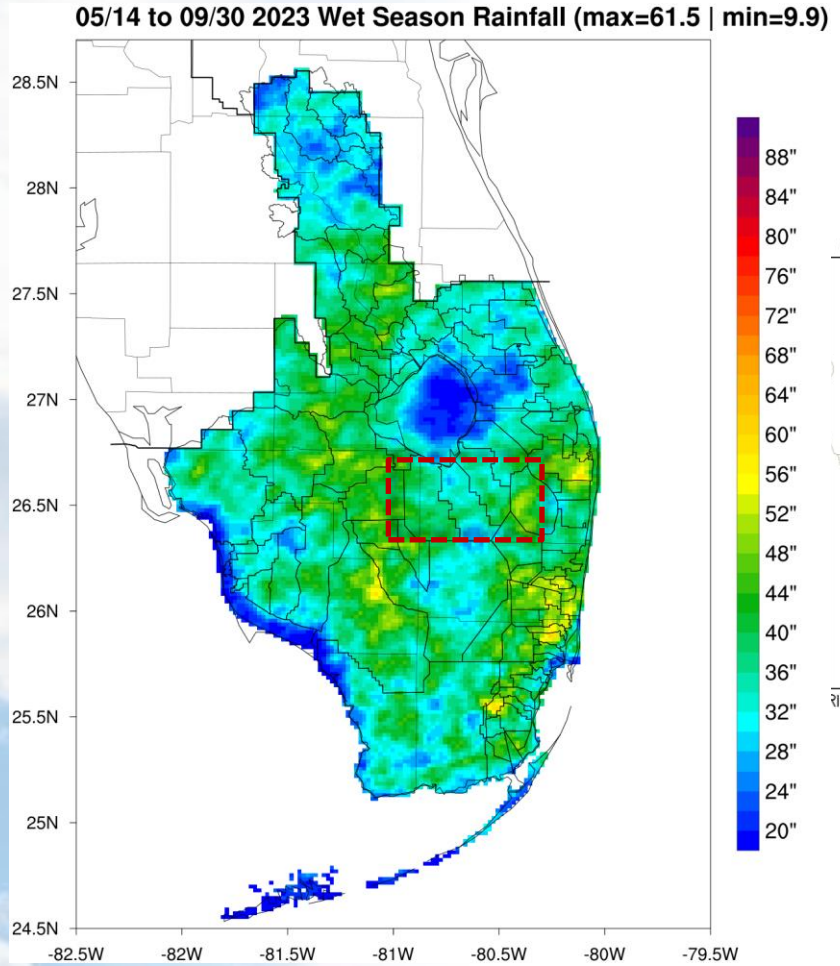


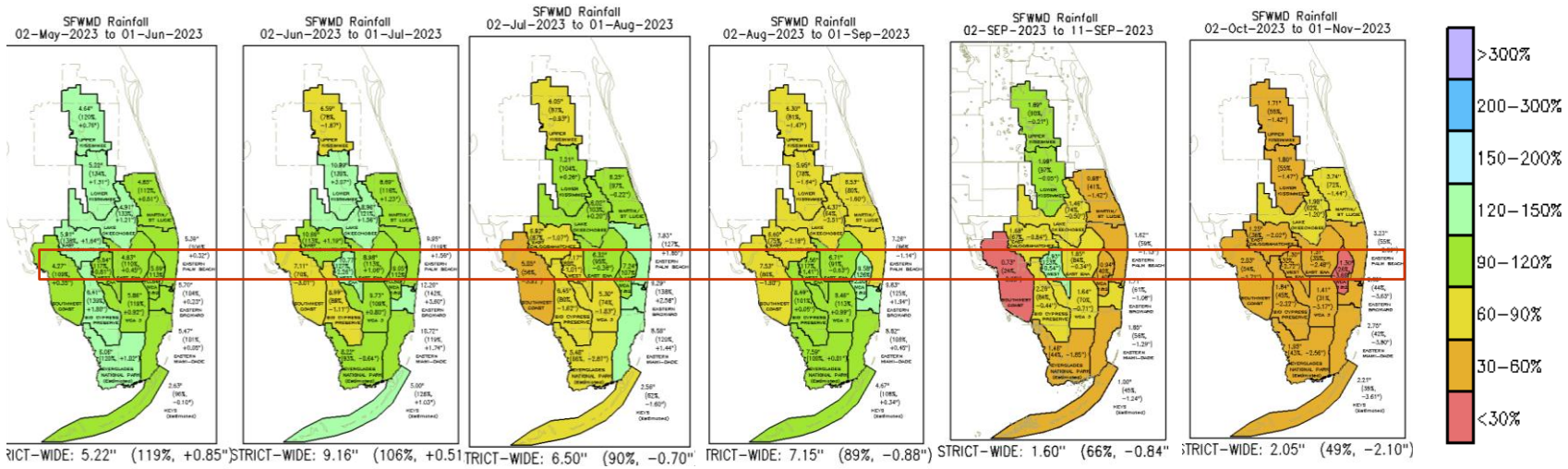


- Nov 2022 and Apr 2023 were wettest months
- Jan – Mar extremely dry (except Dade & Broward)

Presenter: Robert Shuford

WET SEASON RAINFALL
Water Year 2024

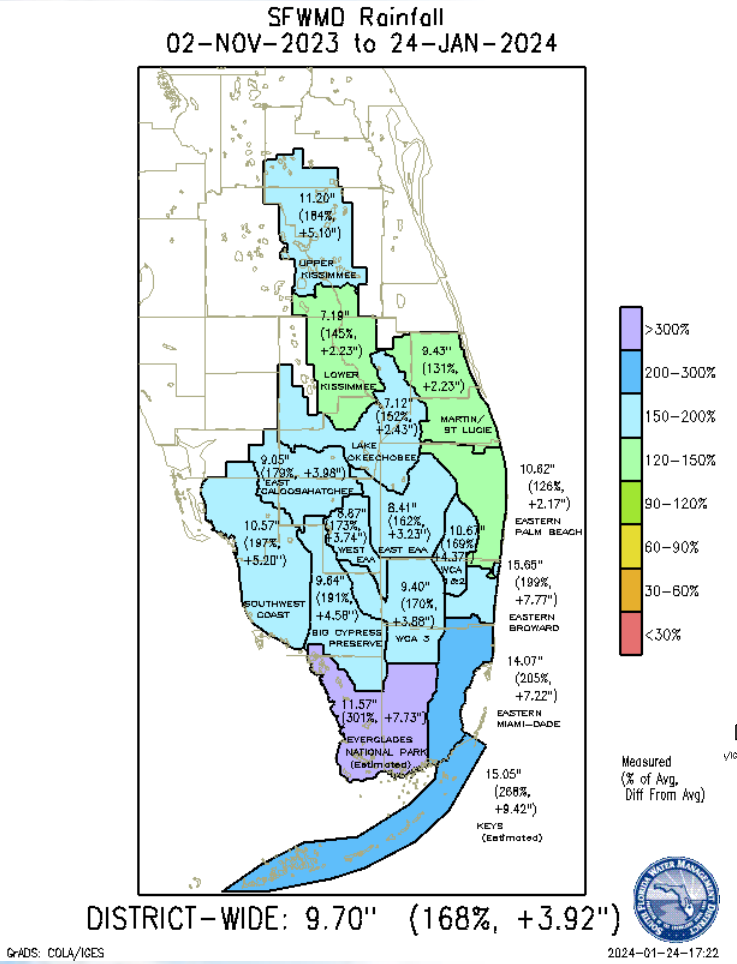


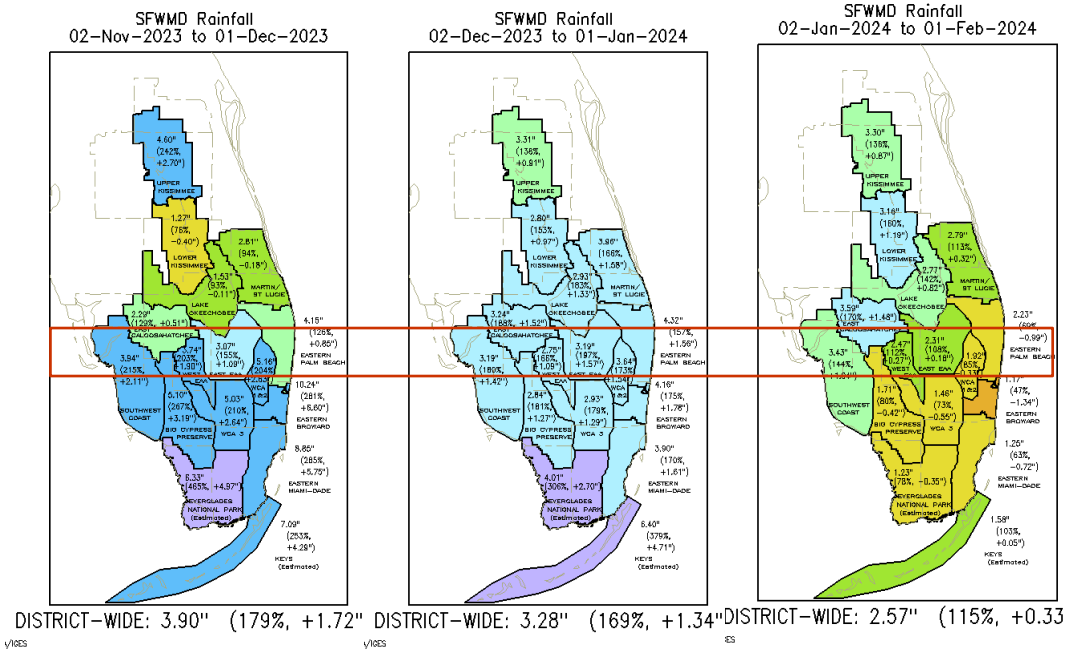


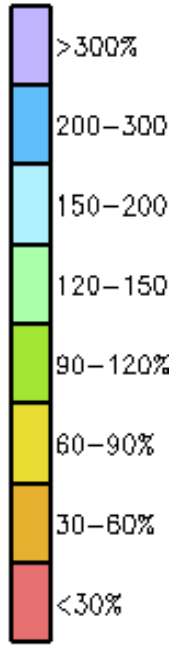
- May – Aug experienced normal conditions
- Sep – Oct increased drying trend

Presenter: Robert Shuford

DRY SEASON RAINFALL
Water Year 2024



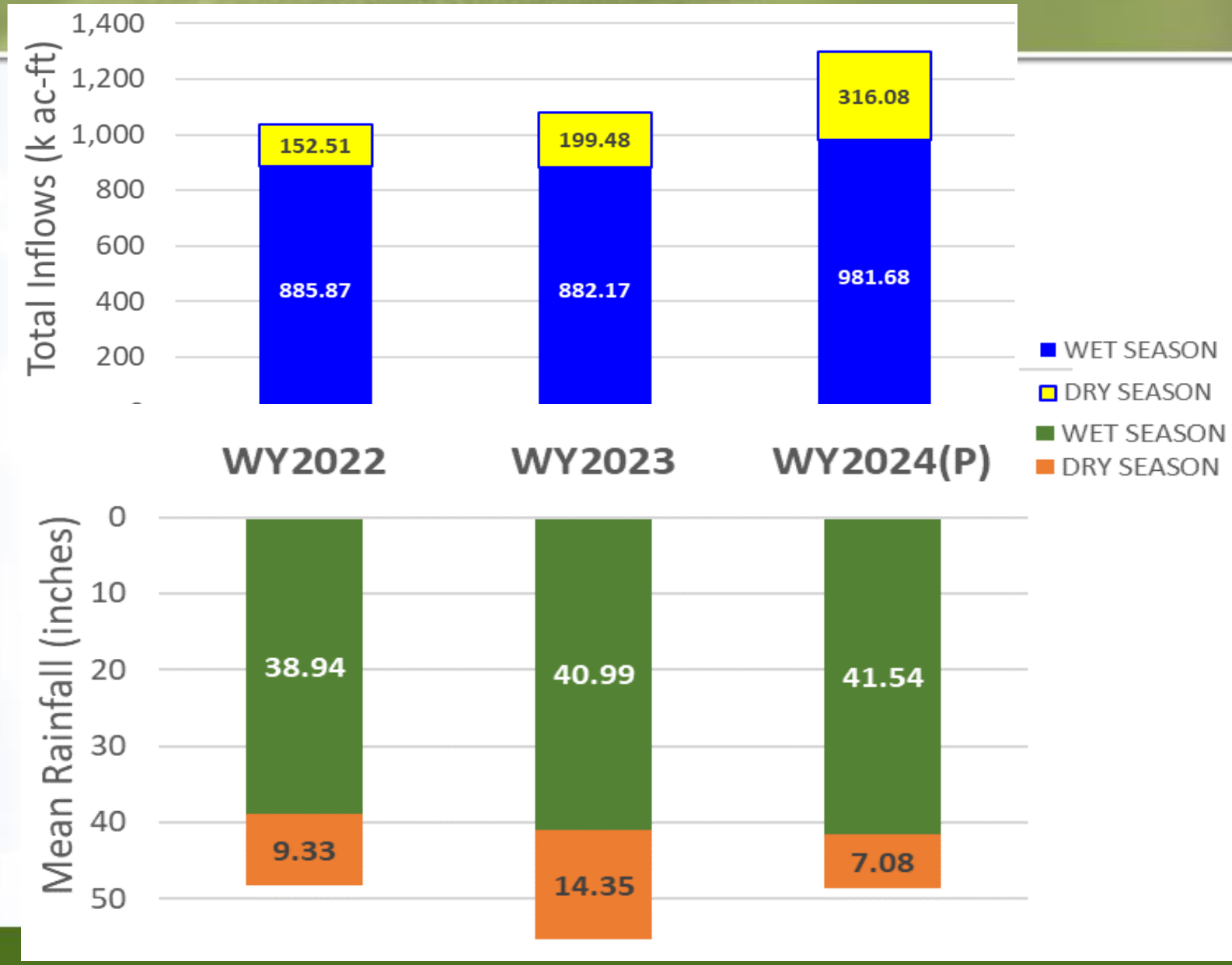




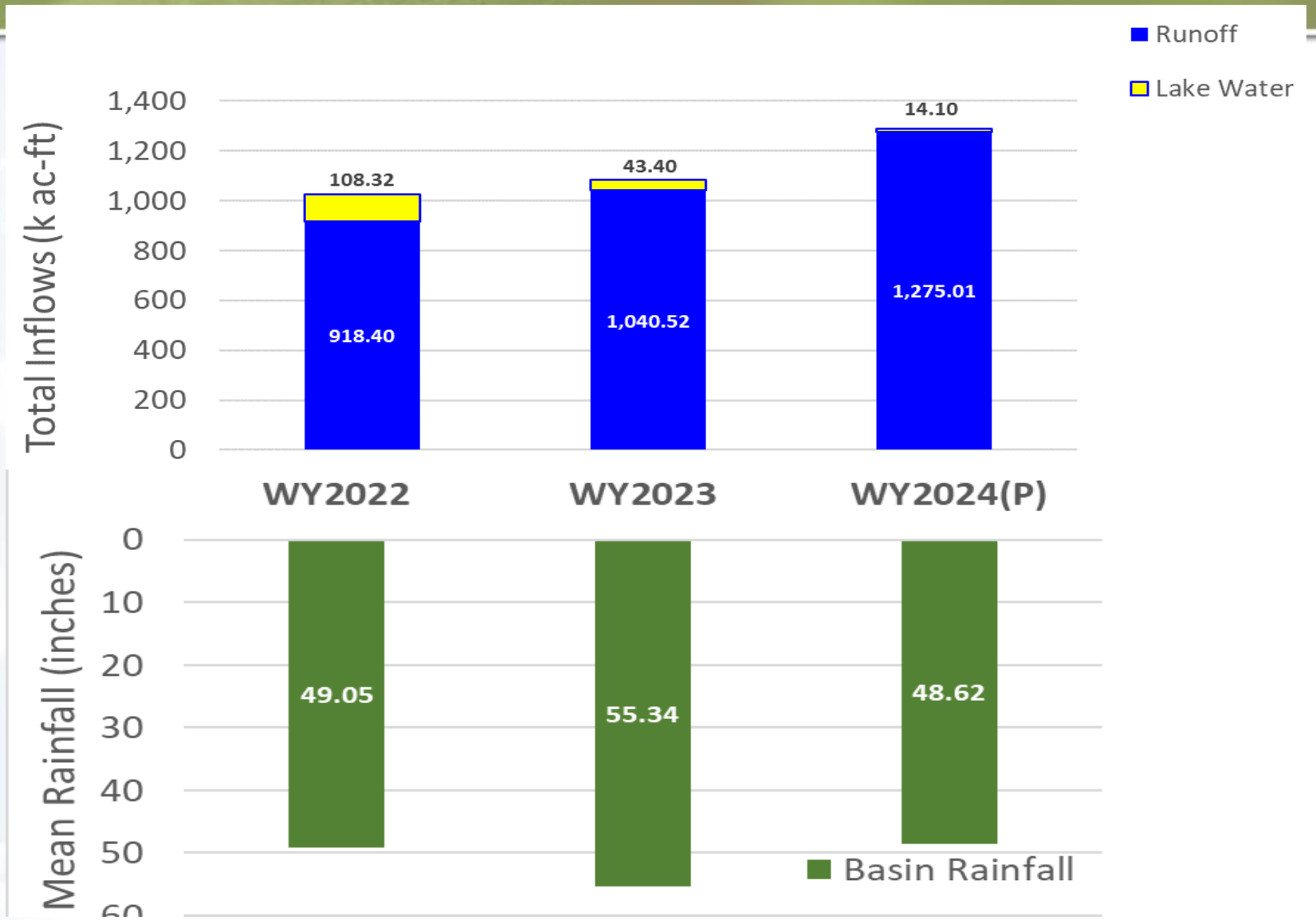
- Above normal Dry Season
- Greatest EAA rains in November

Presenter: Robert Shuford

Seasonal Rainfall and Inflows



Water Year Rainfall and Inflows



CONTACT INFORMATION

rshufor@sfwmd.gov

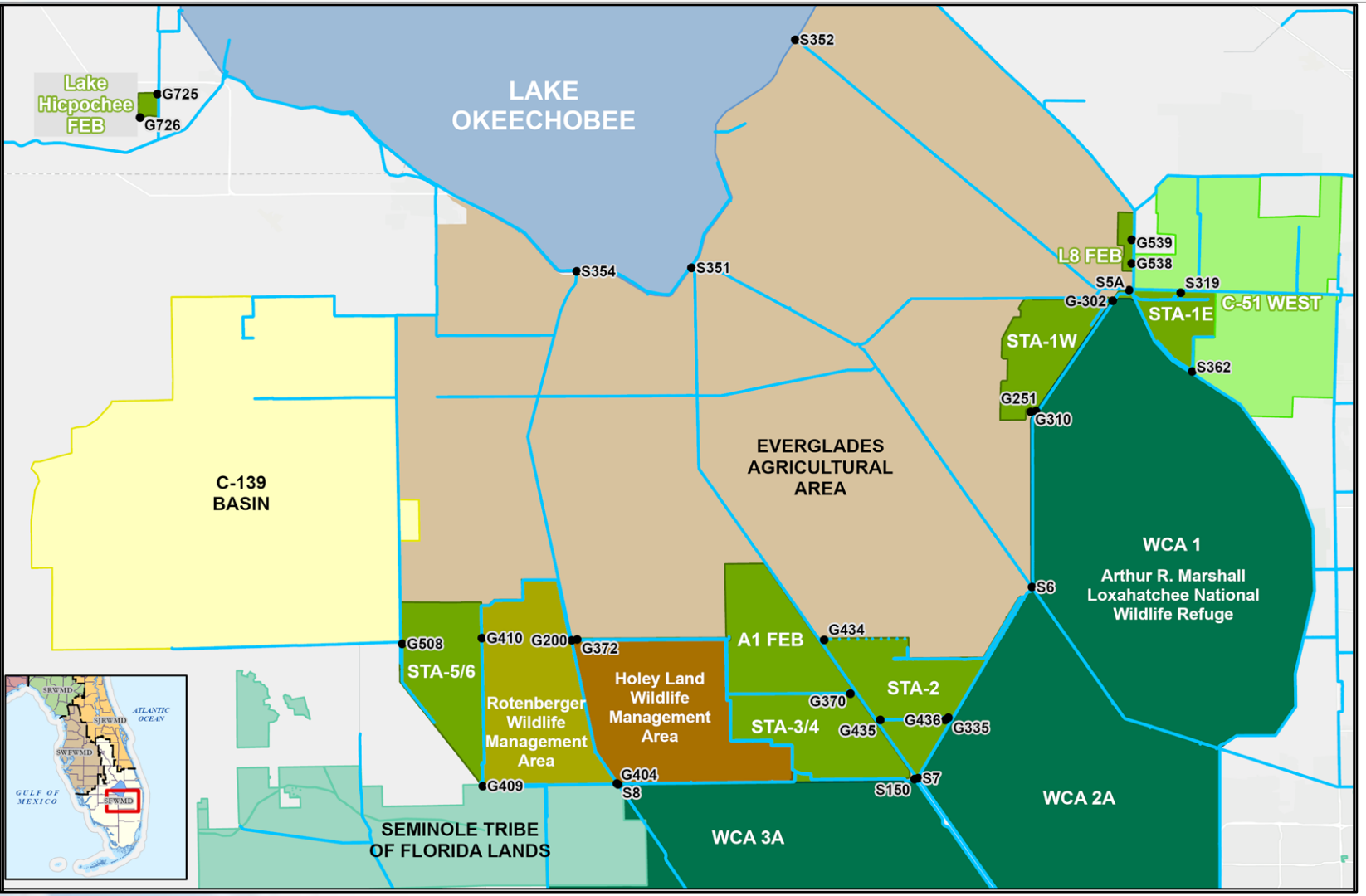
Everglades Stormwater Treatment Areas Performance Update

Jake Dombrowski
Senior Scientist
Applied Sciences

21st Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins

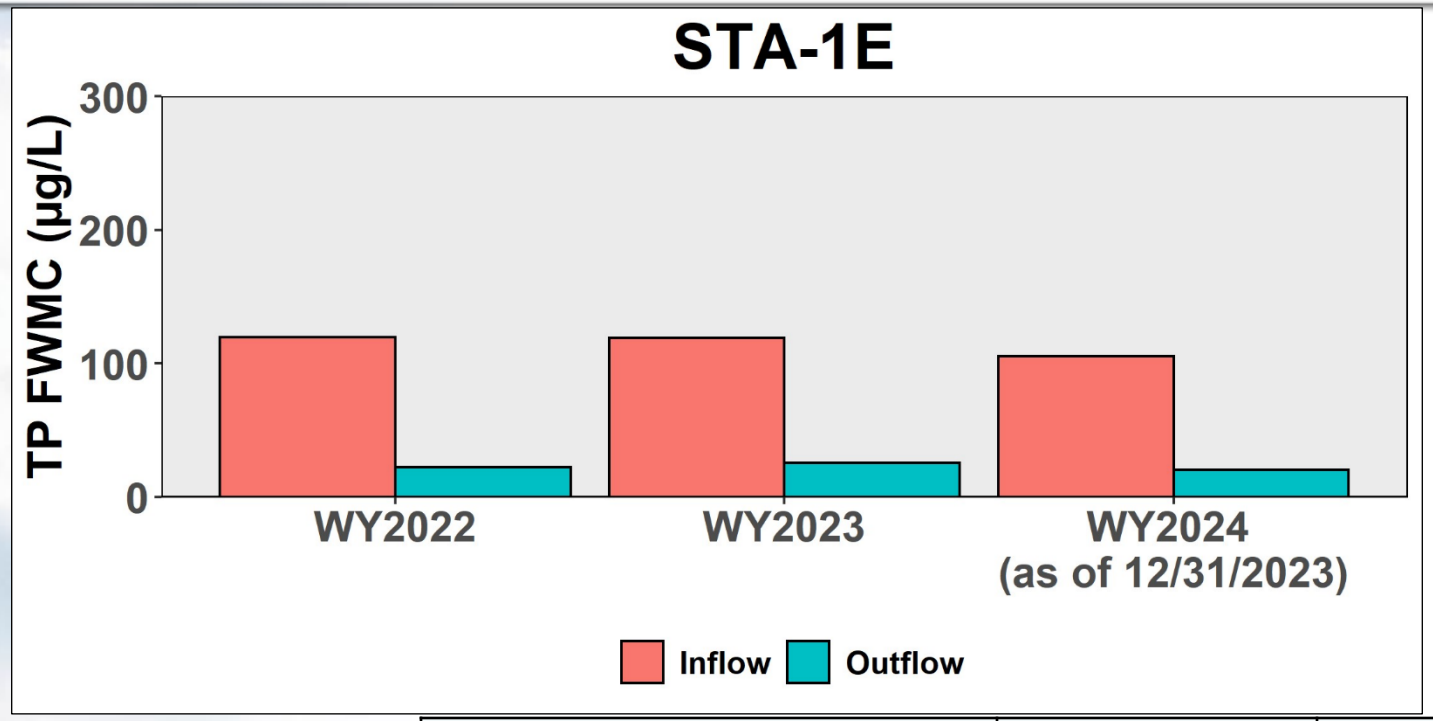
February 26, 2024

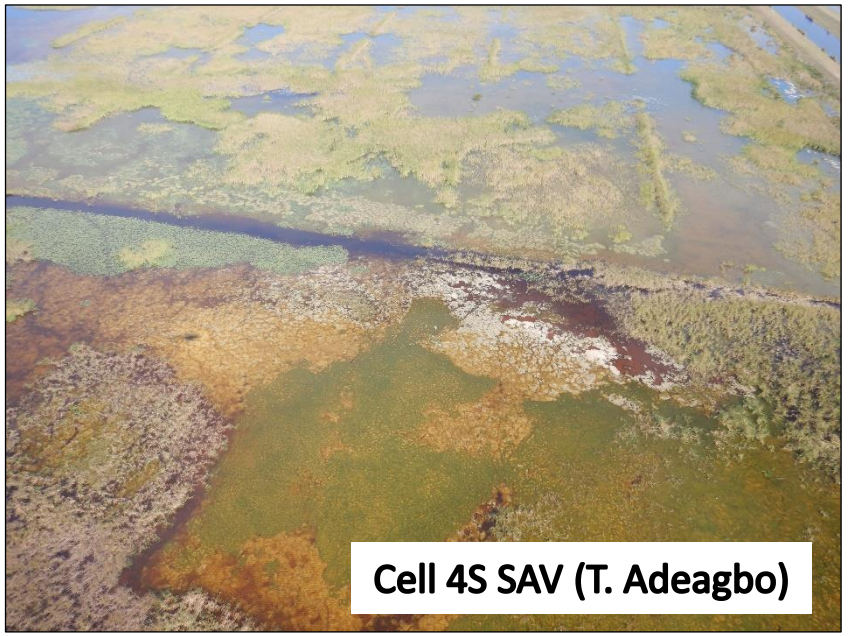
Introduction



- STA Performance
  - Flow volumes
  - TP loads
  - Flow-Weighted Mean Concentration (FWMC)
- Yearly and monthly variation
  - Water Year
- Construction and operational restrictions

STA-1E Performance Comparison by Water Year

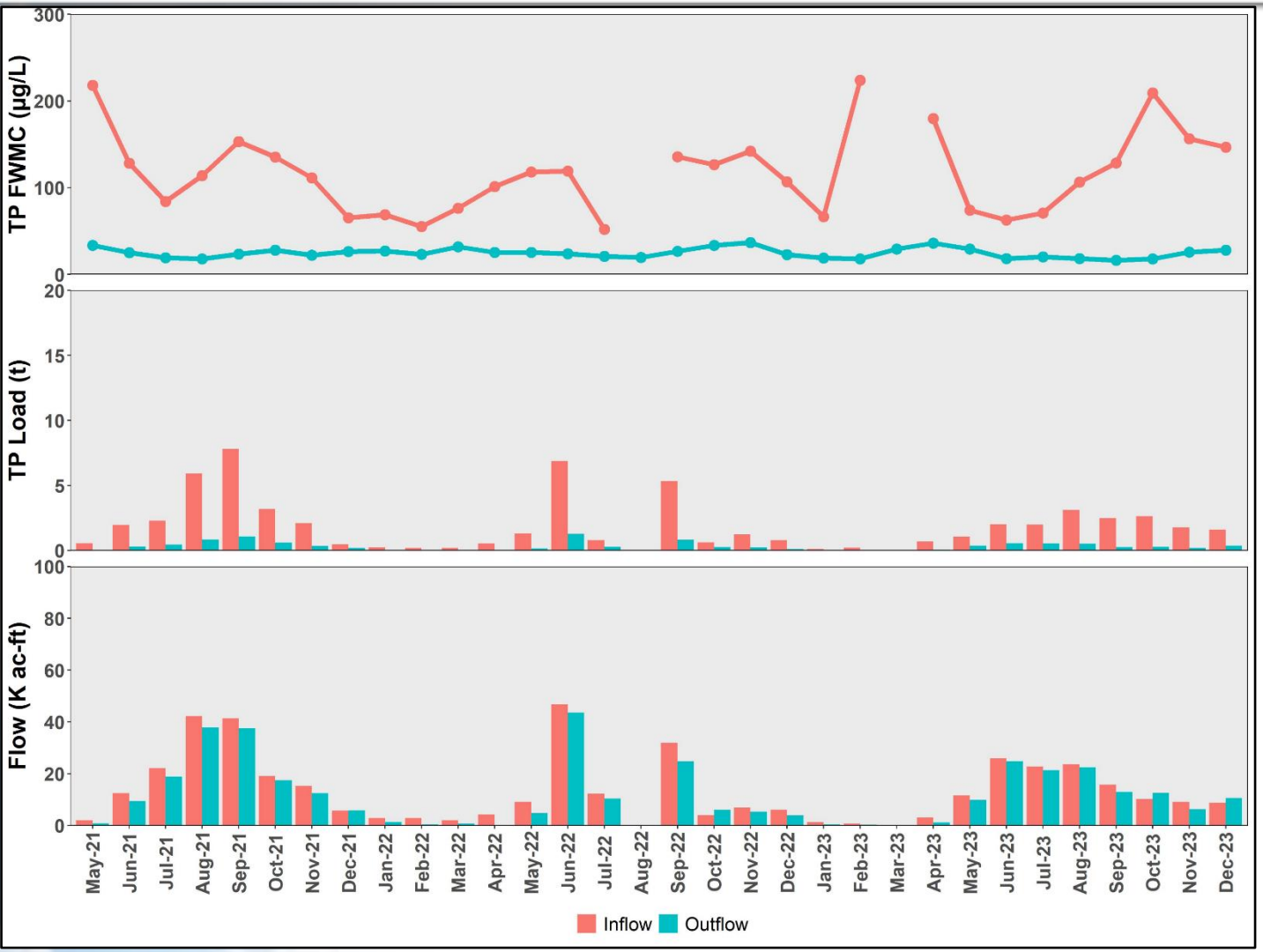




	WY2022	WY2023	Partial WY2024 (05/01/2023 - 12/31/2023)
Total inflow (k acre-feet)	172	122	128
Lake releases (k acre-feet)	4	2	1
TP FWMC inflow / outflow (µg/L)	120 / 22	119 / 26	105 / 20
TP load inflow / outflow (tons)	25 / 4	18 / 3	17 / 3
Reduction in TP FWMC / load	81% / 85%	81% / 82%	81% / 82%

