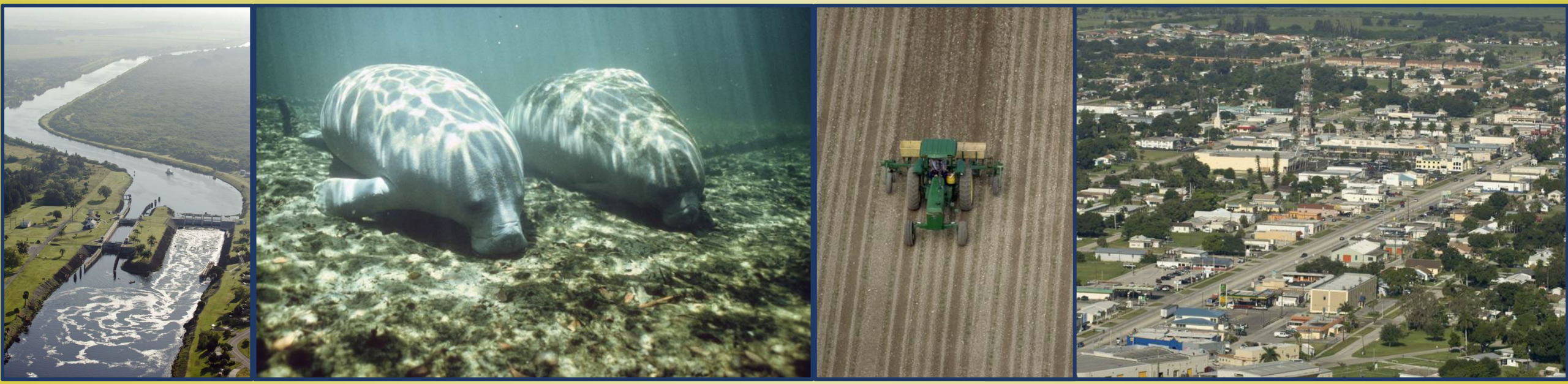
SOUTH FLORIDA WATER MANAGEMENT DISTRICT

2022 Lower West Coast Water Supply Plan Update



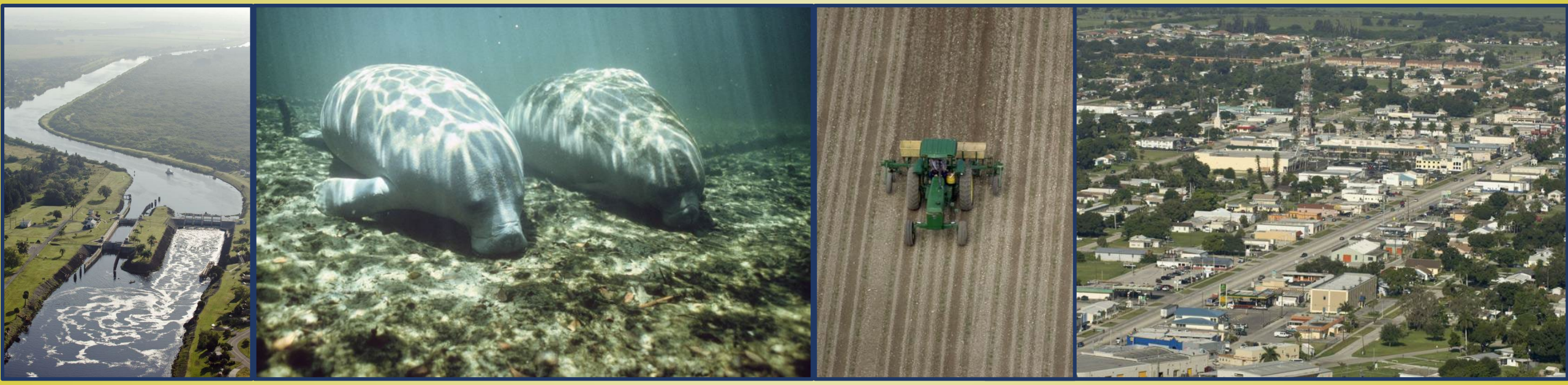
2022 LWC Stakeholder Meeting 2
May 25, 2022

Agenda

- **Welcome and Opening Remarks** – *Tom Colios, SFWMD*
- **SFWMD Water Resource Protection Measures** – *Natalie Kraft, SFWMD*
- **Update on Everglades Restoration Projects** – *Leslye Waugh, SFWMD*
- **Regional LWC Groundwater Modeling and Saltwater Interface Mapping** – Pete Kwiatkowski, *SFWMD*
- **SFWMD Resiliency Initiatives** – Carolina Maran, *SFWMD*
- **Next Steps** – *Bob Verrastro, SFWMD*
- **Adjourn**

Questions and public comment will occur after each presentation.

Welcome and Opening Remarks



Tom Colios

Section Leader, Water Supply Planning

2022 LWC Stakeholder Meeting 2

May 25, 2022

Lower West Coast Planning Area

- Includes:
  - Lee County and portions of Collier, Glades, Hendry, Monroe, and Charlotte counties
- Population:
  - 2020 1,188,599
  - 2045 1,617,071*
- Major agricultural industry
  - ~300,000 acres of irrigated crops
- Significant environmental features

*University of Florida (UF) Bureau of Economic and Business Research estimate.

Regional Water Supply Plan

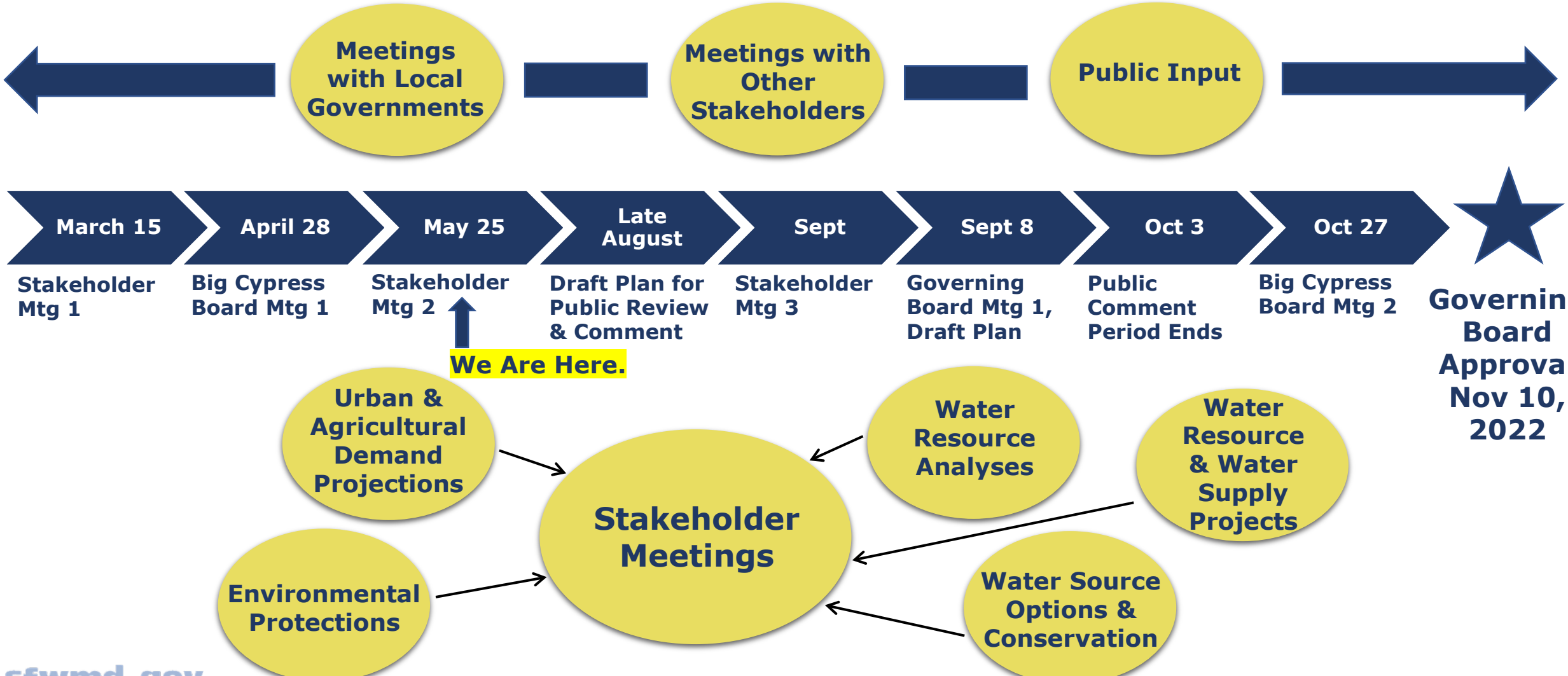
What It Does

- Provides a road map to meet future water needs while protecting water resources and natural systems
- Conducts a planning-level approach
- Projects future water demands
- Identifies and evaluates water source options

What It Does NOT Do

- Does not authorize consumptive use permits
- Does not establish MFLs
- Does not adopt rules
- Does not require water users to implement specific projects
- Does not address surface water quality issues (e.g., algal blooms)

Water Supply Plan Update Timeline



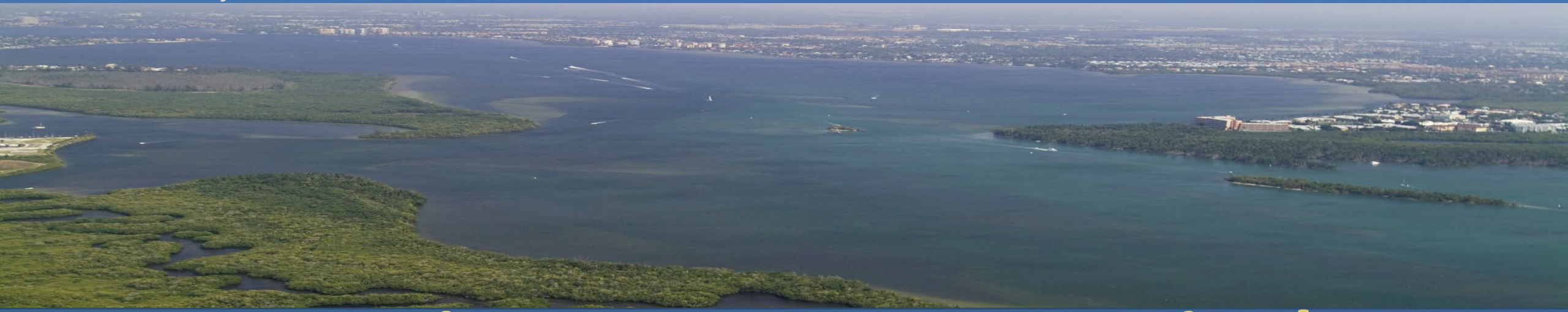
Major Efforts Since the First Meeting

- Prepared Draft Chapters
  - 1 – Introduction*
  - 2 – Demand Estimates and Projections
  - 3 – Demand Management: Water Conservation*
  - 4 – Water Resource Protection*
  - 5 – Water Source Options
  - 6 – Water Resource Analysis
  - 7 – Water Resource Development Projects
- Big Cypress Basin Board Presentation – April 28
- Ongoing coordination with utilities

* Signifies that these chapters are now available for public review

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Caloosahatchee Estuary in Fort Myers



Protecting Water Resources in the South Florida Water Management District

Natalie Kraft
Lead Scientist

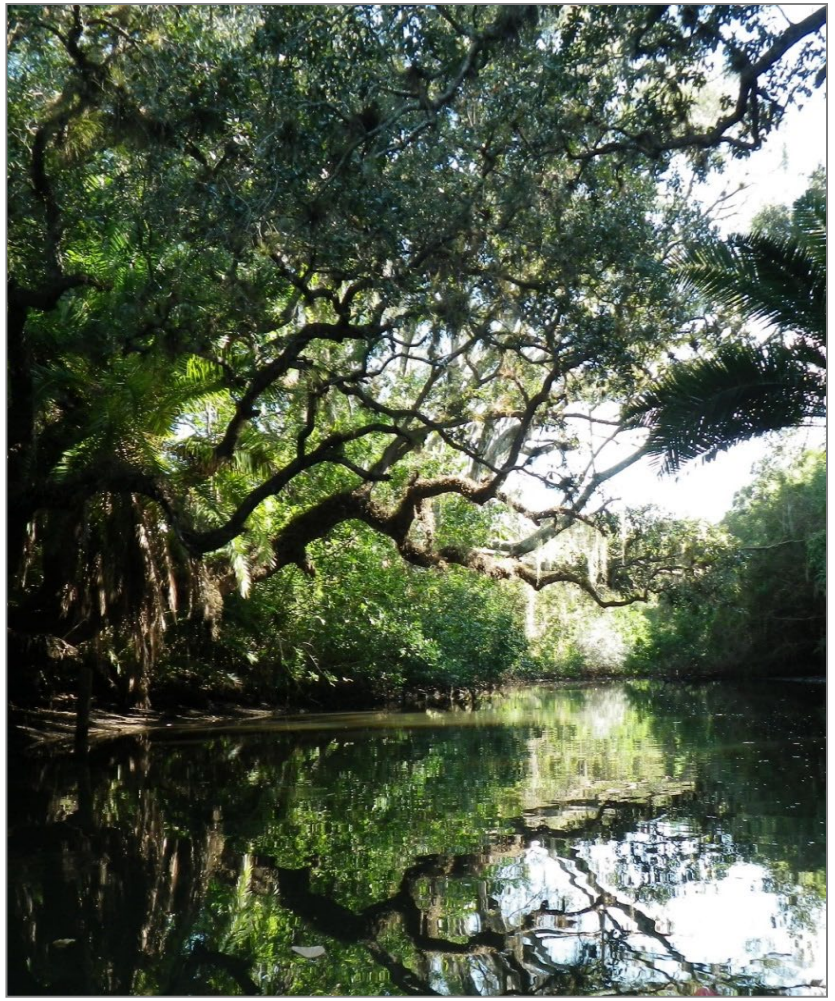
Lower West Coast Water Supply Plan Public Workshop
May 25, 2022

sfwmd.gov

Water Resource Protection Tools

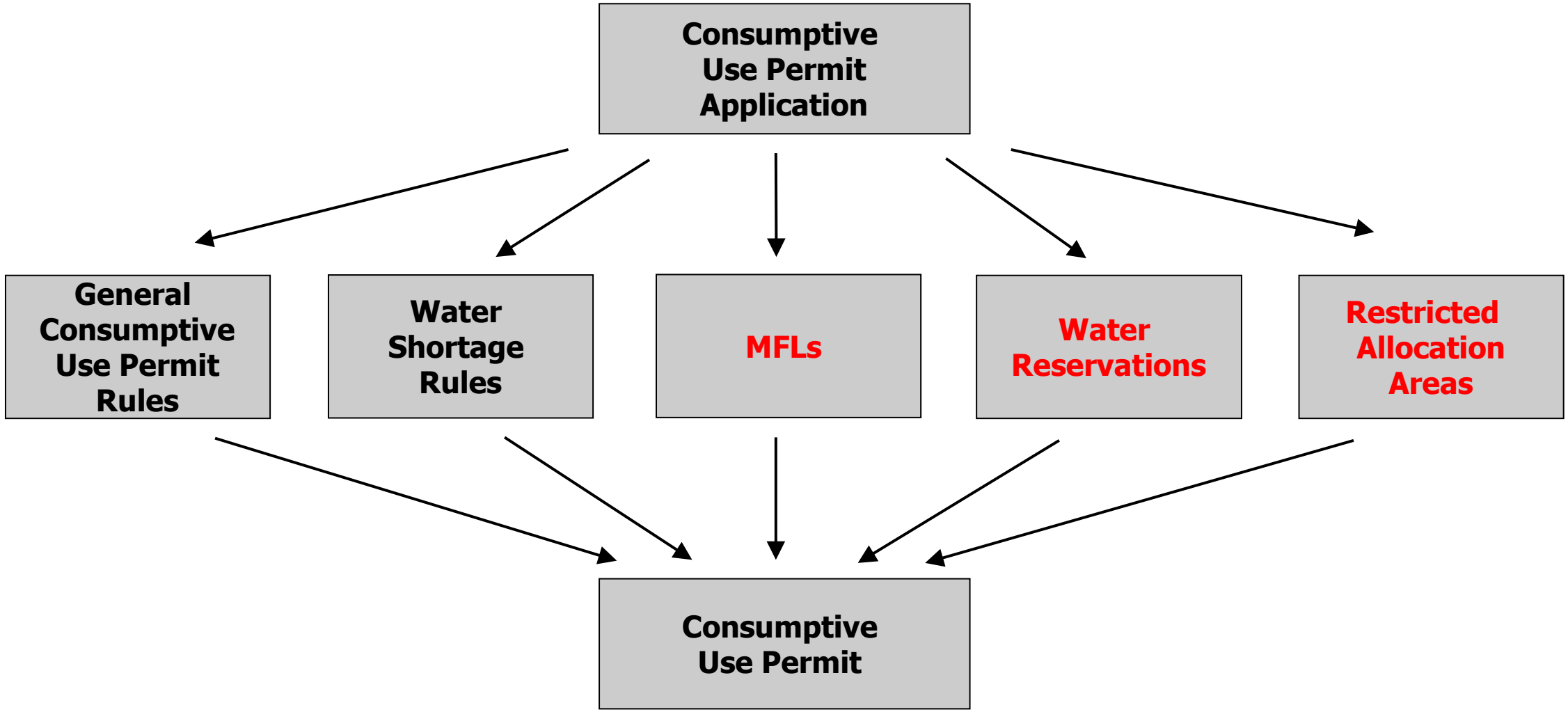
- Minimum flows and minimum water levels (MFLs)
- Water reservations
- Restricted allocation areas (RAAs)

- All three tools are adopted by rule in the Florida Administrative Code (F.A.C.)
- More than one tool can protect a waterbody



Estero River
From: http://www.shminhe.com/images/134557.html

Factors Considered in Consumptive Use Permitting



Minimum Flows and Minimum Water Levels (MFLs)

Statutory Authority:
Chapter 373, F.S.

Defined in 40E-8.021, F.A.C.

- **MFLs**: Point at which further withdrawals will cause "significant harm" to the water resources or ecology of an area
- **Significant harm**: Temporary loss of water resource functions that takes more than 2 years to recover but is less severe than serious harm
- May be adopted for surface waters or aquifers

Great blue heron, *Ardea herodias*, in Big Cypress National Preserve
From: https://www.flickr.com/photos/andrei_deev/444685936

Water Resource Protection Conceptual Model

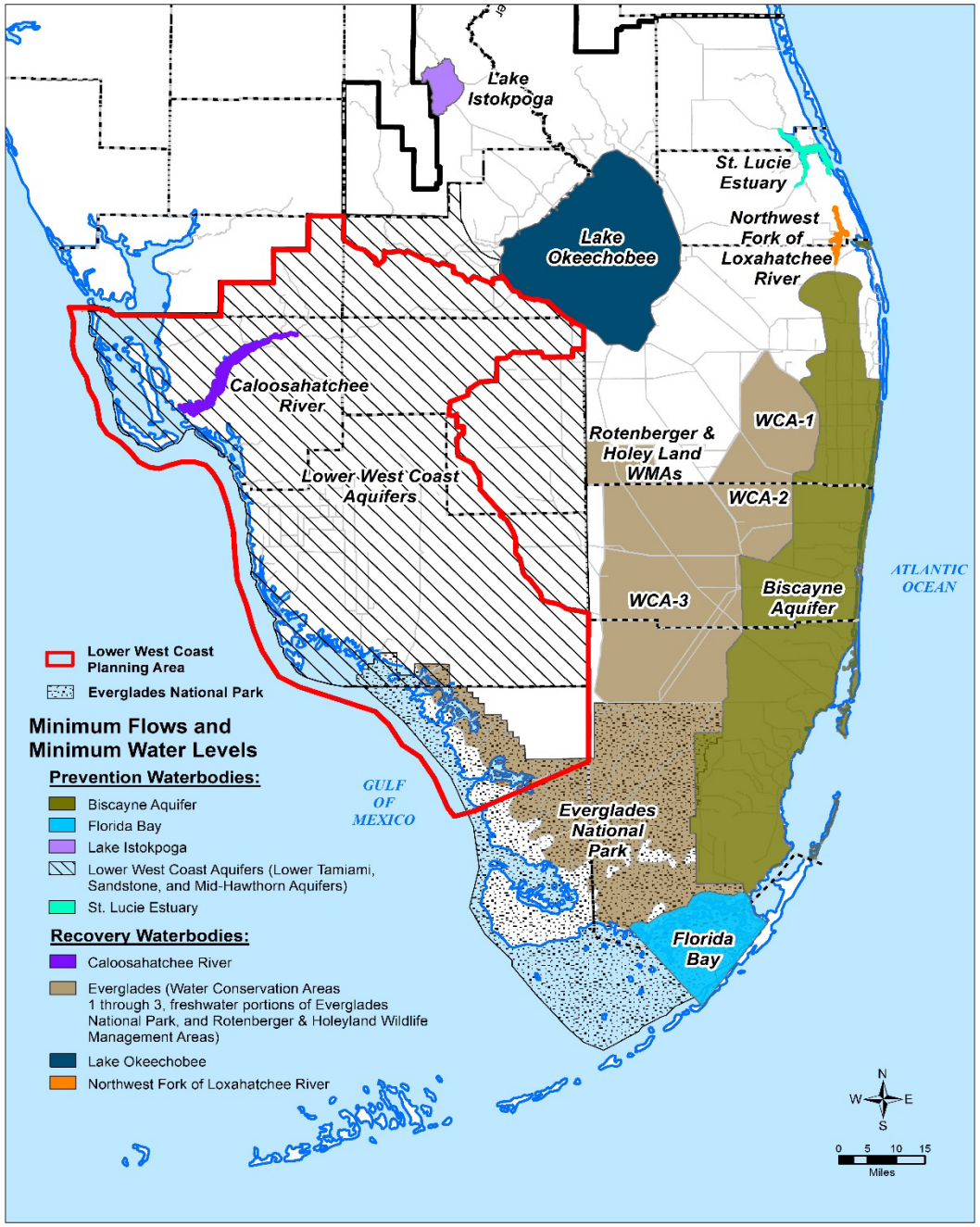
	Water Resource Protection Tools	Water Resource Protection Standards	Observed Impacts
Water Levels/Flow Decreasing	Permittable Water Reservation of Water	NO HARM (1-in-10 Level of Certainty*)	Normal Permitted Operations Environmental Restoration
	Phase I Water Shortage Phase II Water Shortage	HARM	Temporary loss of water resource functions taking 1 to 2 years to recover
	MINIMUM FLOWS & MINIMUM WATER LEVELS		
Drought Severity Increasing	Phase III Water Shortage	SIGNIFICANT HARM	Water resource functions require multiple years to recover (> 2 year)
	Phase IV Water Shortage	SERIOUS HARM	Permanent or irreversible loss of water resource functions

** 1-in-10 Level of Certainty – Reasonable assurance that the proposed use will not harm water resources or interfere with existing legal water users up to a 1-in-10-year drought condition (a drought condition that occurs only once in 10 years).*

MFL Recovery and Prevention Strategies

Subsection 373.0421(2), F.S.