Includes preliminary data

STA-1E Monthly Inflows and Outflows



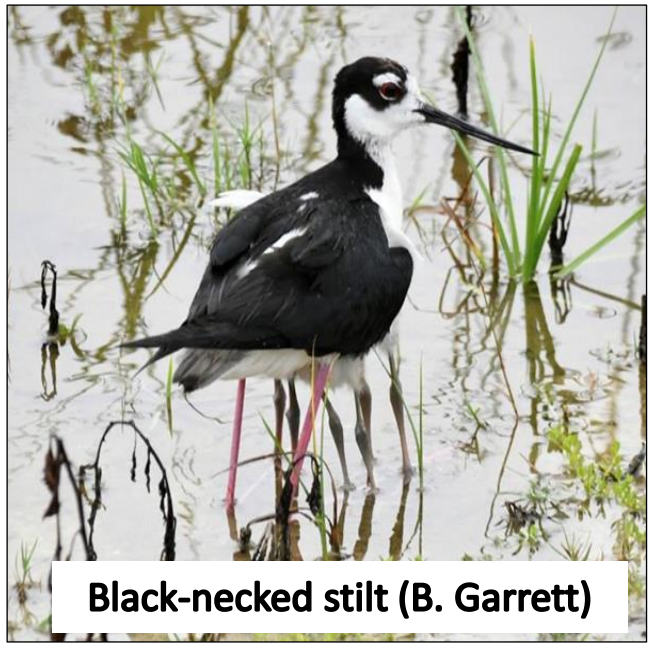
- Lower inflows in WY24 relative to previous years
  - Ongoing post-construction vegetation grow-in
  - STA-1W capturing more inflows than previous years
- Low and stable outflow TP FWMC

Includes preliminary data

STA-1E Operational Restrictions (Jan. 1, 2023 – Dec. 31, 2023)

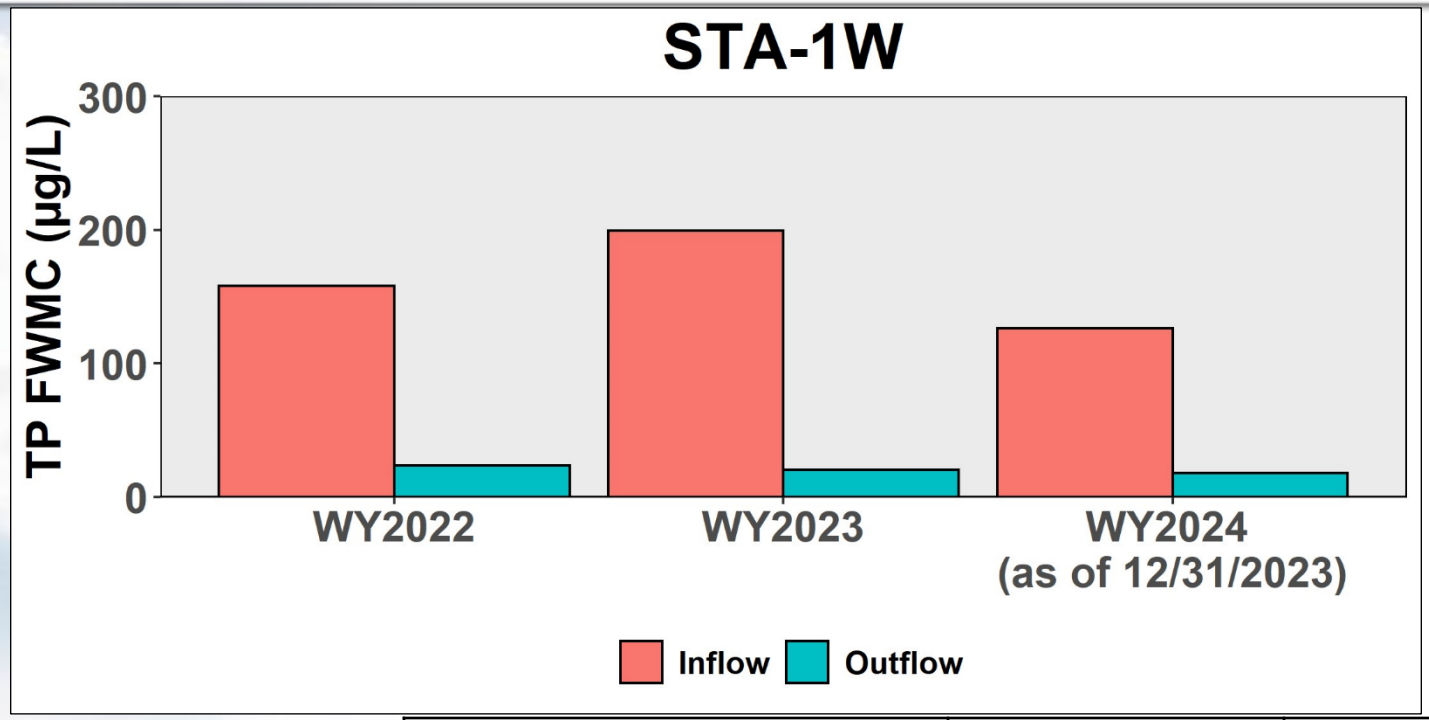
- Western Flow-way offline for post-construction vegetation grow-in
- Periodic restrictions in the Eastern and Central Flow-ways for vegetation management, a Restoration Strategies Science Plan study, and black-necked stilt (BNS) nesting

Cell 7 post-earthwork (N. Ralph)



Black-necked stilt (B. Garrett)

STA-1W Performance Comparison by Water Year

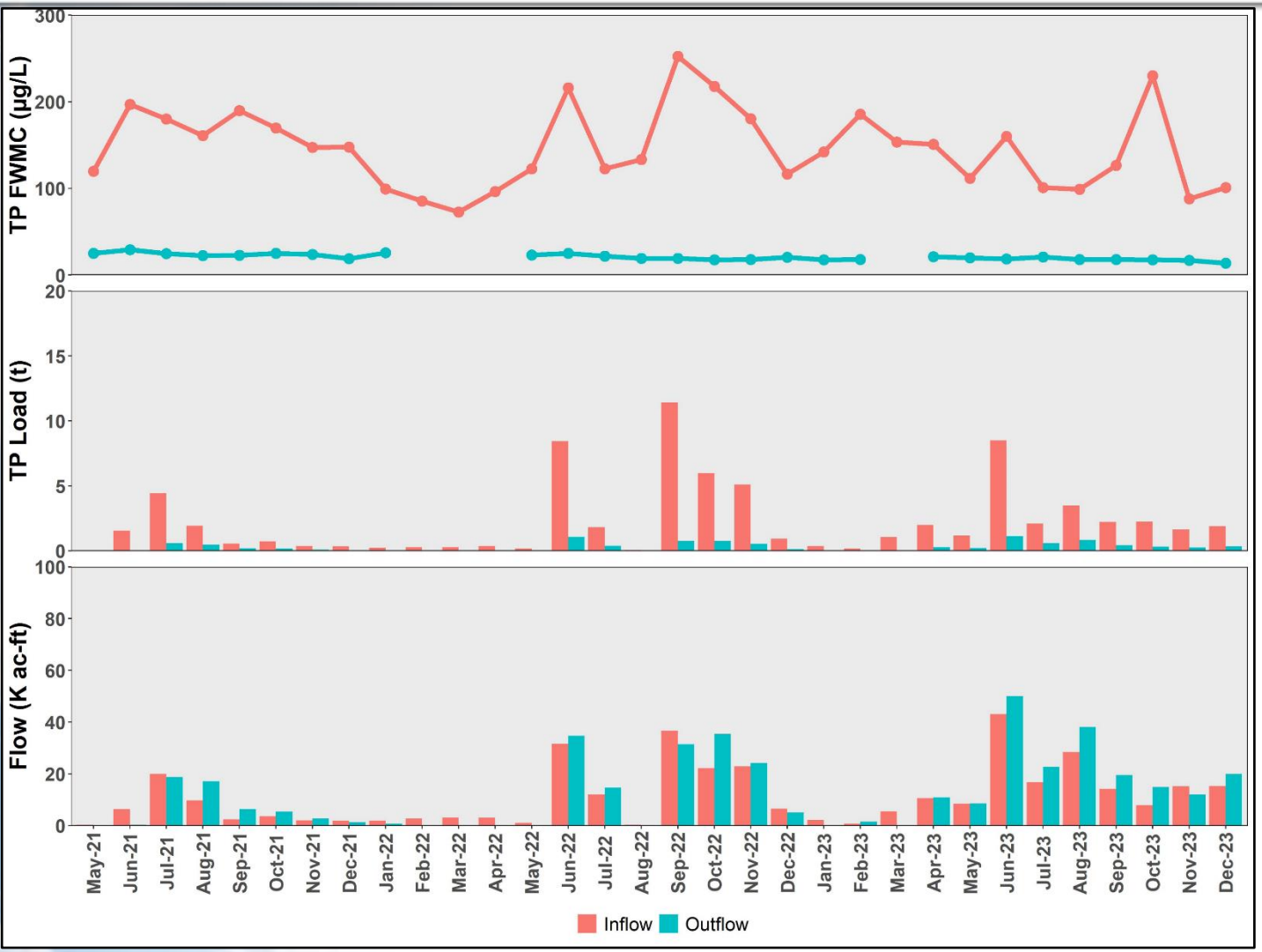



Cell 6 mixed marsh (T. Adeagbo)

	WY2022	WY2023	Partial WY2024 (05/01/2023 - 12/31/2023)
Total inflow (k acre-feet)	57	152	149
Lake releases (k acre-feet)	3	9	1
TP FWMC inflow / outflow (µg/L)	158 / 24	199 / 20	126 / 18
TP load inflow / outflow (tons)	11 / 2	37 / 4	23 / 4
Reduction in TP FWMC / load	85% / 86%	90% / 89%	86% / 82%

Includes preliminary data

STA-1W Monthly Inflows and Outflows



- Higher WY24 inflow volume relative to recent years
  - Refurbishments projects complete
  - Ongoing construction in STA-1E
- Outflow TP FWMC low and stable
  - Declining trend in WY24

Includes preliminary data

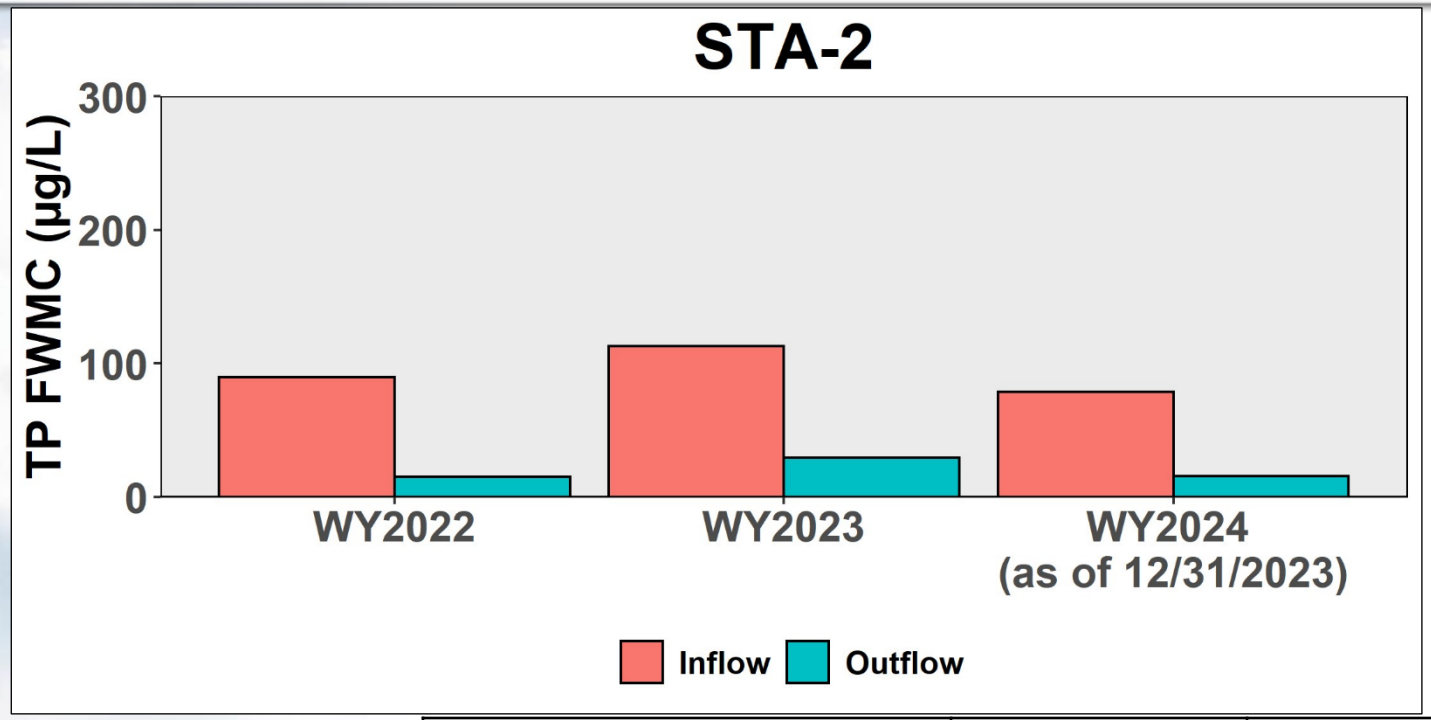
STA-1W Operational Restrictions (Jan. 1, 2023 – Dec. 31, 2023)

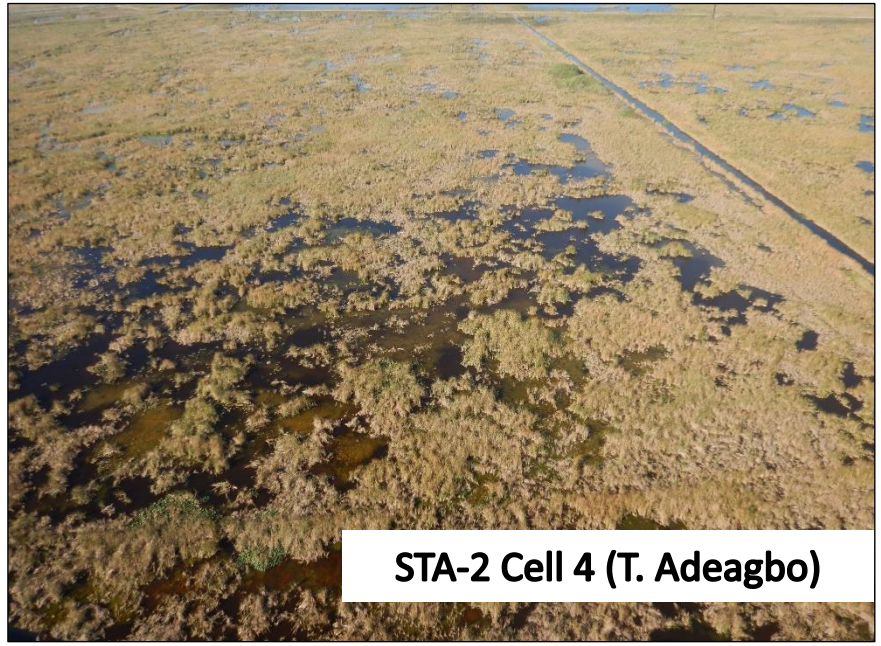
- Periodic restrictions in all flow-ways
  - Post-construction vegetation grow-in in Northern, Western, and Eastern Flow-ways
  - Vegetation management in the Northern Flow-way
  - Construction related to STA-1W Expansion #2 in Cell 8
  - BNS nesting in the Northern Flow-way, and Cells 7 and 8

Cell 5B EAV planting (T. Adeagbo)

Exp #2 Pump station (H. Andreotta)

STA-2 Performance Comparison by Water Year

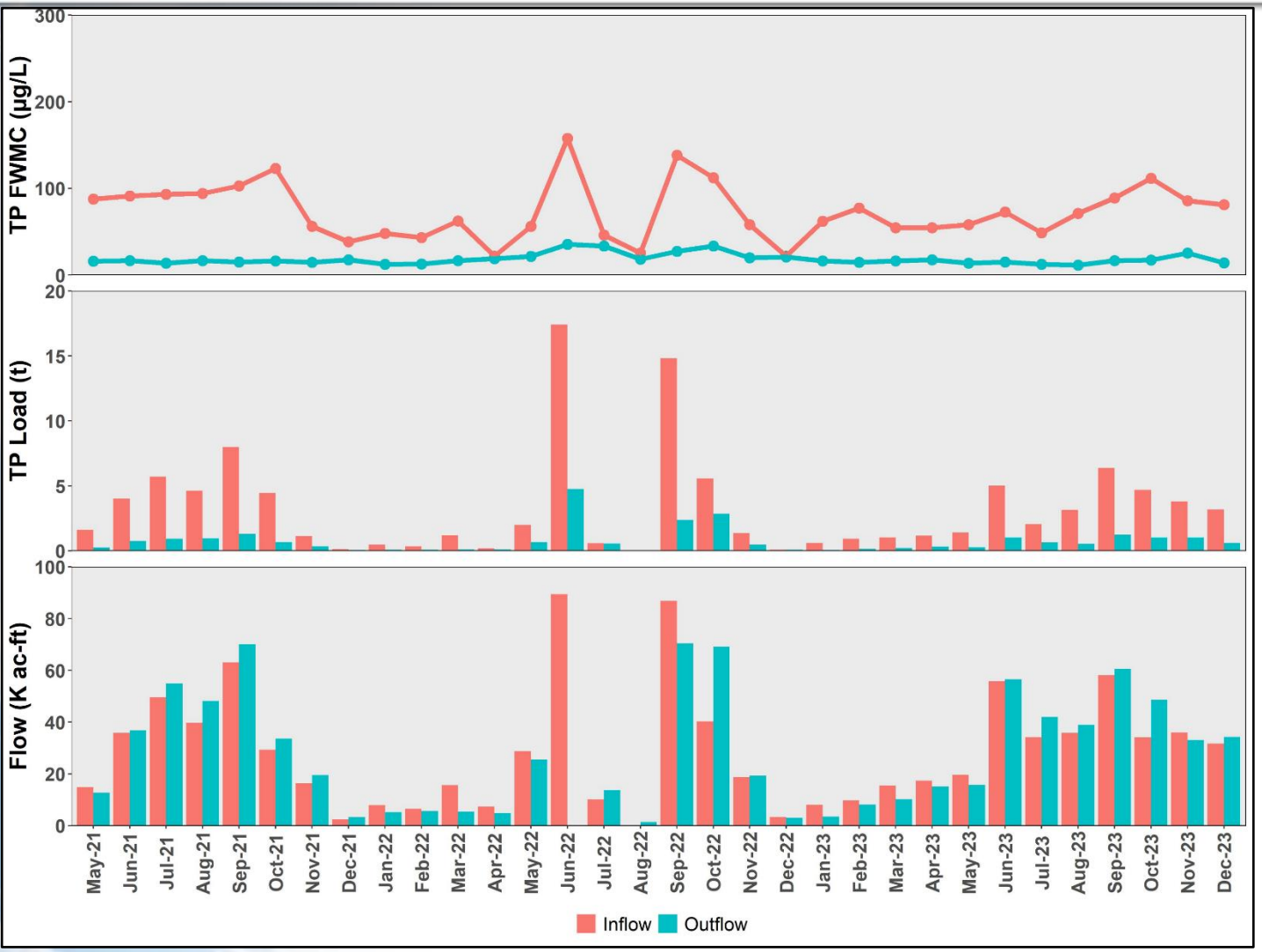




	WY2022	WY2023	Partial WY2024 (05/01/2023 - 12/31/2023)
Total inflow (k acre-feet)	289	327	305
Lake releases (k acre-feet)	38	29	1
TP FWMC inflow / outflow (µg/L)	89 / 15	113 / 29	79 / 16
TP load inflow / outflow (tons)	32 / 6	45 / 13	30 / 6
Reduction in TP FWMC / load	83% / 82%	74% / 72%	80% / 79%

Includes preliminary data

STA-2 Monthly Inflows and Outflows



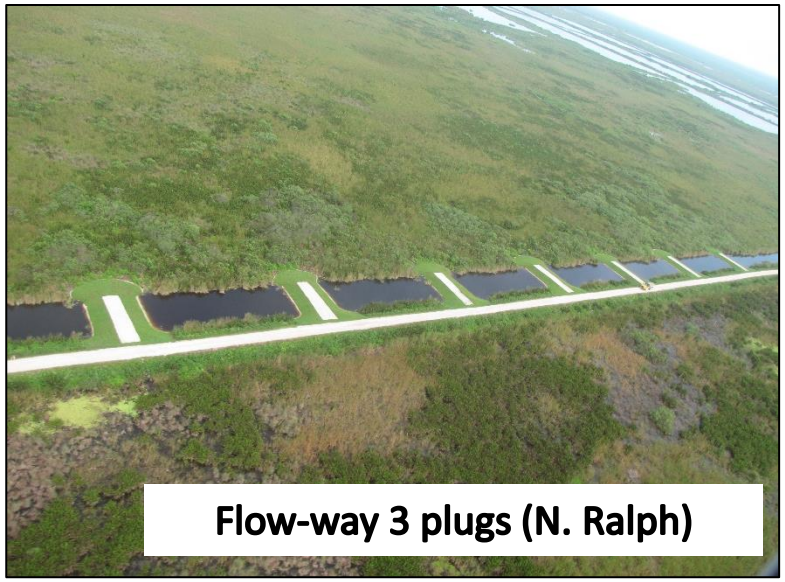
- Lower and less variable inflow TP loads and FWMC
  - A-1 FEB captured peak flows and loads
- Outflow TP FWMC low and stable

Includes preliminary data

STA-2 Operational Restrictions (Jan. 1, 2023 – Dec. 31, 2023)

- Flow-way 2 offline for earthwork and post-construction vegetation grow-in
  - Earthwork complete, restriction for grow-in continues
- Periodic restrictions in Flow-ways 1, 3, and 4
  - Vegetation management activities
  - Canal plug refurbishments in Flow-ways 2 and 3
  - BNS nesting in Flow-way 3

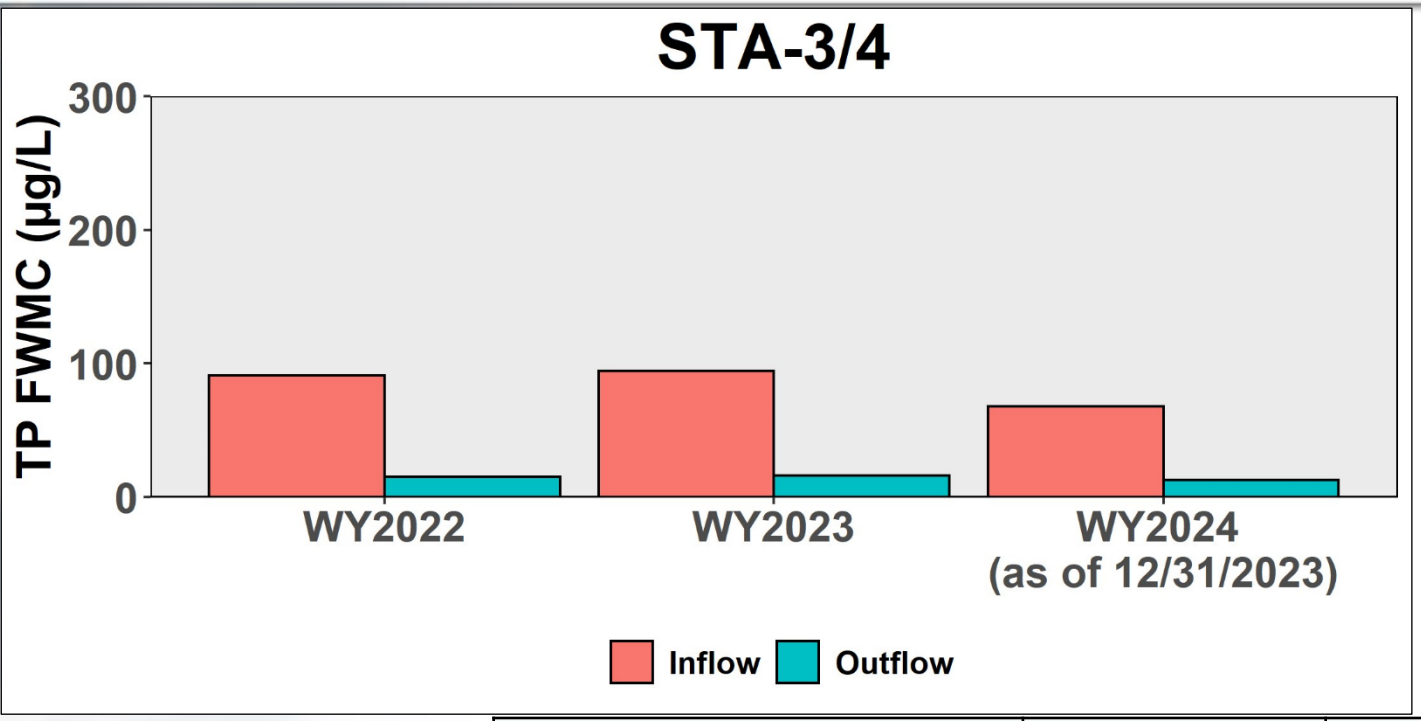
Flow-way 2 planting (T. Adeagbo)



Flow-way 3 plugs (N. Ralph)

Flamingos in Cell 3

STA-3/4 Performance Comparison by Water Year

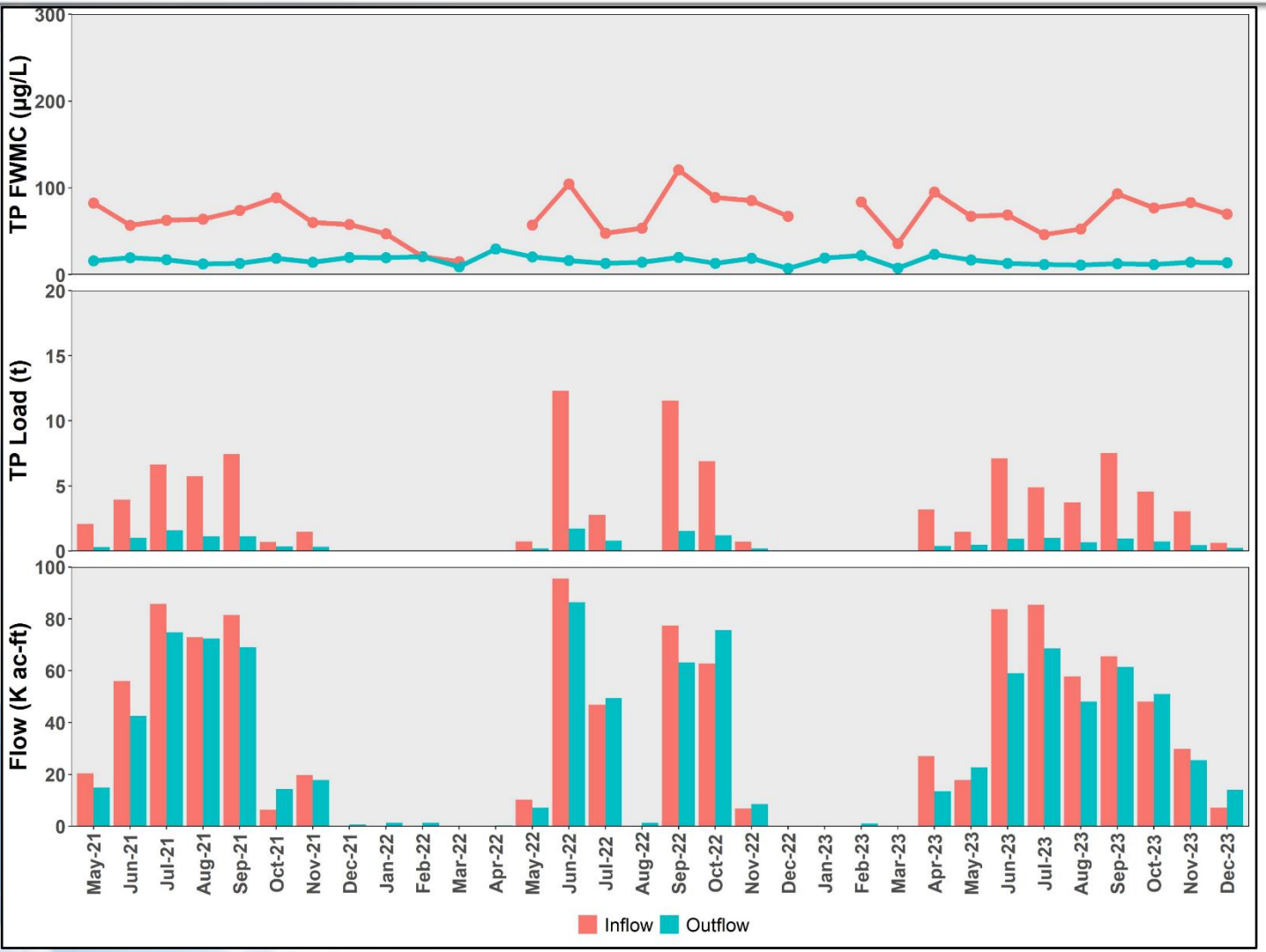



STA-3/4 Mixed Marsh (T. Adeagbo)

	WY2022	WY2023	Partial WY2024 (05/01/2023 - 12/31/2023)
Total inflow (k acre-feet)	330	327	395
Lake releases (k acre-feet)	31	3	1
TP FWMC inflow / outflow (µg/L)	91 / 15	95 / 16	68 / 13
TP load inflow / outflow (tons)	37 / 6	38 / 6	33 / 5
Reduction in TP FWMC / load	83% / 84%	83% / 84%	81% / 83%

Includes preliminary data

STA-3/4 Monthly Inflows and Outflows

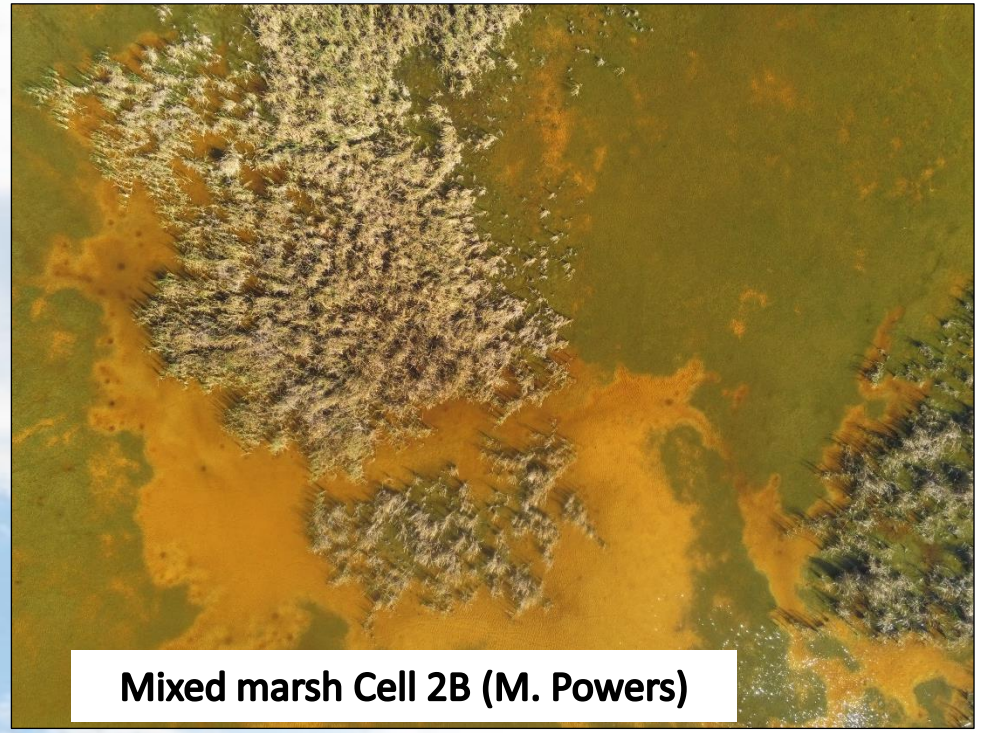


- Compared to other STAs, less variability in inflow TP loads due to A-1 FEB
- Higher flows in WY2024
  - A-1 FEB captured large portion of flows
- Outflow TP FWMC remains low and stable

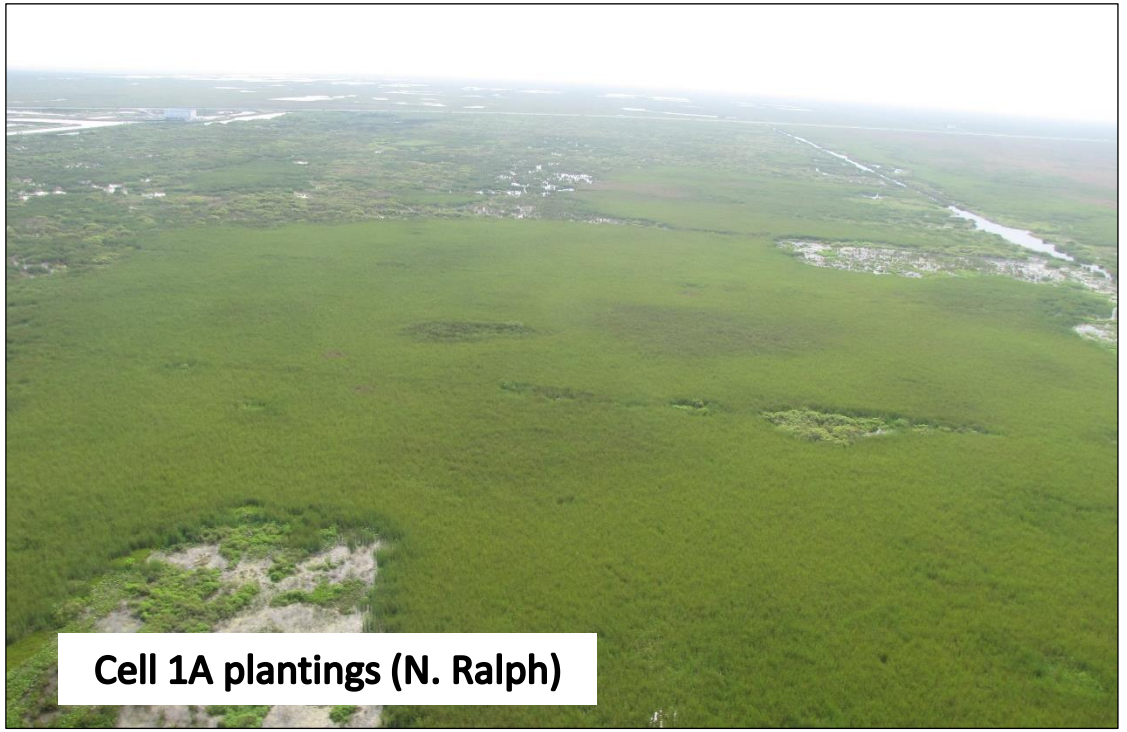
Includes preliminary data

STA-3/4 Operational Restrictions (Jan. 1, 2023 – Dec. 31, 2023)

- Eastern Flow-way offline for vegetation rehabilitation/drawdown
  - Drawdown complete, restriction for vegetation management continues

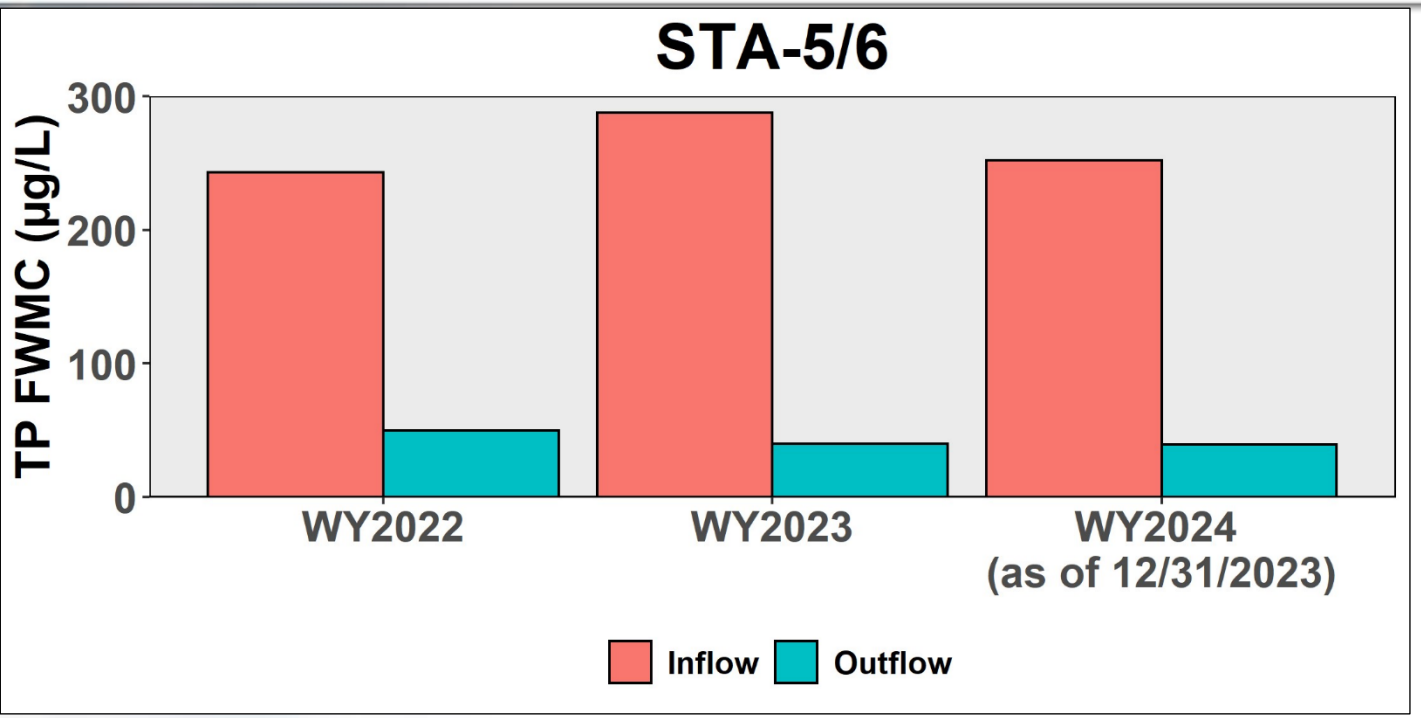


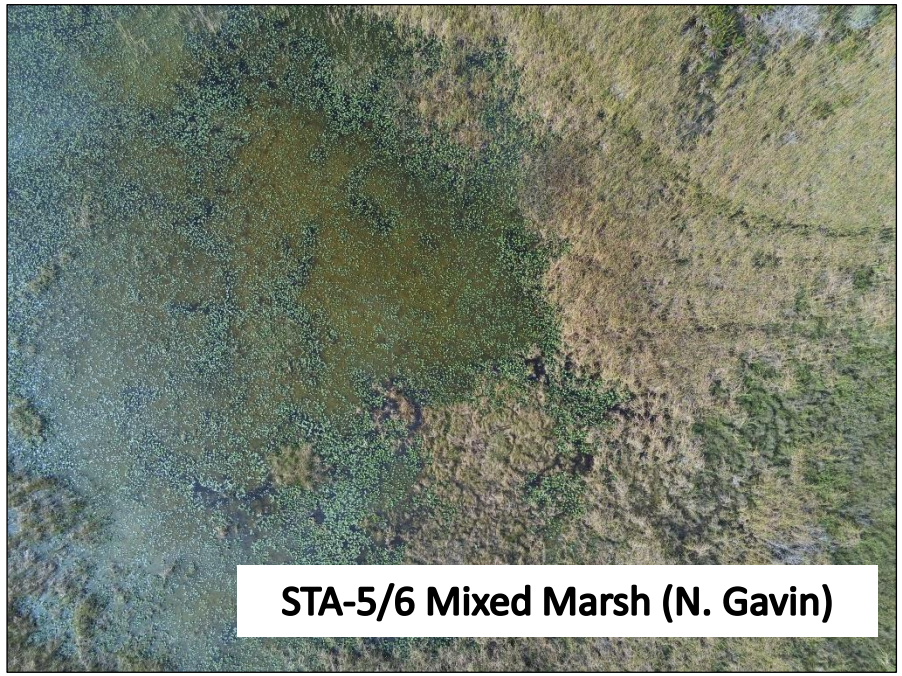
Mixed marsh Cell 2B (M. Powers)



Cell 1A plantings (N. Ralph)

STA-5/6 Performance Comparison by Water Year

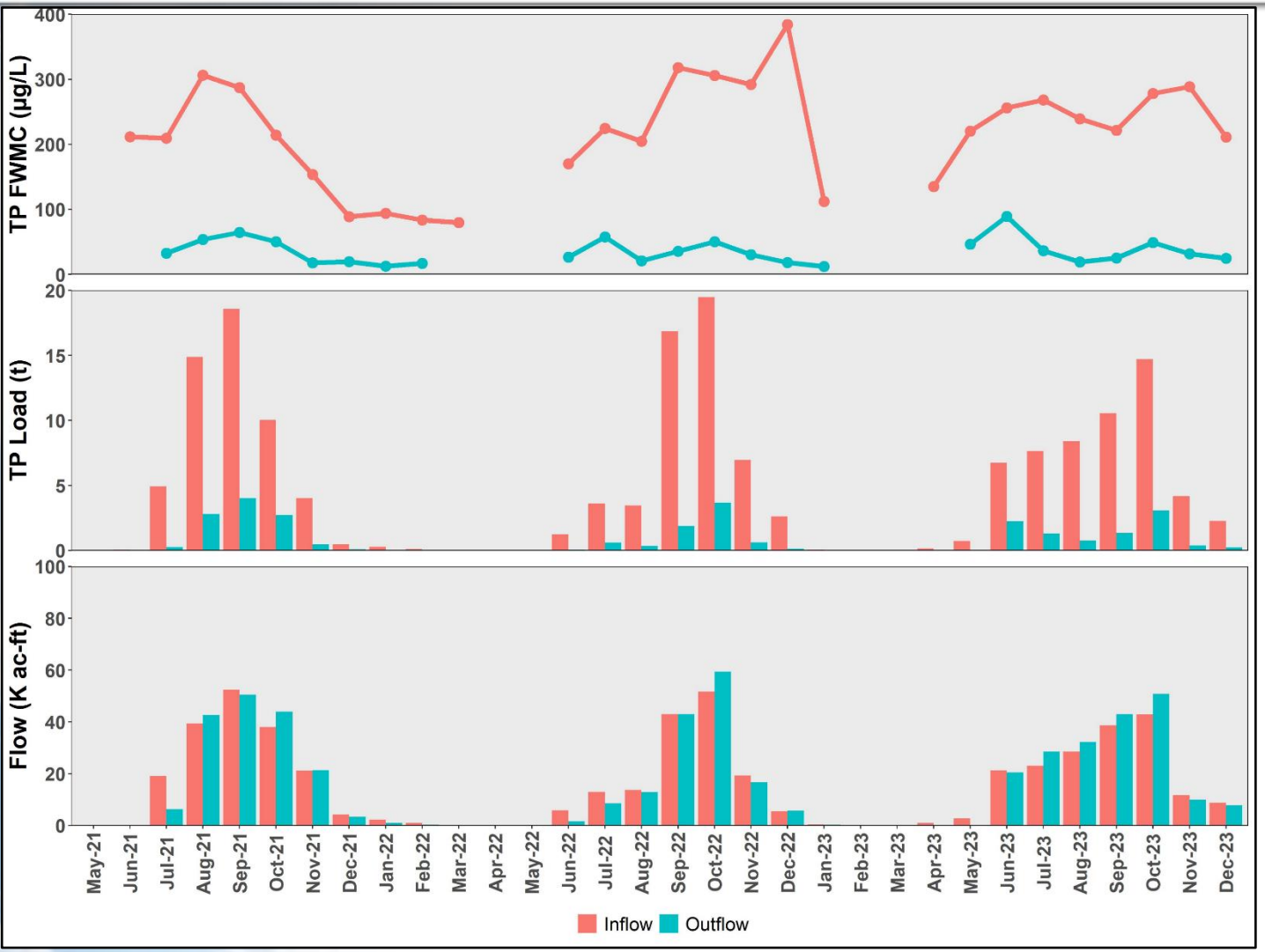



STA-5/6 Mixed Marsh (N. Gavin)

	WY2022	WY2023	Partial WY2024 (05/01/2023 - 12/31/2023)
Total inflow (k acre-feet)	178	153	178
TP FWMC inflow / outflow (µg/L)	243 / 50	288 / 40	252 / 39
TP load inflow / outflow (tons)	53 / 10	54 / 7	55 / 9
Reduction in TP FWMC / load	80% / 81%	86% / 87%	84% / 83%

Includes preliminary data

STA-5/6 Monthly Inflows and Outflows

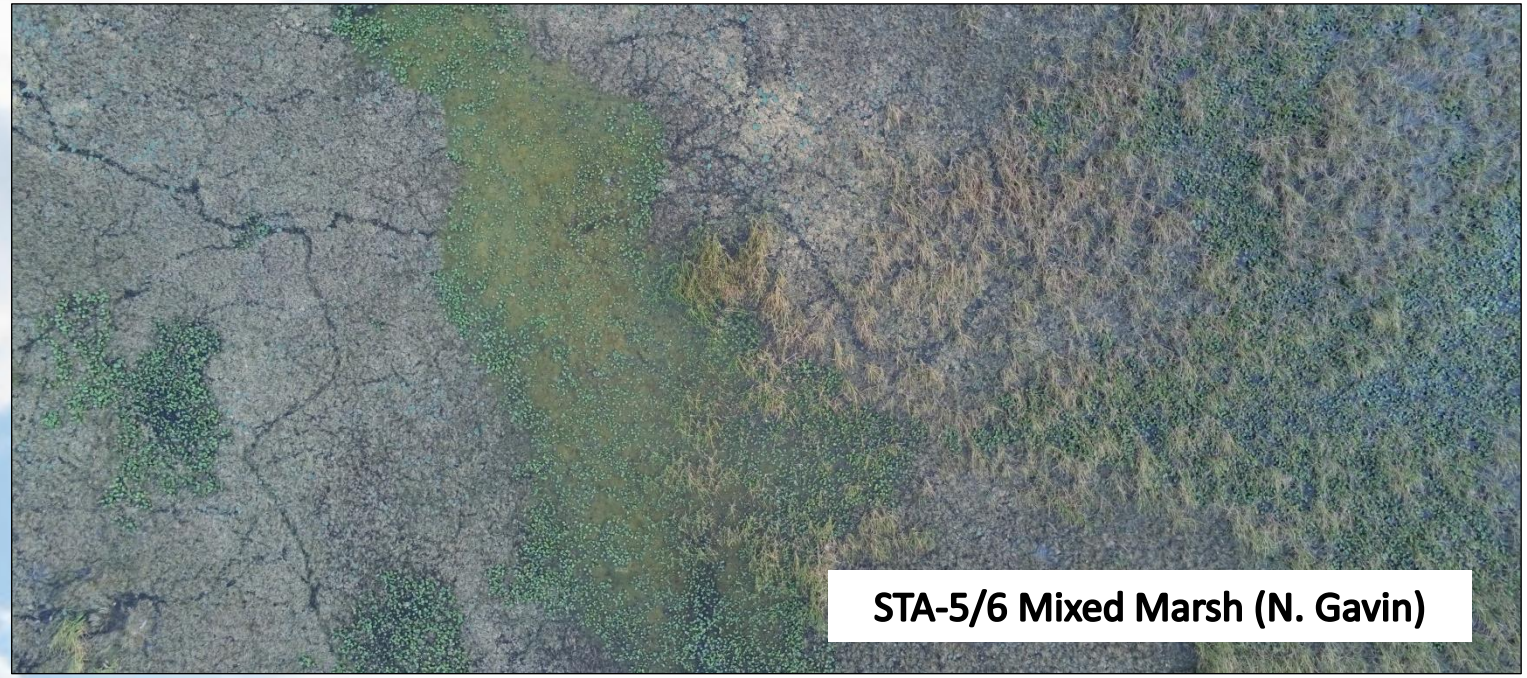


- Frequent dry-out conditions during the dry seasons
- Elevated inflow/outflow TP FWMC following dry-out
  - Reduced impact in recent WYs
- C-139 FEB will reduce dry-out events

Includes preliminary data

STA-5/6 Operational Restrictions (Jan. 1, 2023 – Dec. 31, 2023)

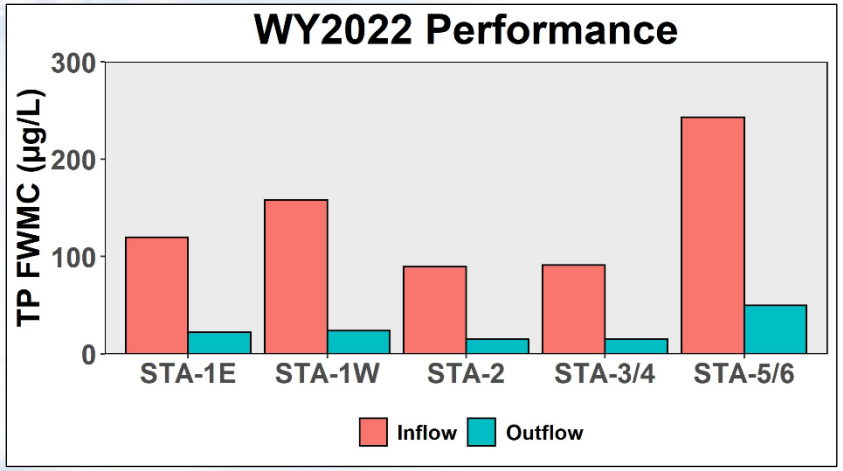
- Periodic restrictions in Flow-ways 2, 4, and 6
  - Prescribed burn in Flow-way 4
  - BNS nesting in Flow-ways 2 and 6

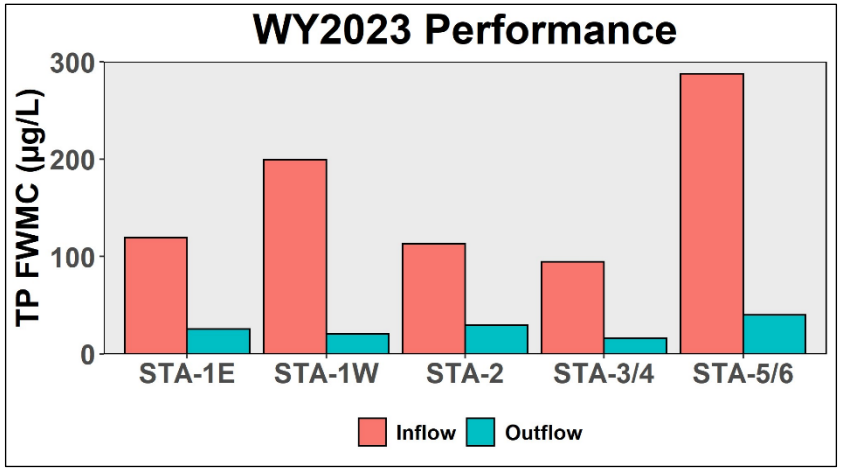


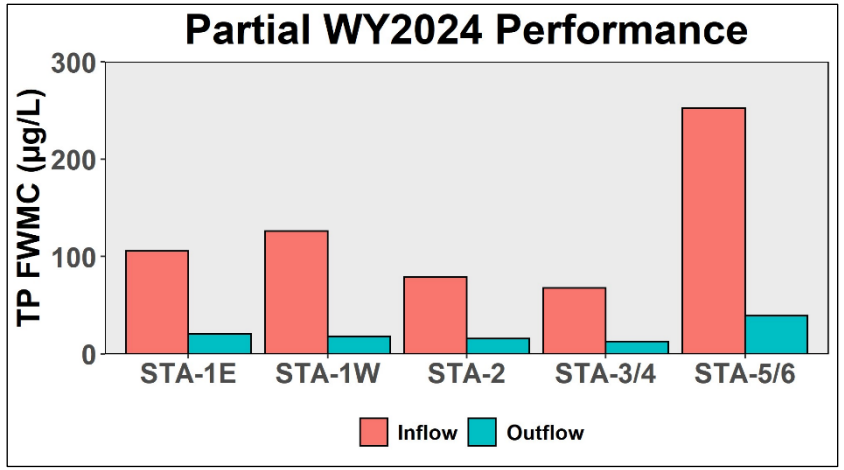
STA-5/6 Mixed Marsh (N. Gavin)

Cell 1B SAV coverage (J. Wilson)

All STAs Performance Comparison by WY







	WY2022	WY2023	Partial WY2024 (05/01/2023 - 12/31/2023)
Total inflow (k acre-feet)	1,027	1,084	1,155
Lake releases (k acre-feet)	108	43	8
TP FWMC inflow / outflow (µg/L)	125 / 23	144 / 25	111 / 19
TP load inflow / outflow (tons)	159 / 27	193 / 33	158 / 28
Reduction in TP FWMC / load	82% / 83%	82% / 83%	82% / 82%

Includes preliminary data

CONTACT INFORMATION

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STA VEGETATION MANAGEMENT

ERIC CRAWFORD
Lead Scientist
Land Resources

21st Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins

February 26, 2024

Management Objectives

Maintain sustainable vegetation-based phosphorus uptake processes

Vegetation Enhancement

- Establish/maintain appropriate vegetation communities
- Improve stability and functional redundancy
- Protect vulnerable communities/ locations

Selective Management

- Increase desirable species
- Control nuisance populations

STA Vegetation Function

Emergent plantings after cattail failure

- **Emergent Aquatic Vegetation (EAV)**
  - Stabilize soils
  - Create beneficial flow patterns
  - Decrease turbidity
  - Create litter
  - Protect SAV
- **Submerged Aquatic Vegetation (SAV)**
  - Water column nutrient uptake
  - Periphyton substrate

STA Vegetation

Desirable Plants

A healthy mix of emergent and submerged vegetation

Undesirable Plants

Nuisance vegetation, floating mats and floating delaminated soils

Vegetation Management Process

- Monitor Vegetation and Cell Health
- Constant observation
- Proactively Manage Vegetation
- Increase cover and health of desired species where needed
- Control undesirable species
- Repair Damage and Restore Functionality
- Emergent vegetation enhancements where vegetation is damaged or undesirable and SAV inoculations where appropriate

EAV Management

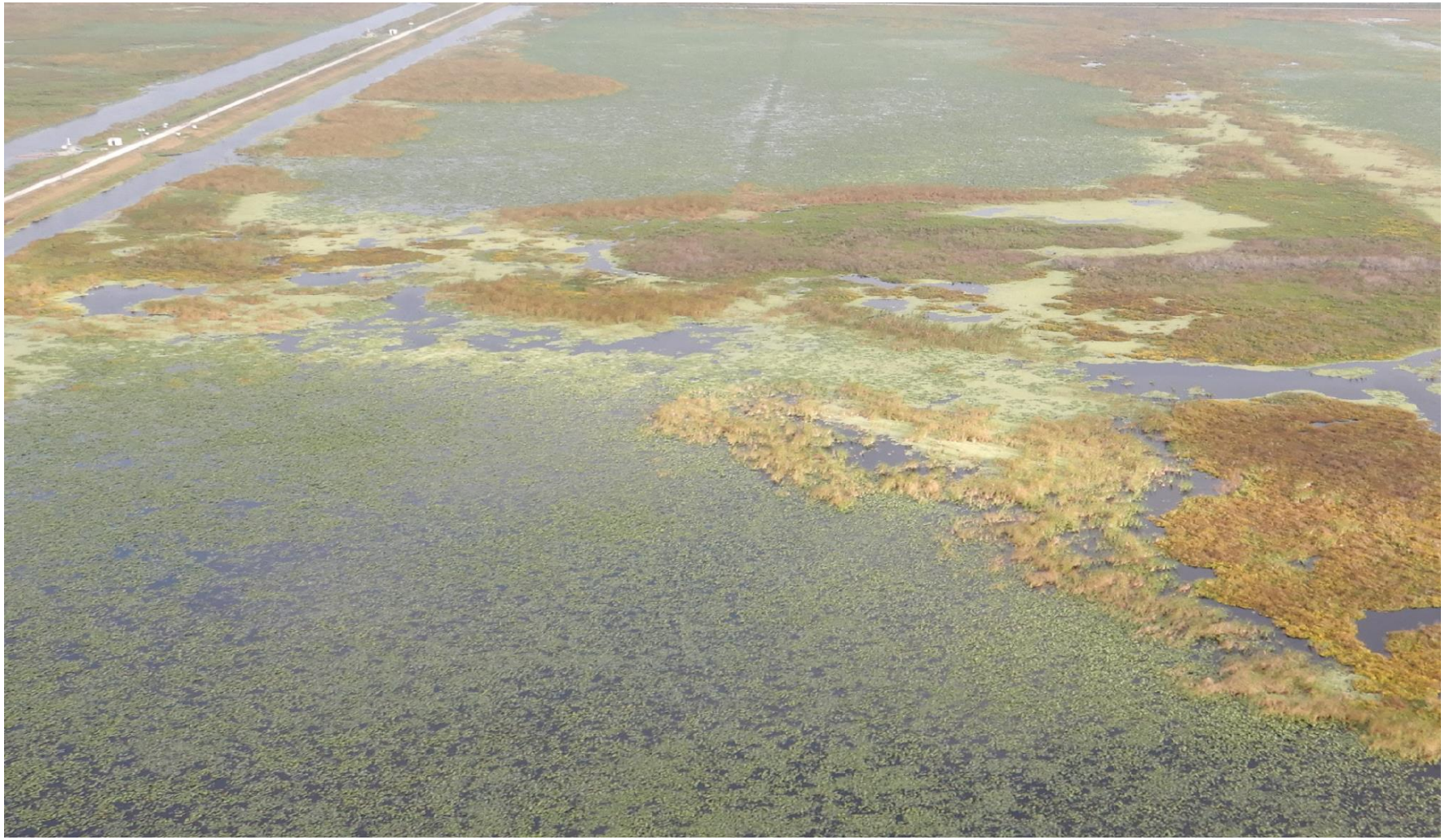
- Dense native vegetation can interfere with the spread of invasive plants
- Multiple native species used in varying conditions to maximize resiliency and performance
- Redirect flows, repair damage, stabilize sediments

SAV Management

- Compartmentalizing the SAV cells with vegetation strips
- Smaller, more diverse and compartmentalized SAV beds can be more resistant
- EAV provides structure, protection, and litter to assist with nutrient uptake

Floating Aquatic Vegetation Control

- FAV control is needed to protect desirable vegetation
- Dense vegetation helps reduce FAV penetration into the Cells



STA 5/6 Burn

- Controlled Burn
  - Reduce woody and nuisance vegetation
  - Reduce standing and horizontal dead cattail biomass
  - Increase light penetration

STA 5 Burn Regrowth

STA 1E Cell 2 Erosion

- Low stages and rapid flow rates move sediment and plants
- Short circuits form in weakened areas
- Erosion, sediment movement, and loss of functionality

STA 2 Cell 2 Erosion Repair/ Generator

STA 2 Cell 2 Erosion Repair/ Generator

STA Surprises

- You never know what you will see in the STAs
- Wildlife
- Birds
- Flowers
- Sharks
- Come out for a walk

CONTACT INFORMATION

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Status of Restoration Strategies Science Plan (RSSP) Studies

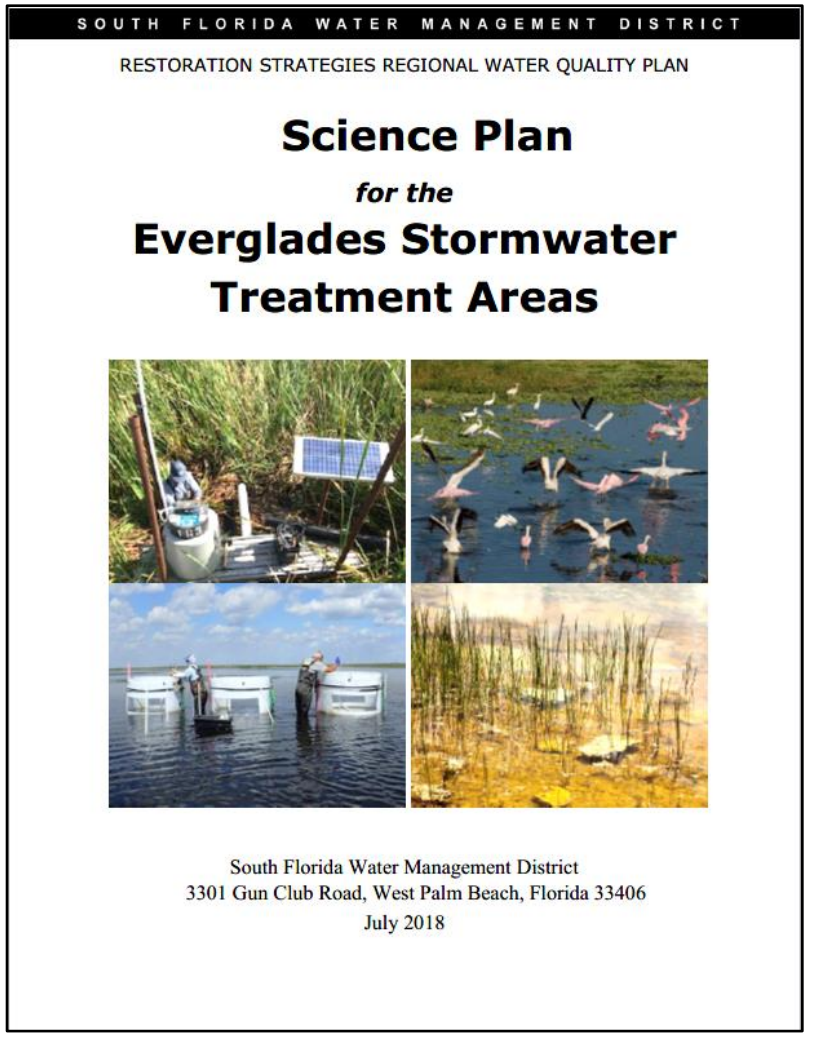
R. Thomas James, Ph. D.
Principal Scientist
Applied Sciences Bureau

21st Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins

February 26, 2024

The Science Plan

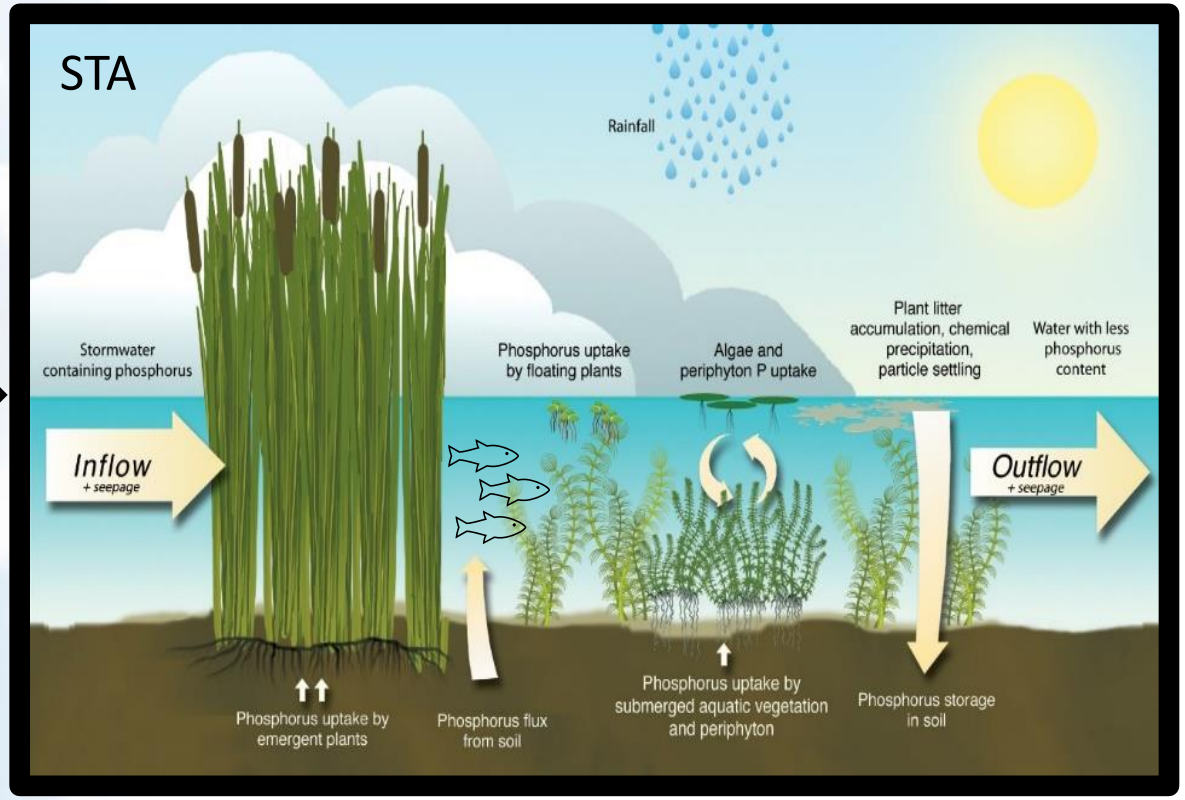
- Developed in 2013 and updated in 2018
- Specified in Restoration Strategies Regional Water Quality Plan
- Required by Stormwater Treatment Area (STA) permits and consent orders
- Framework for studies
  - Evaluate key factors and processes that affect phosphorus (P) removal in the STAs
  - Support design, operation, & management of STAs to achieve Water Quality-Based Effluent Limits (WQBEL)