- **Recovery Strategy** for those not meeting the MFL at the time of adoption
  - Achieve recovery to the established MFL as soon as practicable
- **Prevention Strategy** for those that are meeting the MFL but not expected to meet it in 20 years
  - Prevent the existing flow or level from falling below the established MFL
- Strategies are included in the planning process
- Adopted simultaneously with MFL rule adoption in the SFWMD



MFLs in the SFWMD

With Prevention Strategies

- Biscayne Aquifer – 2001
- Lower West Coast Aquifers – 2001
- St. Lucie Estuary – 2002
- Lake Istokpoga – 2006
- Florida Bay – 2006

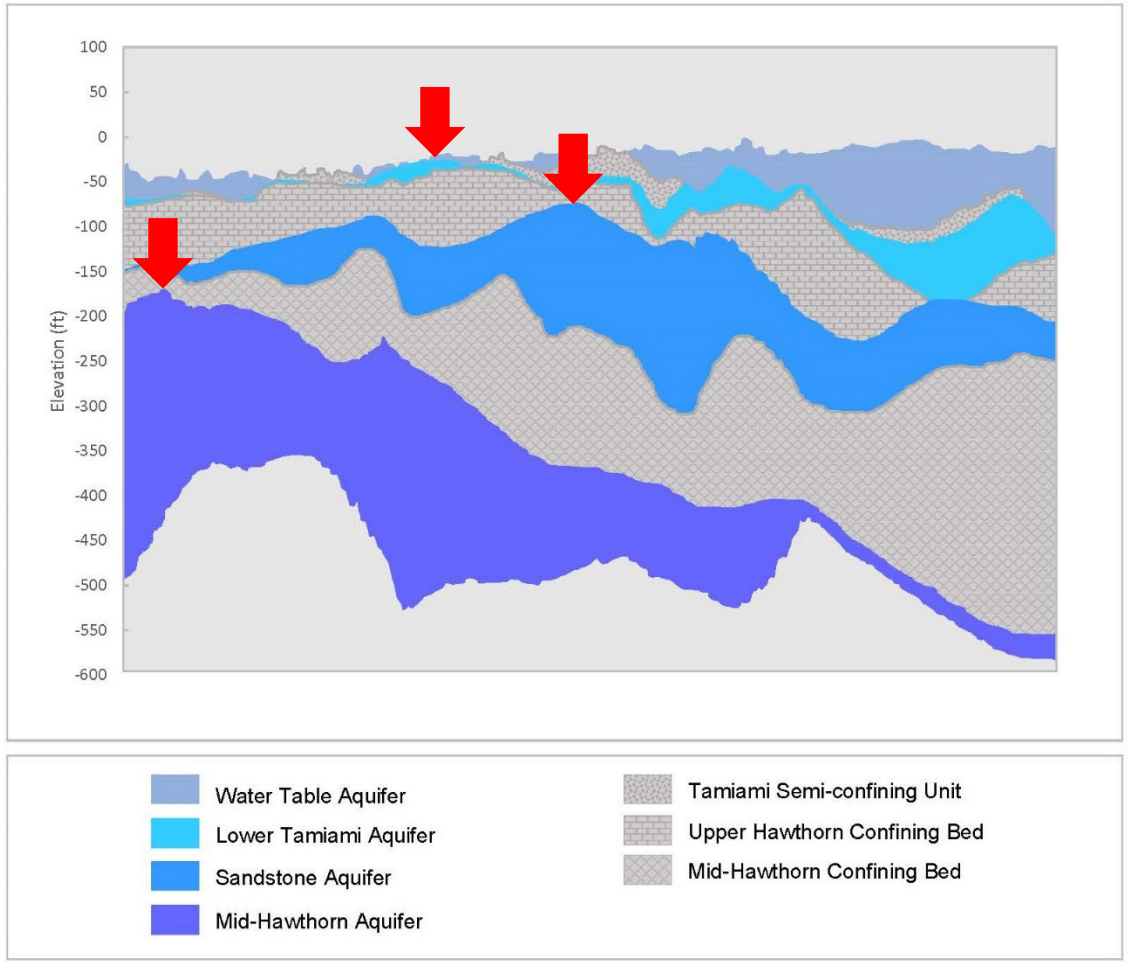
With Recovery Strategies

- Caloosahatchee River – 2001
- Everglades – 2001
- Lake Okeechobee – 2001
- Northwest Fork of Loxahatchee River – 2003

Cover ~6.6 million acres Districtwide

Lower West Coast Aquifers Adopted MFL

Generalized Hydrogeologic Cross-Section



Adopted in 2001

Section 40E-8.331, F.A.C.

The minimum levels for the

- Lower Tamiami aquifer
- Sandstone aquifer
- Mid-Hawthorn aquifer

shall equal the structural top of the aquifer

An MFL violation occurs when:

- Water level drops below the top of the uppermost geologic stratum that comprises the aquifer, at any point in time

Lower West Coast Aquifers Prevention Strategy

Subsection 40E-8.421(4), F.A.C. and LWC Water Supply Plan

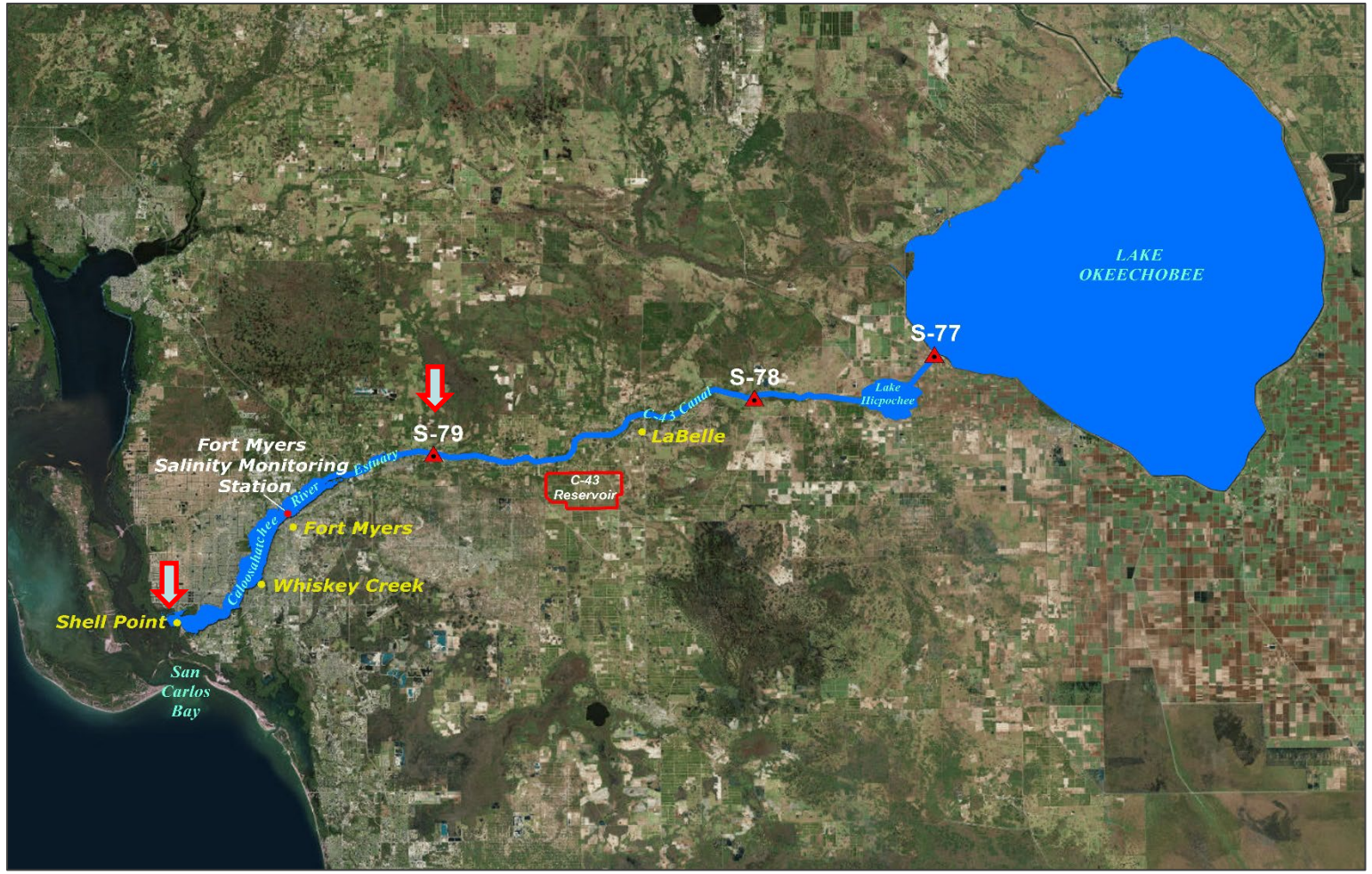
- Establish "no harm" maximum permittable regulatory levels for each aquifer
  - Maximum developable limits in Section 3.9.3 of the Applicant's Handbook or Water Use Permit Applications in the South Florida Water Management District
- Implement rule criteria to prevent harm through consumptive use permitting process
  - Consumptive use permitting criteria in Rule 40E-2.301, F.A.C.
- Construct and operate water resource and supply development projects
  - Alternative water supply and water conservation projects
- Implement Chapter 40E-21, F.A.C., water shortage plan as needed to prevent serious harm during drought conditions in excess of 1-in-10-year level of certainty

Caloosahatchee River Adopted MFL

Adopted in 2001, reevaluated in 2019

Subsection 40E-8.021(2), F.A.C.

<u>Caloosahatchee River</u> – Surface waters that flow through the S-79 structure, combined with tributary contributions below S-79 that collectively flow southwest to San Carlos Bay.



Caloosahatchee River MFL Reevaluation

- Evaluated new data and information obtained since 2003 (previous reevaluation)
- Developed and applied models and a resource-based approach to:
  - Evaluate alterations in the watershed and the effects on flows
  - Understand water sources and their contributions to the estuary
  - Assess responses of multiple ecological indicators to flow scenarios
  - Evaluate performance of the MFL recovery strategy
  - Reevaluate MFL criteria
- Conducted technical analysis and revised MFL criteria
- Drafted a technical report
- Conducted an independent scientific peer review on technical approach, analysis, and report
- Gained public input

Caloosahatchee River MFL Reevaluation

December 2017	Governing Board authorizes rulemaking to revise MFL
September 2018	Governing Board adopts minimum flow of 400 cfs at S-79
October 2018	Administrative hearing held following a rule challenge
March 2019	Administrative law judge issued final order; rule was a valid exercise of delegated legislative authority
April 2019	Governing Board directs staff to evaluate potential to increase minimum flow above 400 cfs
May/June/Sept. 2019	Public workshops held
October 2019	Governing Board adopts revised minimum flow of 457 cfs
December 2019	Final MFL rule effective

Caloosahatchee River Adopted MFL

Subsection 40E-8.221(2), F.A.C.

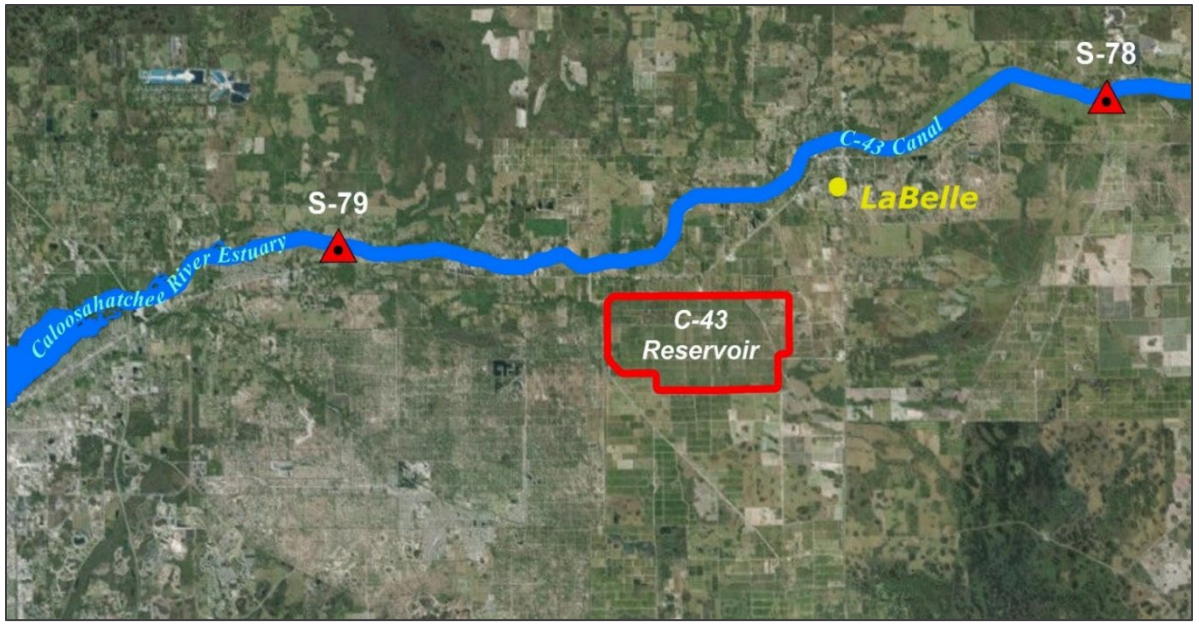
- 30-day moving average flow of 457 cfs at the S-79 water control structure
- An MFL exceedance occurs during a 365-day period when the 30-day moving average flow at S-79 is below 457 cfs
- An MFL violation occurs when an exceedance occurs more than once in a 5-year period

Caloosahatchee River Recovery Strategy

Subsection 40E-8.421(2), F.A.C.

Components listed in LWC Water Supply Plan:

- Research and monitoring plan
- Caloosahatchee River (C-43) West Basin Storage Reservoir
- Water reservation rule [Subsection 40E-10.041(3), F.A.C.] to ensure intended benefits of reservoir
- Water control plan for the reservoir



Water Reservations

Statutory Authority: Chapter 373, F.S.

- Reserves water for the protection of fish and wildlife or public health and safety
- Prevents use of reserved water for consumptive uses
- Protects existing legal uses unless they are contrary to the public interest
- Required for Comprehensive Everglades Restoration Plan (CERP) projects per federal Water Resources Development Act of 2000
- May be used as part of MFL recovery or prevention strategy

Osprey, *Pandion haliaetus*, and bass, *Micropterus* sp. on Merritt's Mill Pond
From: http://nykography.weebly.com

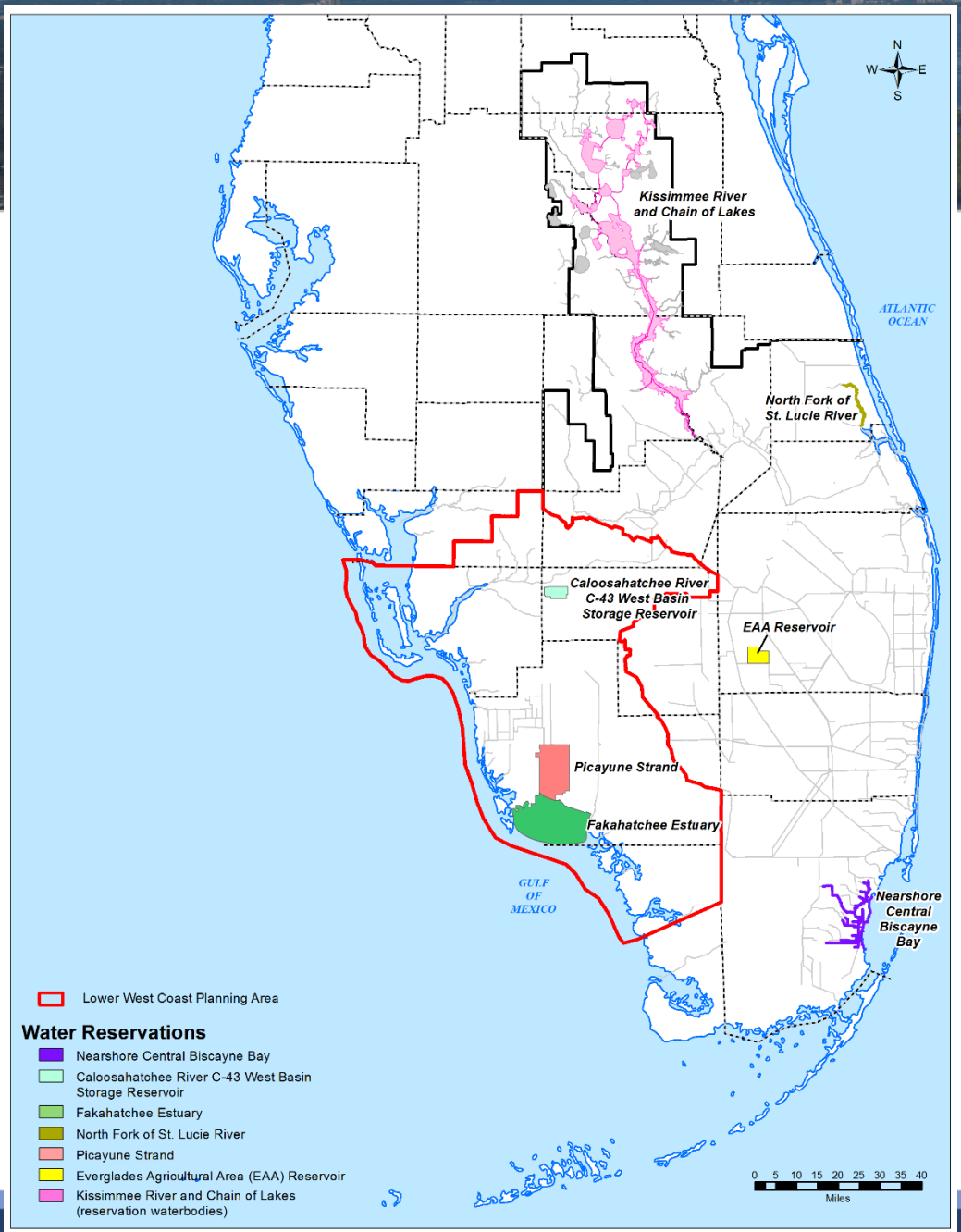
Water Reservations Do Not…

- Prevent use of unreserved water or water allocated under consumptive use permits
- Establish an operating regime
- Drought-proof the natural system
- Ensure wildlife proliferation

Drought conditions
From: http://sfwmd.gov

American aliigator *Alligator mississipiensis*
From http://www.photodrom.com

Water Reservations in the SFWMD



- Picayune Strand – 2009
- Fakahatchee Estuary – 2009
- North Fork of the St. Lucie River – 2010
- Nearshore Central Biscayne Bay – 2013
- Caloosahatchee River (C-43) West Basin Storage Reservoir – 2014
- EAA Reservoir – 2021
- Kissimmee River & Chain of Lakes – 2021

Cover 356,281 acres Districtwide

Caloosahatchee River (C-43) West Basin Storage Reservoir Adopted Water Reservation

Subsection 40E-10.041(3), F.A.C.

All surface water contained within and released, via operation, from the reservoir

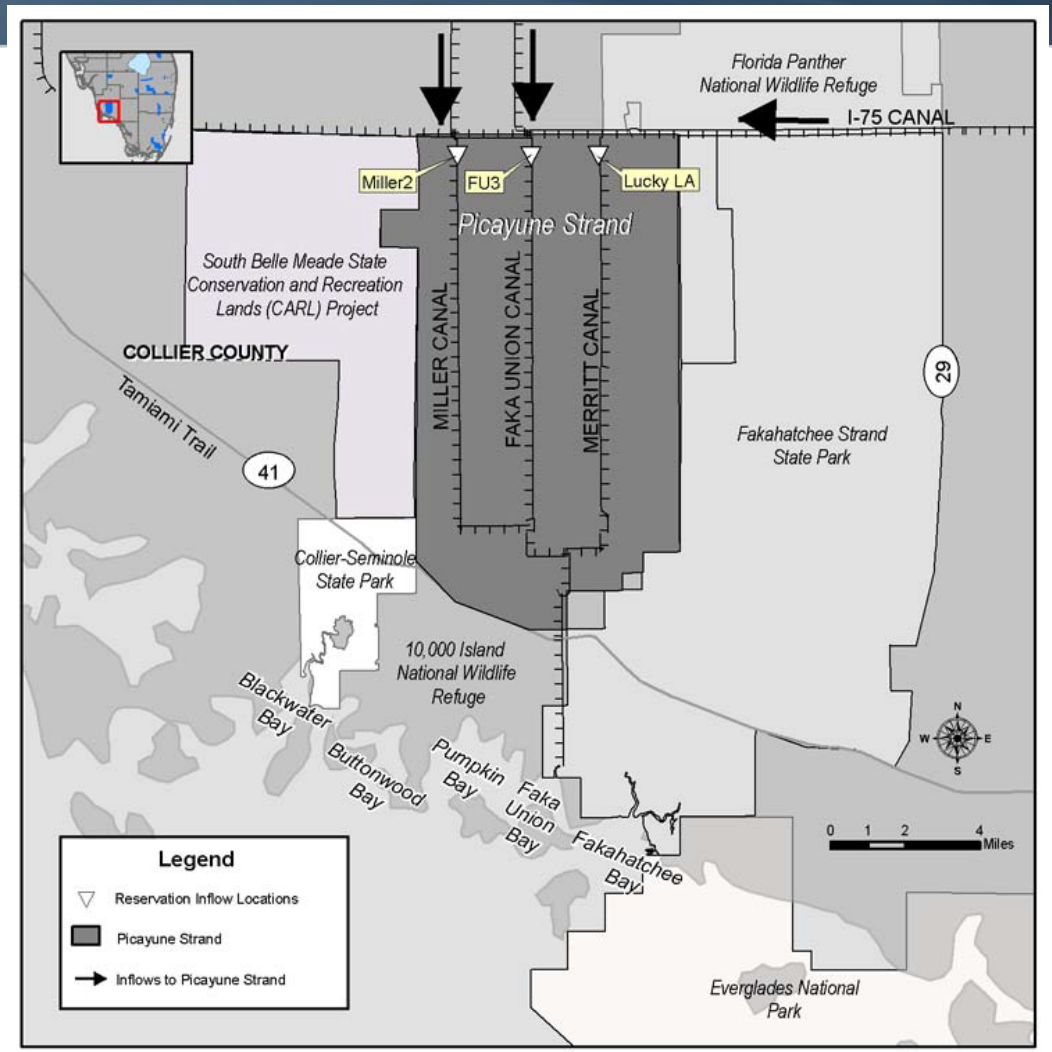
- Prospective reservation adopted by rule in 2014 for protection of fish and wildlife
- Reservoir & reservation are key components of the Caloosahatchee River MFL recovery strategy
- CERP project being constructed through SFWMD/USACE cost-share agreement

Double crested cormorants, *Phalacrocorax auritus*, with roseate spoonbill, *Platalea ajaja*, coming in for a landing
From: https://tockify.com/apogeephoto/detail/99/1490328000000

Picayune Strand Adopted Water Reservation

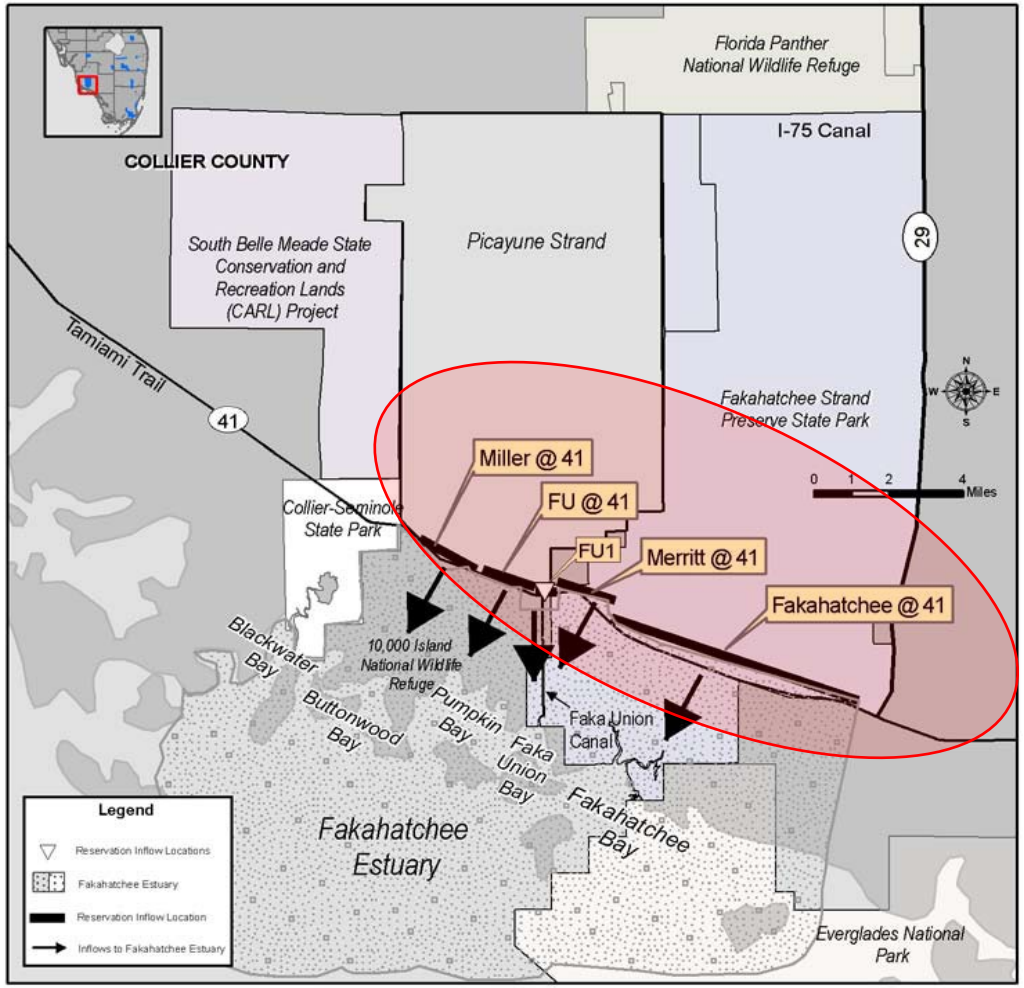
Subsection 40E-10.041(1), F.A.C.