Areas of Investigation

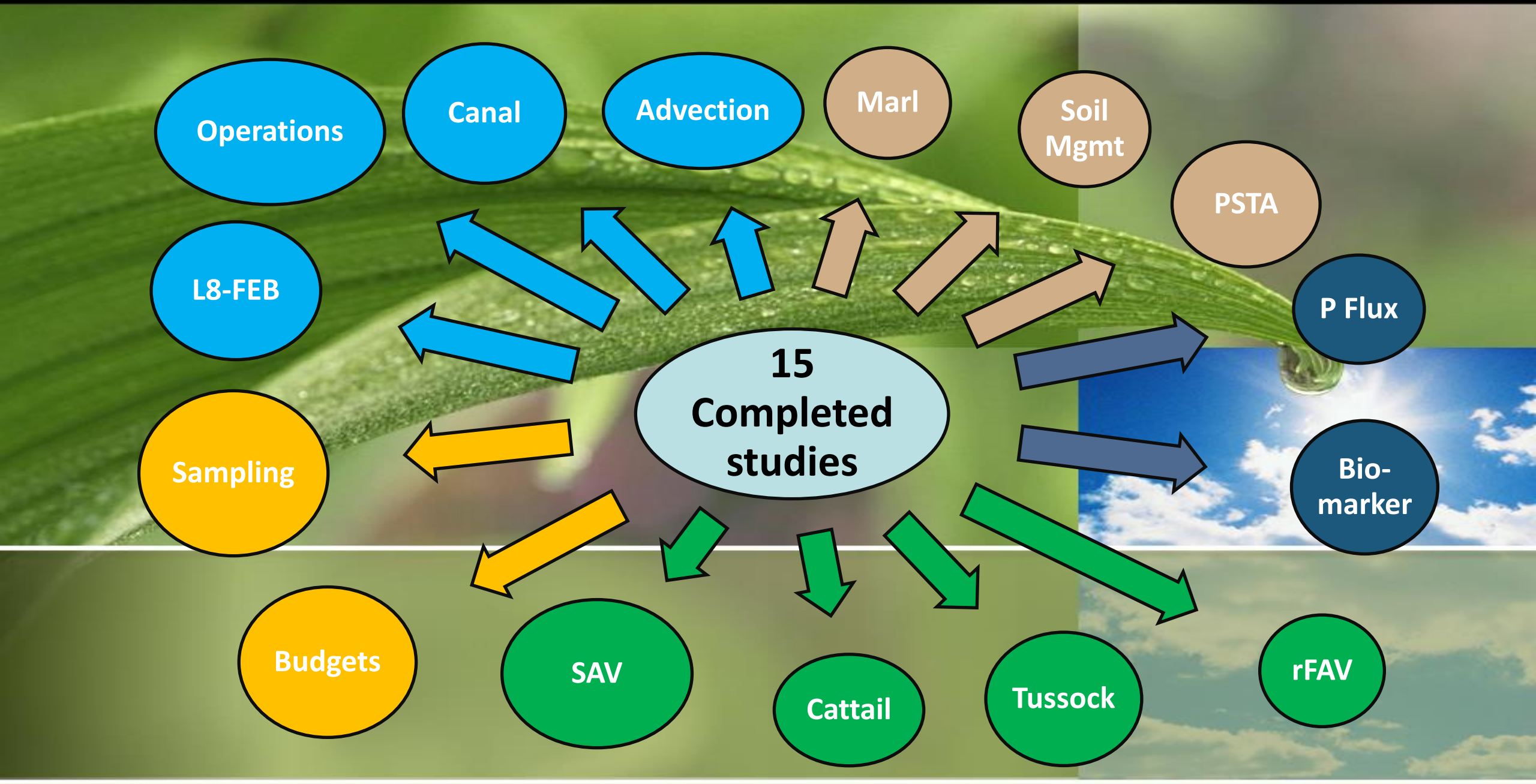
6 Key questions and 18 sub-questions on these topics

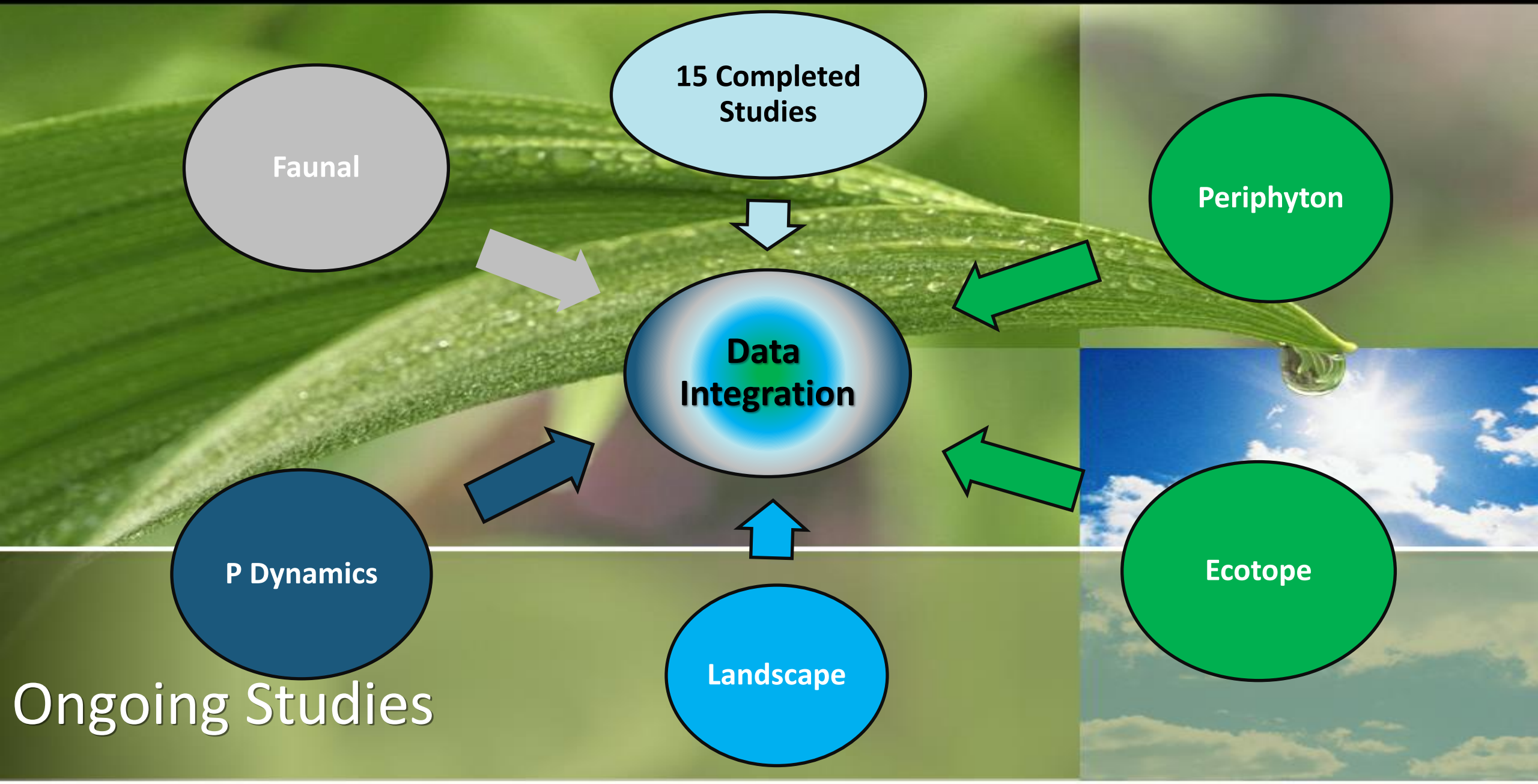
FEB



1. Design and operation of Flow Equalization Basins (FEBs)
2. Design and operation of STAs
3. Vegetation management
4. Internal loading of phosphorus
5. Biogeochemical and physical mechanisms
6. Role of fauna

The Team


Operations
Canal
Advection
Marl
Soil Mgmt
PSTA
L8-FEB
P Flux
15 Completed studies
Sampling
Bio-marker
Budgets
SAV
Cattail
Tussock
rFAV



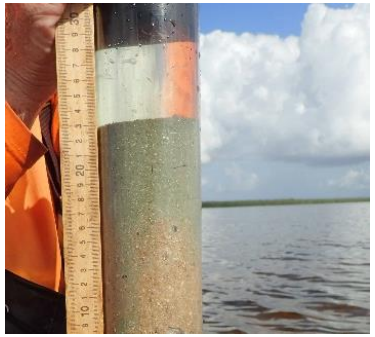
Ongoing Studies

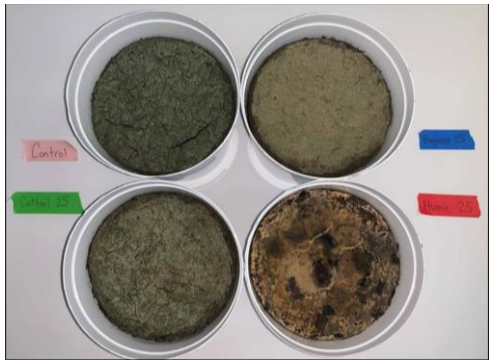
L-8 Flow Equalization Basin (FEB) Study (Recently Completed)

- **Objective**
  - Determine source of past excess total P (TP) in L-8 FEB discharge
  - Develop guidance to reduce TP in the discharge
- **Results**
  - Sources of P
    - Minor-groundwater and runoff from embankments
    - Major-large inflows
      - External P loads and sediment resuspension
      - Increases TP which declines over a few weeks
  - TP is strongly releated to turbidity and dissolved inorganic P (DIP)
  - Alum addition
    - At low concentration removes inorganic P
    - Jar tests and model results: small amount of P removed by alum
    - Expensive (~ $4,000 per lb of P removed)
  - **Potential options**
    - Retain water for a few weeks after a major inflow event
    - Use near real-time monitoring of DIP and turbidity to estimate TP before discharge to STAs

Marl Study (Recently Completed)

- **Objectives**
  - Evaluate Marl soil stability and resuspension
    - TP and turbidity
    - Potential methods to reduce resuspension
      - Drying
      - Addition of organic materials
- **Results**
  - Marl soils less susceptible to resuspension than organic muck soils
  - Organic amendments not very effective
  - Drying followed by rehydration
    - TP flux measurements in water column
      - compared to non dried control
      - Lower in first few days
      - Higher than after one week
      - Equal after a few weeks
- **Potential Option**
  - If cell dries out, once reflooded retain water for a few weeks to allow SAV germination and growth –(SAV study)



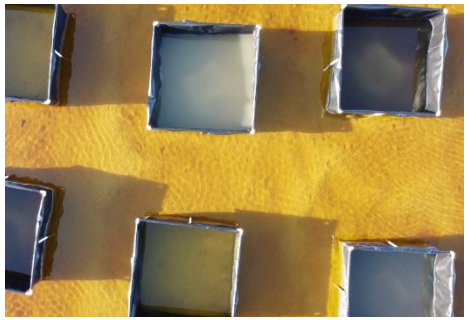


Biomarker Study (Recently Completed)

- **Objective**
  - Analyze organic material (OM) as markers of P origins
  - Determine sources and potential turnover of P within STAs
- **Results**
  - Inflow waters
    - Dissolved OM (DOM) varies based on watershed
    - Exposure to sunlight (photodegradation)
      - Breaks down DOM and dissolved organic P (DOP)
      - Breakdown enhances uptake by microbial community
  - Fresh Litter
    - DOM released quickly
    - SAV faster release than EAV
    - More dissolved inorganic P (DIP) released from SAV than EAV
  - DOM in STAs
    - Primarily from litter decomposition of vascular plants
    - Microbial processes affect it more than sunlight
  - **Potential Option**
    - Maintain open water (SAV) regions in STAs to allow photo-degradation of DOP

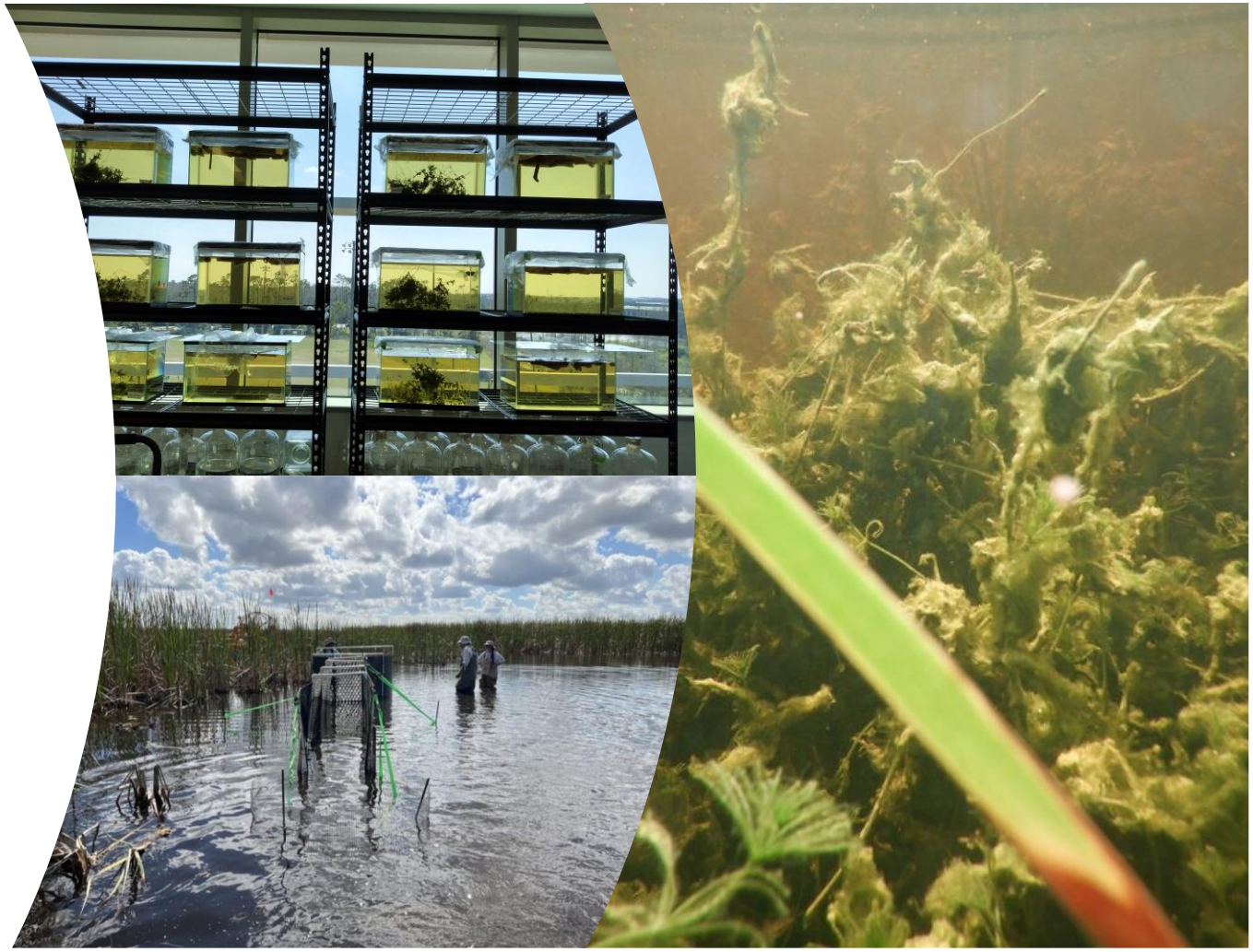
Fauna Study (ongoing)

- **Objective**
  - Quantify fauna abundance and effects on P cycle and retention
- **Results**
  - Large fish densities
    - Related to water levels (when low, fish are in canals)
    - Underestimated by electrofishing
    - Capture rate between 1 to 50 % depending on species
  - Substantial recycling of P
    - Large Fish: Bioturbation
      - Sailfin catfish (high)
      - Largemouth Bass (low)
    - Small Fish: Excretion (3 X greater than Bioturbation)
    - Impedes P retention in STA
  - Herbivory of SAV is significant
- **Status and Potential Option**
  - Herbivory report in review
  - To regrow SAV in bare areas lower water levels (if possible) to reduce fish herbivory of growing plants



Periphyton Study (ongoing)

- **Objective**
  - Evaluate role of STA periphyton in P cycling
    - Metagenomics and microscopy
    - Lab nutrient addition incubations
    - Field flume shear stress studies
- **Results**
  - Metagenomics
    - Seasonal changes
- **Status**
  - Sampling complete
    - Metagenomics and microscopy
    - Flume study
    - Laboratory nutrient addition incubations
  - Awaiting analyses

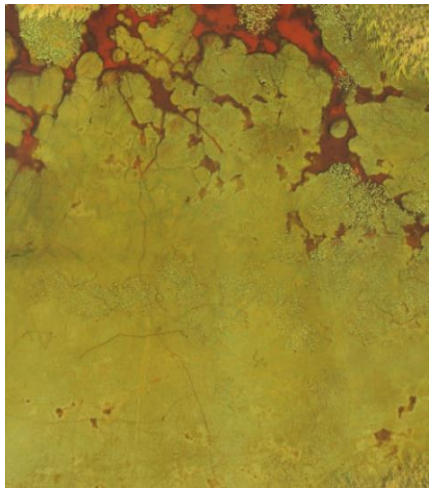


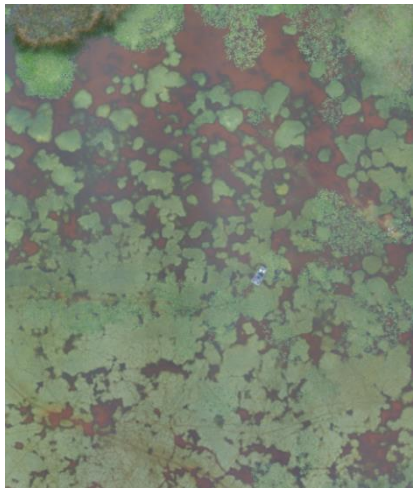
P Dynamics Study (ongoing)

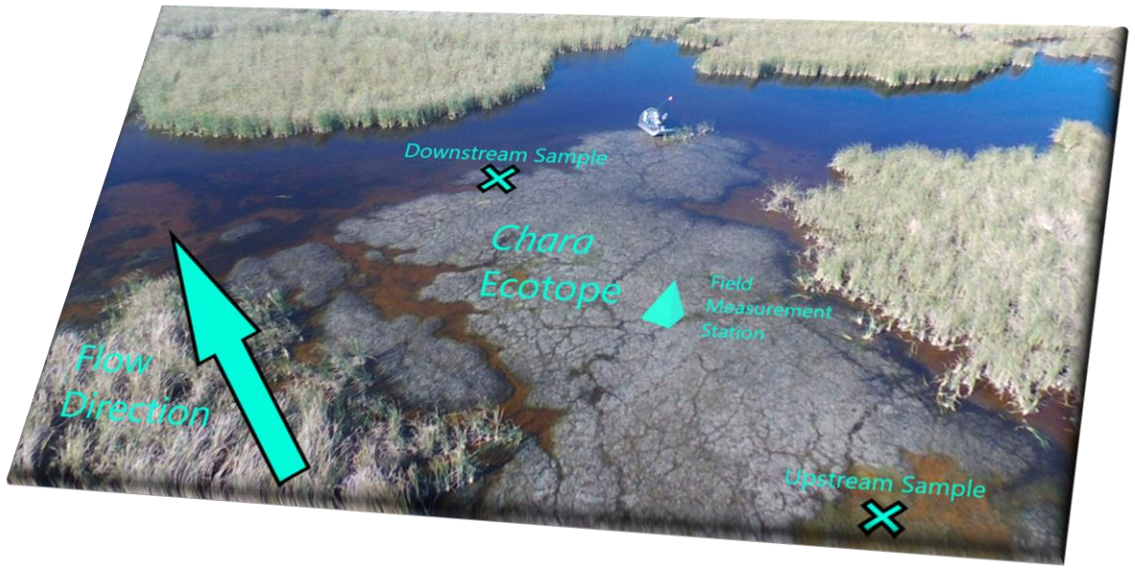
- **Objective**
  - Evaluate factors affecting P reduction in underperforming flow-ways
- **Results**
  - Underperformance – Historical analysis
    - High external P loads
    - Dry out/reflood
    - Damage or loss of vegetation
    - Construction
  - Soils
    - EAV – organic
    - SAV – inorganic- calcium (marl)
  - No flow
    - Water column is dominated by PP
  - Flow
    - TP concentration higher with low flow
- **Status**
  - All sampling is complete

Ecotope Study (ongoing)

- **Objective**
  - Estimate P retention by common STA ecotopes
- **Results**
  - DIP near detection limit
  - Seasonal effects
    - Higher TP in dry season
  - Rank of TP concentration by Ecotope
    - Chara < Mixed ≈Naiad < Typha < Bare
    - Differences smaller than seasonal differences
    - DOP is largest P fraction
  - Higher flow
    - Lower TP concentration
  - SAV genetic diversity
    - High variation within and between sites
    - Little clonal reproduction
- **Status**
  - Sampling complete

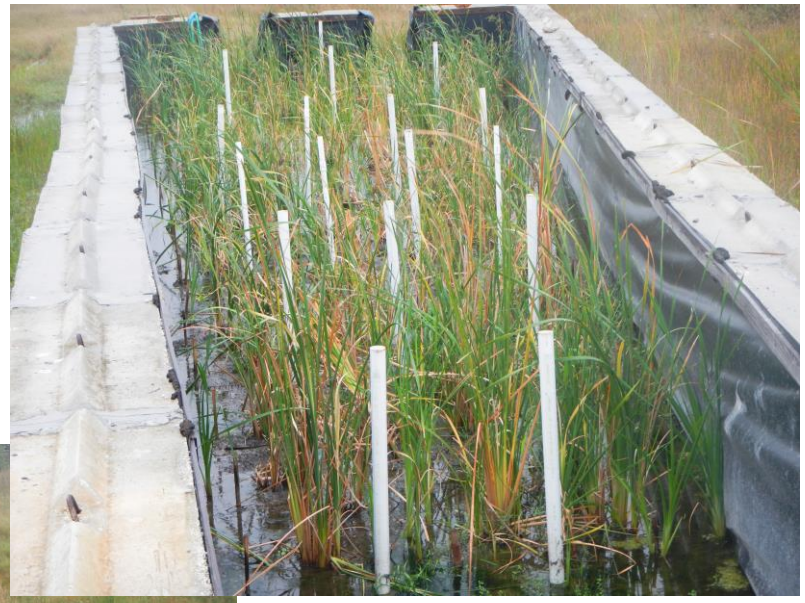


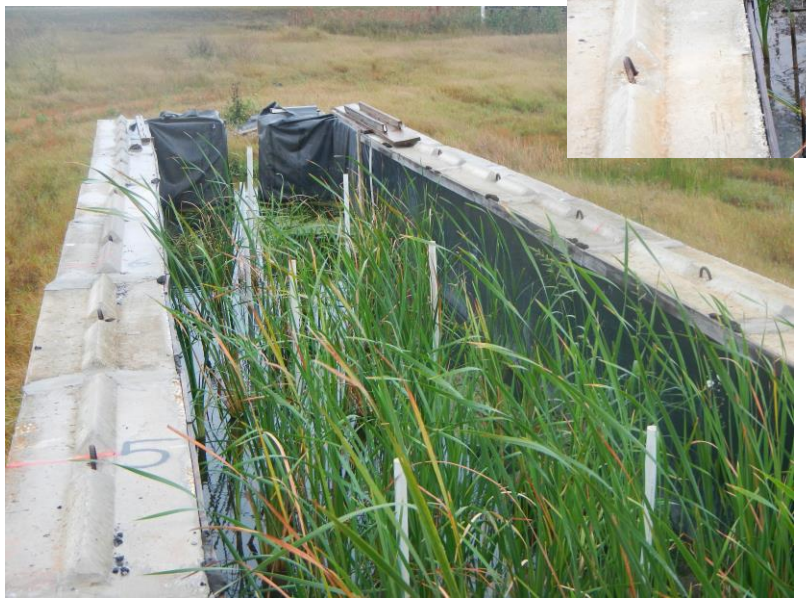




Landscape Study (ongoing)

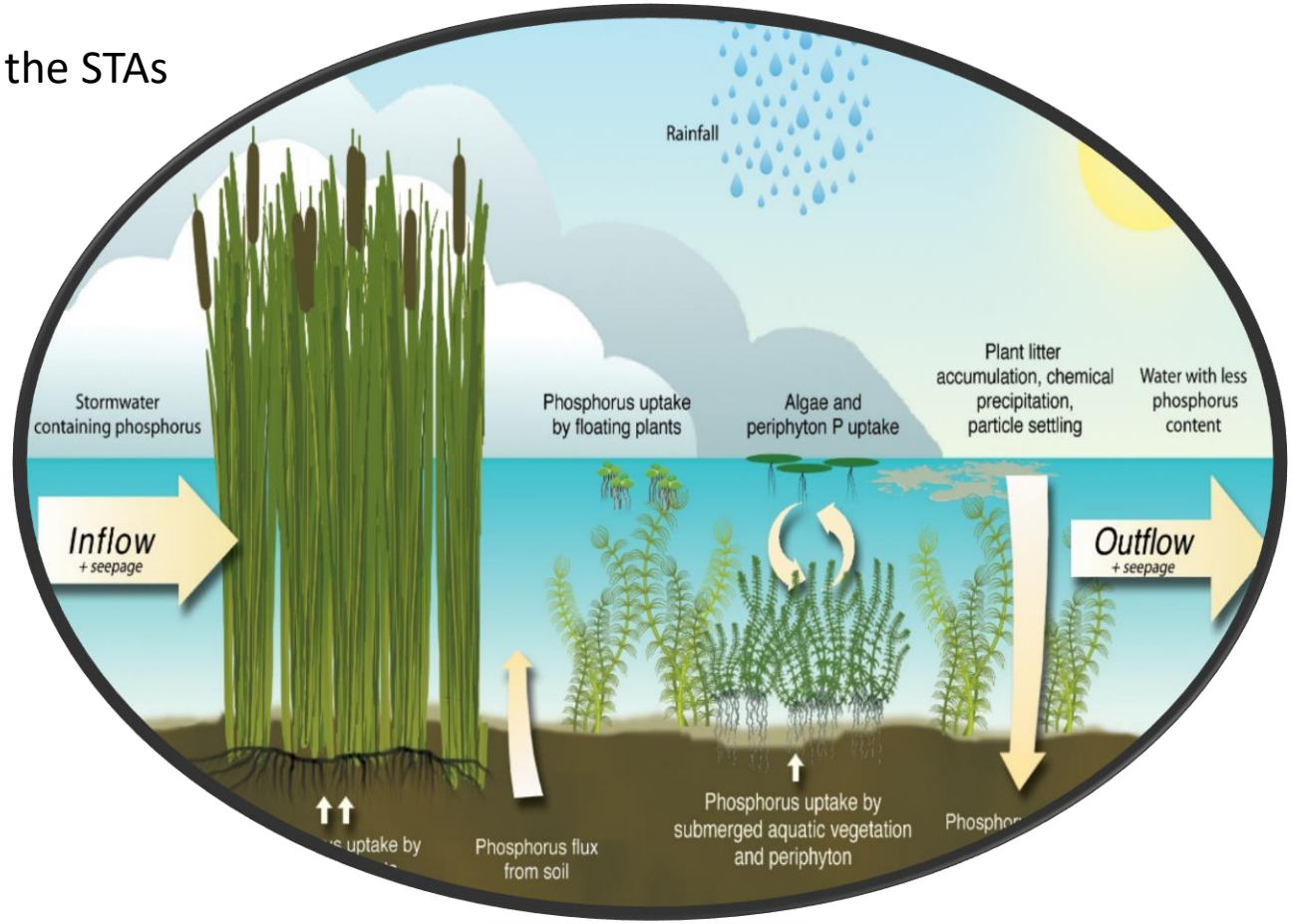
- **Objective**
  - Quantify flow effects on hydraulic mixing given different plant densities and water depths
- **Results**
  - Two flumes installed
    - Straight
    - V sthaped
      - Evaluate multiple flow velocities at once
  - Baseline (without plants)
    - Steady state flows achieved
    - Salt and P were measurable
    - Standing waves were produced and measured
- **Status**
  - Cattails were planted in October 2023
  - First round of flow experiments underway





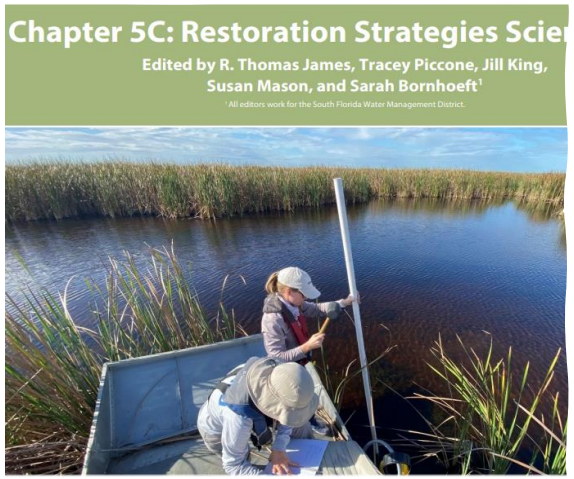
Data Integration Study (ongoing)

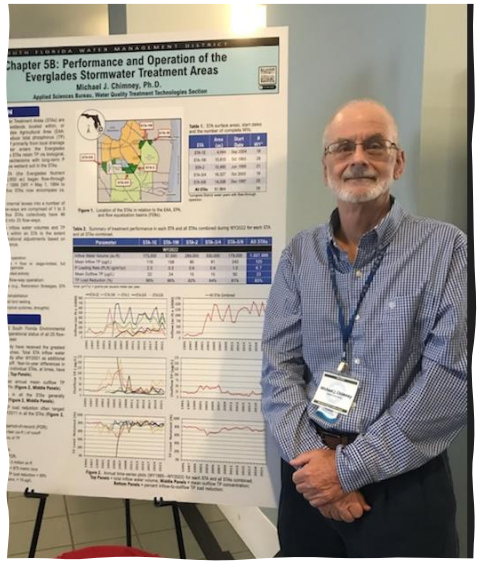
- **Objective**
  - Compile RSSP study results
  - Develop potential options to optimize P removal in the STAs
  - Determine gaps in research
- **Results**
  - Low TP outflow associated with:
    - Phosphorus loading rate < 1.3 g/m2/yr
    - No disturbances
    - Dense SAV
    - Active periphyton community
  - Biogeochemical and Food web models of STA-2 FW1 have been developed
  - Synthesizing results from a previous prescribed burn study in the Water Conservation Areas
- **Status**
  - Biogeochemical and Food Web model are being validated
  - Final synthesis document is being drafted