- Reservation adopted by rule in 2009 for protection of fish and wildlife
- Required for the CERP Picayune Strand Restoration Project (PSRP) to restore pre-drainage condition
- Water reserved:
  - Existing surface water in the strand
  - Water made available through the PSRP (simulated at three weirs)
  - All groundwater in the water table and unconfined portions of the Lower Tamiami aquifer beneath the strand



Historic inflow locations into Picayune Strand from Miller, Faka Union and Merritt Canals

Fakahatchee Estuary Adopted Water Reservation



Historic inflow locations into Fakahatchee Estuary from Picayune Strand

Subsection 40E-10.041(2), F.A.C.

- Reservation adopted by rule in 2009 for protection of fish and wildlife
- Supports the CERP Picayune Strand Restoration Project (PSRP) objective to improve flows to coastal estuaries
- Water reserved:
  - All surface water flowing into the estuary via one weir and four transects
  - All groundwater in the water table and unconfined portions of the Lower Tamiami aquifer beneath the estuary

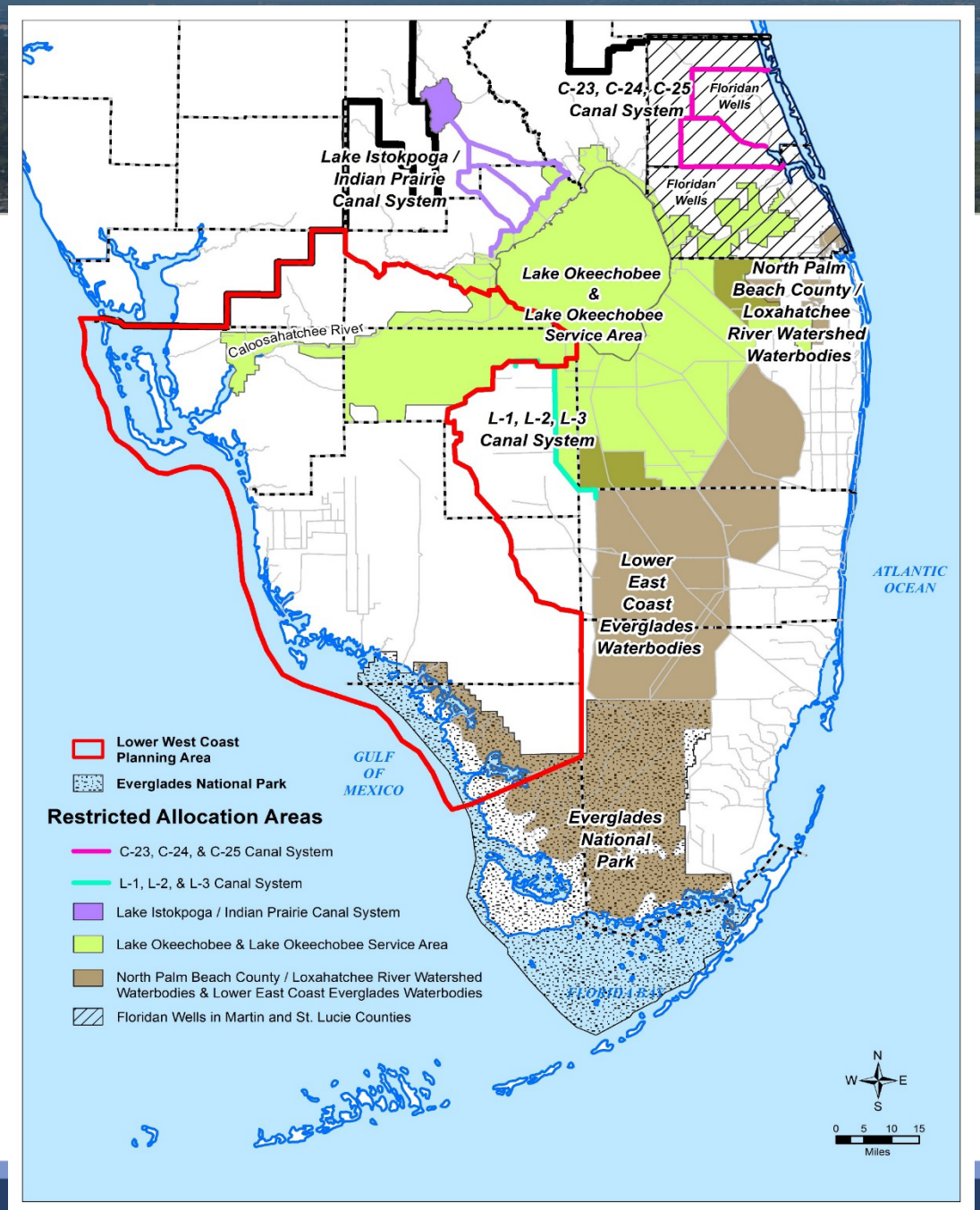
Restricted Allocation Areas (RAAs)

Areas from which new or increased water allocations are restricted

- Implemented for a variety of reasons:
  - Where there is a lack of water available to meet the projected needs of the region
  - To protect water for natural systems and future restoration projects (CERP)
  - As part of MFL recovery or prevention strategies
- Listed in Section 3.2.1 of the Applicant's Handbook, incorporated by reference in Rule 40E-2.091, F.A.C.

Wild American flamingos, *Phoenicopterus ruber*, in Stormwater Treatment Area 2
From: http://whqeps02p:8085/wildlife/#/asset/1353 (SFWMD website)

Restricted Allocations Areas in the SFWMD



- C-23, C-24, & C-25 Canal System – 1981
- L-1, L-2, & L-3 Canal System – 1981
- Lake Istokpoga/Indian Prairie Canal System – 1981
- North Palm Beach County/Loxahatchee River Watershed – 2007 (amended 2022)
- Lower East Coast Everglades Waterbodies – 2007
- Pumps on Floridan Wells in Martin and St. Lucie Counties – 2007
- Lake Okeechobee & Lake Okeechobee Service Area – 2008
- Utilization of the Upper Floridan Aquifer or Avon Park Permeable Zone Near the C-18W Reservoir – 2022

Cover ~4.4 million acres Districtwide

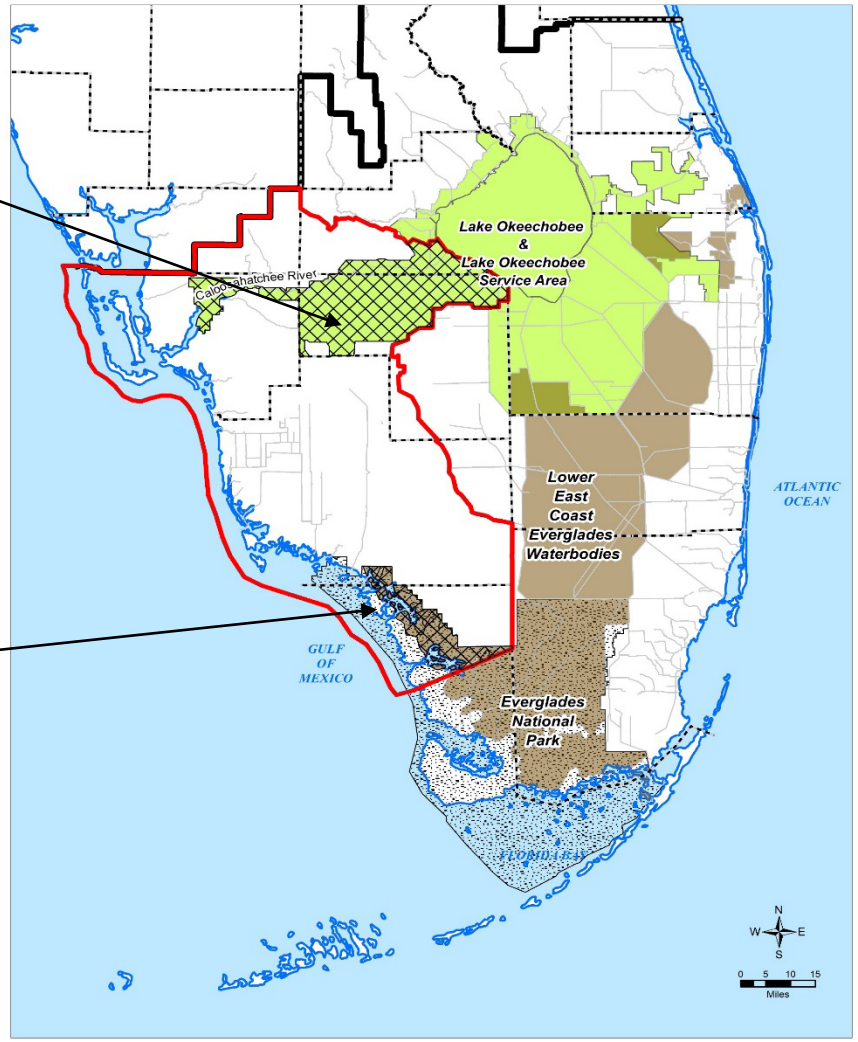
Restricted Allocation Areas in the LWC Planning Area

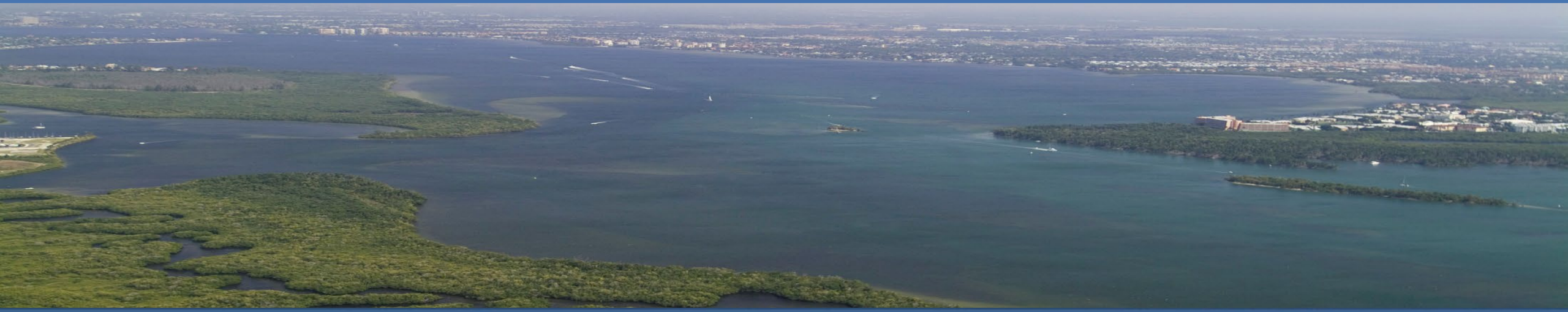
Lake Okeechobee & Lake Okeechobee Service Area

Water allocations are limited to base condition water uses that occurred from April 1, 2001 to January 1, 2008

Lower East Coast Everglades Waterbodies

Water allocations are limited to base condition water uses permitted as of April 1, 2006





Thank You

nkraft@sfwmd.gov

(561) 682-2196

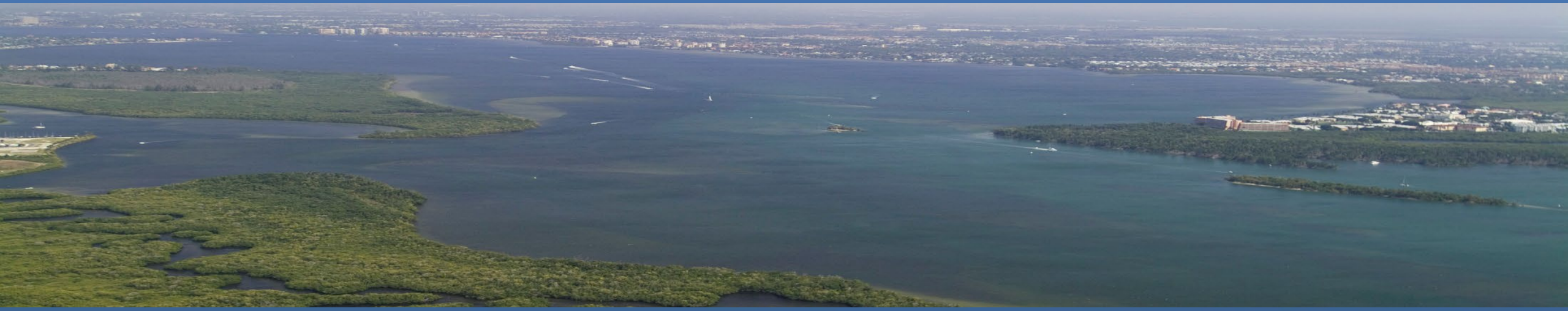
Questions and Public Comment

Picayune Strand

- If you are participating via Zoom:
  - Use the Raise Hand feature
- If you are participating via phone:
  - *9 raises hand
  - *6 mutes/unmutes your line
- When you are called on, please state your full name and affiliation prior to providing comments and/or questions.

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Caloosahatchee
Estuary in Fort Myers



Comprehensive Everglades Restoration Plan: Project Updates

2022 Lower West Coast Water Supply Plan Update – Public Stakeholder Meeting #2

May 25, 2022

Leslye Waugh
Section Administrator
Ecosystem Restoration Planning & Project Management

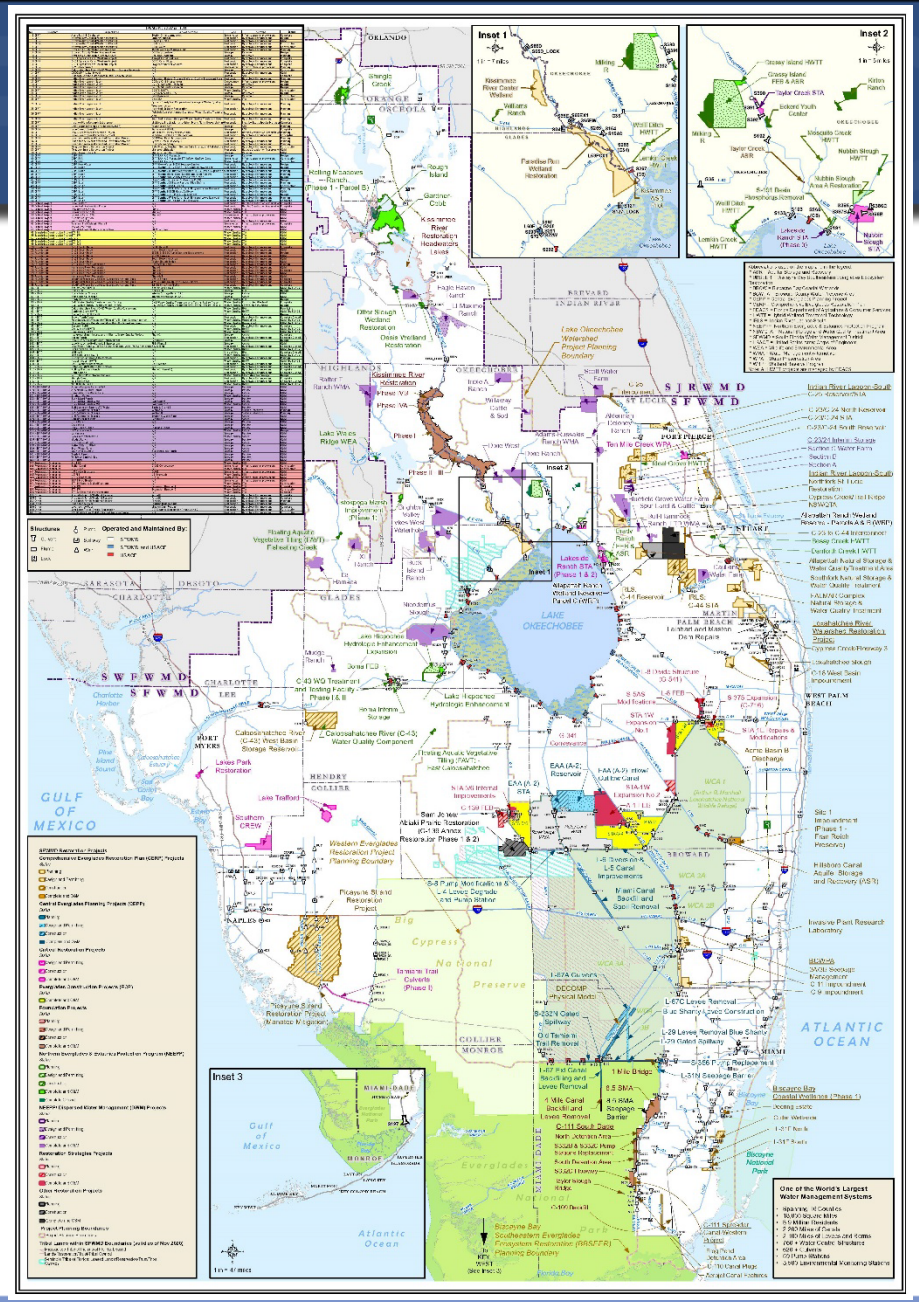
Presentation Outline

- **Restoration Projects**
  - State Restoration Projects
  - Comprehensive Everglades Restoration Plan (CERP) Projects
- **CERP Planning Projects**
- **Integrated Delivery Schedule (IDS)**

Restoration Projects

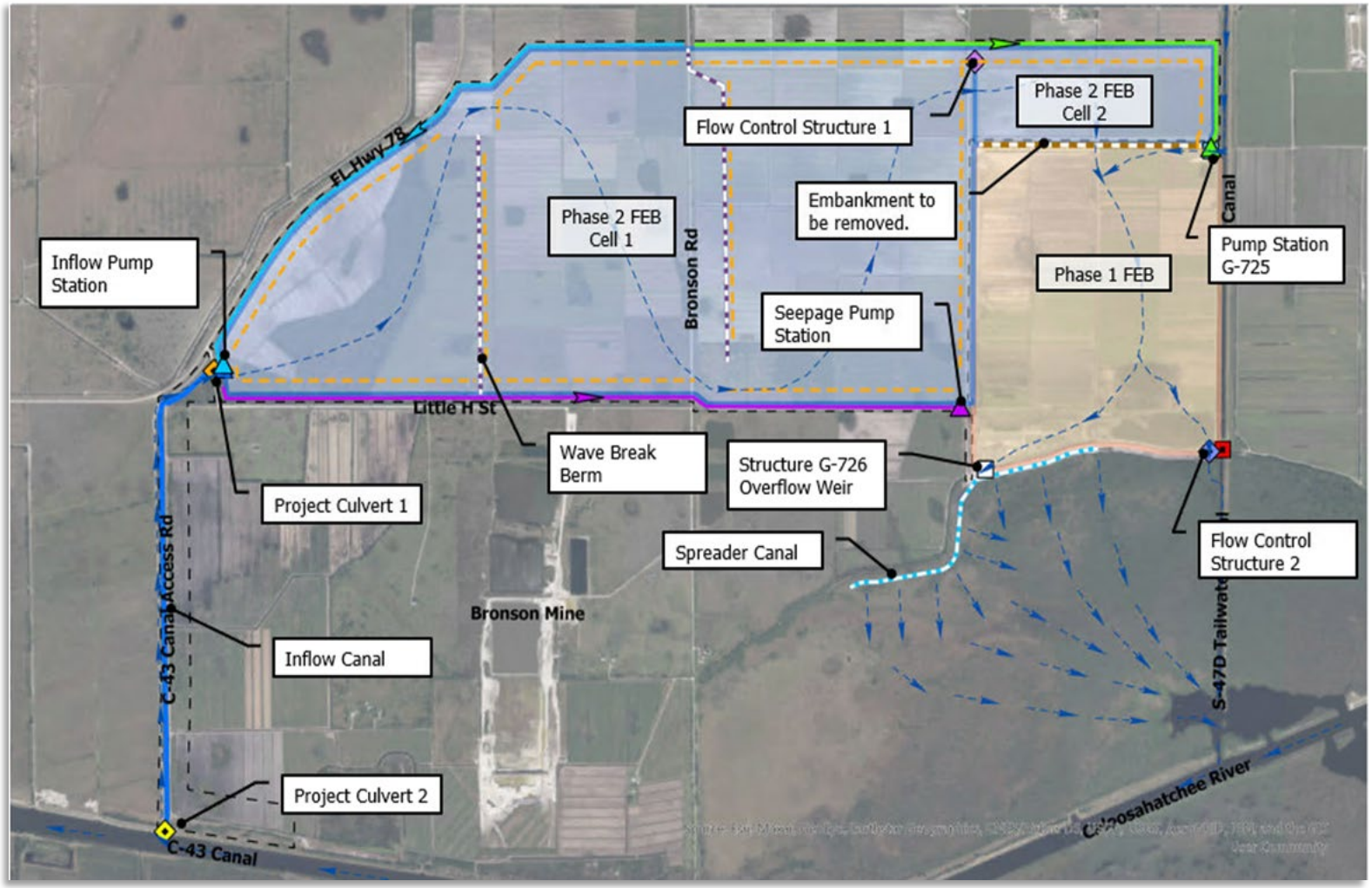
- **State Projects**
  - Restoration Strategies Program
  - Everglades Construction Project
    - Stormwater Treatment Areas (STA)
  - Northern Everglades and Estuaries Program
    - Dispersed Water Management
- **Federal Projects**
  - South Florida Ecosystem Restoration Program
    - Comprehensive Everglades Restoration Plan (CERP)
    - Non-CERP

https://sfwmd.maps.arcgis.com/apps/MinimalGallery/index.html?appid=1facf32f199240b49a326432258c102f