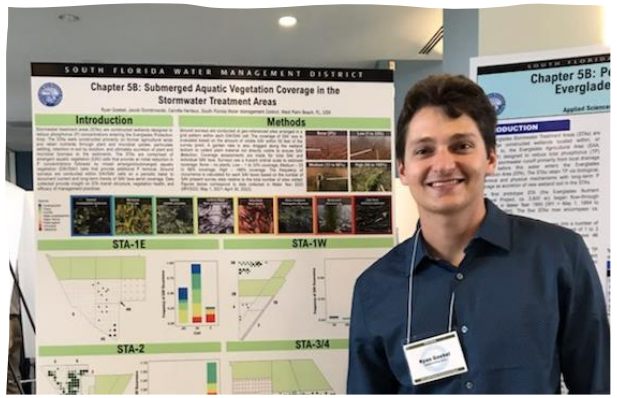


South Florida Environmental Report 2023

- **Chapter 5C Volume 1**
  - Soil Management
  - Tussock
  - Faunal
  - SAV Resilience
  - Biomarker
  - Marl
  - Periphyton
  - Data Integration
  - L-8 FEB
  - P Dynamics
  - Ecotope
  - Advective Transport
  - Landscape
- Poster session
  - Nutrient loadings (Chapter 5B)
  - SAV monitoring (Appendix 5B-4)
  - Restoration Strategies (Chapter 5C)







Greater Everglades Ecosystem Restoration Conference

- **29 presentations**

- **7 STA sessions**
  - Introduction
  - Vegetation
  - Dissolved organic matter
  - Innovative science
  - Legacy P
  - Modeling

Ecological Engineering Special Issue

➢ Twenty publications on STA Research

Amaral, J.H.F.; Gaddy, J.R.; Bianchi, T.S.; Osborne, T.Z.; Newman, S.; Dombrowski, J.; Morrison, E.S. 2023. Controls on the composition of dissolved organic matter in treatment wetland source waters of South Florida, USA. Ecological Engineering. 194, 107047

Armstrong, C.; Piccone, T.; Dombrowski, J. 2023. The largest constructed treatment wetland project in the world: The story of the Everglades stormwater treatment areas. Ecological Engineering. 193, 107005

Barton, M.B.; Goeke, J.A.; Dorn, N.J.; Cook, M.I.; Newman, S.; Trexler, J.C. 2023. Evaluation of the impact of aquatic-animal excretion on nutrient recycling and retention in stormwater treatment wetlands. Ecological Engineering. 197, 107104

Buchanan, A.C.; Inglett, P.W.; Judy, J.D. 2023. Ultrafine (< 0.45 µm) particulate SRP fluxes entering and leaving Everglades Stormwater Treatment Areas as a function of STA management and performance. Ecological Engineering. 194, 107043

Diaz, O.A.; Chimney, M.J.; Temple, N.A.; Vaughan, K.A.; Chen, H. 2023. Evaluation of water depth and inundation duration on *Typha domingensis* sustainability in the Everglades Stormwater treatment areas: A test cell study. Ecological Engineering. 195, 107081

Dombrowski, J.; King, J.; Powers, M.; Wilson, J. 2023. Biomass and nutrient storage of aquatic plants along phosphorus gradients in everglades stormwater treatment areas. Ecological Engineering. 195, 107080

Grace, K.; Juston, J.M.; DeBusk, T.A.; Piccone, T. 2023. Mesocosm studies clarify effects of external and internal phosphorus (P) loads to treatment wetlands at lower limits of P removal. Ecological Engineering. 194, 107048

Hu, J.; Baiser, B.; James, R.T.; Reddy, K.R. 2024. An analysis of long-term Everglades Stormwater Treatment Areas performance using structural equation models. Ecological Engineering. 198, 107130

Hu, J.; Vardanyan, L.G.; Villapando, O.; Bhomia, R.; Inglett, P.W.; Li, X.; Feng, G.; Reddy, K.R. 2023. Seasonal and spatial patterns of surface water quality in large-scale treatment wetlands with different vegetation communities. Ecological Engineering. 197, 107125

James, R.T.; Chimney, M.J.; Armstrong, C.; Piccone, T.; King, J.; White, J.R.; Reddy, K.R. 2024. Everglades Stormwater Treatment Area Research: Synthesis, Conclusions, and Potential Management Options. Ecological Engineering,

Jerauld, M.; Dierberg, F.; DeBusk, T.; Jackson, S.; Grace, K.; Juston, J. 2024. The role of calcium and alkalinity on phosphorus removal by submerged aquatic vegetation in hardwater wetlands. Ecological Engineering. 198, 107129

Larios, K.; Gerber, S.; Muñoz-Carpena, R.; Inglett, P.; Reddy, K.R.; Chimney, M. 2024. Effects of increasing complexity in biogeochemistry and hydrology on variability of total phosphorus concentration in models of a low flow subtropical wetland. Ecological Engineering. 198, 107131

Pietro, K.C.; Inglett, K.; Wright, A. 2023. Periphyton enzymatic activities in the water column along internal low-phosphorus nutrient gradients in the Everglades Stormwater Treatment Areas. Ecological Engineering. 196, 107100

Powers, M.; Zamorano, M.F.; Chimney, M.J. 2023. Assessment of a diel phosphorus pattern's potential to benefit phosphorus retention in the stormwater treatment areas. Ecological Engineering. 197, 107108

Reddy. K. R, C. Armstrong, M. J. Chimney, and J. R. White. 2024. Stormwater Treatment Areas of the Everglades Ecosystem: Science and Applications. Ecological Engineering.

Schafer, T.B.; Julian, P.; Villapando, O.; Osborne, T.Z. 2023. Abiotic mineralization of dissolved organic phosphorus for improved nutrient retention in a large-scale treatment wetland system. Ecological Engineering. 195, 107078

Toumasis, N.; Simms, D.; Rust, W.; Harris, J.; White, J.R.; Zawadzkal, J.; Corstanje, R. 2024. Emerging Resilience metrics in an intensely managed ecological system. Ecological Engineering,

VanZomeren, C.M.; Bhomia, R.K.; Tfaily, M.M.; Inglett, K.S.; Cooper, W.Tstormwater treatment area (PSTA). Ecological Engineering. 194, 107046.; White, J.R.; Reddy, K.R. 2024. Influence of Vegetation on Soil Organic Nitrogen Composition and Mineralization in a Subtropical Wetland. Ecological Engineering,

Villapando, O.; Reddy, K.; King, J. 2024. Biogeochemical response of subtropical treatment wetlands to different flow conditions. Ecological Engineering. 198, 107127

Zamorano, M.F.; Piccone, T.; Chimney, M.J.; James, R.T.; Grace, K.A.; Zhao, H. 2023. History and performance of the Everglades STA-3/4 periphyton-based stormwater treatment area (PSTA). Ecological Engineering. 194, 107046

CONTACT INFORMATION

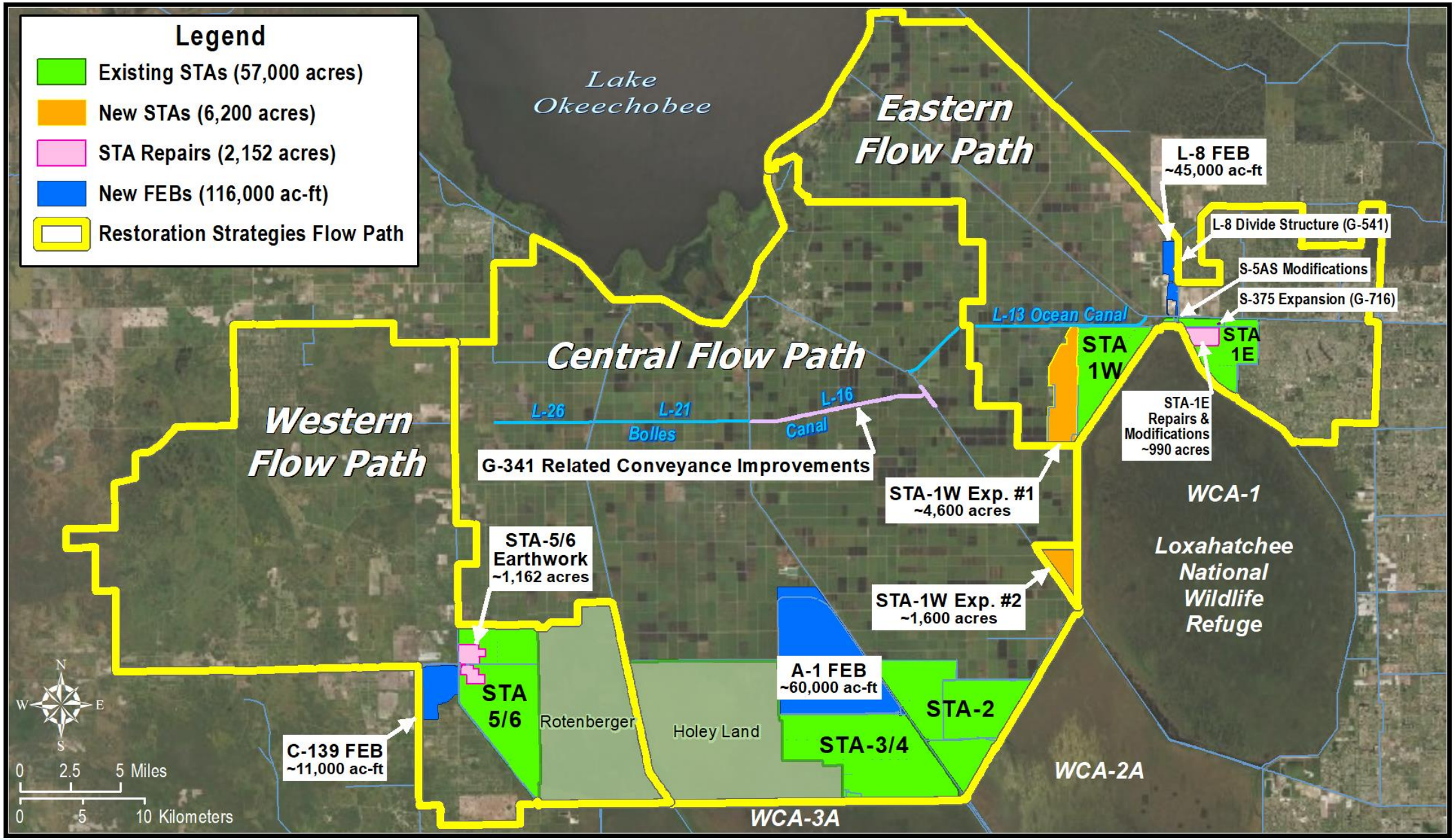
Restoration Strategies

Engineering & Construction Update

Alexis San-Miguel, P.E.
Project Management Section Administrator
Engineering & Construction Bureau

21st Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins

February 26, 2024


Legend
Existing STAs (57,000 acres)
New STAs (6,200 acres)
STA Repairs (2,152 acres)
New FEBs (116,000 ac-ft)
Restoration Strategies Flow Path
Lake Okeechobee
Eastern Flow Path
Central Flow Path
Western Flow Path
L-8 FEB
~45,000 ac-ft
L-8 Divide Structure (G-541)
S-5AS Modifications
S-375 Expansion (G-716)
L-13 Ocean Canal
STA 1W
STA 1E
STA-1E Repairs & Modifications ~990 acres
L-26
L-21
Bolles
L-16
Canal
G-341 Related Conveyance Improvements
STA-1W Exp. #1
~4,600 acres
WCA-1
Loxahatchee National Wildlife Refuge
STA-5/6 Earthwork
~1,162 acres
STA-1W Exp. #2
~1,600 acres
A-1 FEB
~60,000 ac-ft
STA 5/6
Rotenberger
Holey Land
STA-2
STA-3/4
C-139 FEB
~11,000 ac-ft
WCA-2A
WCA-3A
N
W
E
S
0 2.5 5 Miles
0 5 10 Kilometers

Restoration Strategies Project Status

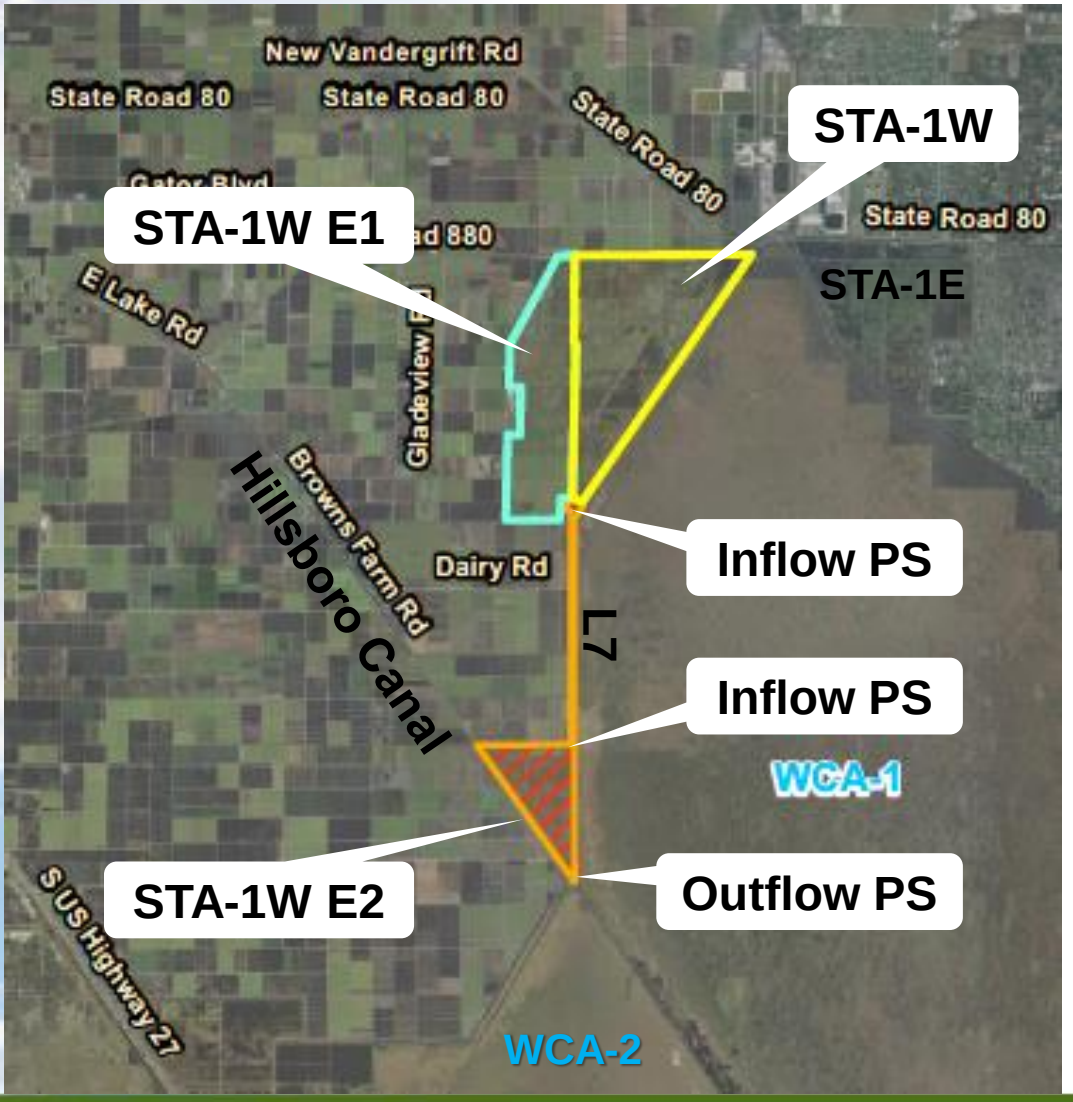
Completed Construction:

- STA2 Expansion Compartment B
- STA 5/6 Expansion Compartment C
- S-5AS Modifications
- L-8 FEB
- A-1 FEB
- L-8 Divide Structure (G-541)
- S-375 Expansion (G-716)
- STA 5/6 Earthwork ***Optimization***
- STA-1W Expansion #1
- G-341 Segments 1 – 5
- STA-1E Repair

Ongoing:

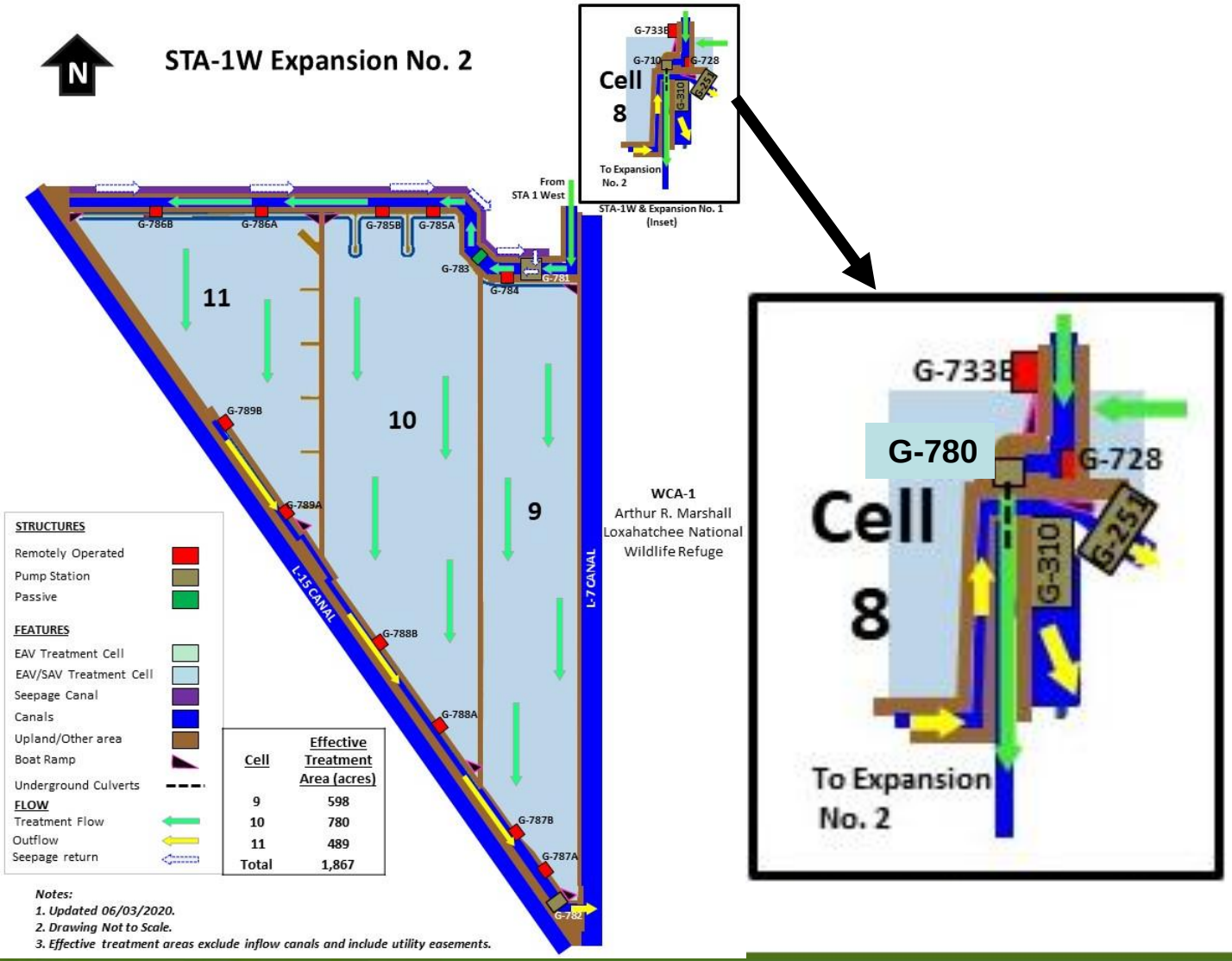
- STA-1W Expansion #2 ***Construction***
- C-139 FEB ***Construction***

STA-1W Expansion No. 2



- Purpose is to extend treatment flow-ways for STA-1W
- Overall Construction Cost $214M
- Features 1,600 acres of additional treatment area
- Inflows from S-5A and C-51 West Basins via STA-1W
- Outflow to Water Conservation Area 1

STA-1W Expansion No. 2
Schedule of Construction



- Underground Piping Complete
  - Construction Complete - December 2020
- STA and Connector Canal
  - Start Construction - September 2020
  - 98% Complete
- Inflow Pump Stations (G780 & G781)
- Start Construction – December 2020
  - 60% Complete
- Outflow Pump Station (G782)
  - Start Construction – December 2020
  - 60% Complete

STA-1W Expansion No. 2
STA Civil Works

Concrete Conveyance Canal and G-781

North Inflow Canal and STA Cells

STA-1W Expansion No. 2
Inflow Pump Stations

G-780 & Intake Channel

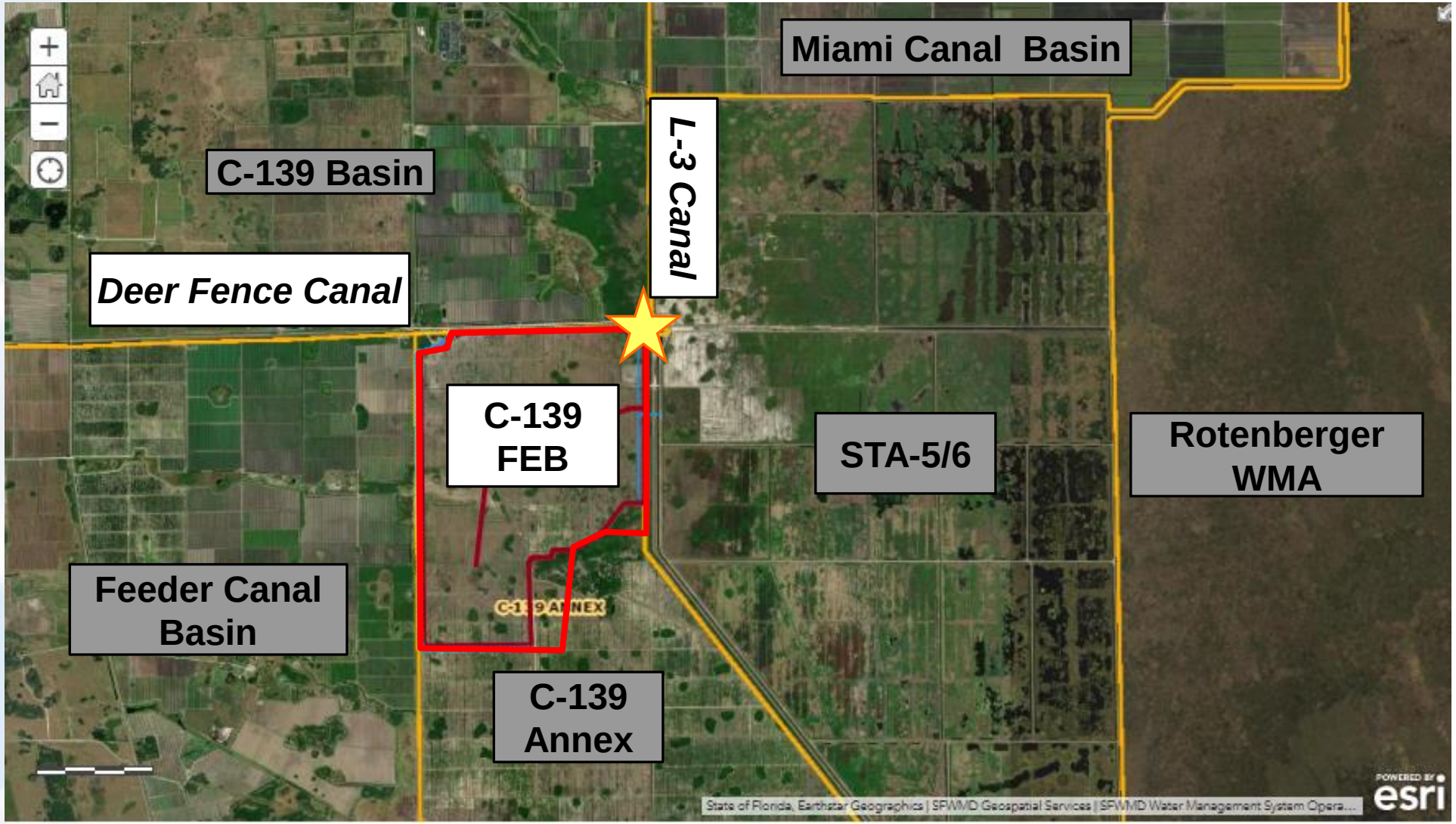
G-781, Lined Channel & STA Intake Channel

STA-1W Expansion No. 2
Outflow Pump Station

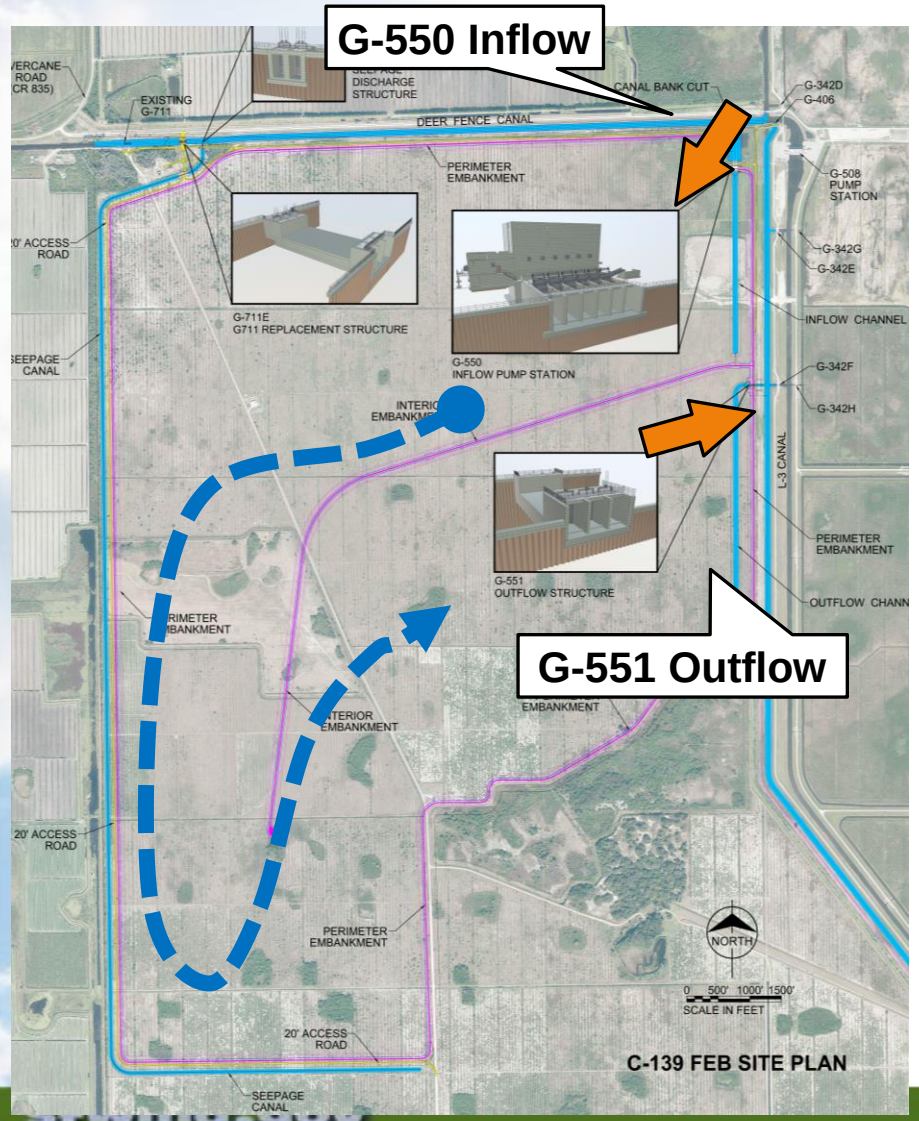
G-782 Electrical Bldg Wall Construction

G-782 & Discharge to WCA-1

C-139 Flow Equalization Basin



C-139 Flow Equalization Basin



- Overall Project - 98% Complete
- G550 Pump Station - 96% Complete
- G551 Outflow Structure – 98% Complete
- G552 Seepage Structure-95%
- G711E Control Structure-95%
- Flow Equalization Basin-Complete

C-139 Flow Equalization Basin

G-550 Pump Station

G-551 Outflow Structure

C-139 Flow Equalization Basin

G-552 Seepage Control Structure

G-711E Control Structure

EASTERN FLOW PATH

STA-1W Expansion #2 (100864)

Activity	Deadline	
Complete land acquisition	3/31/2018	✓
Initiate design	10/1/2018	✓
Submit state and federal permit applications	8/1/2019	✓
Complete design	7/31/2020	✓
Initiate construction	11/30/2020	✓
Construction status report	3/1/2021	✓
Construction status report	3/1/2022	✓
Complete construction	**12/31/2022**	
Initial flooding and optimization period complete	12/31/2024	

STA-1W Expansion #1 (100818)

COMPLETE

Activity	Deadline	
Complete land acquisition	9/30/2013	✓
Initiate design	9/30/2013	✓
Submit state and federal permit applications	7/30/2014	✓
Complete design	7/30/2015	✓
Initiate construction	1/31/2016	✓
Construction status report	3/1/2017	✓
Construction status report	3/1/2018	✓
Complete construction	12/31/2018	✓
Initial flooding and optimization period complete	12/31/2020	✓

STA-1E Repairs and Modifications

COMPLETE

Activity	Deadline	
PSTA Decommissioning complete	12/31/2022	✓
Culvert repairs complete	12/31/2022	✓
Cell 5 and 7 improvements complete	12/31/2022	✓

L-8 FEB (100813)

COMPLETE

Activity	Deadline	
Submit state and federal permit applications	1/31/2014	✓
Construction status report	3/1/2014	✓
Construction status report	3/1/2015	✓
Complete construction (begin multi-purpose ops)	12/31/2016	✓
Long term operations commence	12/31/2022	✓

G-341 Related Conveyance Improvements (100802)

COMPLETE

Activity	Deadline	
Initiate design	10/1/2020	✓
Submit state and federal permit applications	8/1/2021	✓
Complete land acquisition (if required)	9/30/2021	✓
Complete design	7/31/2022	✓
Initiate construction	11/30/2022	✓
Construction status report	3/1/2023	✓
Construction status report	3/1/2024	✓
Complete construction	12/31/2024	✓

L-8 Divide Structure (100817)

COMPLETE

Activity	Deadline	
Initiate design	10/1/2012	✓
Complete design	9/30/2014	✓
Initiate construction	10/1/2016	✓
Complete construction	9/30/2018	✓

S-5AS Modifications (100822)

COMPLETE

Activity	Deadline	
Initiate design	10/1/2012	✓
Complete design	9/30/2014	✓
Initiate construction	10/1/2014	✓
Complete construction	9/30/2016	✓

S-375 Expansion (100819)

COMPLETE

Activity	Deadline	
Initiate design	9/30/2013	✓
Complete design	7/30/2015	✓
Initiate construction	1/31/2016	✓
Complete construction	12/31/2018	✓

LEGEND

- Flow Equalization Basin
- Stormwater Treatment Area
- Conveyance Improvement
- ✓ Complete

Projects Complete = 10 of 13
Activities Complete = 69 of 74
% Activities Complete = 93 %
% Time Complete = 85 %

CENTRAL FLOW PATH

STA-2 Expansion: Compartment B

COMPLETE

Activity	Deadline	
Initial flooding and optimization period complete	5/31/2014	✓

A-1 FEB (100706)

COMPLETE

Activity	Deadline	
Initiate design	4/1/2012	✓
Submit state and federal permit applications	12/1/2012	✓
Design status report	3/1/2013	✓
Complete design	8/1/2013	✓
Initiate construction	6/30/2014	✓
Construction status report	3/1/2015	✓
Construction status report	3/1/2016	✓
Complete construction	7/30/2016	✓
Operational monitoring and testing period complete	7/29/2018	✓