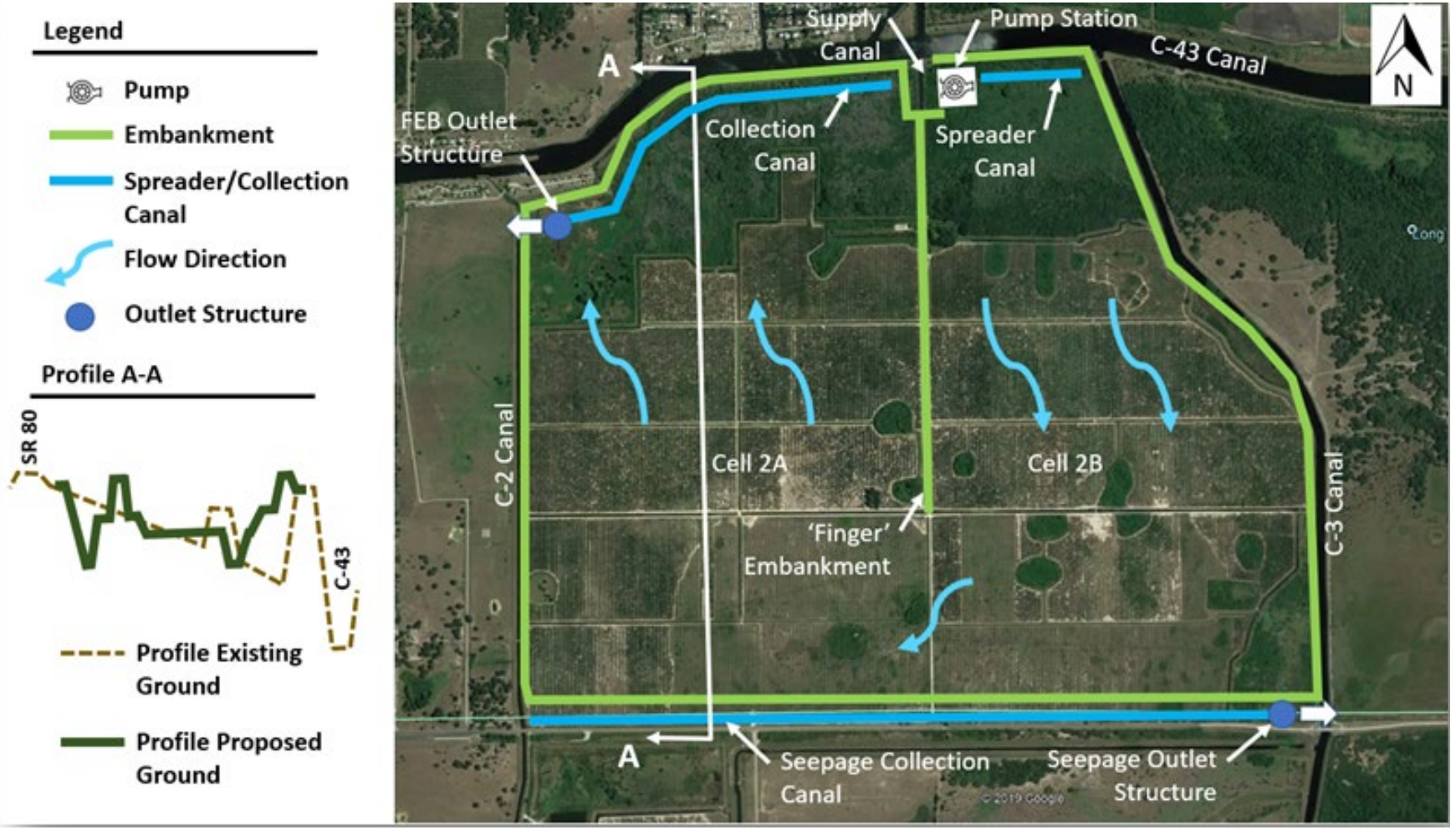
State Restoration Projects

Lake Hicpochee Storage and Hydrologic Enhancement Project



- **Phase 1**
  - **Operational**
- **Phase 2:**
  - **In Design**

Boma Flow Equalization Basin (FEB)



- **In Design**
- **Construction Completion December 2025**

Caloosahatchee (C-43) Reservoir Water Quality Component

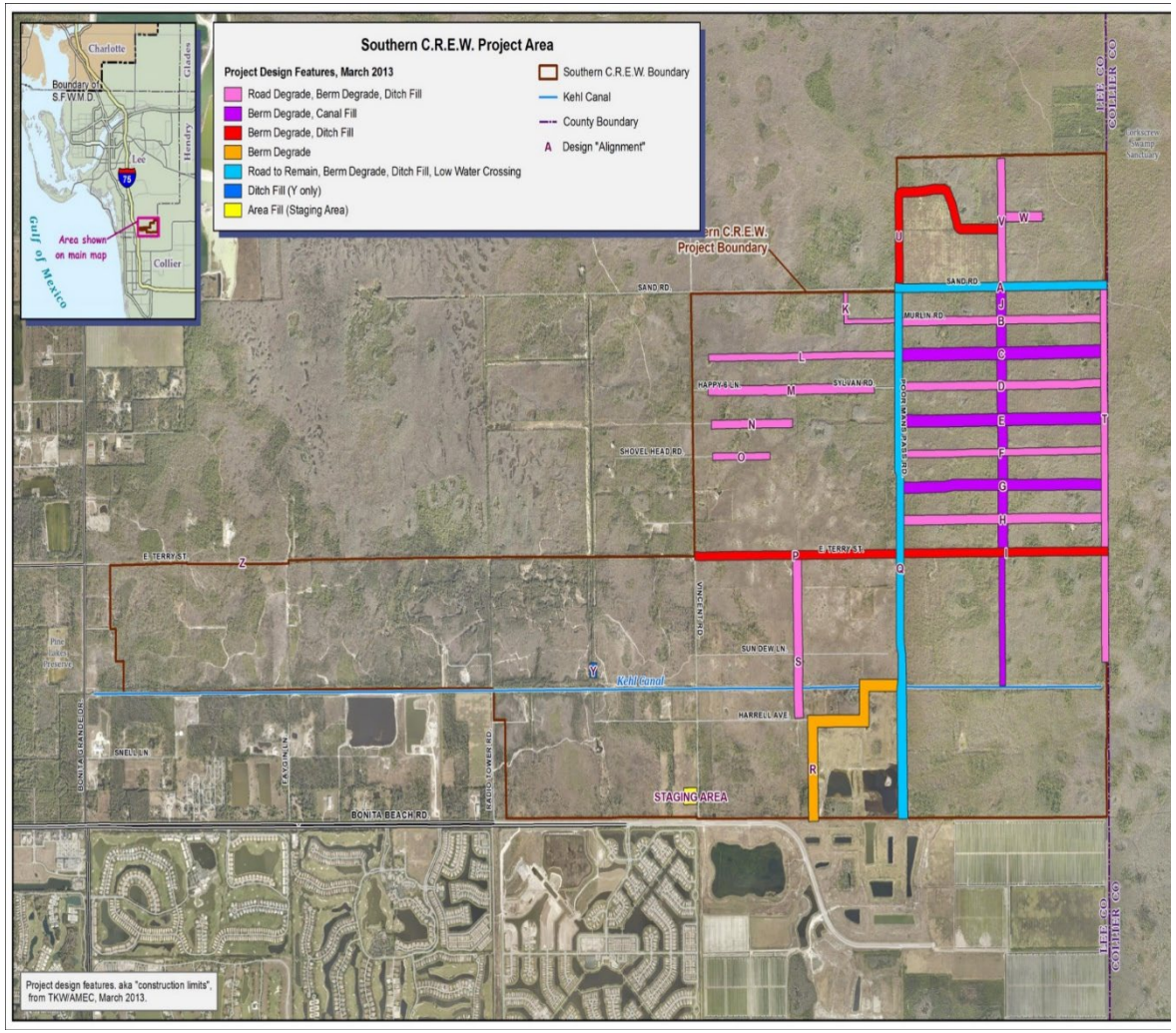
- Operational when reservoir is completed

Working Group

Southern CREW

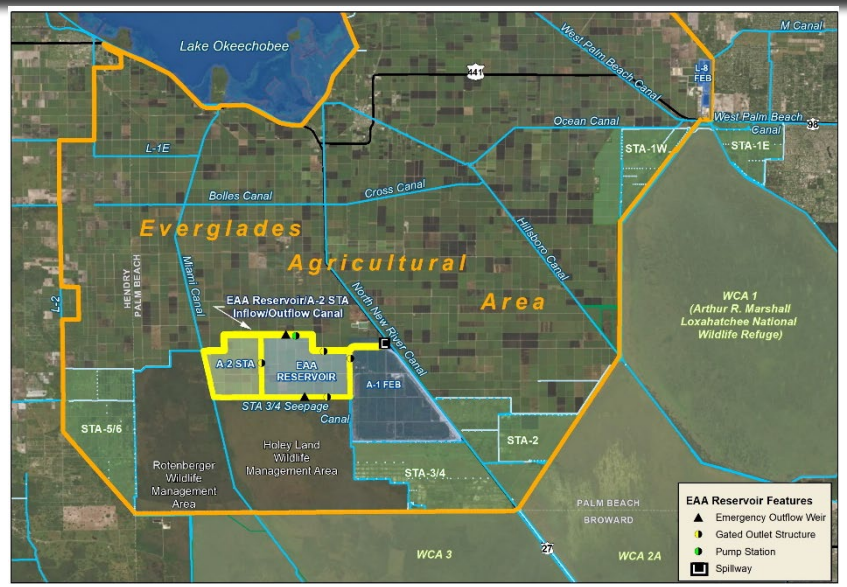
- 4,000 acres of restored wetlands to improve regional hydrology
- Completed in 2018

Red-shouldered hawk on the CREW Boardwalk



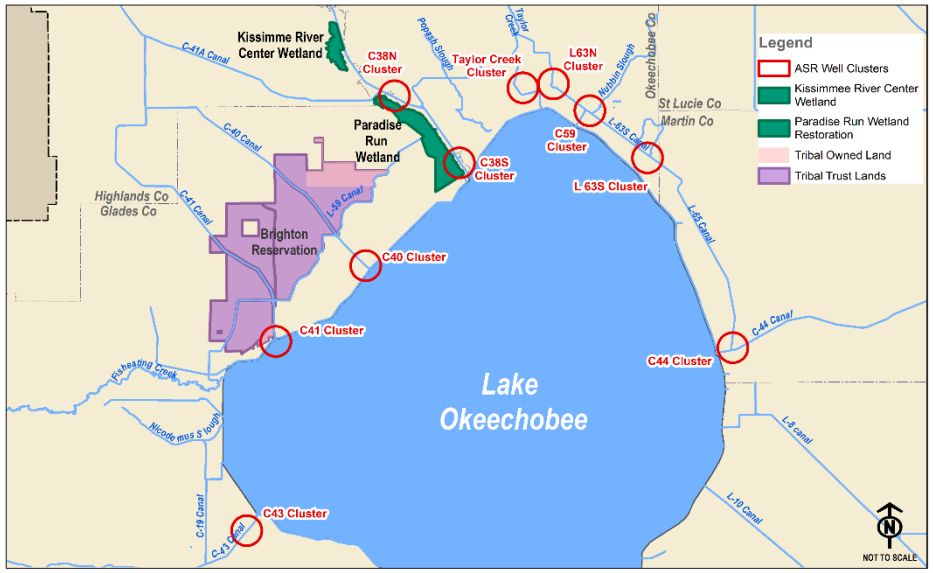
Comprehensive Everglades Restoration Plan (CERP) Project Updates

Central Everglades Planning Project (CEPP)



- **CEPP Everglades Agricultural Area (EAA) Phase**
  - STA under construction by SFWMD
  - Canal Conveyance Improvements in design by SFWMD
  - Reservoir in design by USACE
- **CEPP North Phase**
  - SFWMD in design by SFWMD
- **CEPP South Phase**
  - S-333N spillway completed by SFWMD
  - Old Tamiami Trail Removal completed by SFWMD
  - L-67A Culverts and L-67C Levee Gaps under construction by USACE
  - USACE lead on design and construction of remaining features
- **CEPP New Water Phase**
  - Seepage Barrier in design by SFWMD

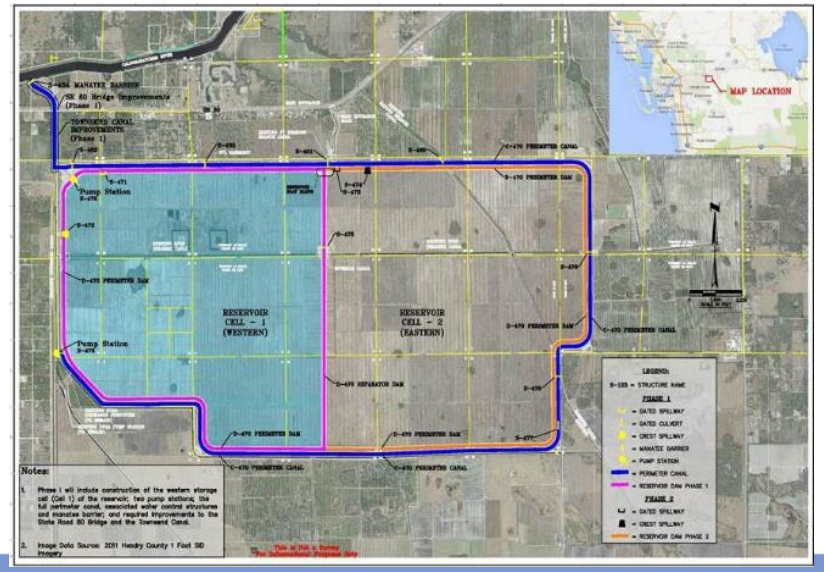
Lake Okeechobee Watershed Restoration Project (LOWRP)



- **Project Objectives**
  - Increase water storage and improve Lake Okeechobee water levels
  - Improve quantity and timing of discharges to the Estuaries
  - Restore wetlands
  - Improve water supply
- **Aquifer storage and recovery**
  - 55 ASR wells
  - 308,000 ac-ft of storage per year
- **Wetland restoration**
  - Paradise Run ~4,700 acres
  - Kissimmee River Center ~1,200 acres
- **Anticipate Water Resources Development Act (WRDA) of 2022 authorization**

Caloosahatchee River (C-43) West Basin Storage Reservoir

- **SFWMD began construction in 2015**
  - Purpose is to improve salinity balance in the Caloosahatchee Estuary by capturing and storing basin runoff and Lake Okeechobee regulatory releases during the wet season and providing essential flows during the dry season.
  - 10,700-acre area with 170,000-acre-feet storage capacity
  - Construction completion expected in 2024

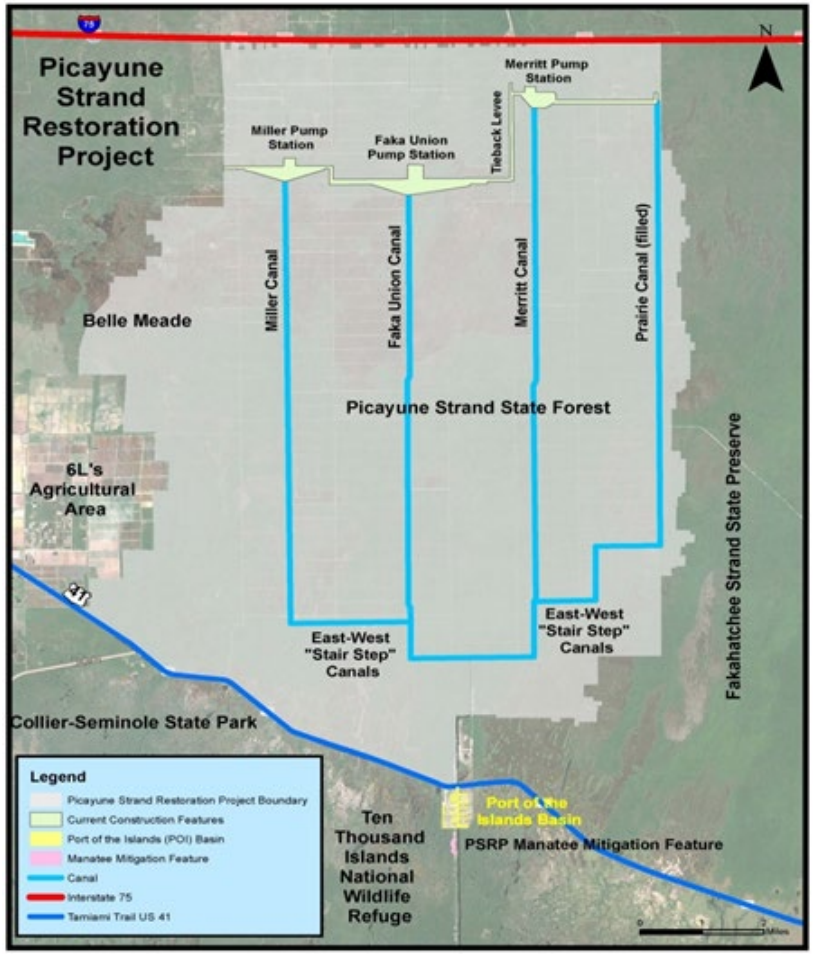



S-470 Pump Station


Perimeter Canal

Picayune Strand Restoration Project (PRSP)

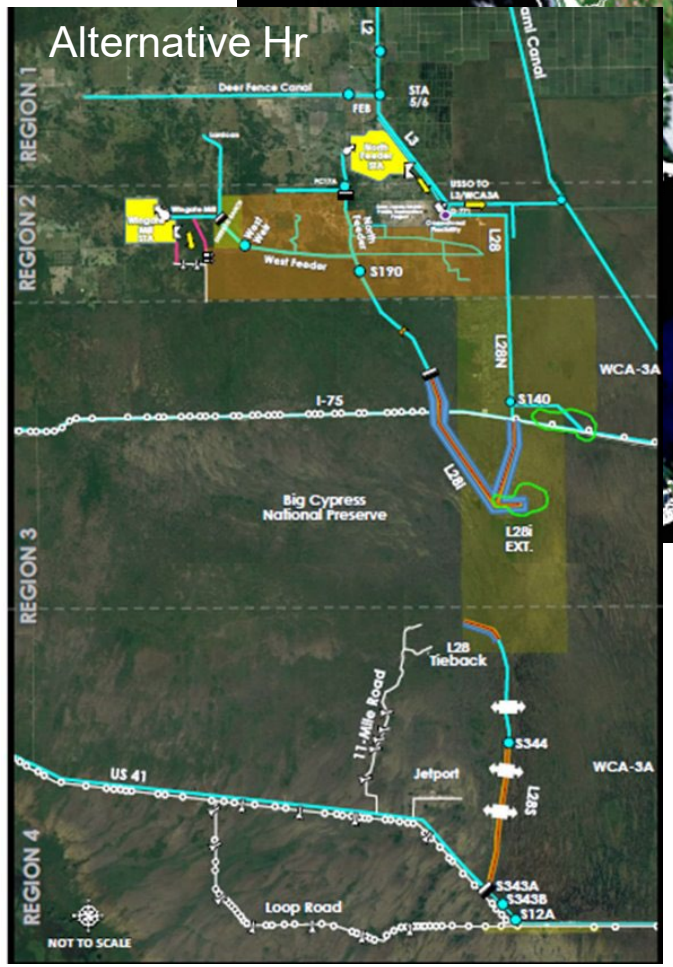
- PSRP began in 2007 with the plugging of the northern 7 miles of the Prairie Canal and the removal of 65 miles of roadways
- 3 pump stations are complete
- Road removal and canal plugging ongoing
- Manatee mitigation feature is complete
- Southwest Protection Feature under construction
- Project completion expected 2025

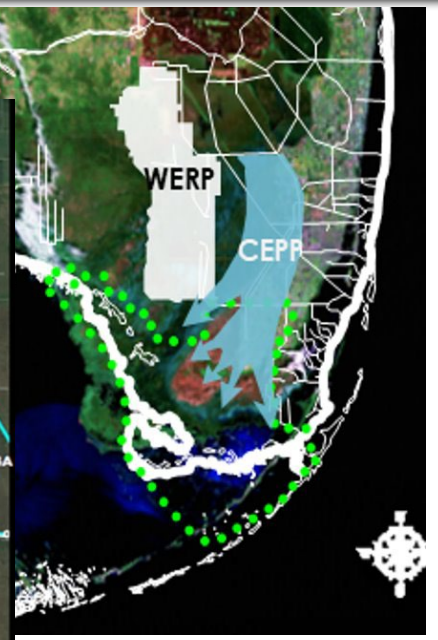


Western Everglades Restoration Project (WERP)

- **Objectives**
  - Improve the quantity, quality, timing and distribution of water in the Western Everglades.
  - Reestablish ecological connectivity of wetland and upland habitats in the western Everglades with restored freshwater flow paths
  - Reduce the severity and frequency of wildfires
  - Restore low nutrient conditions

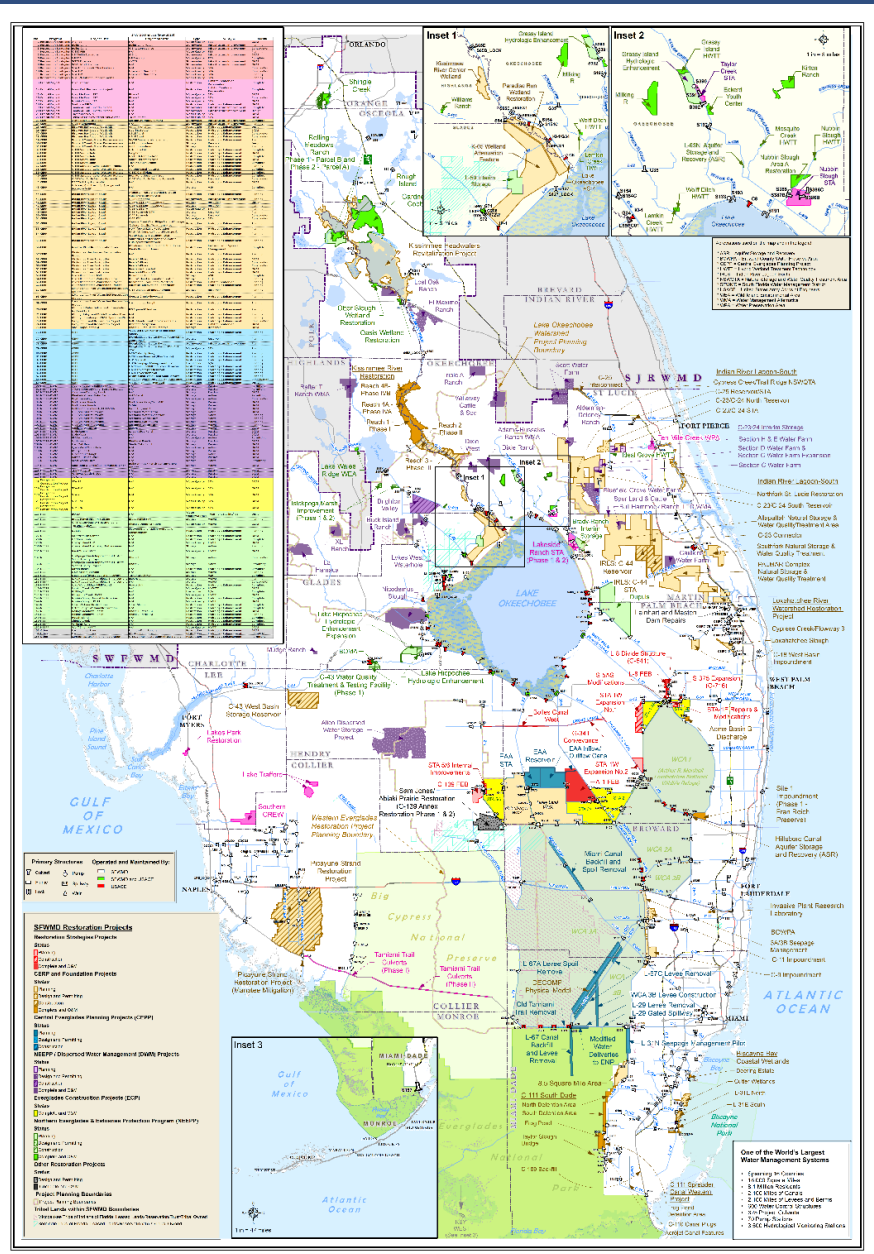
- **Proposed Tentatively Selected Plan (TSP): Alternative Hr**
  - Currently in planning phase
  - Proposes management measures such as 2 STAs (roughly 7,000 acres total), canal backfilling, and culverts to restore hydrology
  - Utilizes existing water from the North Feeder Basin and Western Basin
  - Does not use discharges from Lake Okeechobee
  - Anticipate WRDA 2024 authorization





Planning Projects

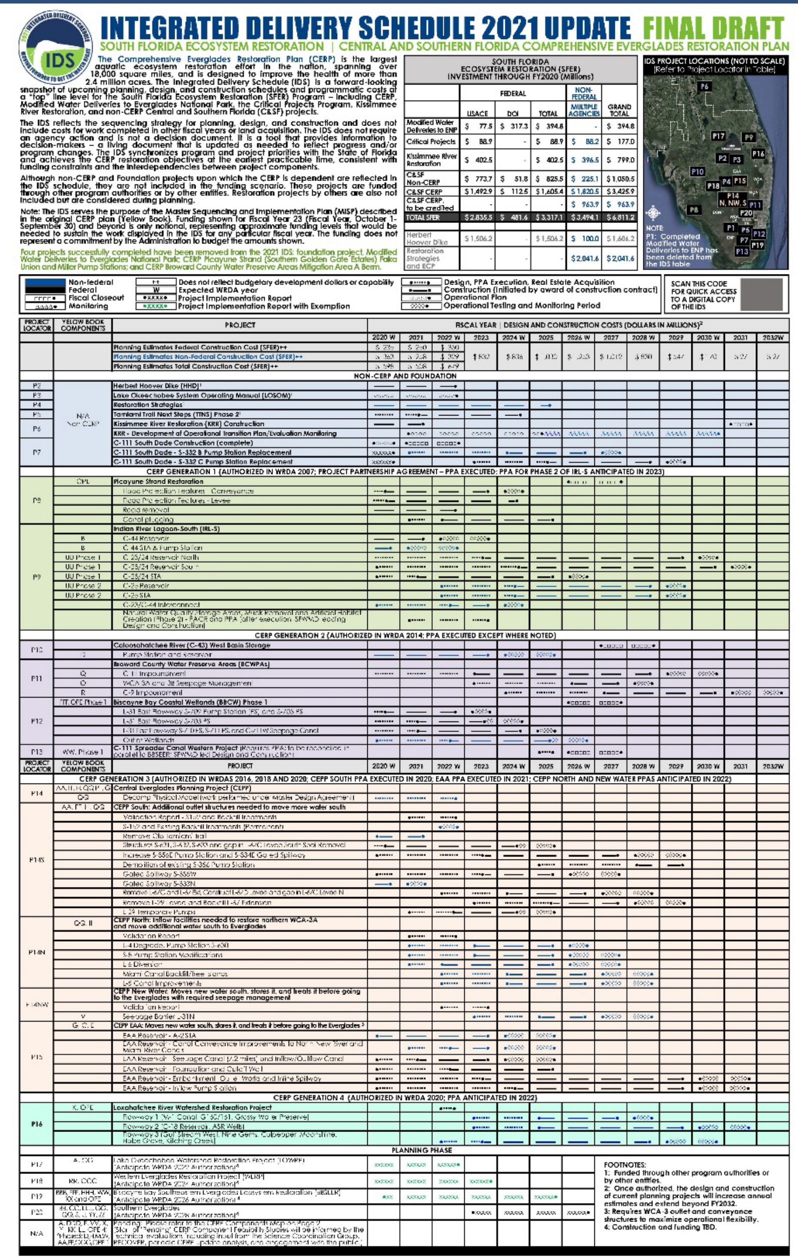
- Lake Okeechobee Watershed Restoration Project (LOWRP) (includes ASR Wells)
- Western Everglades Restoration Project (WERP)
- Biscayne Bay Southeastern Everglades Ecosystem Restoration Project (BBSEER)



Integrated Delivery Schedule (IDS)

- Proven to be a steady, reliable "road map" that guides projects and maximizes the benefits of all Comprehensive Everglades Restoration Plan (CERP) efforts
- Schedule is reviewed each year and has yielded significant Everglades restoration progress
- Developed through an extensive public process with participation of the South Florida Ecosystem Restoration Task Force and its Working Group

https://www.saj.usace.army.mil/IDS


INTEGRATED DELIVERY SCHEDULE 2021 UPDATE FINAL DRAFT
SOUTH FLORIDA ECOSYSTEM RESTORATION | CENTRAL AND SOUTHERN FLORIDA COMPREHENSIVE EVERGLADES RESTORATION PLAN

Thank You

Sunrise at C-43 Reservoir

Leslye Waugh

Section Administrator

Ecosystem Restoration Planning & Project Management

lwaugh@sfwmd.gov

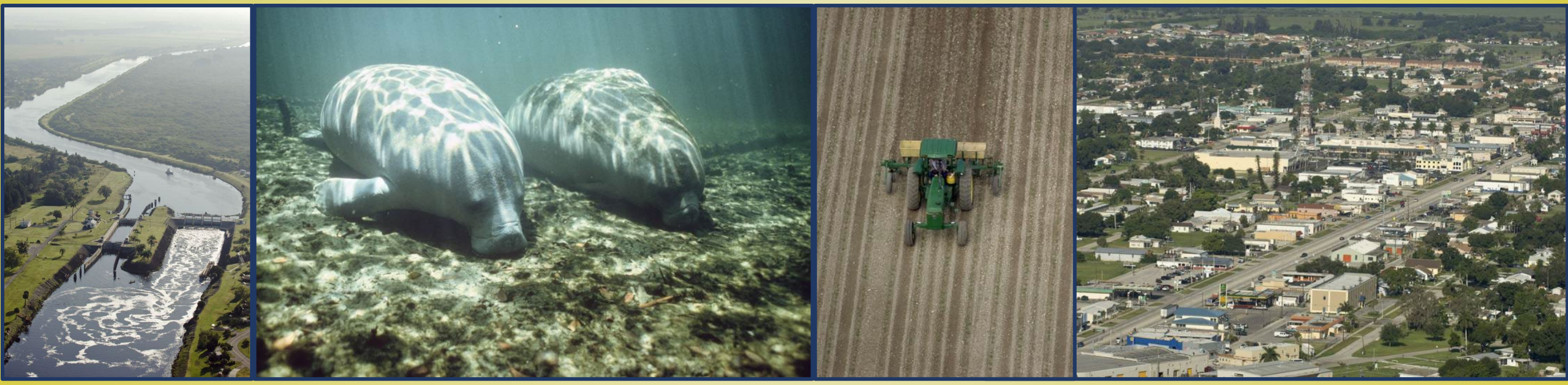
561-682-6483

Questions and Public Comment

C-43 West Storage Reservoir

- If you are participating via Zoom:
  - Use the Raise Hand feature
- If you are participating via phone:
  - *9 raises hand
  - *6 mutes/unmutes your line
- When you are called on, please state your full name and affiliation prior to providing comments and/or questions.

Groundwater Modeling and Saltwater Intrusion Mapping Update

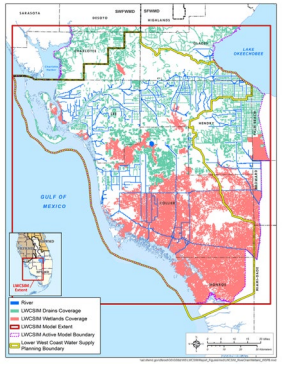


Peter J. Kwiatkowski, P.G.
Section Administrator, Resource Evaluation

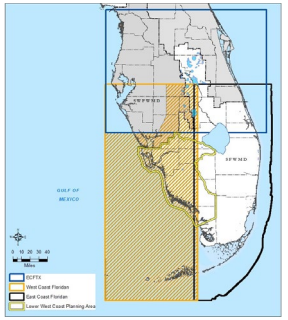
2022 LWC Stakeholder Meeting 2
May 25, 2022

Presentation Outline

- Lower West Coast Surficial and Intermediate Aquifer Systems Model (LWCSIM) Simulation Results



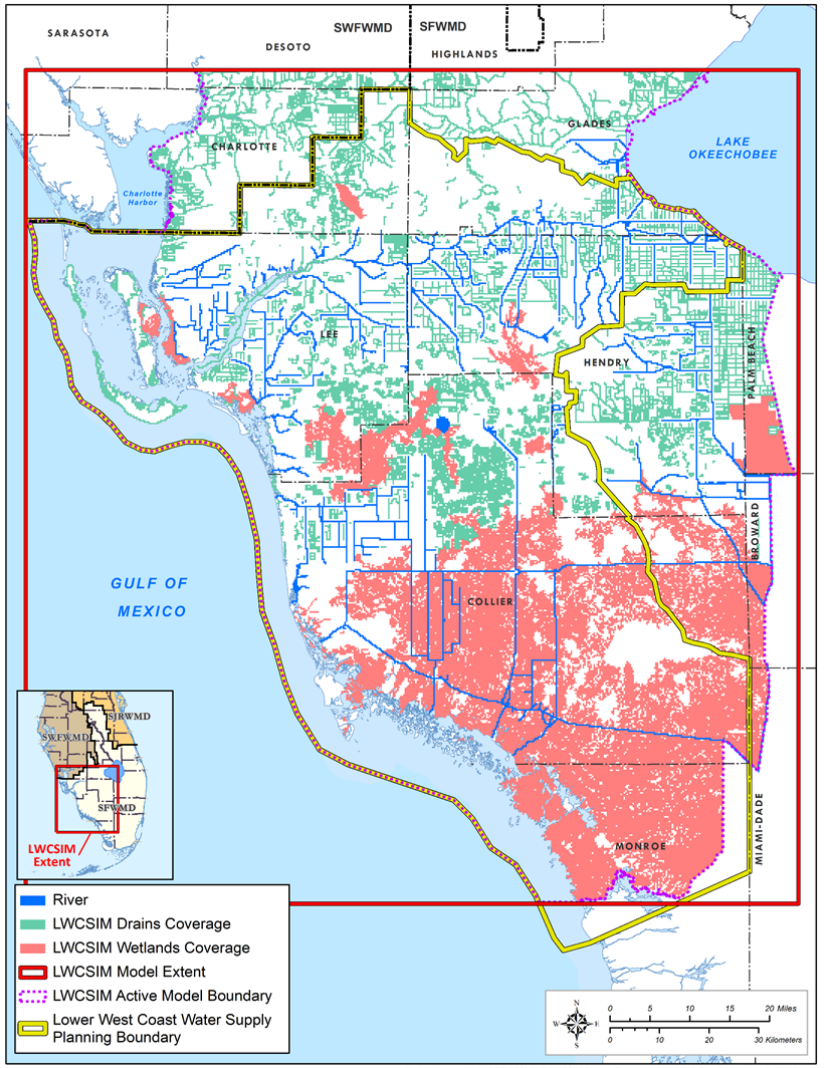
- West Coast Floridan Model (WCFM) Simulation Results



- Saltwater Intrusion Mapping Update

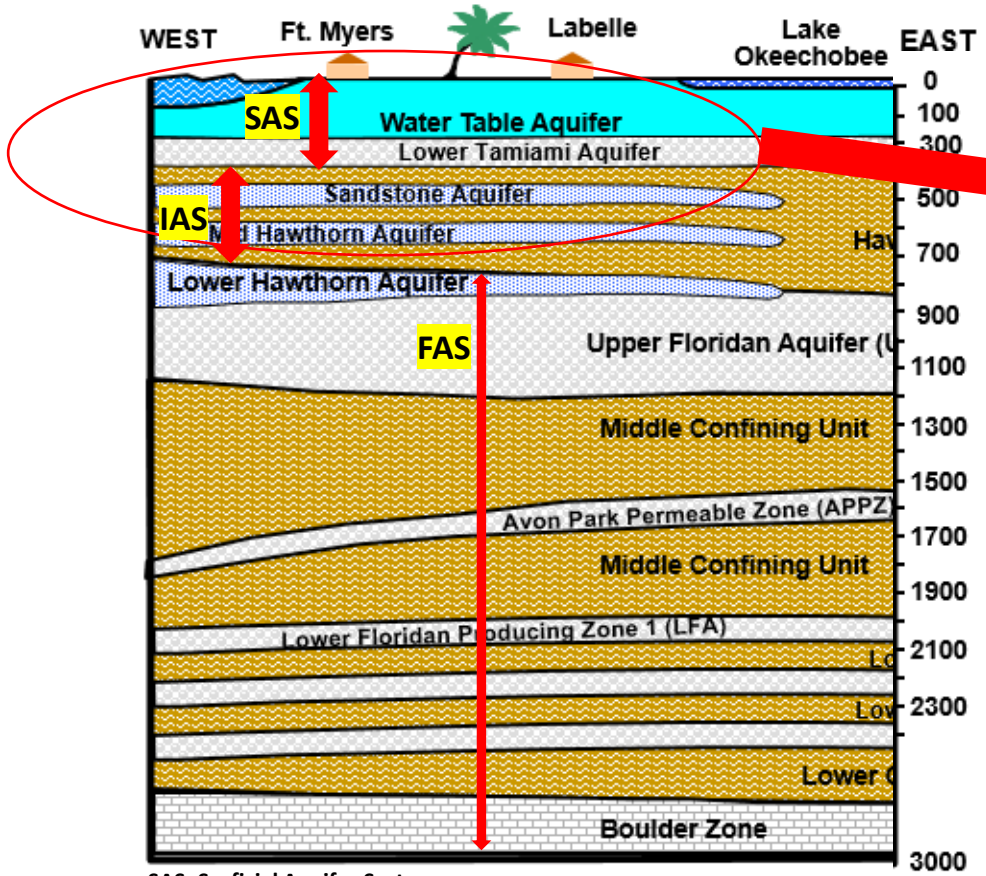
Lower West Coast Surficial and Intermediate Aquifer Systems Model (LWCSIM) Overview

- Surficial (SAS) and Intermediate aquifer system (IAS)
- Used updated hydrostratigraphy for model layering
  - District publication by Geddes, et al., 2015
- MODFLOW-based groundwater flow model
- Uniform grid size of 1,000 ft x 1,000 ft
- Monthly stress periods (time-varying data input interval)
- Calibration period 1999-2012 and verification period 2013-2014
- Calibrated for surface water flows/levels and groundwater levels
- Independent scientific peer review
  - Concurrently with model development
  - Consisted of 3 experts in South Florida hydrogeology and groundwater modeling
  - At 3 major milestones the panel reviewed the model and provided feedback



LWCSIM Aquifers and Model Layers

Cross section of generalized hydrogeology of LWC

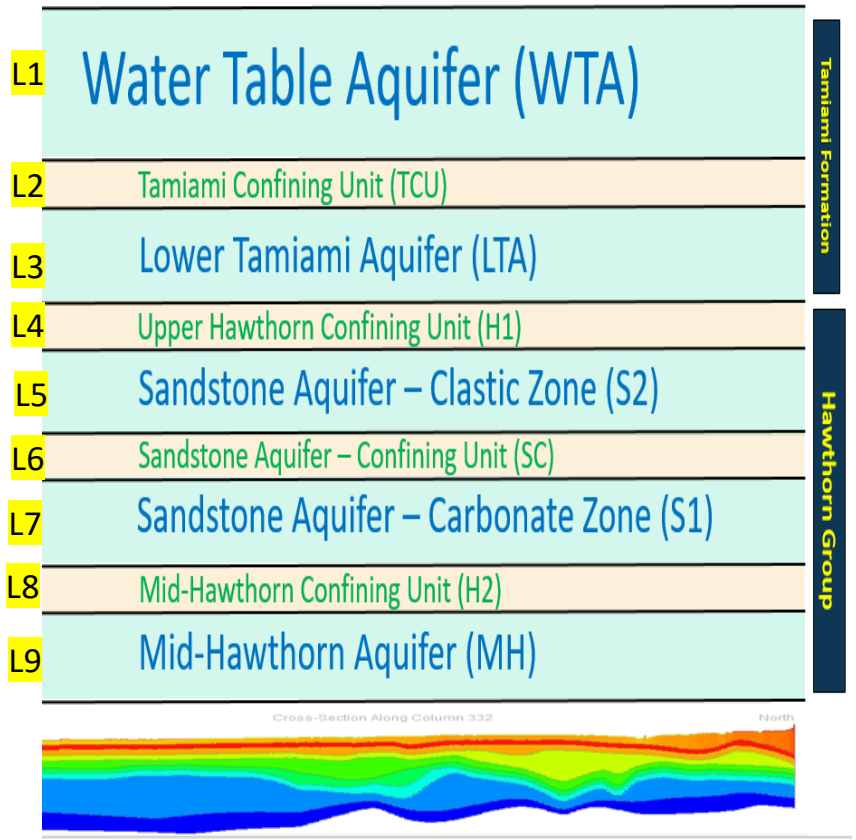


SAS=Surficial Aquifer System

IAS=Intermediate Aquifer System

FAS=Floridan Aquifer System

9-Layer model with 5 productive aquifers



Model Application

Reference Condition (2014) and Future Condition (2040)

- Similar simulation period to calibration run-16 years
- Similar climatic conditions to calibration run
- New pumping values

2014 Reference Condition

- Public Supply demands from reported pumpage data
- Agricultural and Recreational demands are estimated using AFSIRS*
- Domestic Self Supply (DSS) demands were estimated using per capita usage per county
- Industrial demands from permitted allocations

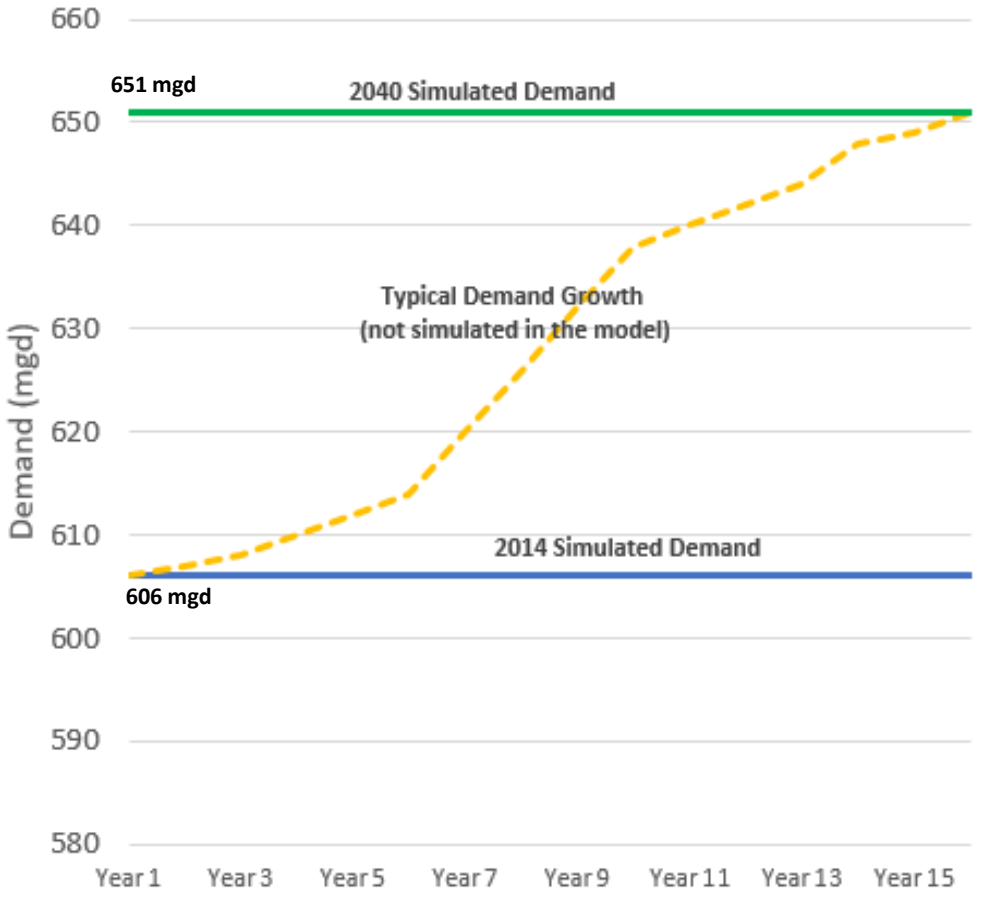
2040 Future Condition

- Public Supply, Agricultural, Recreational, and DSS demands from planning projections
- Industrial demands from permitted allocations

***AFSIRS = Agricultural Field Scale Irrigation Requirement Simulation Model, A.G. Smajstrla**

Limitations in Simulating Demands in Scenarios

- For future scenario (2040)
- Model does not simulate annual demand growth
- Simulated demands are “instant on” and continued throughout the period
- Results from the 2040 simulation are considered conservative

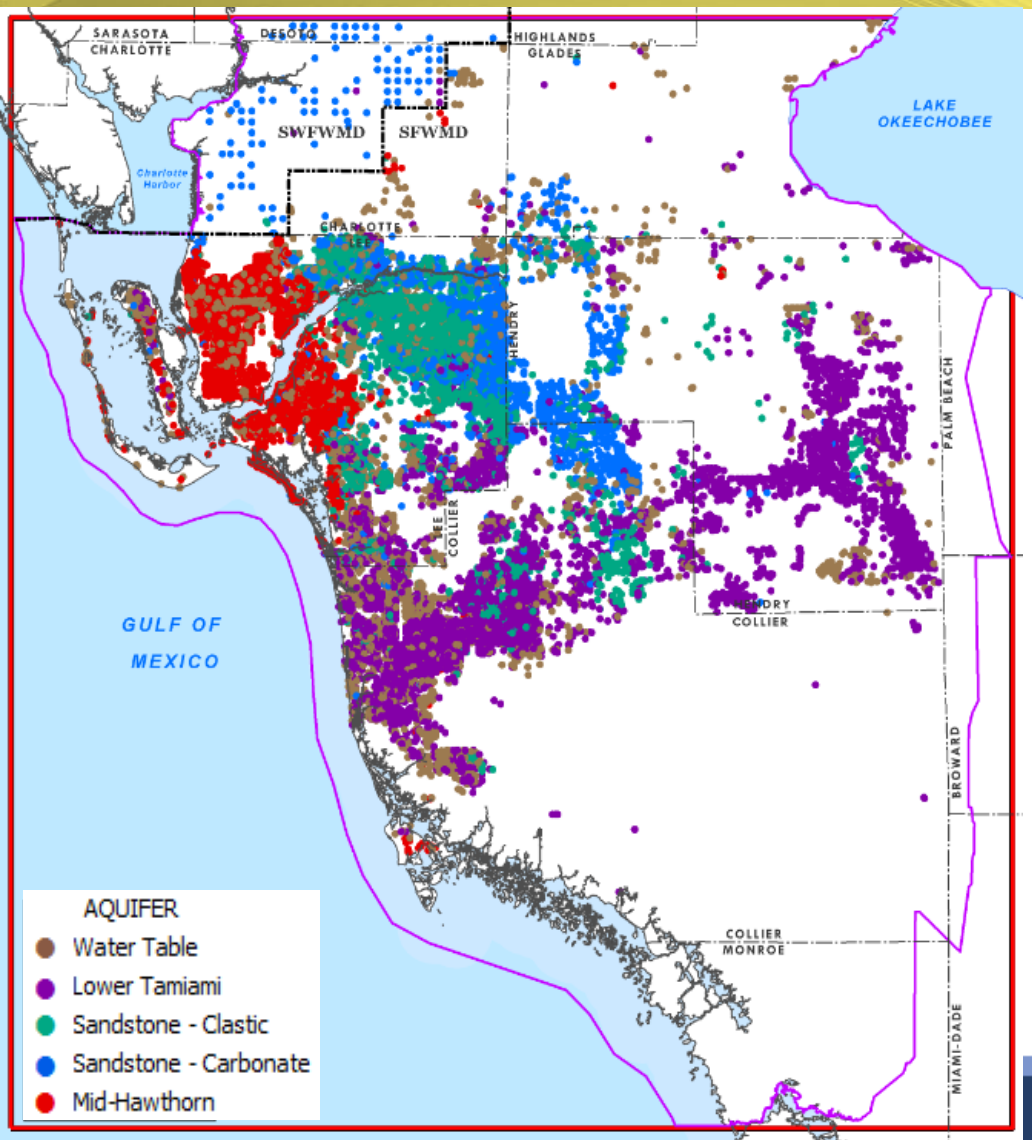


Raw water demand shown for all use types

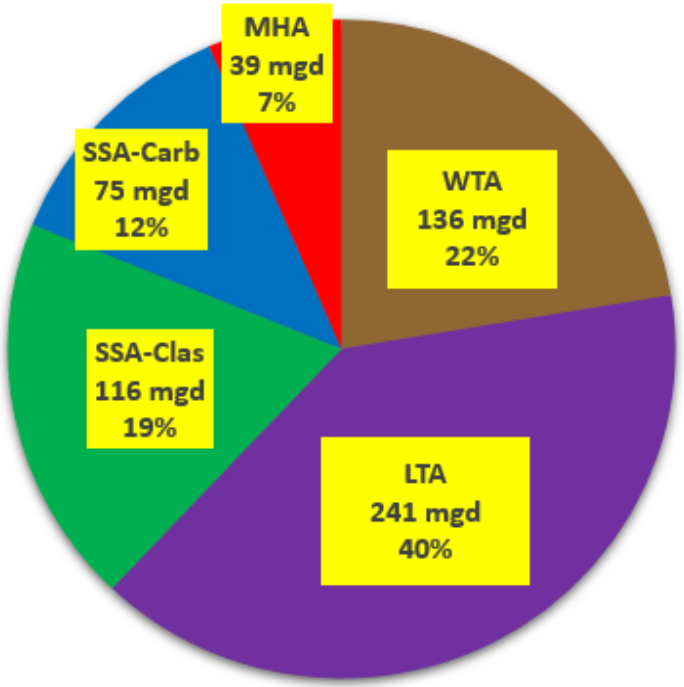
Regional Model Limitations

- Heterogeneity
  - Regional model (1,000 ft x 1,000 ft cells) may not capture local variability in aquifer properties and may not capture the response at individual wells
- Multiple wells in a single model cell
  - Model aggregates all withdrawals at the center of the model cell
  - Tends to exaggerate water level drawdowns: results are conservative
- Regional model results should be considered as an overall planning tool and results should not be taken as absolutes