WESTERN FLOW PATH

STA-5/6 Internal Improvements (100868)

Activity	Deadline	
Initiate design	10/31/2019	✓
Submit state and federal permit applications	8/30/2020	✓
Complete design	10/31/2021	✓
Initiate construction	1/31/2022	✓
Construction status report	3/1/2023	✓
Construction status report	3/1/2024	✓
Complete construction	12/31/2024	✓
Initial flooding and optimization period complete	**12/31/2025**	

STA-5/6 Expansion: Compartment C

COMPLETE

Activity	Deadline	
Initial flooding and optimization period complete	5/31/2014	✓

C-139 FEB (100867)

Activity	Deadline	
Initiate design	10/31/2018	✓
Submit state and federal permit applications	8/30/2019	✓
Complete design	10/31/2020	✓
Initiate construction	1/31/2021	✓
Construction status report	3/1/2021	✓
Construction status report	3/1/2022	✓
Construction status report	3/1/2023	✓
Complete construction	**12/31/2023**	
Operational monitoring and testing period complete	12/31/2024	

CONTACT INFORMATION

asanmigu@sfwmd.gov

SOUTHERN EVERGLADES NUTRIENT SOURCE CONTROL PROGRAM UPDATE

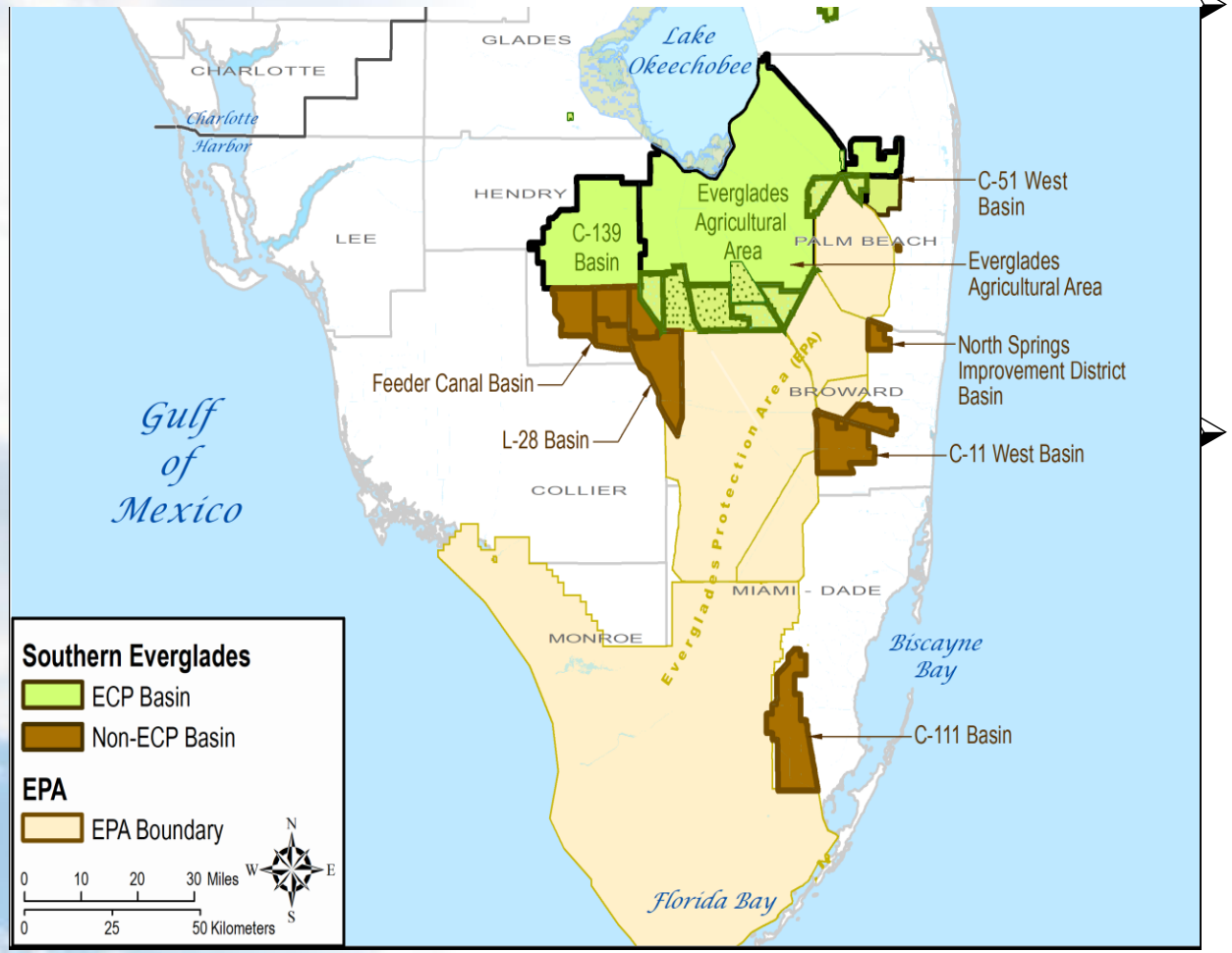
Youchao Wang, Ph.D., P.E.
Lead Engineer
Everglades and Estuaries Protection

21st Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins

February 26, 2024

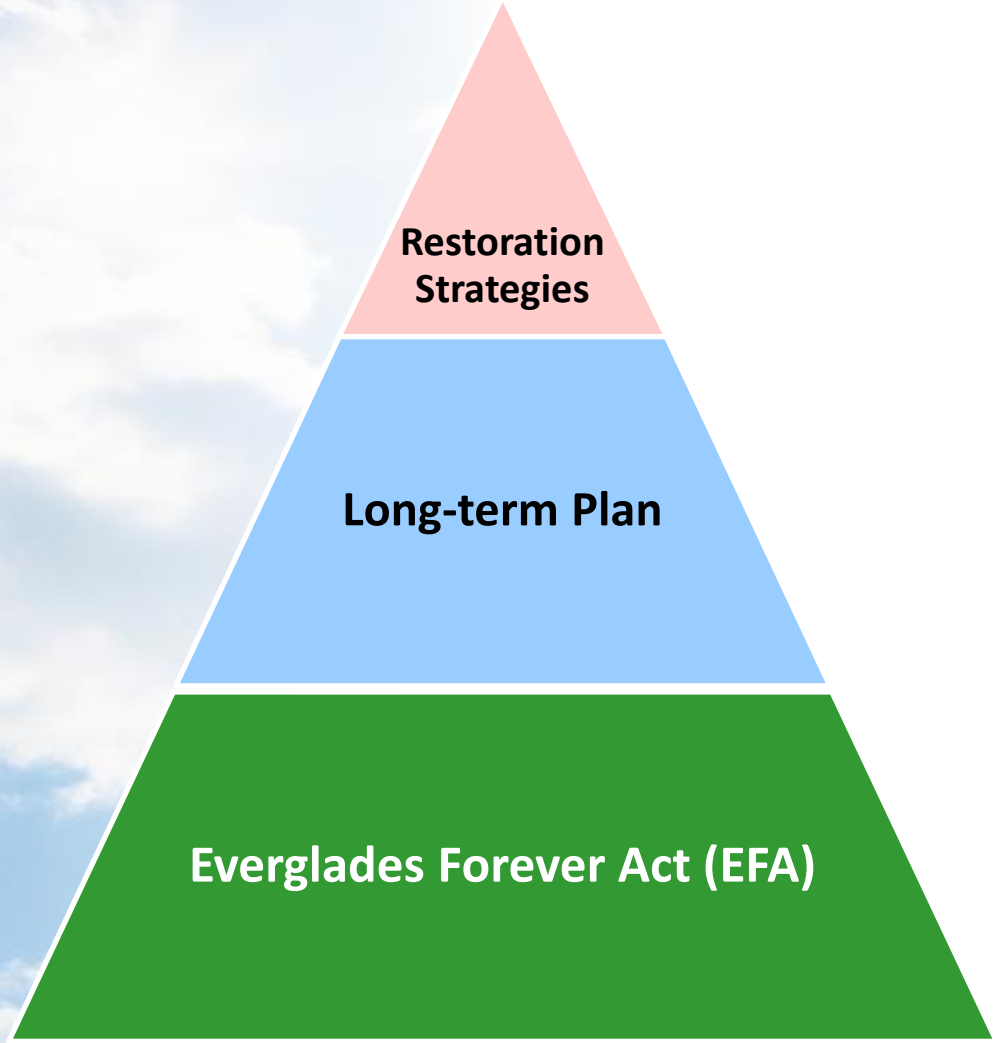
SOURCE CONTROL PROGRAMS

BASINS TRIBUTARY TO THE EVERGLADES



- **Everglades Construction Project (ECP) Basins**
  - Everglades Agricultural Area (EAA)
  - C-139
  - C-51 West /ACME
- **Non-ECP Basins**
  - Feeder Canal
  - L-28
  - North Springs Improvement District (NSID)
  - C-11 West
  - C-111

LONG-TERM PLAN PROJECT OBJECTIVES

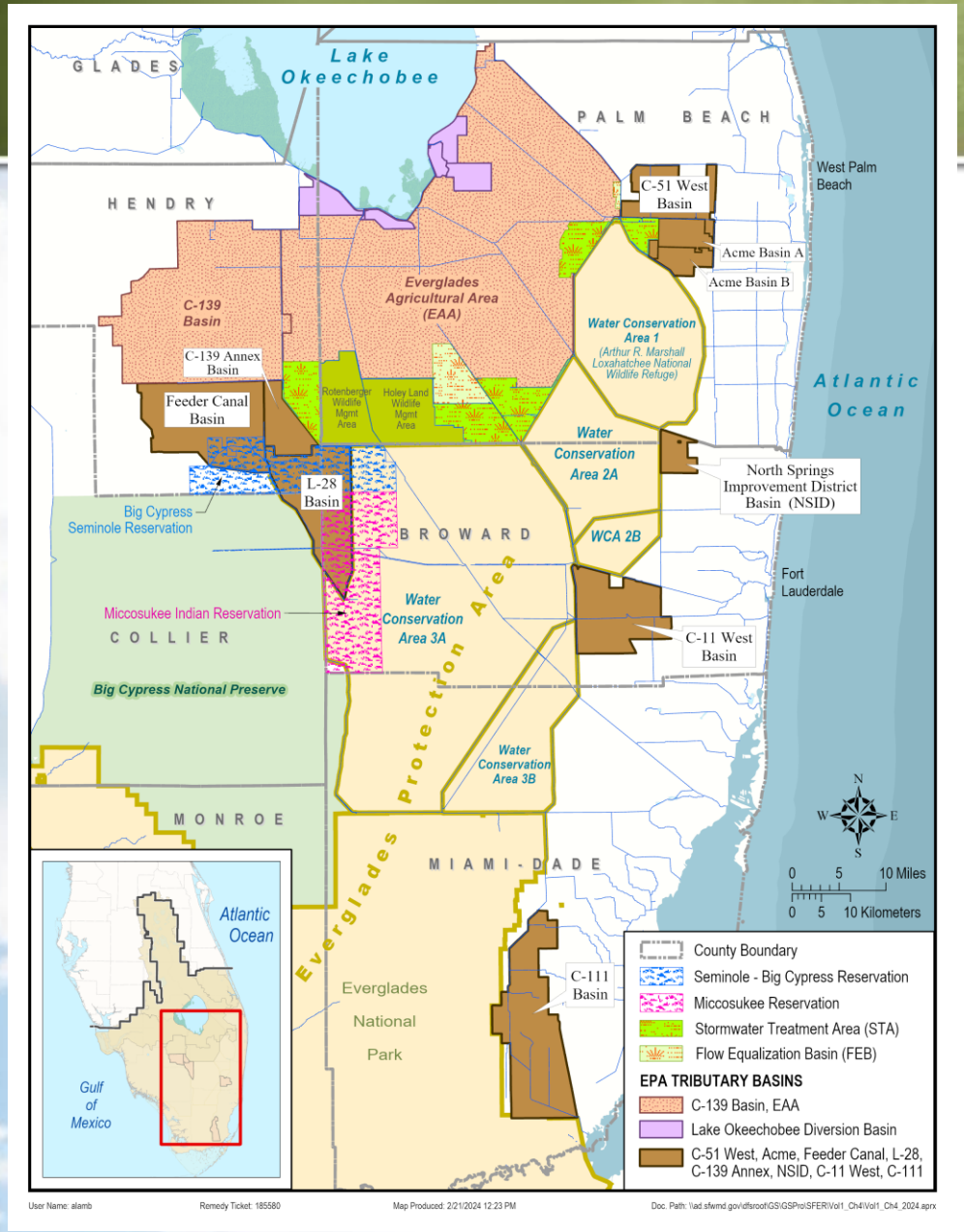


The Long-Term Plan recommends activities designed to:

"***Maintain and improve*** *upon the contribution of source controls to overall water quality improvement goals."*

Specifically:

- **Identify** discharges that are candidates for implementation of **cost-effective** source controls
- Characterize management practices on lands or processes tributary to those discharges
- Implement these source controls **in concert with** landowners or municipalities



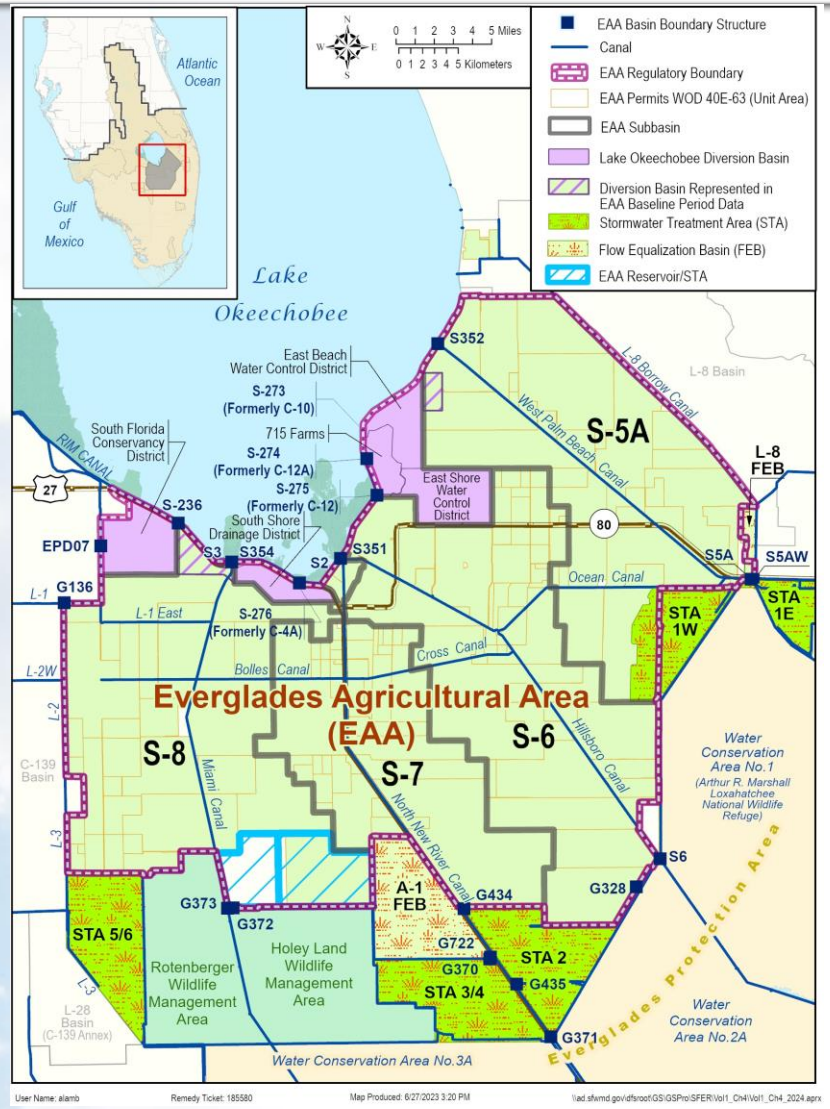
CONTENTS

- **EAA and C-139 Basins**
  - Regulatory compliance and activities
  - Research and demonstration projects
  - Sub-regional source control projects
- **Other Tributary Basins**
  - Regulatory and cooperative activities
  - Environmental Resource Permit (ERP) integration

TOTAL PHOSPHORUS (TP) RUNOFF DATA BY BASIN

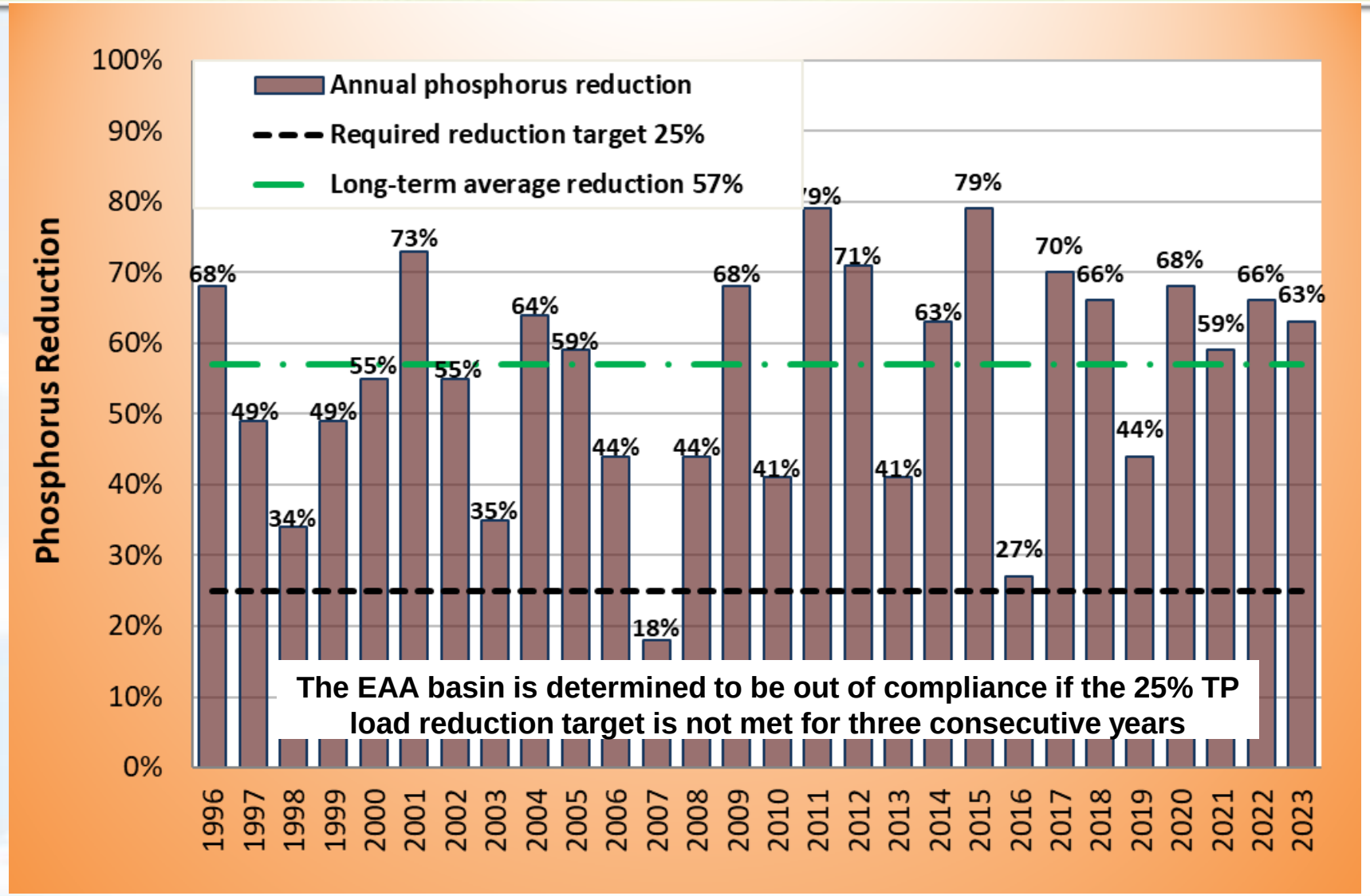
Basin	Receiving Water Body	WY2023 TP Load (metric tons)	WY2023 TP FWMC (µg/L)
Everglades Agricultural Area (EAA)	STAs and Lake Okeechobee	138	118
C-139	STA 5/6 and EAA	56	272
C-51 West (incl. Acme Improvement District)	STA-1E, C-51 East Basin, and WCA-1	13	111
Feeder Canal	WCA-3A	10	121
L-28	WCA-3A	10	96
C-11 West	WCA-3A	6	19
C-111 ✖	ENP	4	9
North Springs Improvement District (NSID)	WCA-2A	0	-

EAA BASIN SOURCE CONTROL PROGRAMS



- EAA Basin level water quality compliance
- Permit level compliance
- Research and demonstration projects
  - EAA Environmental Protection District (EAAEPD) Research Master Permit
- Sub-regional source control projects (S-5A Sub-basin)

EAA BASIN LEVEL COMPLIANCE



EAA PERMIT LEVEL COMPLIANCE

- Comprehensive best management practices (BMP) plan
- Permittee water quality monitoring plan
- Post-permit compliance activities

Nutrient Management

Controlled application

Water Management

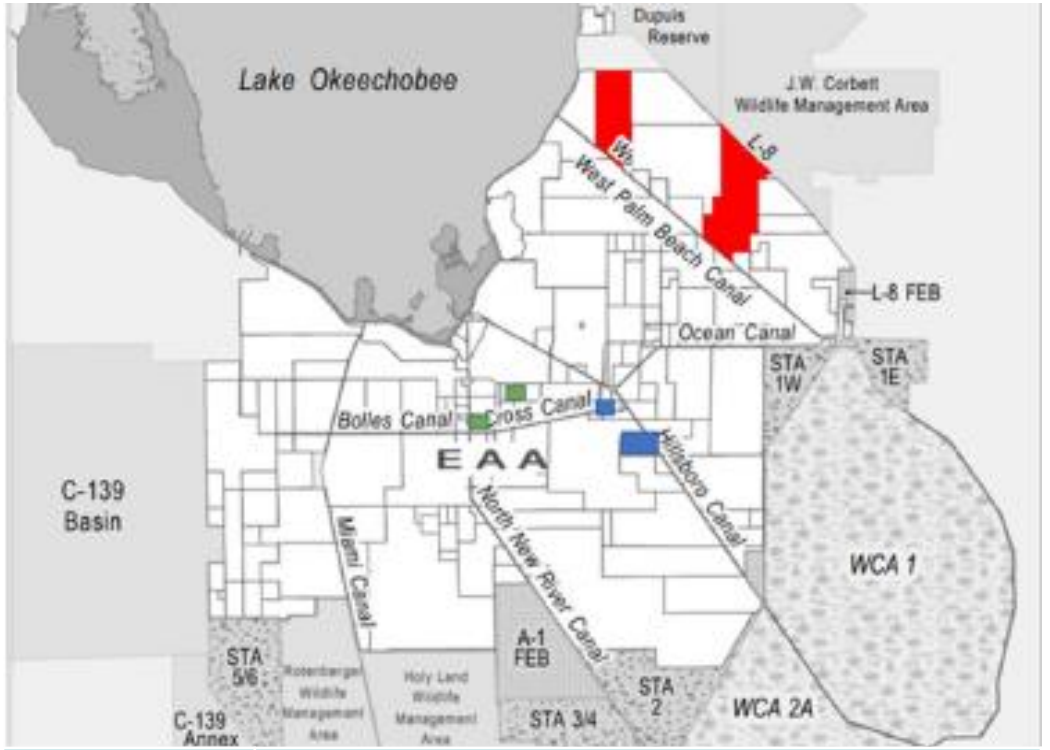
Water control structure

Particulate Matter and Sediment Controls

Canal cleaning, sumps and vegetated banks

EAA BMP MASTER RESEARCH PERMIT

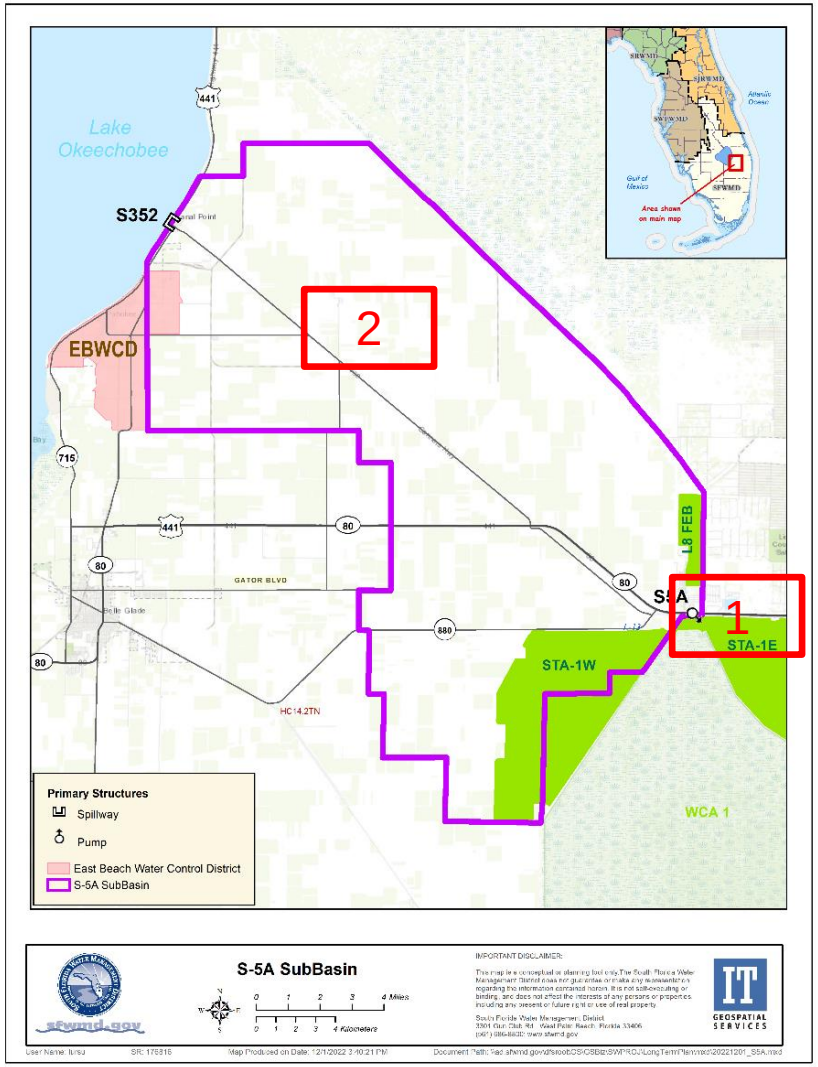
- The Everglades Forever Act (EFA) requires a comprehensive program of research, field testing and implementation of BMPs.
- A 5-year EAA-EPD Master Research Permit was issued in September 2020.
- This research evaluates performance differences between EAA farm basins with similar BMPs.
- Six farms were selected for this research project that started in October 2020.
- Third interim annual report completed in July 2023.



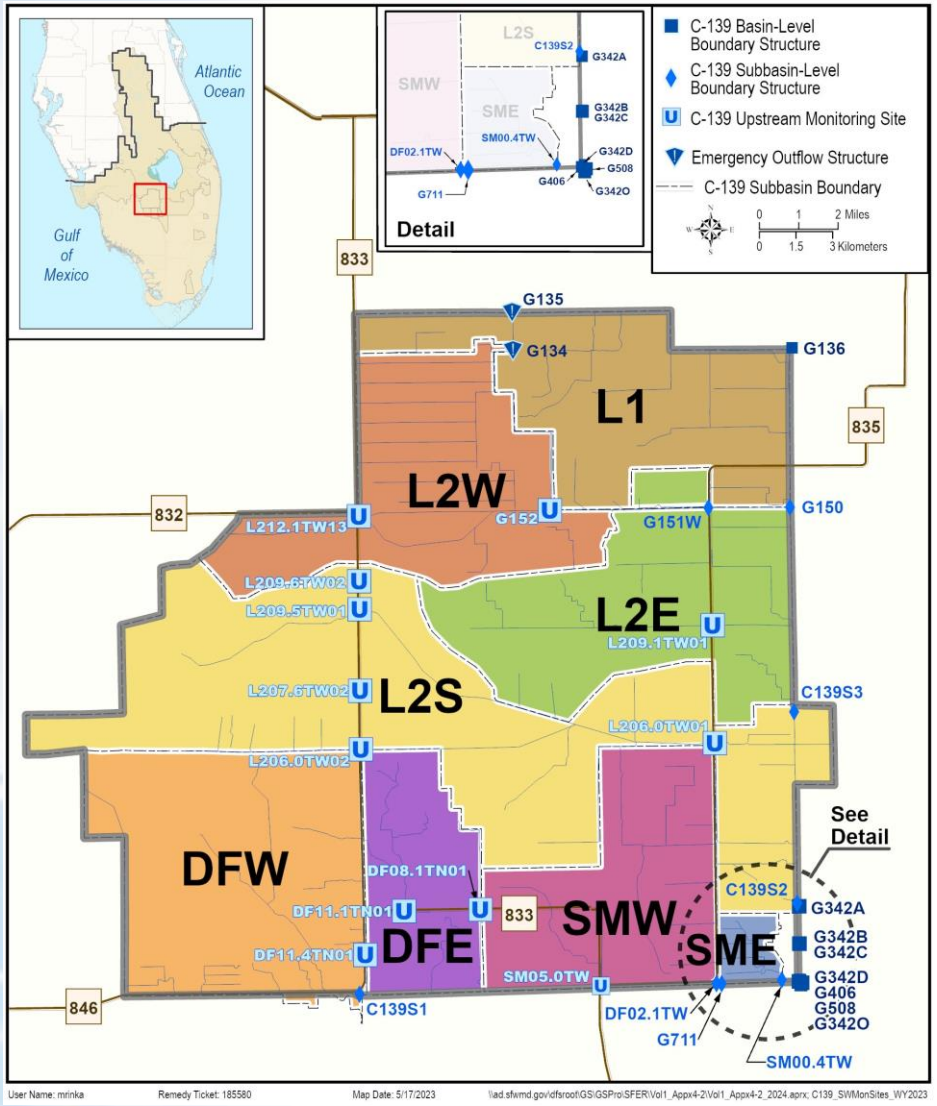
Legend	Farm Basin ID
	50-018-01 and 50-018-03
	50-028-01 and 50-048-01
	50-061-07 and 50-061-12

SUB-REGIONAL SOURCE CONTROL PROJECTS

- "Supplement" existing regulatory BMP program
- Control phosphorus discharges upstream of STA-1E and STA-1W (Eastern Flow Path)
- Currently, two sub-regional source control projects are under consideration
  1. Investigation of West Palm Beach Canal dredging project to avoid sediment resuspension.
  2. East Beach Water Control District load reduction project.