All Pumping Wells in LWCSIM
(PS, AG, REC, DSS, CI- Colored According to Aquifer)



Pumped Volumes by Aquifer - 2014



Total pumped in 2014 = 606 mgd

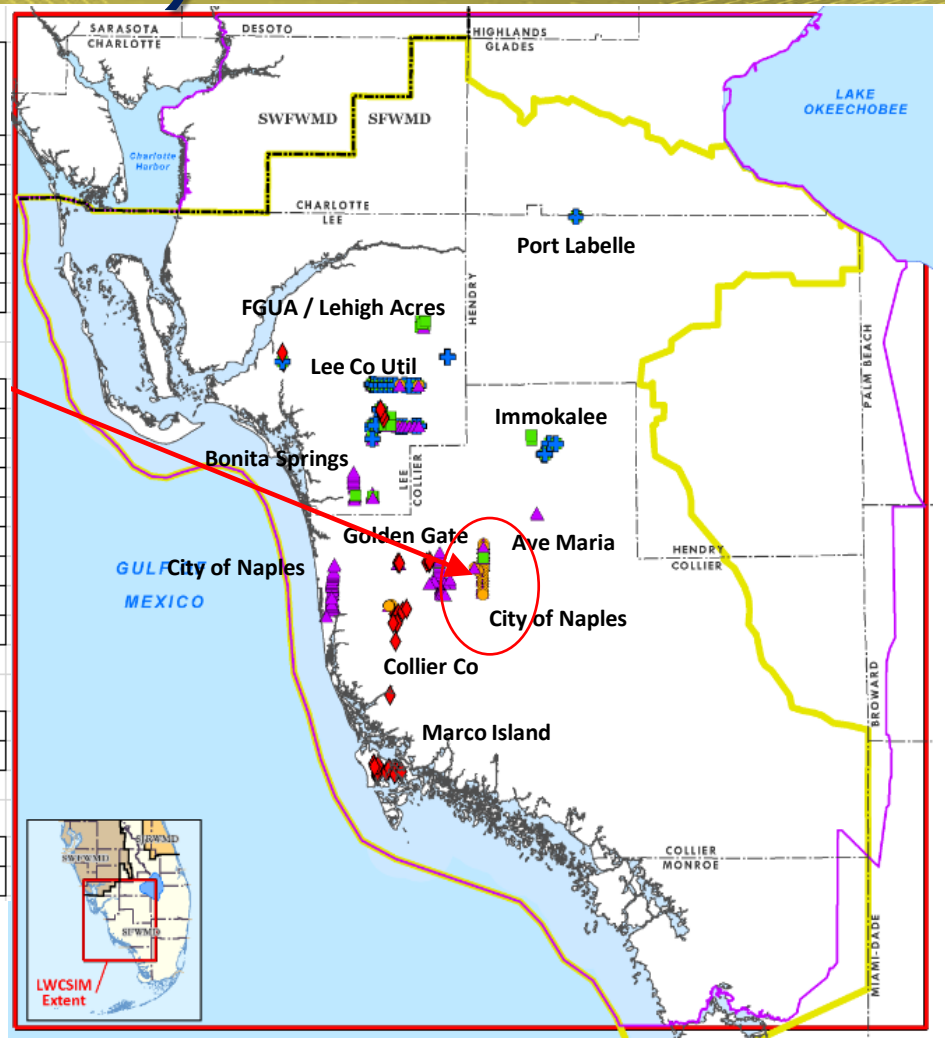
mgd = million gallons per day

PS: Public Supply
AG: Agricultural
REC: Recreational
DSS: Domestic Self Supplied
CI: Commercial and Industrial

Allocations and Demands of Largest PS Permits (SAS/IAS)

Permittee	Current Allocation MGD	2014 Demand MGD	2040 Demand MGD	2040 - 2014 DIFF MGD
Lee				
Lee Co. Util.Corkscrew/Green Meadows/Olga	34.27	13.74	16.24	2.50
Bonita Springs Utilities	5.74	3.53	5.48	1.95
FGUA –Lehigh Acres	3.15	2.06	3.46 *	1.40
Citrus Park RV Resort	0.23	0.19	0.24 *	0.05
Lee County Utilities - Pinewoods	7.36	1.76	1.80	0.04
FGUA – Lake Fairways	0.101	0.10	0.10	0.00
Collier				
Naples, City of – Utility Department	18.42	14.13	20.22 *	6.09
Collier County – N Regional, S Regional	53.5	23.77	25.80	2.03
Marco Island Utilities	13.16	1.85	3.62	1.76
Ave Maria Utility Company	1.16	0.30	2.01 *	1.71
Collier Golden Gate (fka FGUA)	2.5	1.64	0.00	-1.64
Immokalee Water & Sewer District	4.15	1.93	2.41	0.48
Collier County (fka Orange Tree)	0.65	0.42	0.87 *	0.45
Everglades City, City of	0.3	0.16	0.27	0.11
Port of the Islands CID	0.55	0.22	0.25	0.03
Hendry				
LaBelle, City of	1.06	0.36	0.01	-0.35
Port LaBelle Utility System	0.53	0.54	0.53	-0.01
Charlotte				
Town and Country Utilities Company	0.78	0.00	0.78	0.78
Charlotte Correctional	0.12	0.10	0.10	0.00

mgd=million gallons per day



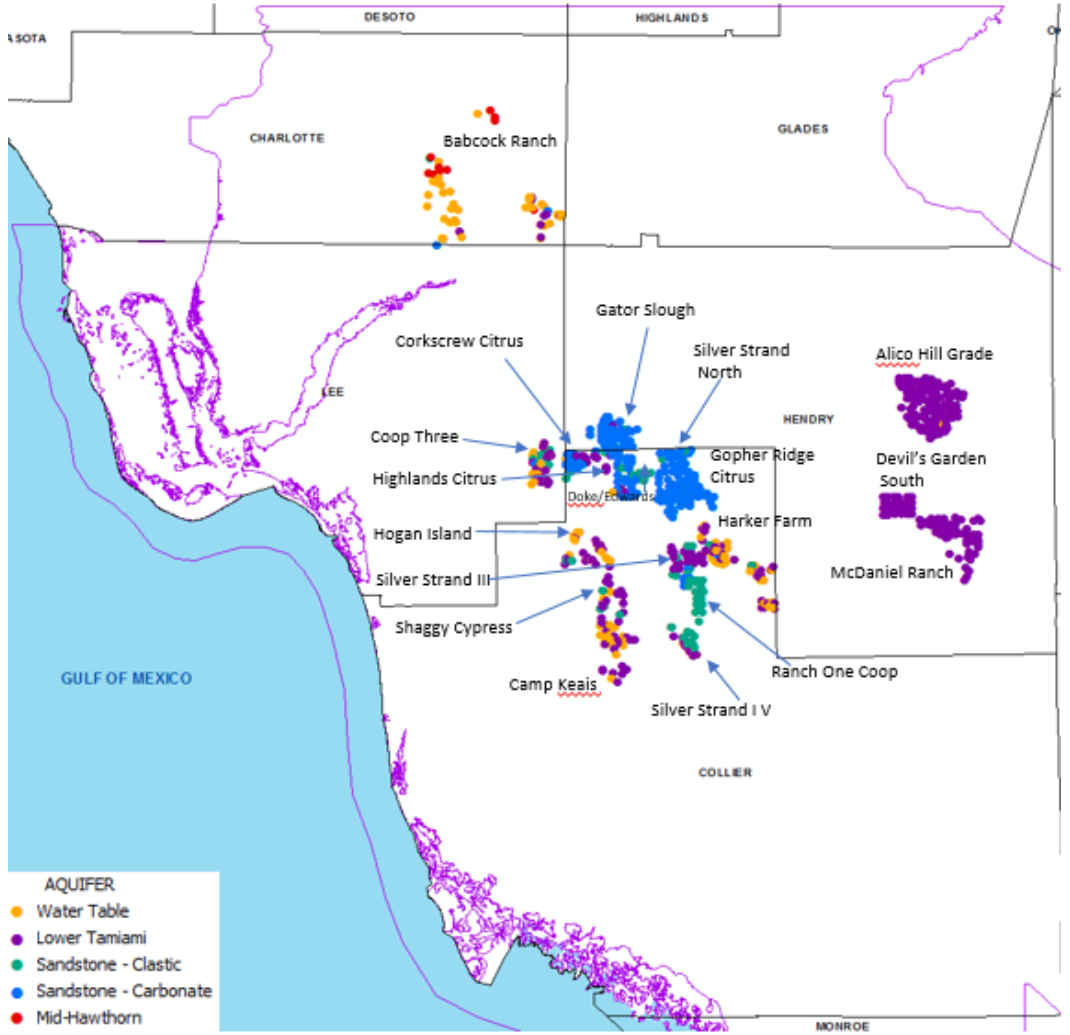
** Indicates a modeled demand over the current permitted allocation; however, it is not guaranteed to be permitted by SFWMD Water Use Bureau*

Naples: most of the increase in Eastern Well Field

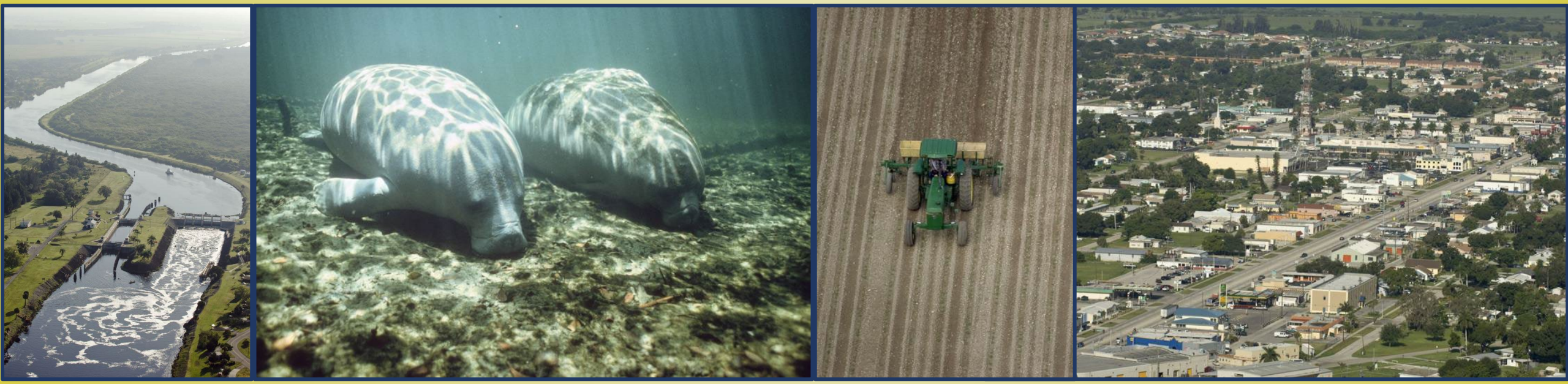
Locations, Allocations, Demands of Largest AG Permits (SAS/IAS)

Permittee	Allocation mgd	2014 Demand mgd	2040 Demand mgd	DIFF (2040-2014 mgd
Charlotte				
Babcock Ranch	8.91	8.07	8.76	**0.69**
Collier				
Corkscrew Citrus	13.78	12.06	9.33	-2.73
Silver Strand I I I	8.05	5.07	4.12	-0.95
Ranch One Coop	9.36	7.30	8.01	0.71
Silver Strand North	11.48	11.06	10.38	-0.68
Highlands Citrus	7.70	4.32	3.74	-0.58
Harker Farm	12.16	10.88	10.35	-0.53
Gator Slough	16.25	13.65	14.17	0.52
Shaggy Cypress	13.43	5.40	4.92	-0.48
Silver Strand I V	6.06	6.00	5.65	-0.35
Hogan Island	10.52	5.09	5.43	0.34
Camp Keais Ag Dev	16.63	5.60	5.32	-0.28
Gopher Ridge Citrus	10.35	6.89	6.89	0.00
Hendry				
lico Hill Grade Combin	10.45	5.25	5.63	0.38
McDaniel Ranch	28.25	22.60	22.83	0.23
Devil's Garden South	7.64	6.01	6.07	0.06
Lee				
Cooperative Three Inc	7.54	1.81	1.69	-0.12

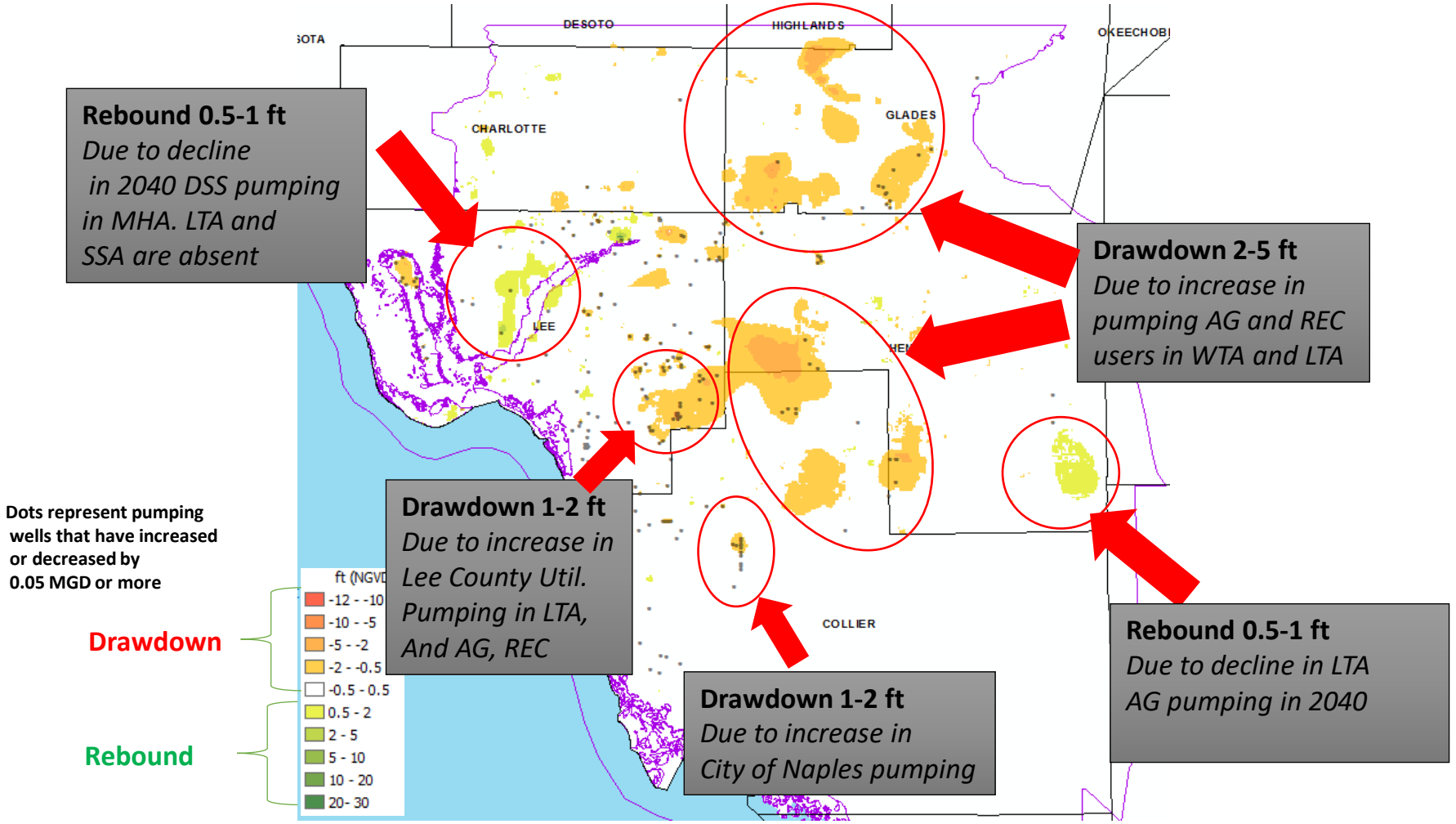
mgd=million gallons per day



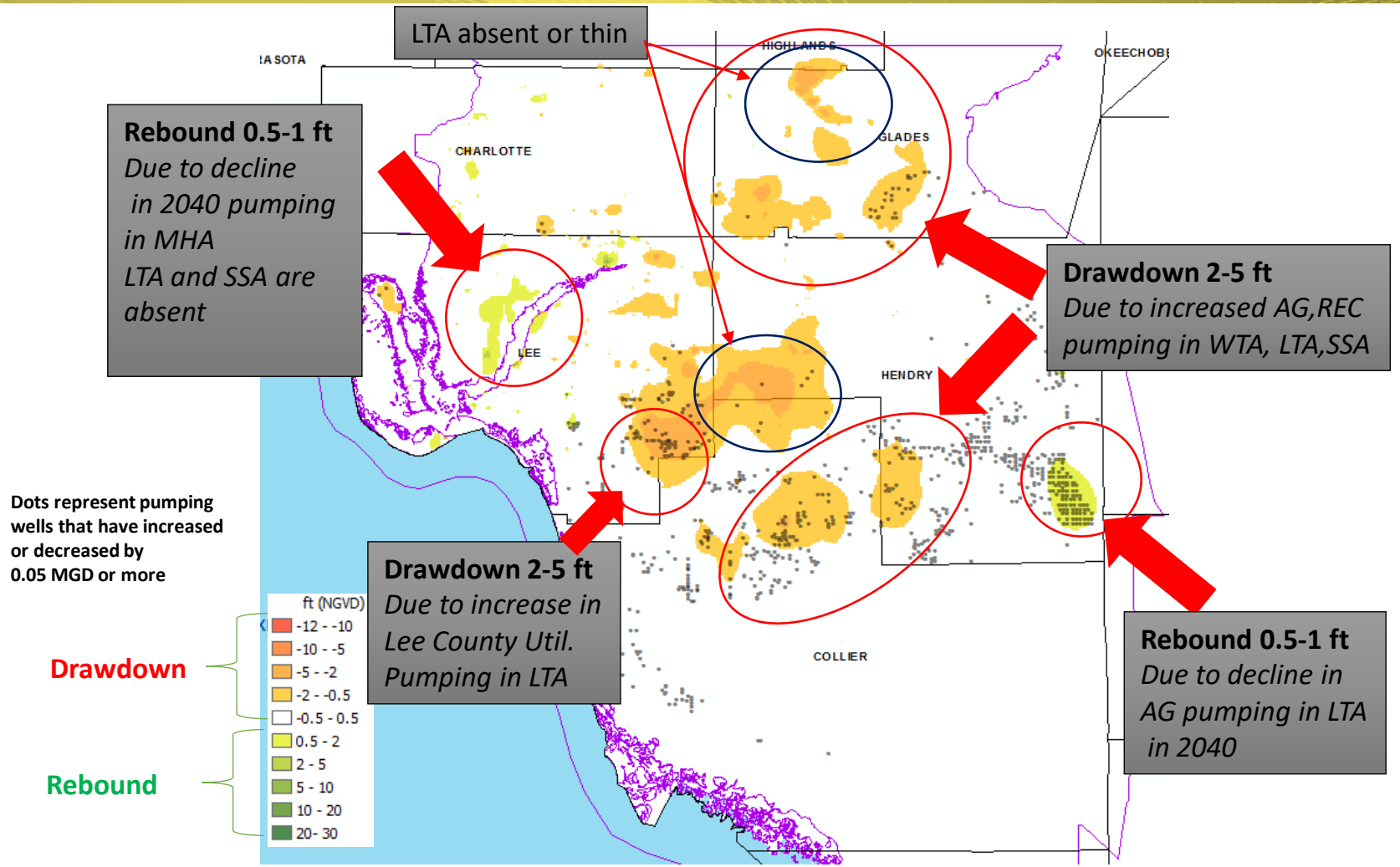
Model Results
Simulated Head Differences



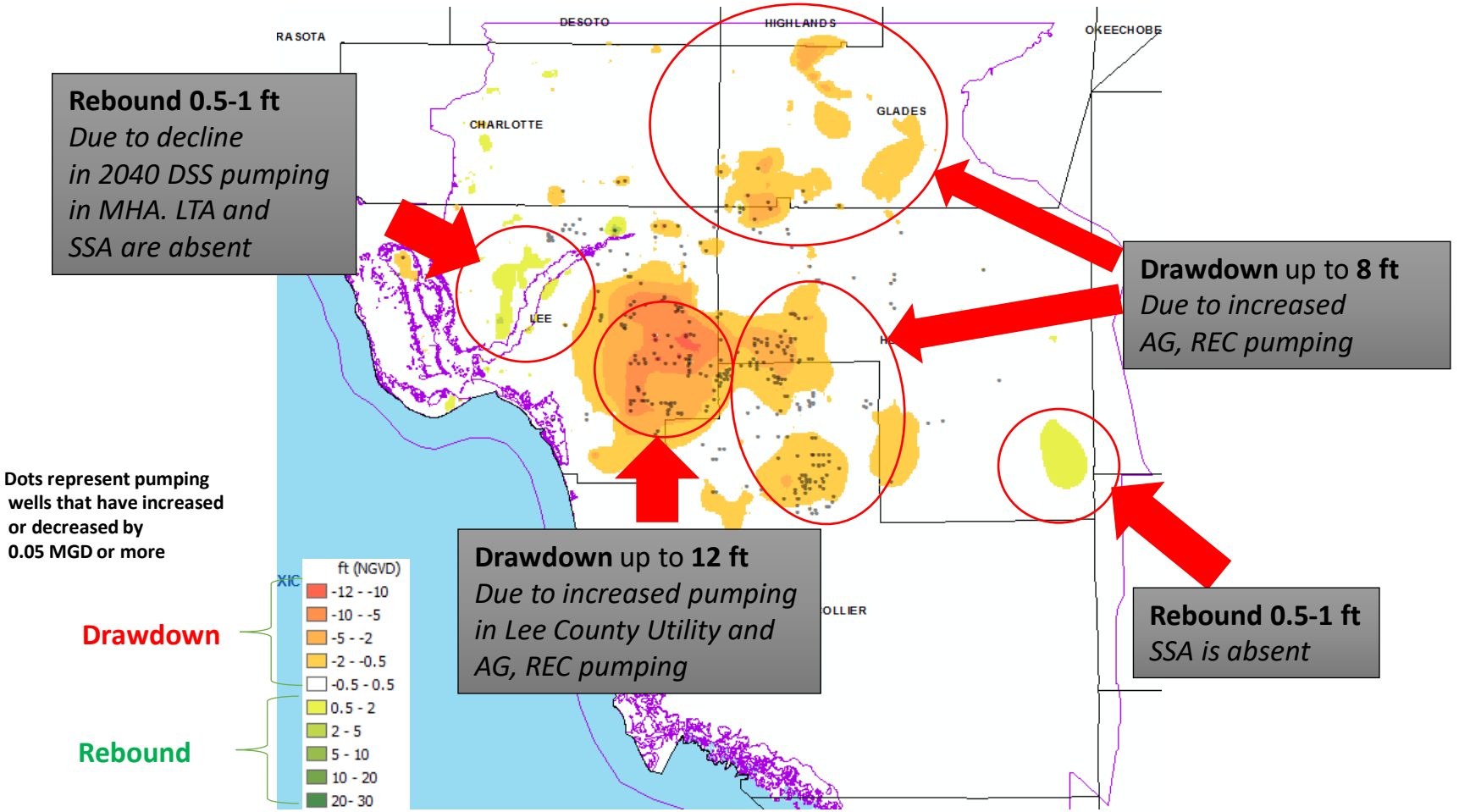
Water Level Difference: Water Table Aquifer 2040 Future – 2014 Reference Condition



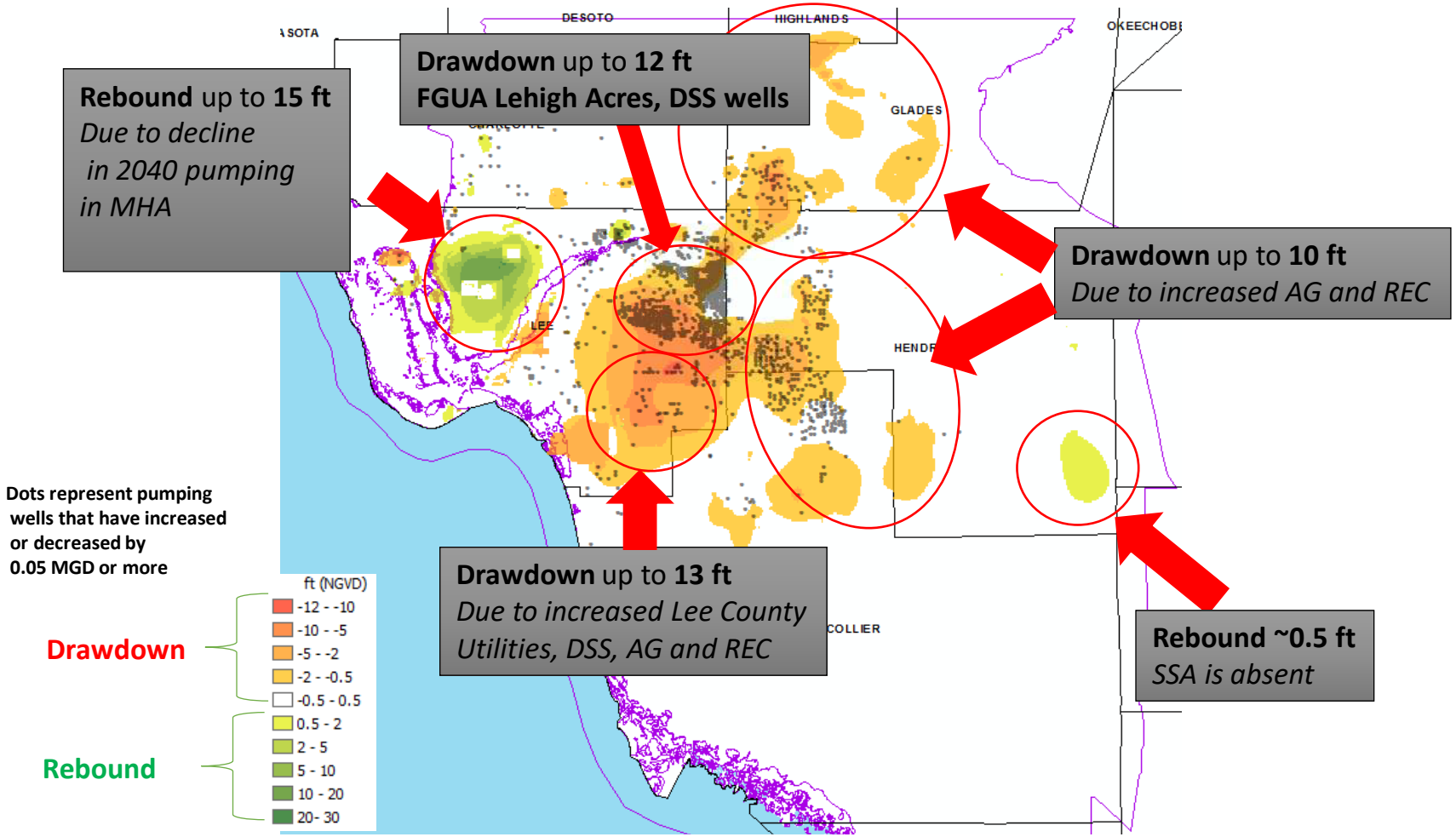
Water Level Difference: Lower Tamiami Aquifer 2040 Future – 2014 Reference Condition



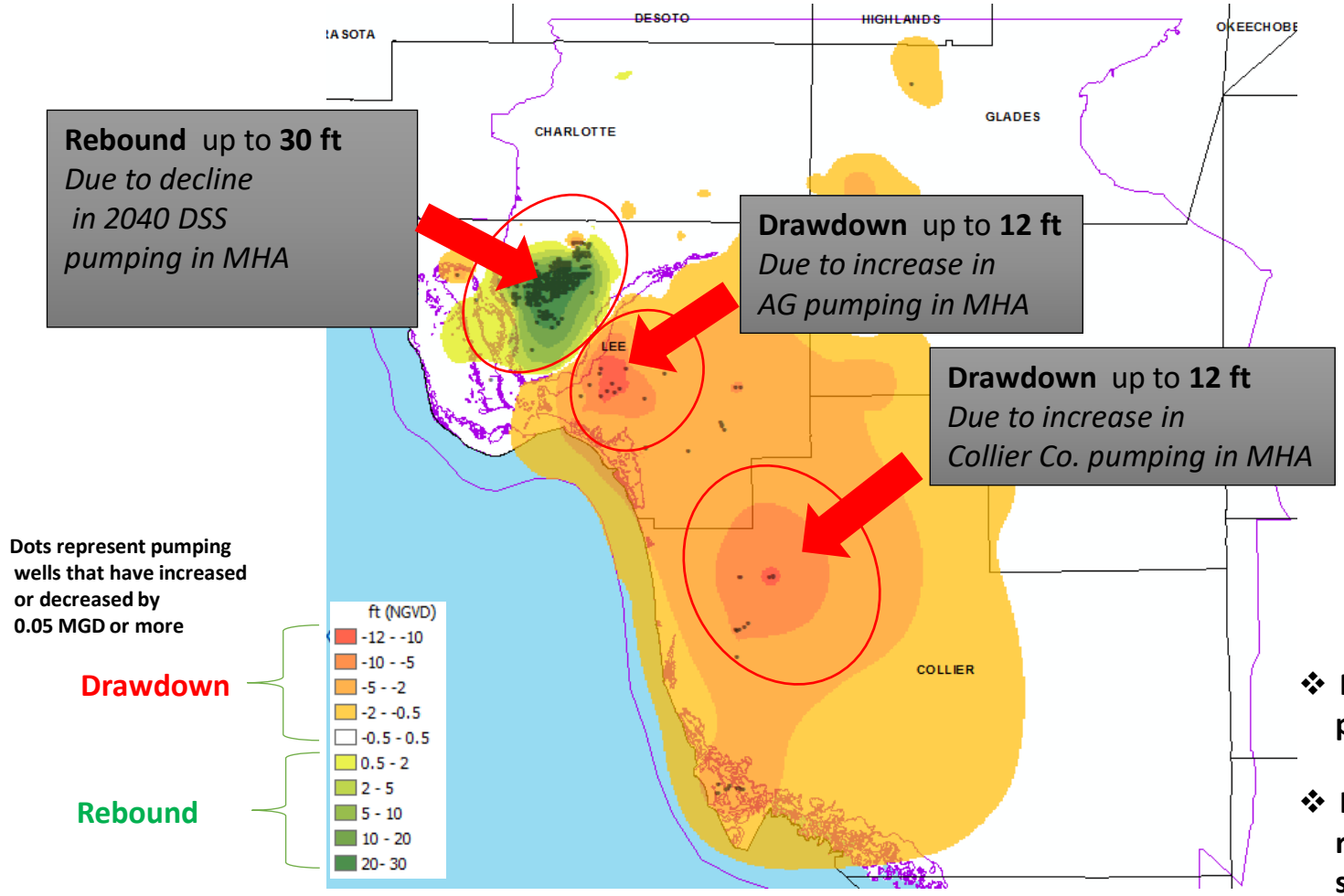
Water Level Difference: Sandstone-Clastic Aquifer 2040 Future – 2014 Reference Condition



Water Level Difference: Sandstone-Carbonate Aquifer 2040 Future – 2014 Reference Condition



Water Level Difference: Mid Hawthorn Aquifer 2040 Future – 2014 Reference Condition



- MHA is not a very productive aquifer
- Higher drawdown responses for even small pumping amounts

Velocity Vectors Analysis

- LWCSIM not a density-dependent model->cannot directly simulate saltwater intrusion nor sea-level rise

- Flow direction can be an indication of whether the flow of water is inland or towards the coast in relation to the mapped saltwater interface

  - Interface positions are plotted as a reference to the wellfield locations ONLY

Velocity Vectors – Bonita Springs-LTA

Permittee	Aquifer	2014 (MGD)	2040 (MGD)	Increase
Bonita Springs	Lower Tamiami Aquifer	3.53	5.48	1.95

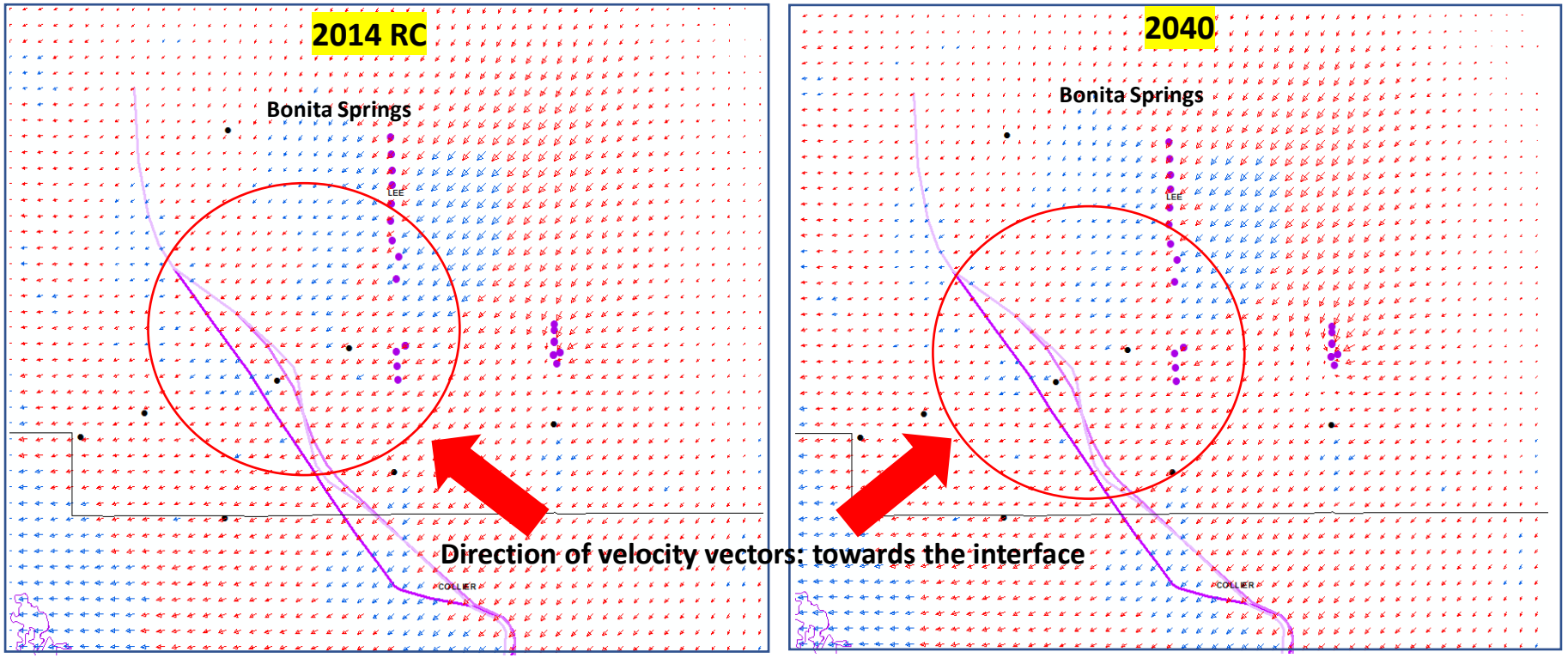
- 2014: Direction of velocity vectors: towards the interface
- 2040: Conditions are almost the same

Saltwater Interface (LTA)

2009
2014
2019

Upward
Downward

Velocity vectors in every model cell
Vector size proportional to velocity



Velocity Vectors – Golden Gate-LTA

Permittee	Aquifer	2014 (MGD)	2040 (MGD)	Increase
Golden Gate	Lower Tamiami Aquifer	16.06	16.80	0.74

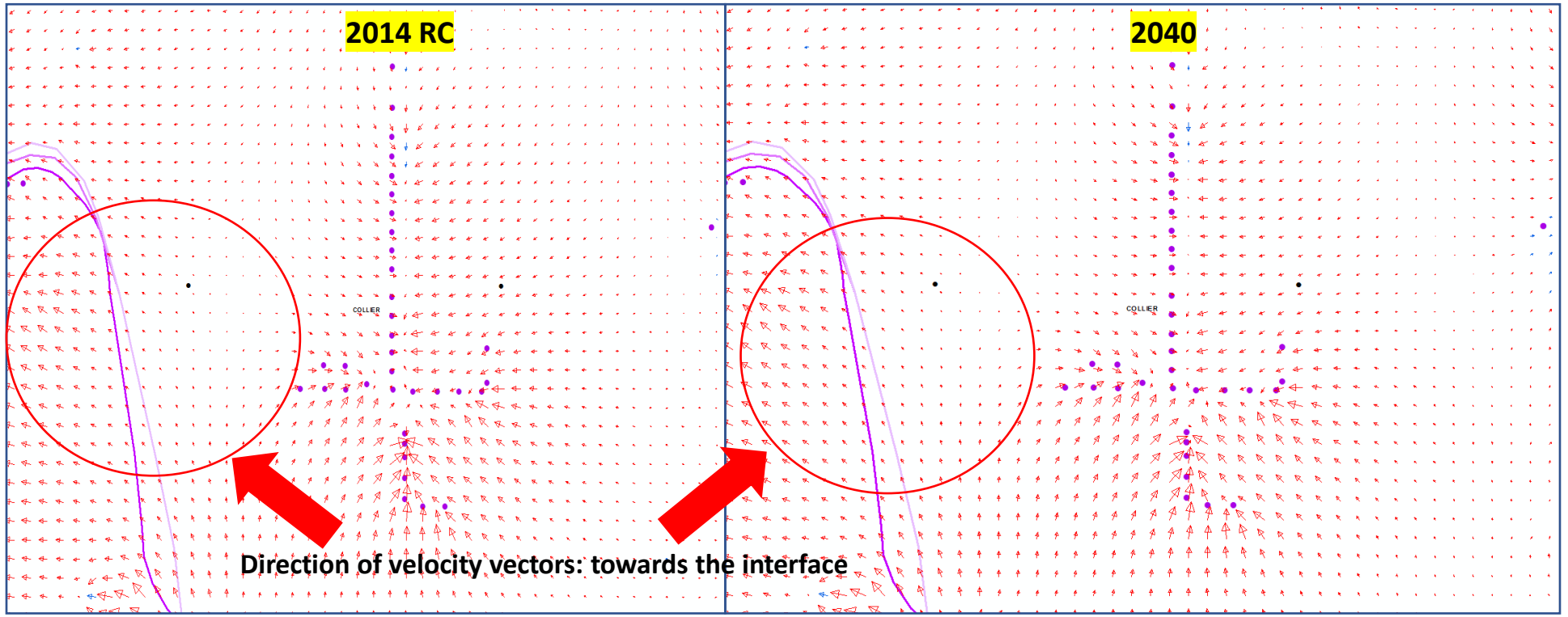
- 2014: Direction of velocity vectors: towards the interface
- 2040: Conditions are almost the same

Saltwater Interface (LTA)

2009
2014
2019

Upward
Downward

Velocity vectors in every model cell
Vector size proportional to velocity



Velocity Vectors – City of Naples (Coastal)-LTA

Permit No	Permittee	Aquifer	2014 (MGD)	2040 (MGD)	Increase
11-00017-W	City of Naples	Lower Tamiami Aquifer	3.75	3.78	0.03

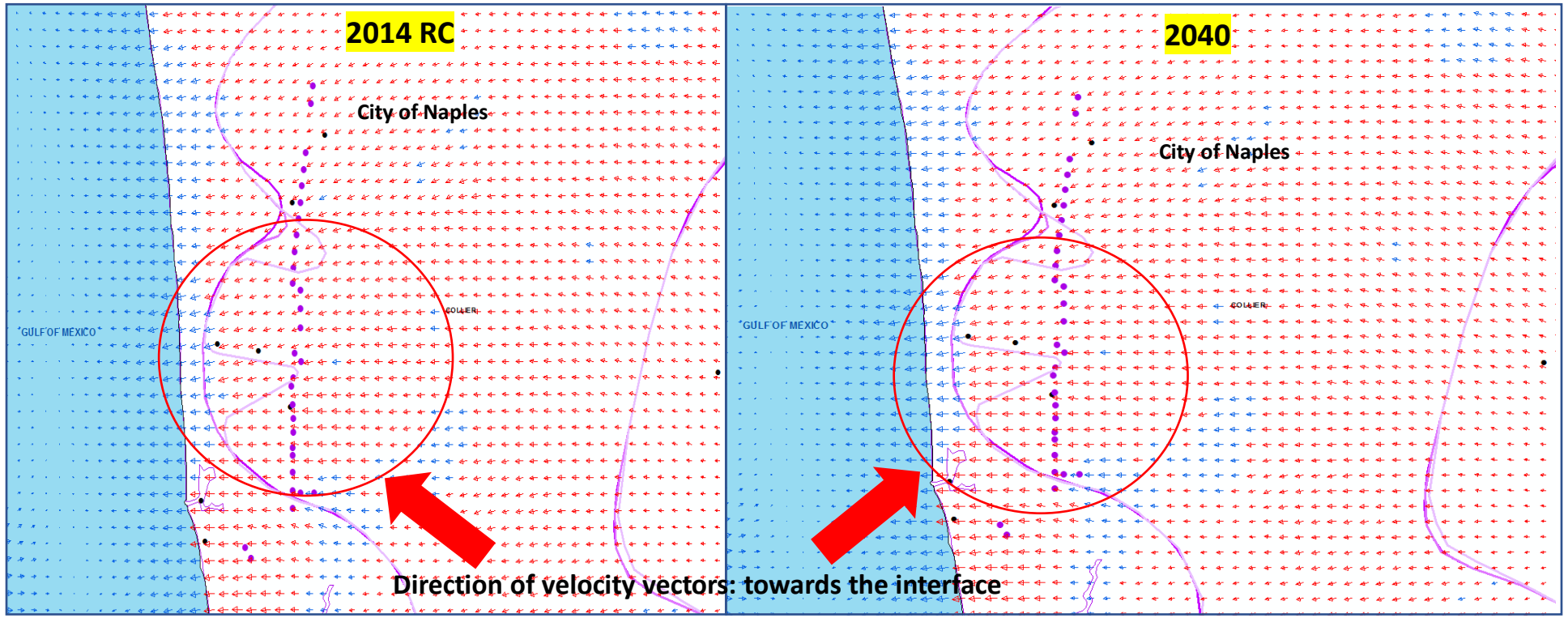
- 2014: Direction of velocity vectors: towards the interface
- 2040: Conditions are almost the same

Saltwater Interface (LTA)

2009
2014
2019

Upward
Downward

Velocity vectors in every model cell
Vector size proportional to velocity
Max vector length = 2000'



Observations

- Velocity vectors did not change in 2040 compared to 2014 in most cases (Bonita Springs, Golden Gate, Naples)

- Not a density-dependent model, but freshwater vectors indicate no major lateral intrusion issues under current or proposed conditions
  - Sea-level rise would change that conclusion, as would increases in proposed pumpage

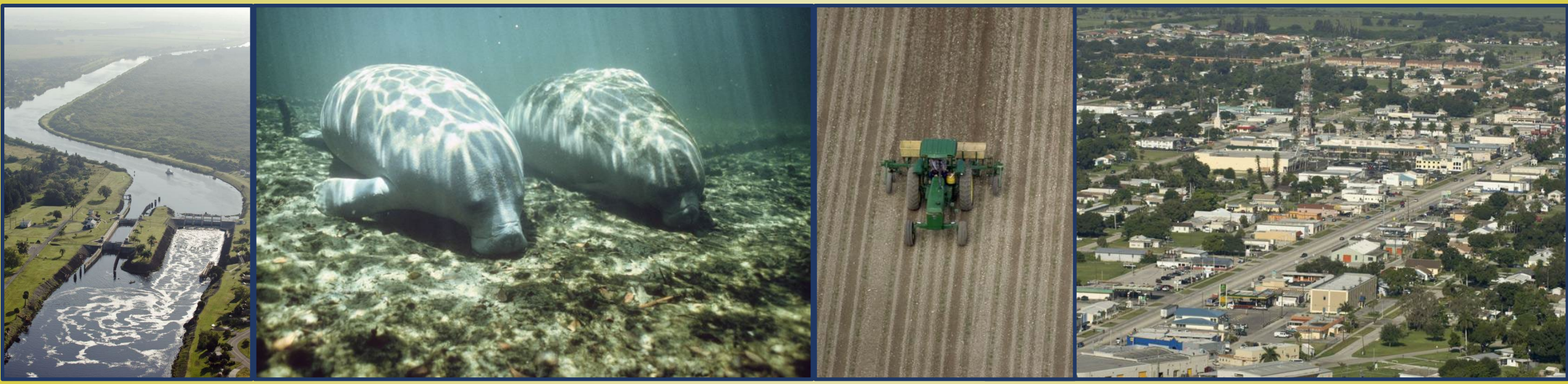
Conclusions of LWCSIM Results

- **LWCSIM** – Regional scale, calibrated, peer-reviewed model for SAS/IAS of Lower West Coast Planning Area

- **Model** indicates that 2040 water demands can be met without undue impacts to natural systems
  - Water levels rebounded in Cape Coral area of MHA and Southeastern Hendry County in WTA, LTA, and SSA due to decline in projected pumping

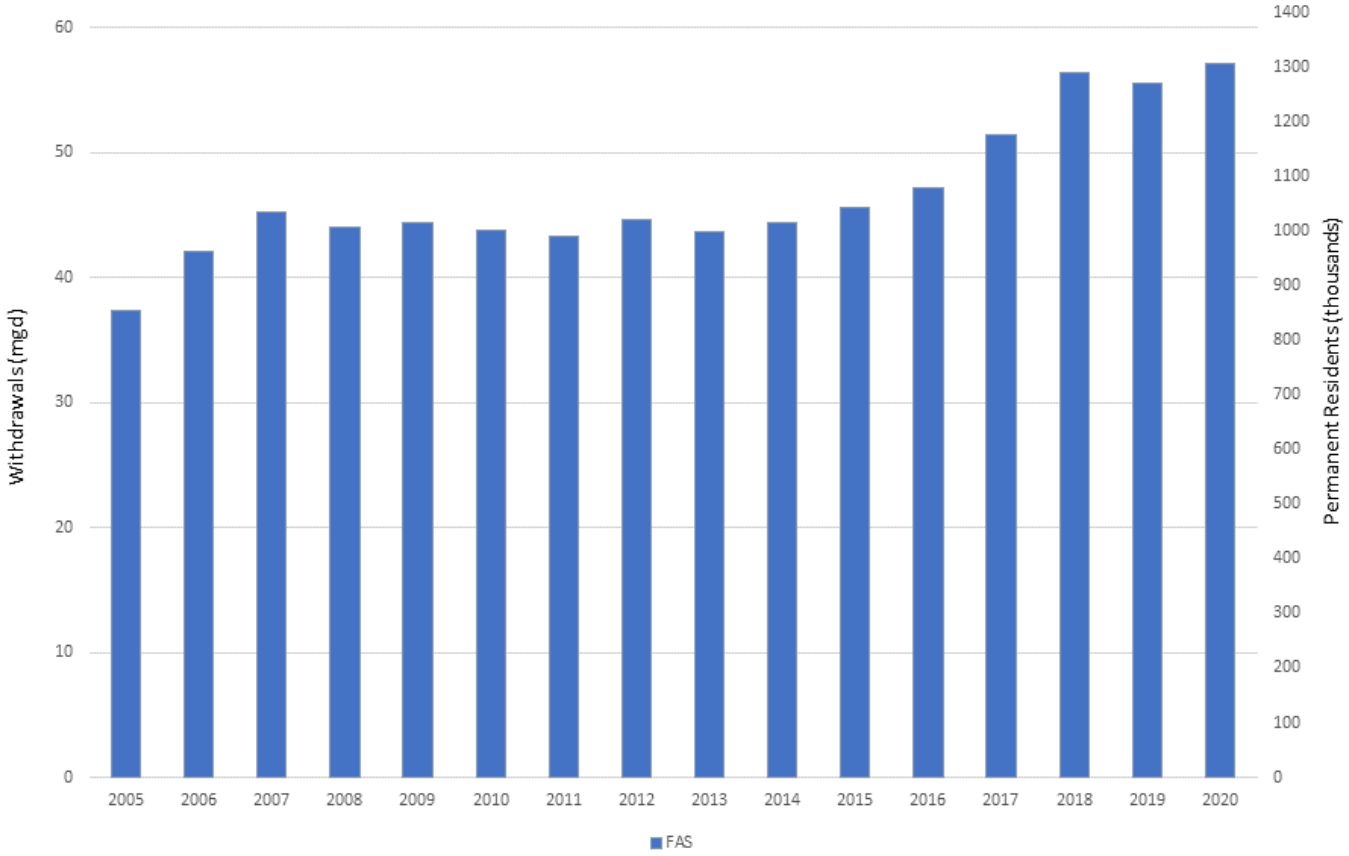
- **Saltwater Intrusion Analysis**
  - LWCSIM is not a density-dependent model but potentially vulnerable areas for **lateral intrusion** can be identified using velocity vectors
  - Freshwater velocity vectors indicate no major **lateral intrusion** issues under current or proposed conditions