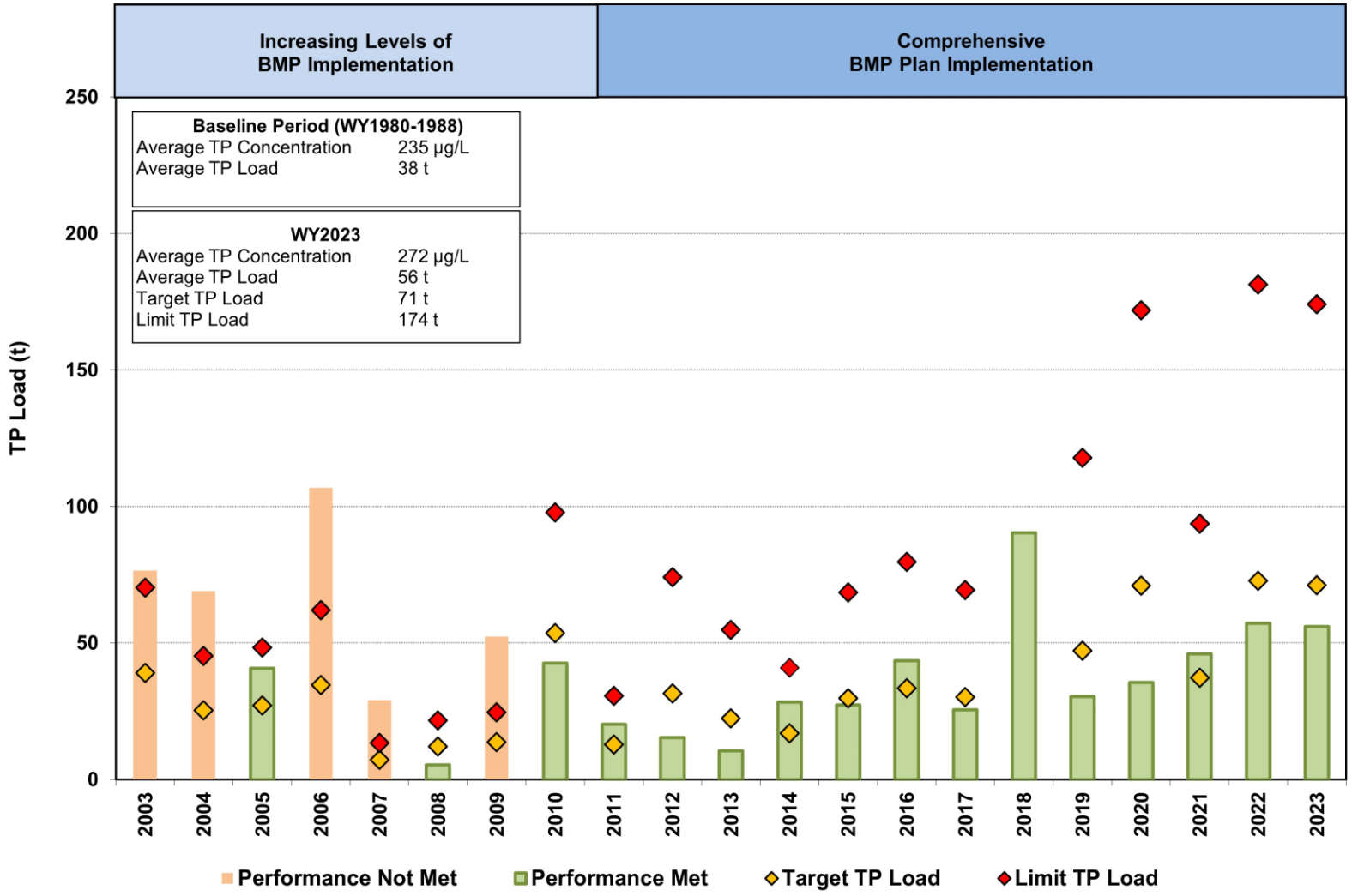


C-139 BASIN SOURCE CONTROL PROGRAMS

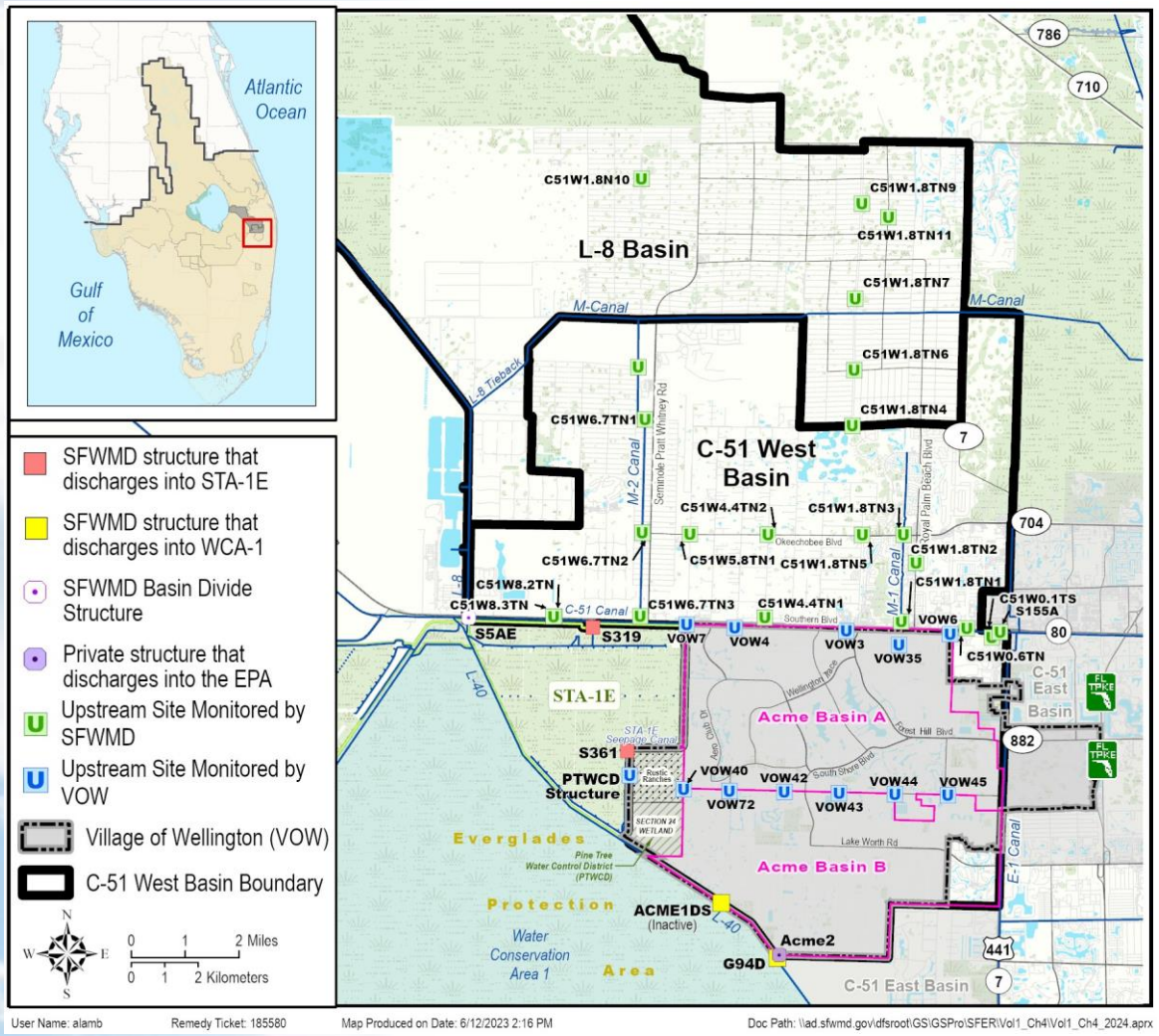


- Basin-level water quality compliance
- Sub-basin water quality monitoring
  - Upstream water quality monitoring
  - Post-permit compliance activities

C-139 BASIN LEVEL COMPLIANCE

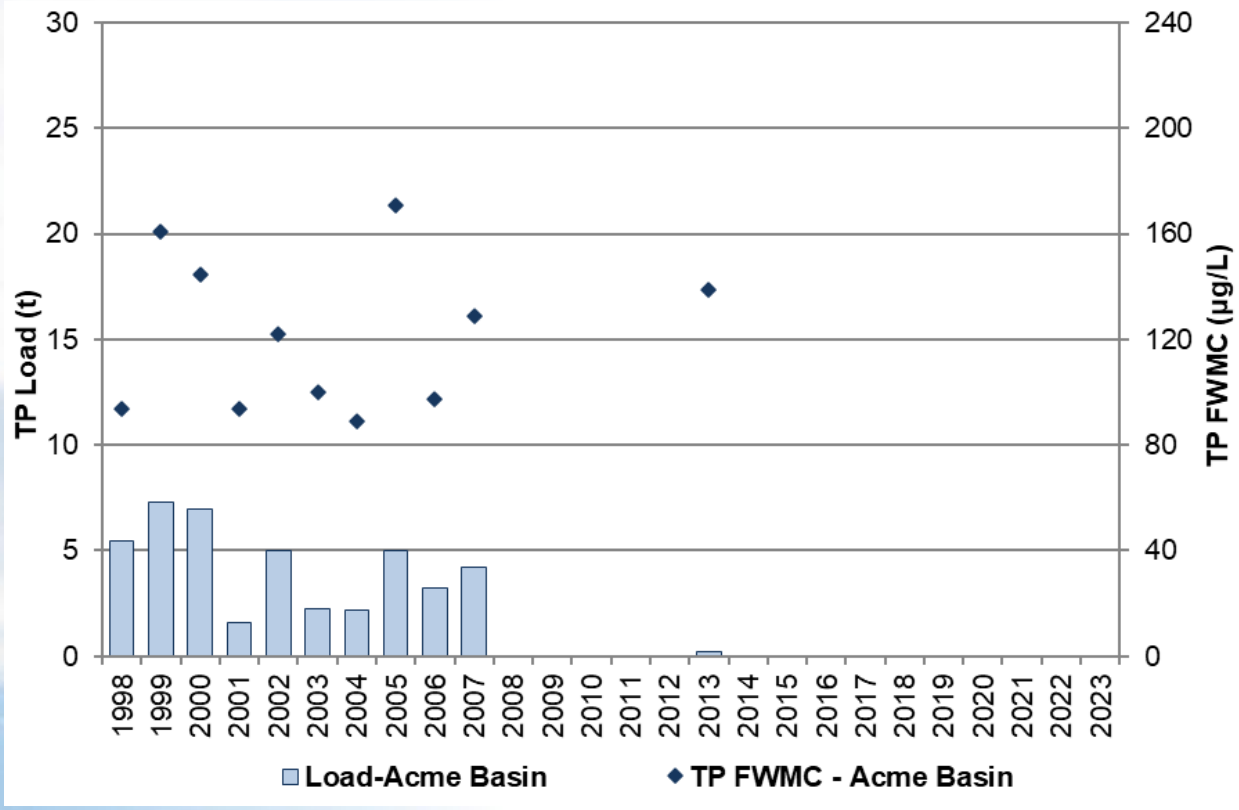


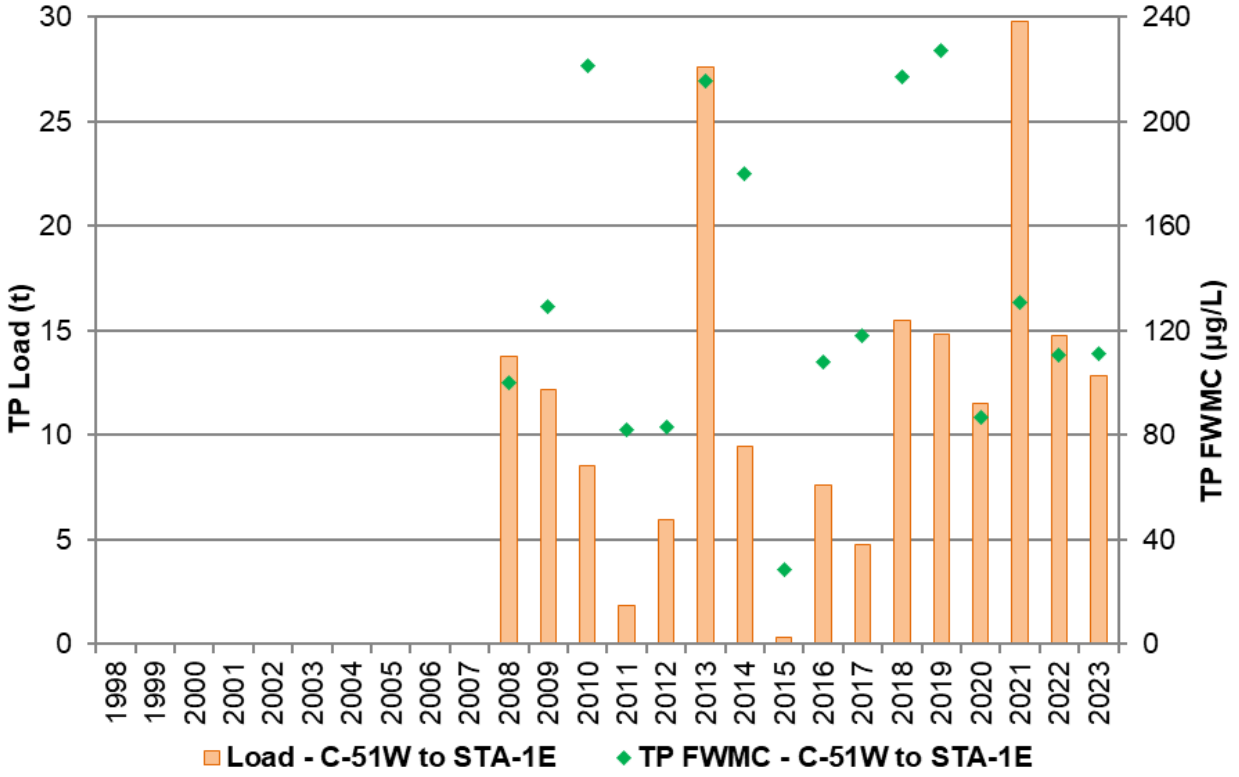
C-51 WEST AND ACME BASIN



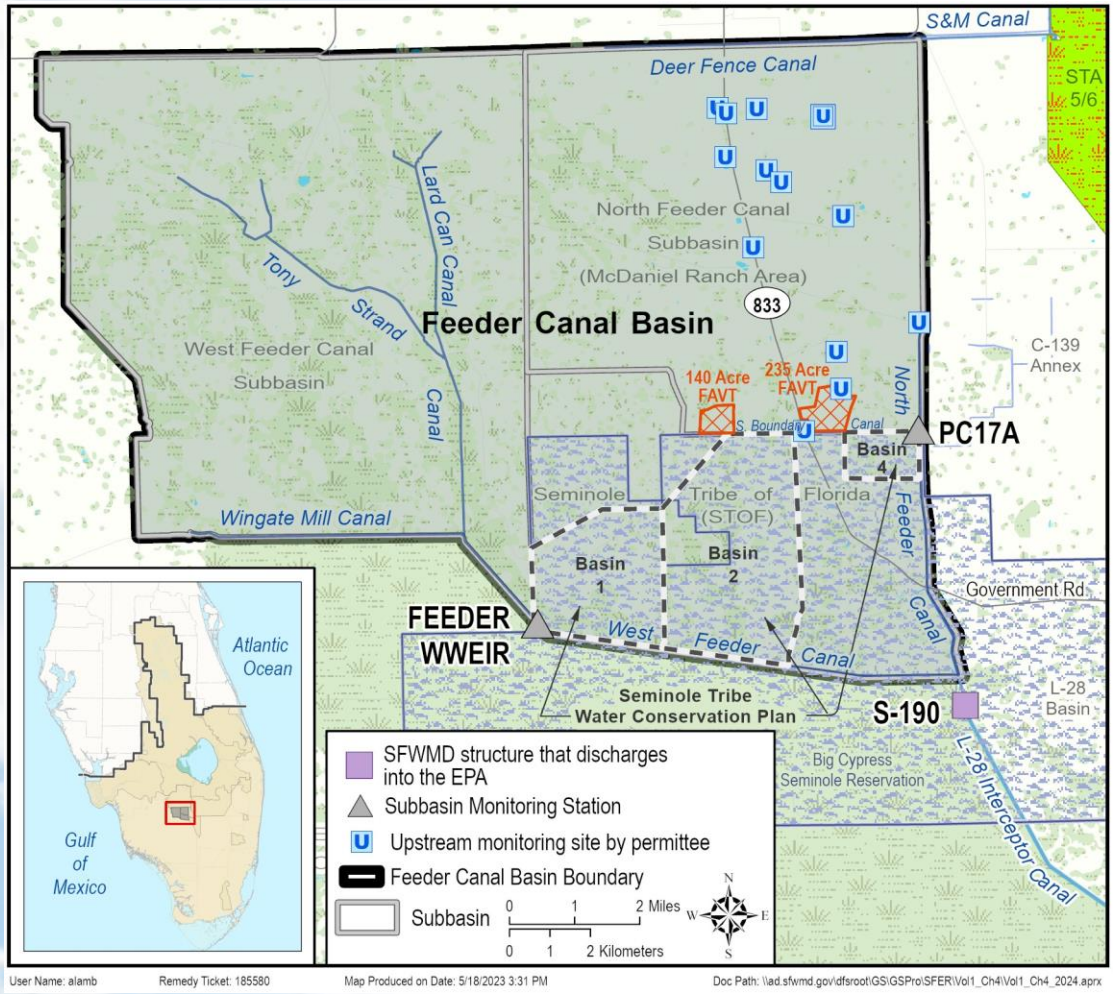
- ERPs and ordinances in Village of Wellington include conditions that require
  - BMPs and livestock waste storage and disposal requirements in coordination with FDACS
  - Water quality monitoring program throughout the Acme basin (U markers)
- Additional sampling has been implemented by SFWMD in areas north of the C-51 West Canal (U markers)

C-51 WEST AND ACME BASIN



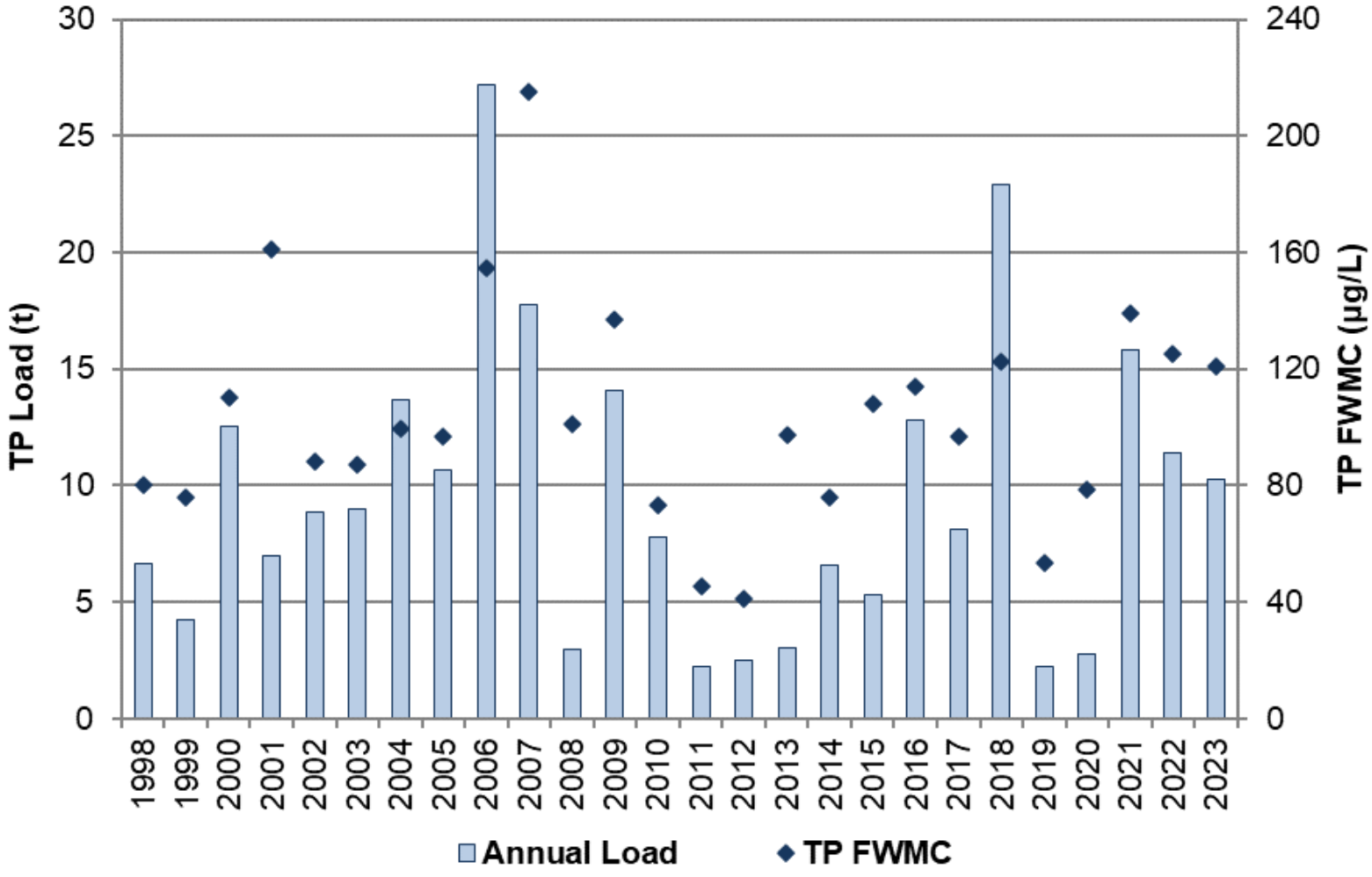


FEEDER CANAL BASIN

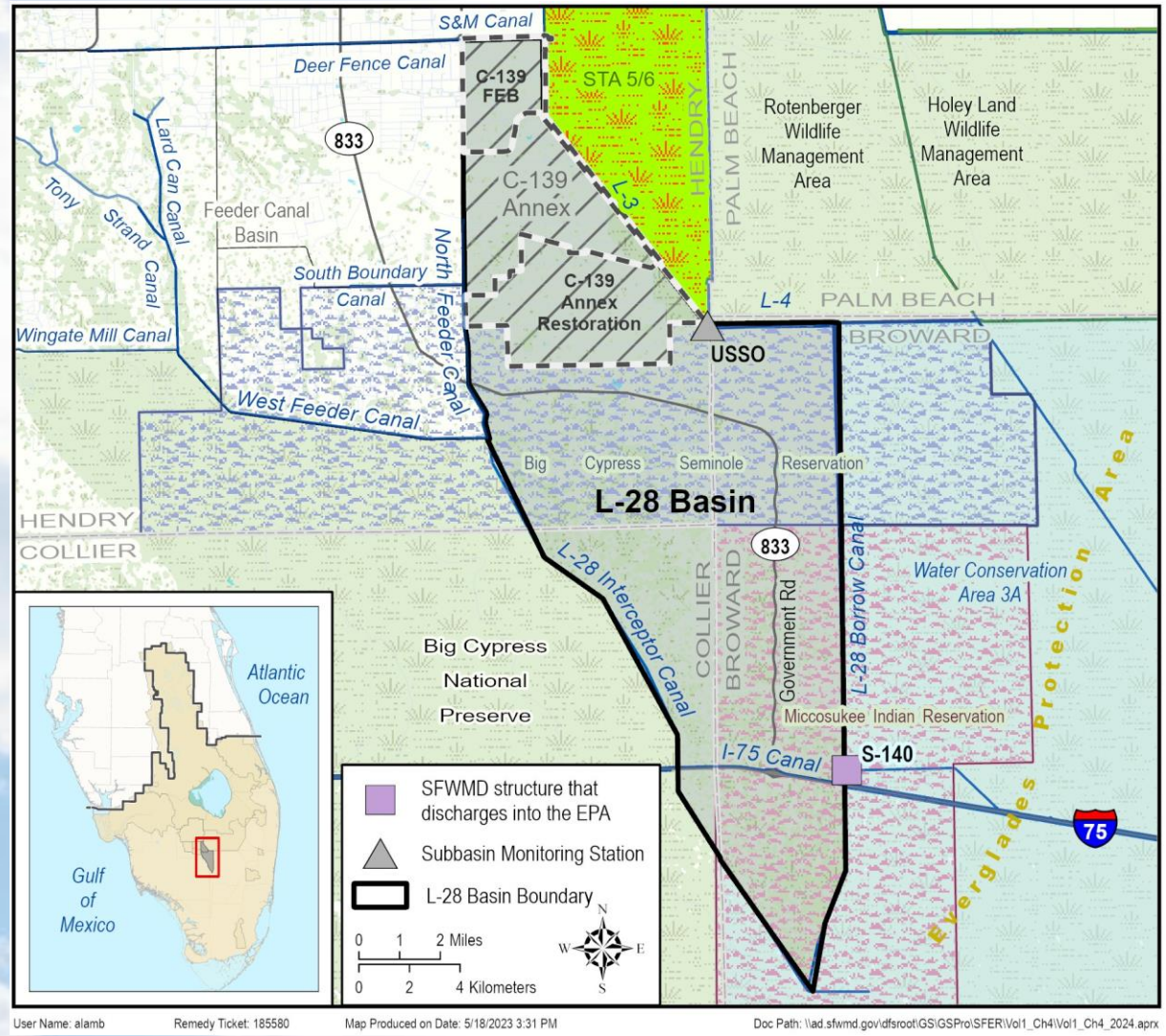


- North Feeder Subbasin:
  - Landowner ERPs require BMPs and water quality monitoring
  - Voluntary FAV tilling projects
- West Feeder Subbasin:
  - Landowners can enroll in the FDACS BMP program.
- CERP Big Cypress/L-28 Interceptor Modification (WERP)

FEEDER CANAL BASIN

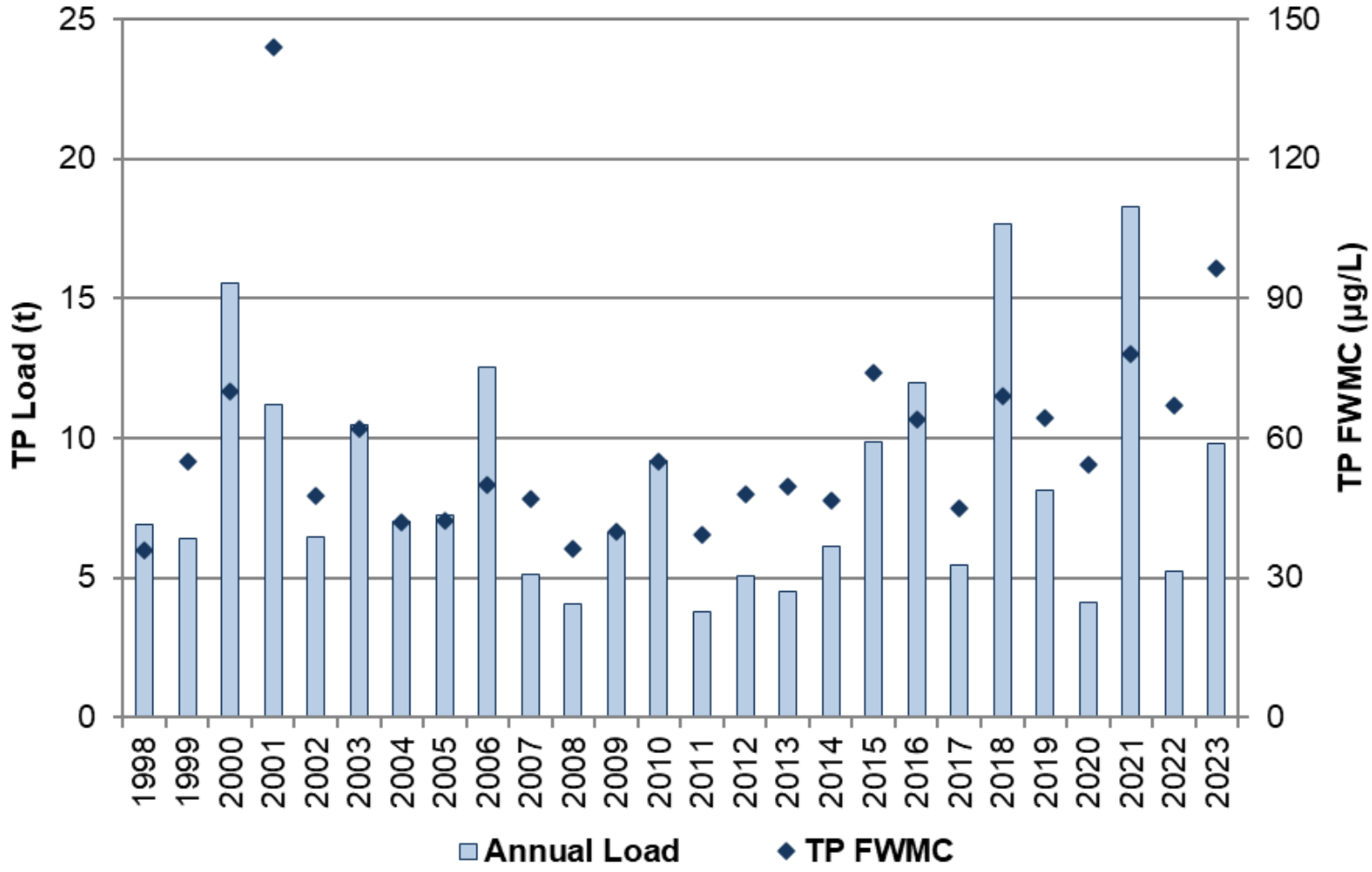


L-28 BASIN

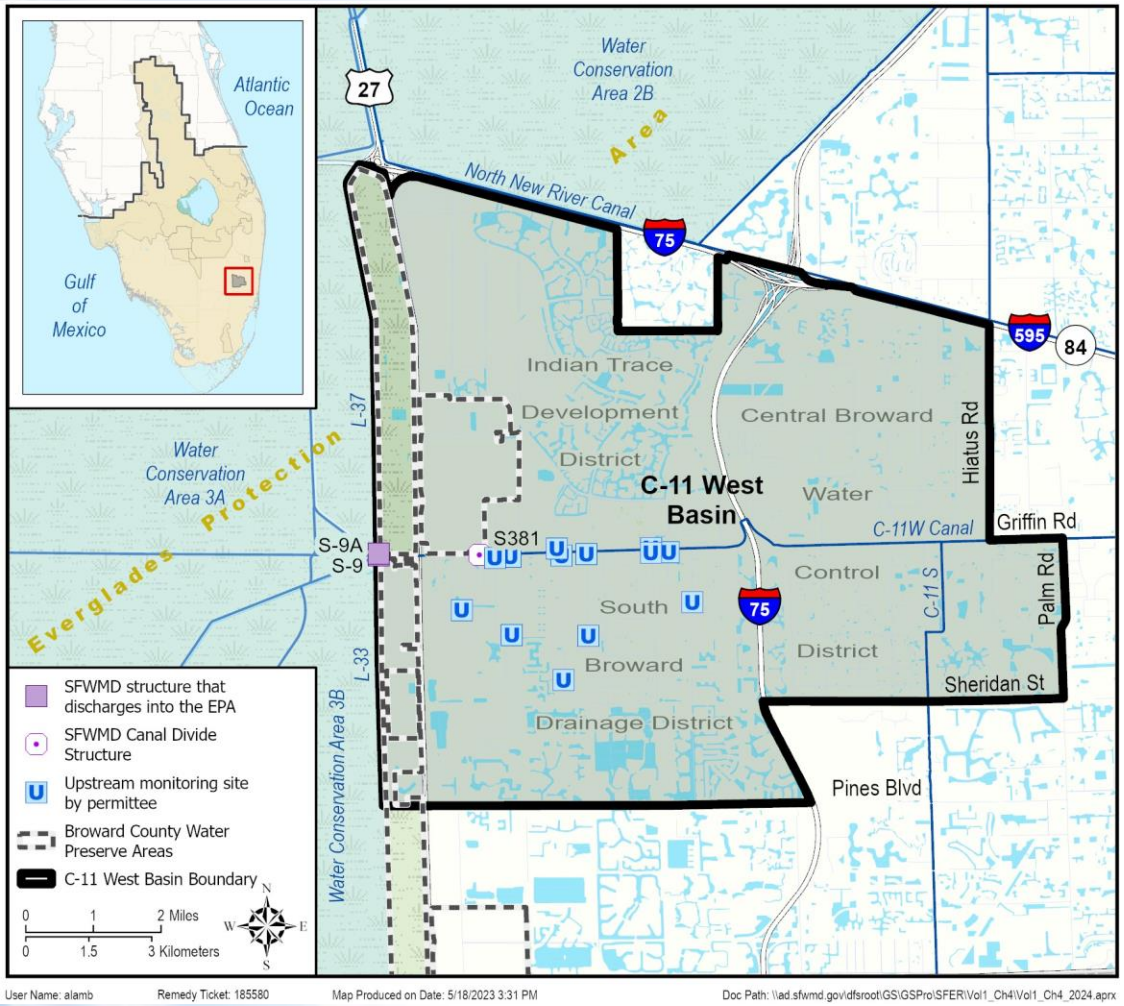


- ERP Southern Gardens Groves in the C-139 Annex includes conditions for BMPs
- CERP projects:
  - CERP Big Cypress/L-28 Interceptor Modification (WERP)
- Other basin projects:
  - C-139 Flow Equalization Basin
  - Sam Jones/Abiaki Prairie Restoration

L-28 BASIN

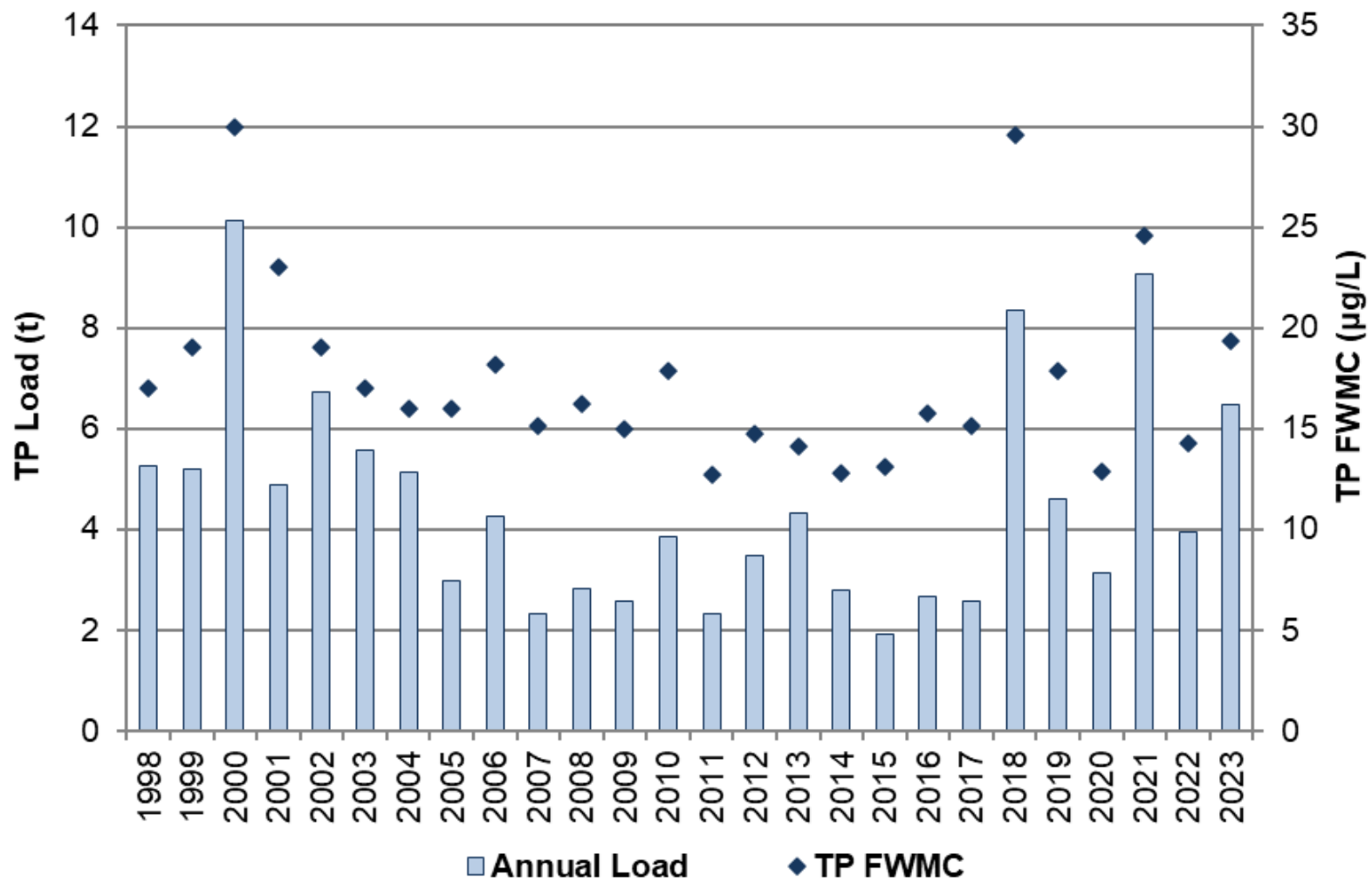

TP Load (t)
TP FWMC (µg/L)
0
5
10
15
20
25
0
30
60
90
120
150
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Annual Load
TP FWMC

C-11W BASIN

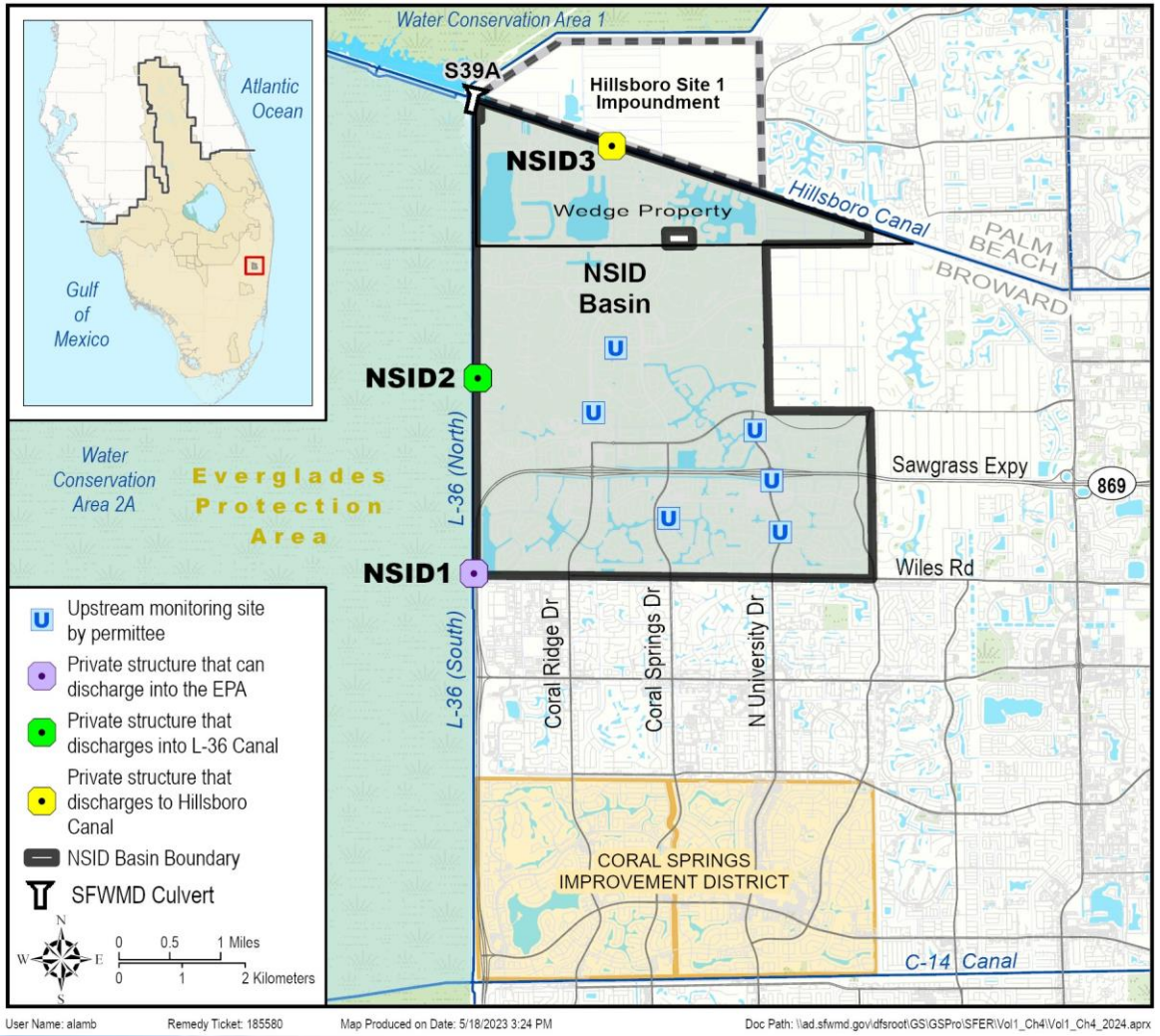


- ERPs issued to water control districts include conditions for BMPs including optimized detention of runoff and water quality monitoring
- CERP project:
  - CERP Broward County Water Preserve Area Project.

C-11W BASIN

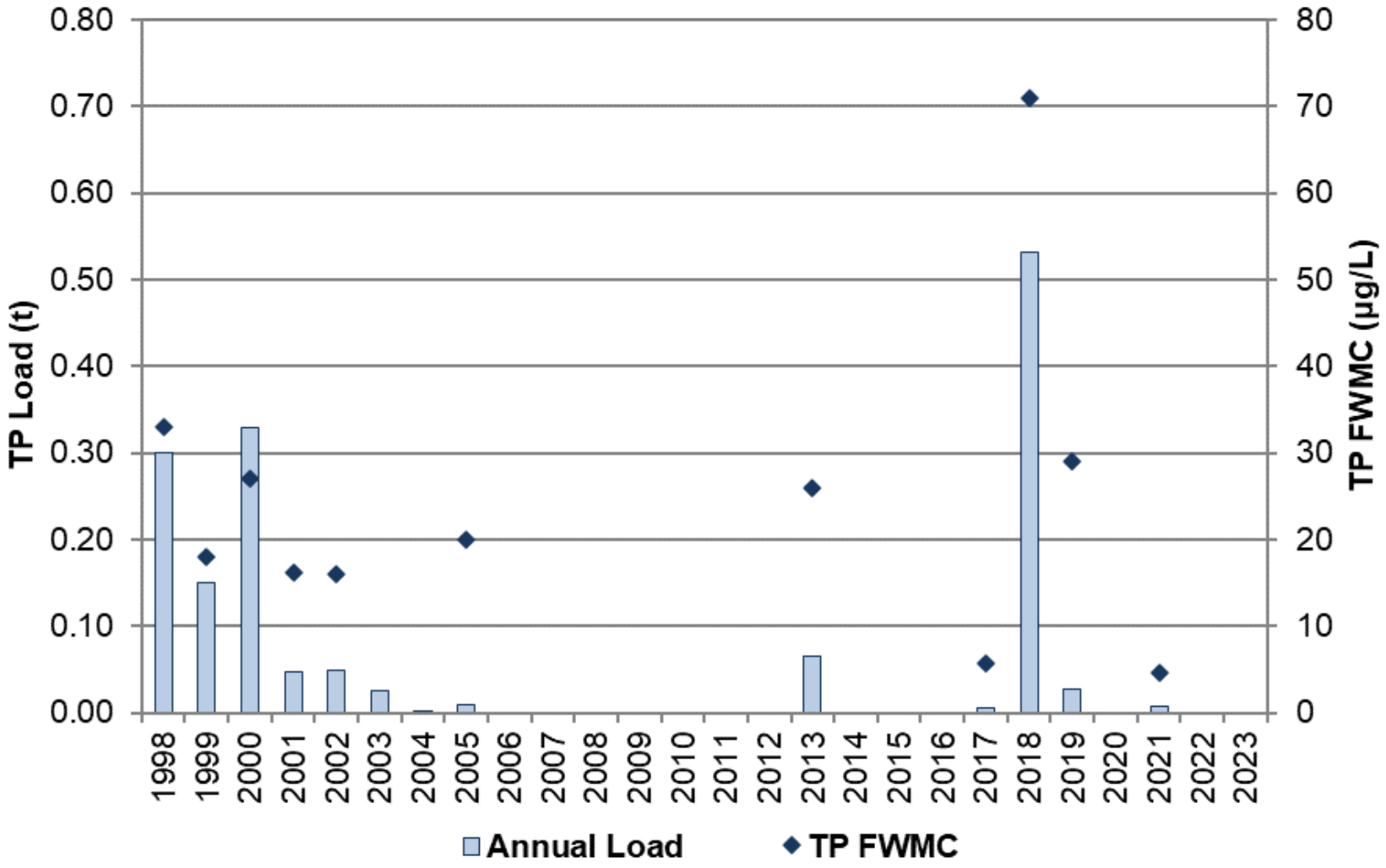

TP Load (t)
TP FWMC (µg/L)
0
2
4
6
8
10
12
14
0
5
10
15
20
25
30
35
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Annual Load
TP FWMC

NSID BASIN



- ERPs issued to NSID include conditions requiring BMPs implementation, water quality reporting, and phosphorus load limits for discharges to WCA-2A.
- CERP project:
  - CERP Hillsboro Site 1 Impoundment Phase 2 needs congressional authorization before moving forward

NSID BASIN


0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
TP Load (t)
80
70
60
50
40
30
20
10
0
TP FWMC (µg/L)
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Annual Load
TP FWMC

SUMMARY

- For the EAA basin, WY2023 TP load reduction is 63%. With the WY2023 results, the 28-year average annual TP load reduction for the program is 57%.
- For the C-139 basin WY 2023 remained in compliance, the measured runoff TP load is below the target phosphorus load.
- For the other tributary basins during WY2023, voluntary BMP implementation and progress toward the completion of CERP projects continued.
- The continued success of and ongoing improvements to the Southern Everglades source control program rely on verifying BMP implementation, continuing meaningful research and tracking program performance based on WQ data and basin-specific metrics.

ADDITIONAL INFORMATION

CHAPTER 4:
NUTRIENT SOURCE CONTROL PROGRAMS
IN THE SOUTHERN EVERGLADES

www.sfwmd.gov/sfer

CONTACT INFORMATION

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Public Use on SFWMD Stormwater Treatment Areas

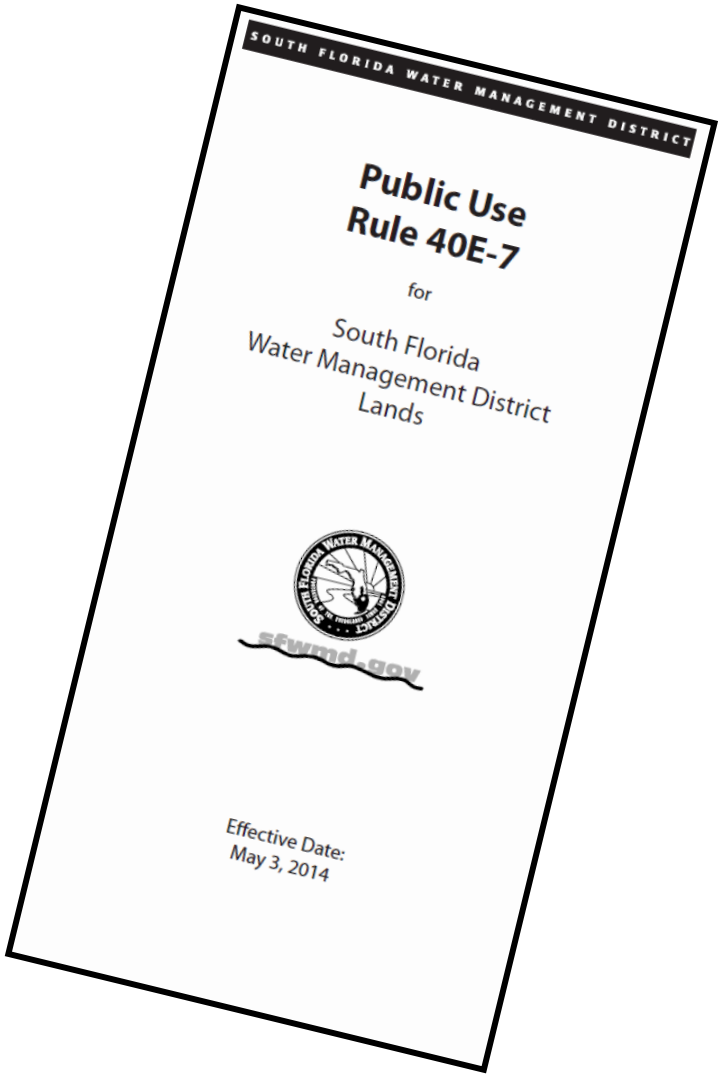
Dan Cotter
Section Leader
Land Resources Bureau

21st Annual Public Meeting on the Long-term Plan for Achieving Water Quality Goals for the Everglades Protection Area Tributary Basins

Mission

- **Why have Public Use?**
- **Florida Statutes 373.4592 - Everglades improvement and management …** These lands shall be made available for recreational use unless … such uses are incompatible with the restoration goals of the Everglades Construction Project or the water quality and hydrological purposes of the STAs or would otherwise adversely impact the implementation of the project.

- **Florida Administrative Code: 40E - 7**



Nature Based Recreation Types

- **Nature based recreation from levees**
  - Hiking
  - Wildlife Viewing
  - Biking
  - Day use picnic
  - Fishing
- **Recreation within cells**
  - Hunting

Partnerships

- **SFWMD**
  - Responsibility to provide recreation opportunities
- **Stakeholders/Partners**
  - Florida Fish and Wildlife Conservation Commission - FWC
  - Florida National Scenic Trail - FNST
  - Audubon Society
  - Conservation/Recreation Clubs
    - i.e. - United Waterfowlers of Florida
    - S. Florida Amateur Astronomer Assoc
    - Many others

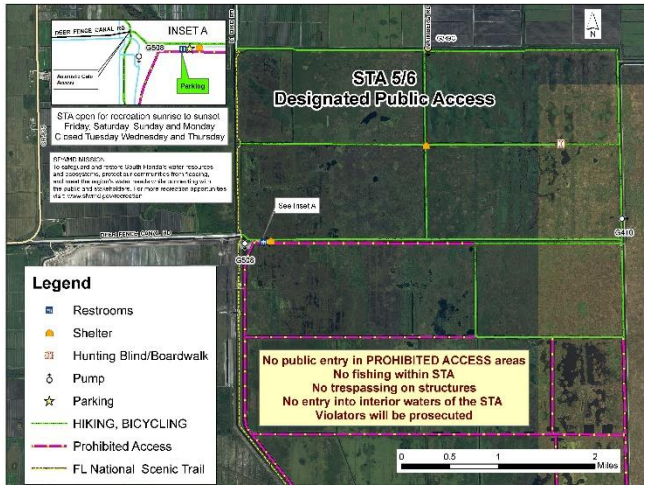
Nature Based Recreation

- **Guided Wildlife Viewing**
  - STA - 5/6
    - Hendry Glades Audubon
  - STA - 1E
    - Everglades Audubon
- **Hiking/Biking**
  - All STA's
    - Fri - Mon


STA 5/6 – L1

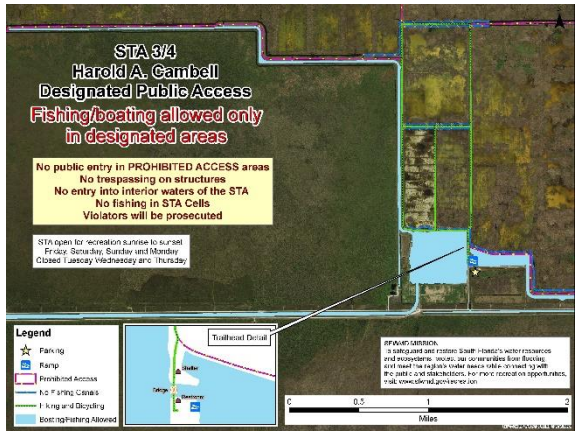

STA-2 Flamingos


STA5/6



Nature Based Recreation

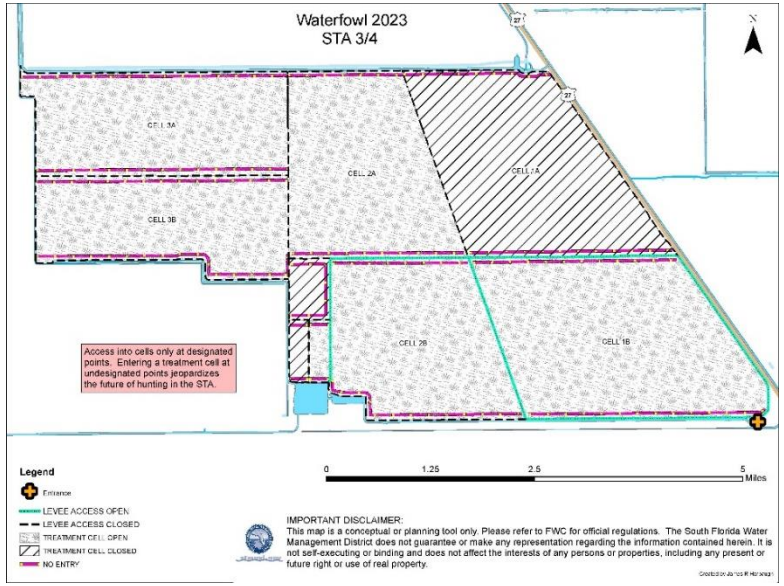
- **FWC quota hunt**
  - Waterfowl & Alligator
    - Access into cells limited
      - Designated access points
- **FWC Youth Hunt Program**
- **Other specialty hunts**
  - Wounded Warrior Hunts
  - Federal Youth Waterfowl Hunt

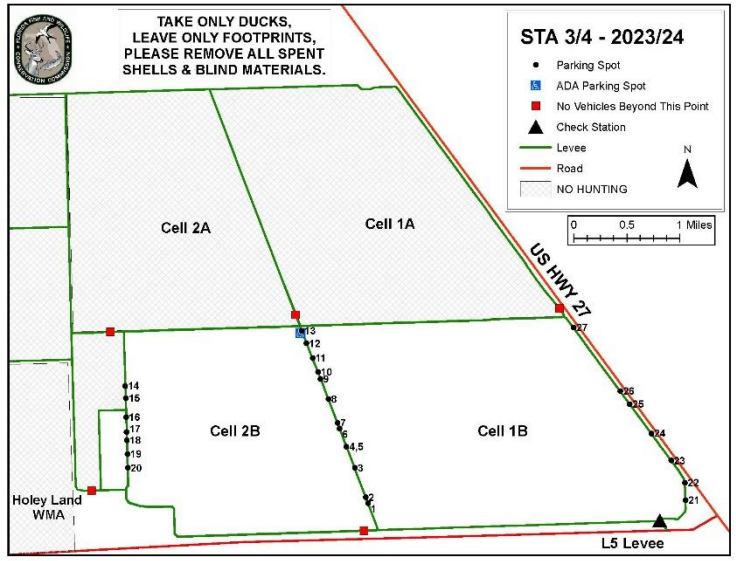


- **Fishing outside project area**
  - i.e. Discharge canals
  - STA - 1E & 1W
    - Bank fishing
  - STA - 3/4, Harold Campbell
    - Motorboat access
    - Non impacting

STA Function vs Public Use

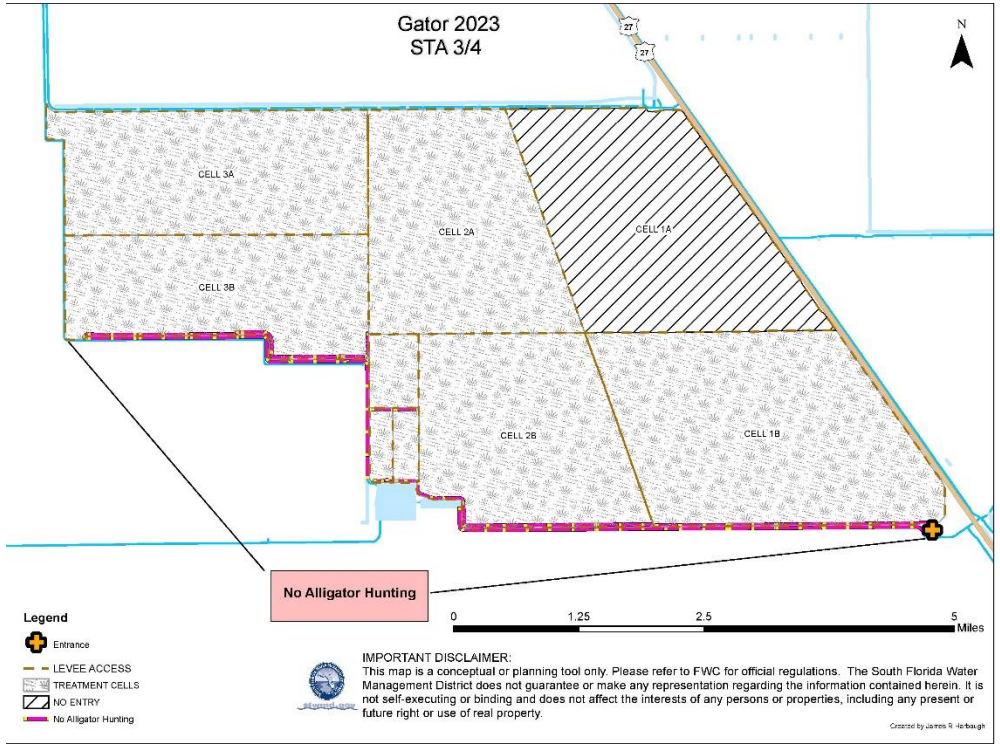
- **A working property**
  - Engineered Restoration
    - Aquatic vegetation management to improve water quality
  - **Internal consultation for access**
    - Field Operations
      - Public access hours
      - Fri - Mon
    - Land Stewardship
      - T/E Wildlife
    - Veg Management Team
    - Construction - Project Manager





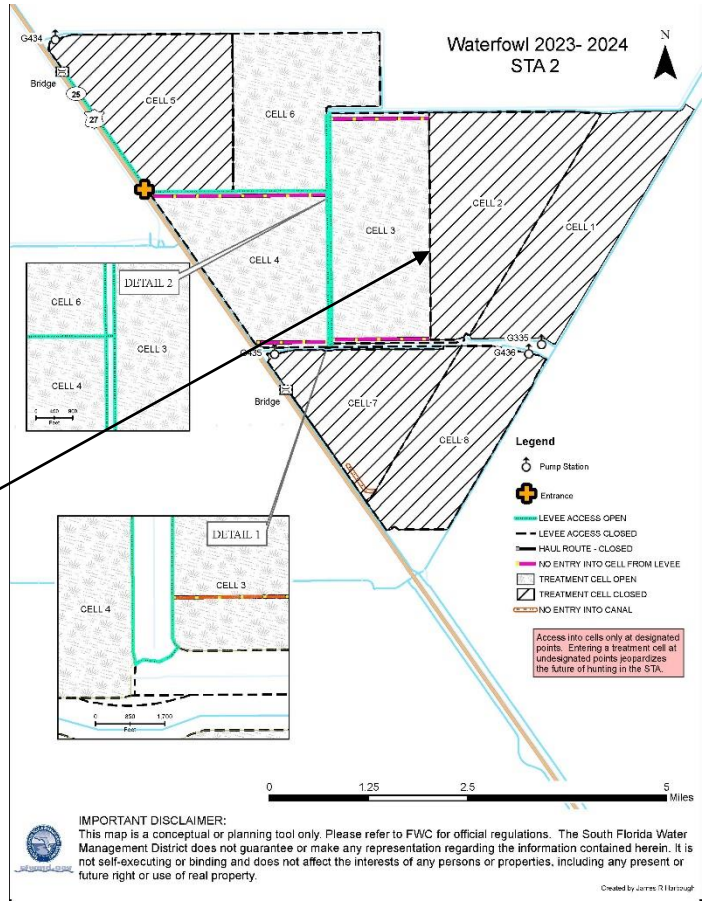
STA Function vs Public Use

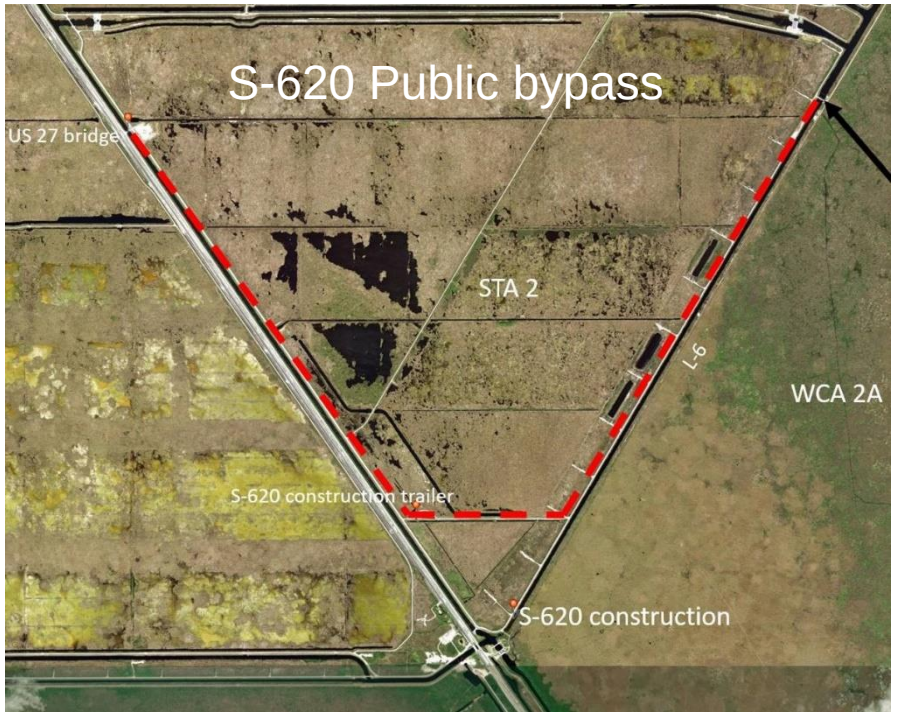
- **Preserve function**
  - Additional signage
    - Restrict alligator hunting
    - Collection canals
    - Levee access



Construction & Maintenance

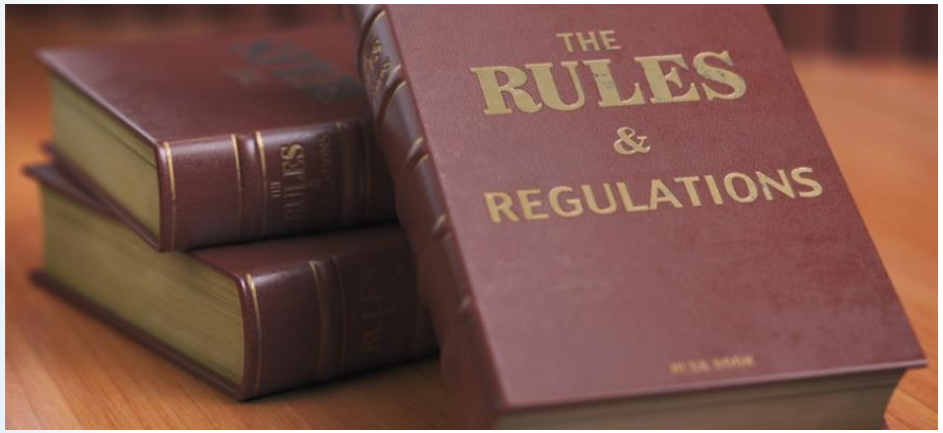
- **Necessary Closures**
  - Construction zone
    - Safety/Deadlines





Public Participation

- Public Meetings - SFWMD
  - Public Meetings and Forums | South Florida Water Management District (sfwmd.gov)
  - Rec Forum – 3 meetings annually
    - 3rd Monday of March, June & September
- Proposed Rule Changes - FWC
  - Proposed Rule Changes | FWC (myfwc.com)



Moving forward – phase involvement

- Rec Infrastructure Standards incorporated in design phase
- Plan presented at Rec Forum Mtg.
- Implement construction
- Construction completion
- Testing phase/finalizing rec infrastructure
  - ADA considerations, facilities, access points, barriers, etc.
- Consulting with internal staff
- Public Input
  - Recreation considerations
    - Hunting
    - Birding tours
    - Etc.
- Testing completion
- Governing Board approval

CONTACT INFORMATION

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PUBLIC COMMENT

If you're participating in person – please fill out a comment card and give to a meeting attendant

If you're participating via Zoom – use the Raise Hand feature

If you're participating via Phone –
*9 Raises Hand
*6 Mutes/Unmutes

PUBLIC COMMENT