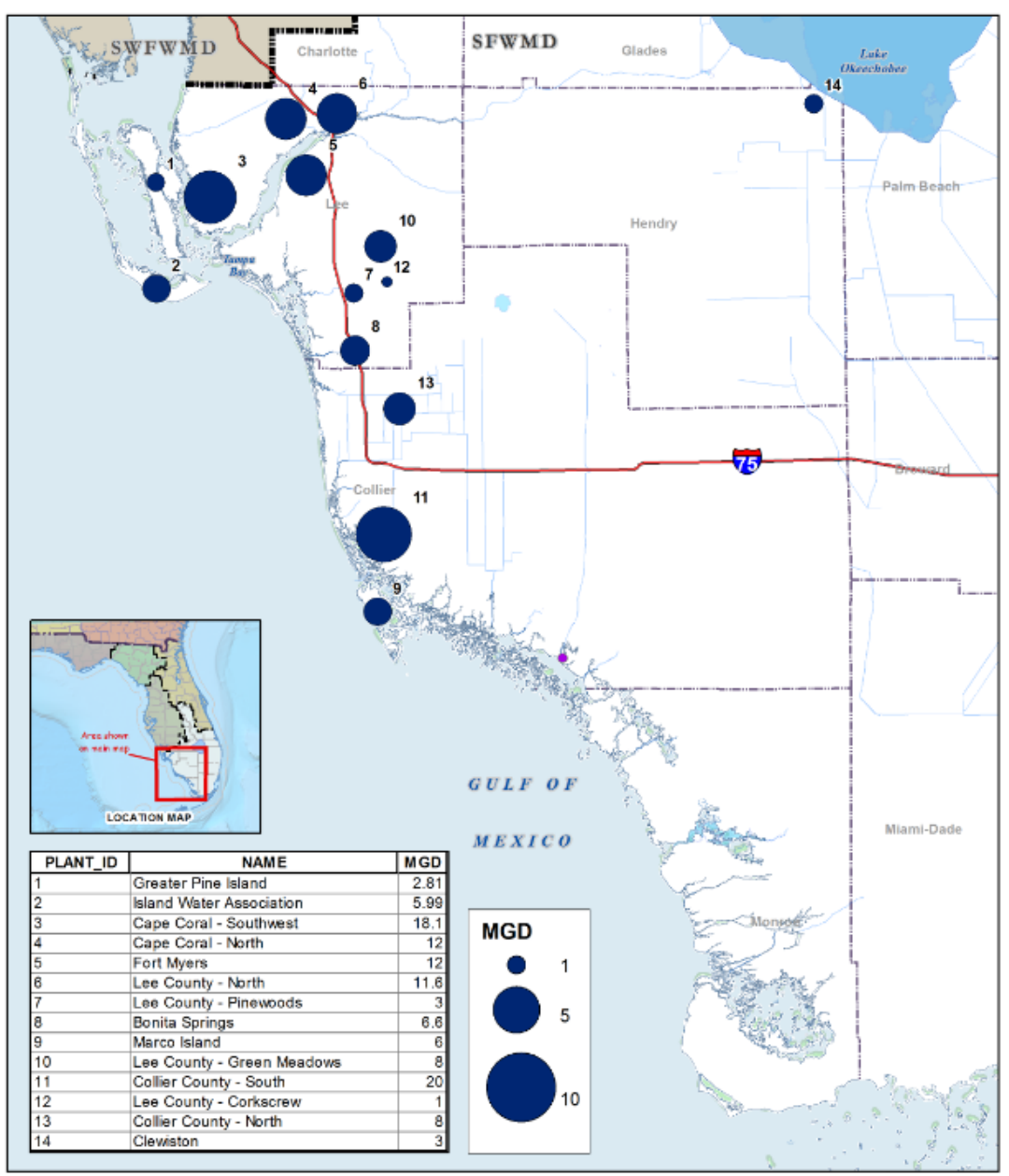
West Coast Floridan Model (WCFM)



Brackish Water from the Floridan Aquifer System

- Currently, 14 facilities, 120 mgd capacity, reverse osmosis (RO) treatment
- Increase in development through 2040

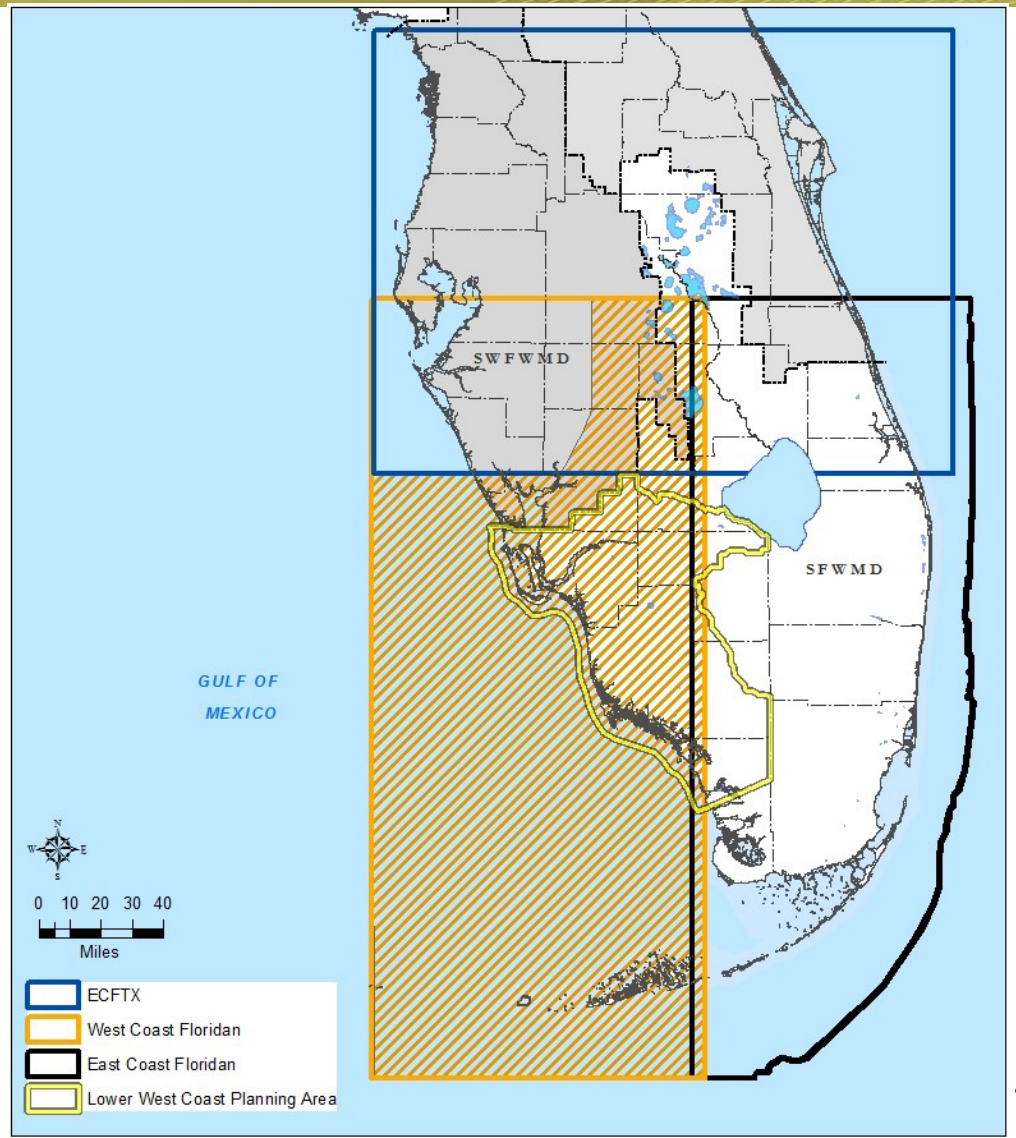




PLANT_ID	NAME	MGD
1	Greater Pine Island	2.81
2	Island Water Association	5.99
3	Cape Coral - Southwest	18.1
4	Cape Coral - North	12
5	Fort Myers	12
6	Lee County - North	11.6
7	Lee County - Pinewoods	3
8	Bonita Springs	6.6
9	Marco Island	6
10	Lee County - Green Meadows	8
11	Collier County - South	20
12	Lee County - Corkscrew	1
13	Collier County - North	8
14	Clewiston	3

West Coast Floridan Model

- SEAWAT model (USGS, 2012)
- Period of record: 1989-2012
- Monthly simulation periods
- Cell size: 2,400 ft × 2,400 ft
- Calibrated to water levels and water quality (Total Dissolved Solids [TDS])

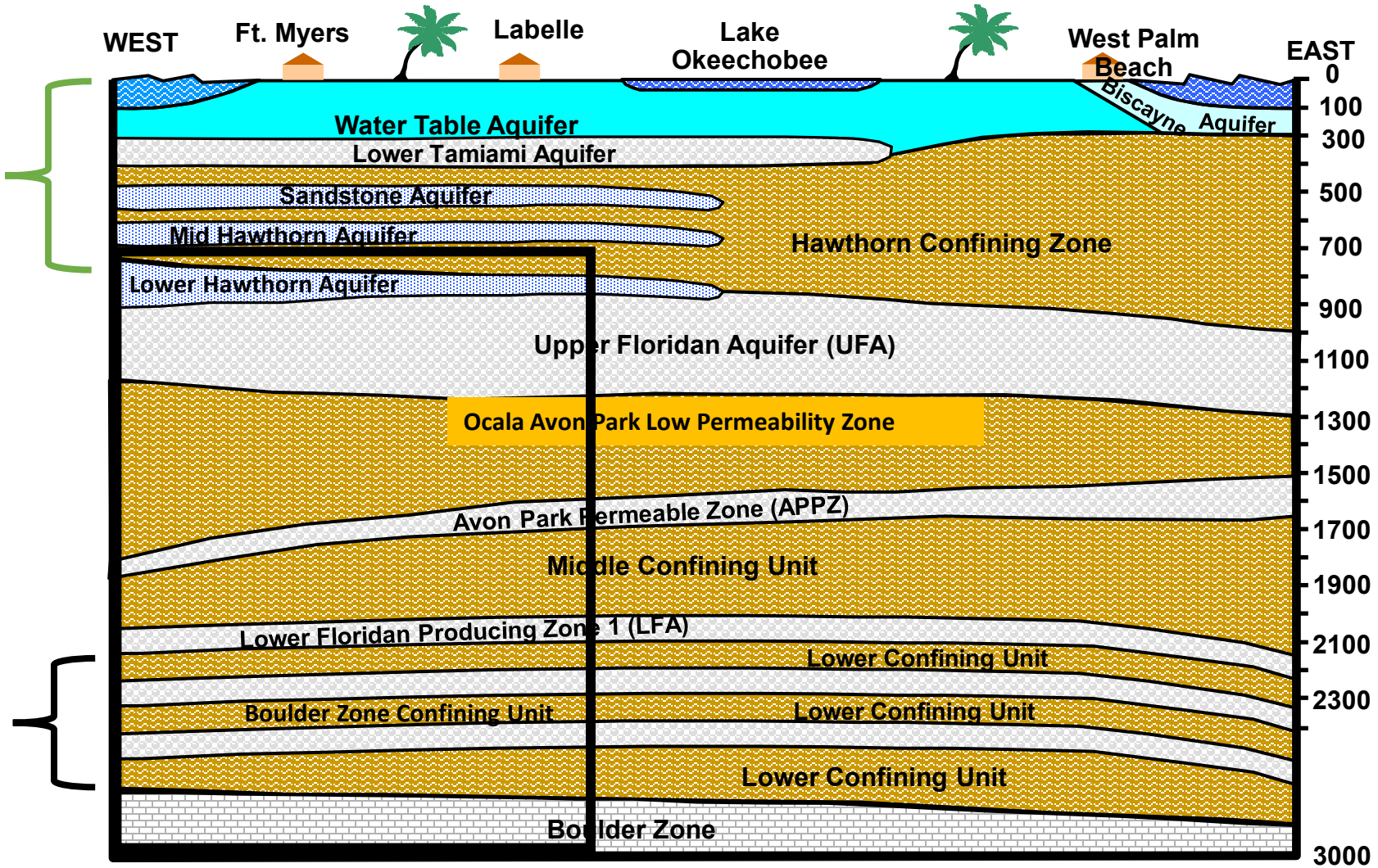


WCFM Aquifers and Model Layers

LWCSIM

WCFM Layers

- Layer 1
- Layer 2
- Layer 3
- Layer 4
- Layer 5
- Layer 6
- Layer 7



WCFM Application

- 2014 base condition
  - Public supply demands from historical pumpage data
  - Agricultural and recreational/landscape demands estimated based on AFSIRS (simulates irrigation demands)
  - Industrial demands from permitted allocations
  - Areas overlapping the ECFTX Model domain have demands consistent with the Central Florida Water Initiative regional water supply plan
- 2040 future condition
  - Public water supply, agricultural, and recreational/landscape demands from planning projections
  - Industrial demands from permitted allocations
  - Areas overlapping the ECFTX Model domain have demands consistent with the 2040 projections in the Central Florida Water Initiative regional water supply plan
  - 2040 projected demands are simulated starting at the initial condition

Public Supply FAS Demands

County	Permit Number	Utility	FAS Allocation (mgd)	2014 (mgd)	2040 (mgd)	Difference (mgd)
Lee	36-00046-W	Cape Coral Utilities	39.25	11.32	27.60	16.28
	36-00035-W	City of Fort Myers	15.25	8.93	17.49*	8.56
	36-00003-W	Lee County – Corkscrew/Green Meadows/Olga	14.21	0.27	13.57	13.29
	36-00152-W	Lee County Utilities – North	16.13	5.00	10.98	5.98
	36-04062-W	Bonita Springs Utilities	13.07	5.61	10.69	5.09
	36-00122-W	Lee County Utilities – Pinewoods	4.90	2.24	6.15*	3.91
	36-00034-W	Island Water Association	4.96	4.43	4.70	0.27
	36-00045-W	Greater Pine Island	2.49	1.54	2.24	0.70
		Total Lee County Demand	**110.26**	**39.34**	**93.42**	**54.08**
Collier	11-00249-W	Collier County North & South Regional	19.52	3.42	14.12	10.70
	11-00013-W	Immokalee Water & Sewer District	0.70	0.00	0.002	0.002
		Total Collier County Demand	**20.22**	**3.42**	**14.122**	**10.702**
Hendry	26-00105-W	Labelle Public Water Supply	1.06	0.33	0.74	0.41
		Total Hendry County Demand	**1.06**	**0.33**	**0.74**	**0.41**

* Indicates a modeled demand over the current permitted allocation; however, it is not guaranteed to be permitted by SFWMD Water Use Bureau

2040 Public Supply FAS Wellfields

Cape Coral Utilities

- 18 additional wells
- 16.28 mgd increase

Greater Pine Island

- 0.70 mgd increase

Island Water Association

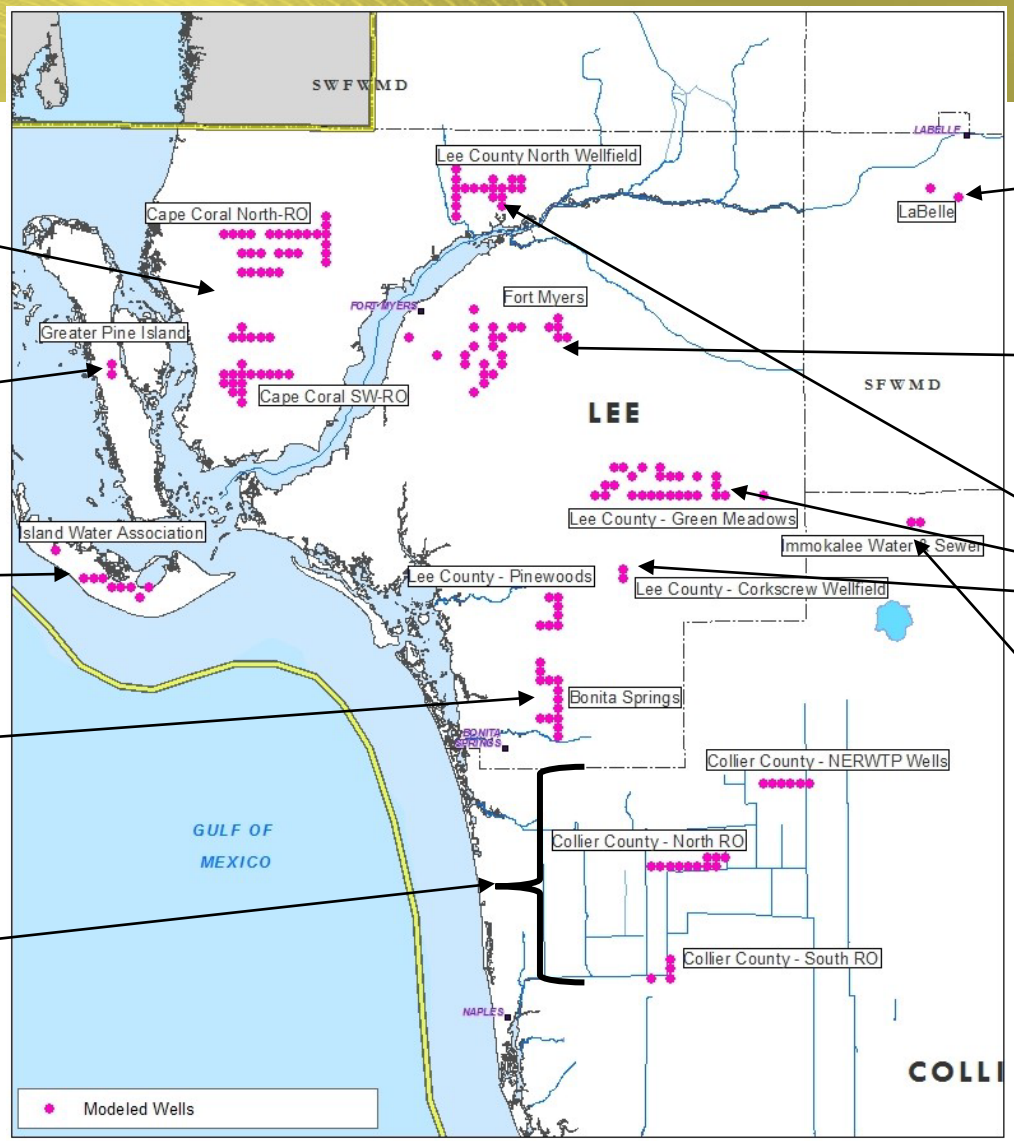
- 0.27 mgd increase

Bonita Springs

- 8 additional wells
- 5.09 mgd increase

Collier County

- 16 additional wells
- 10.70 mgd increase



LaBelle

- 0.41 mgd increase

Fort Myers

- 25 additional wells
- 8.56 mgd increase

Lee County Utilities

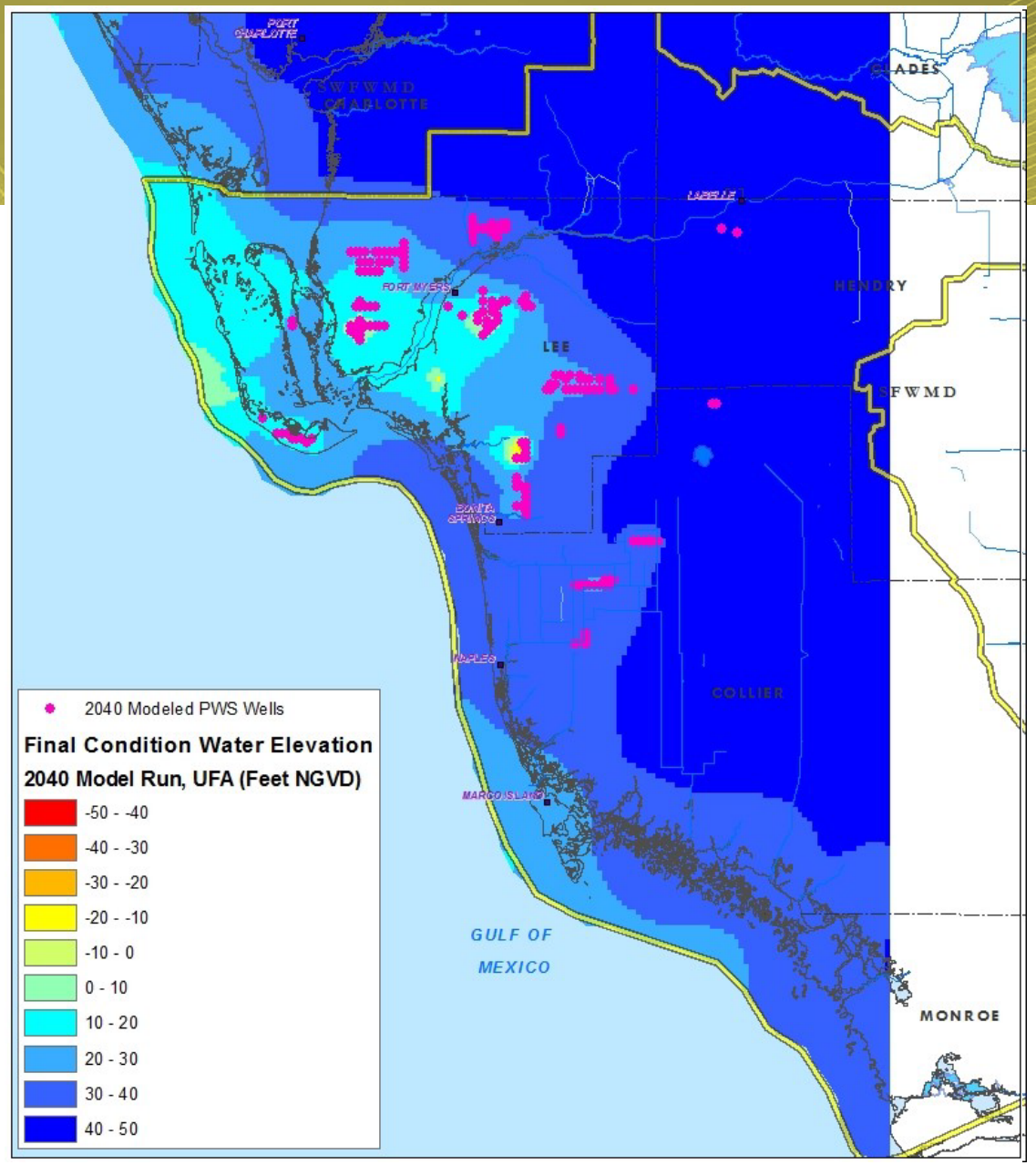
- 29 additional wells
- 13.29 mgd increase

Immokalee Water & Sewer

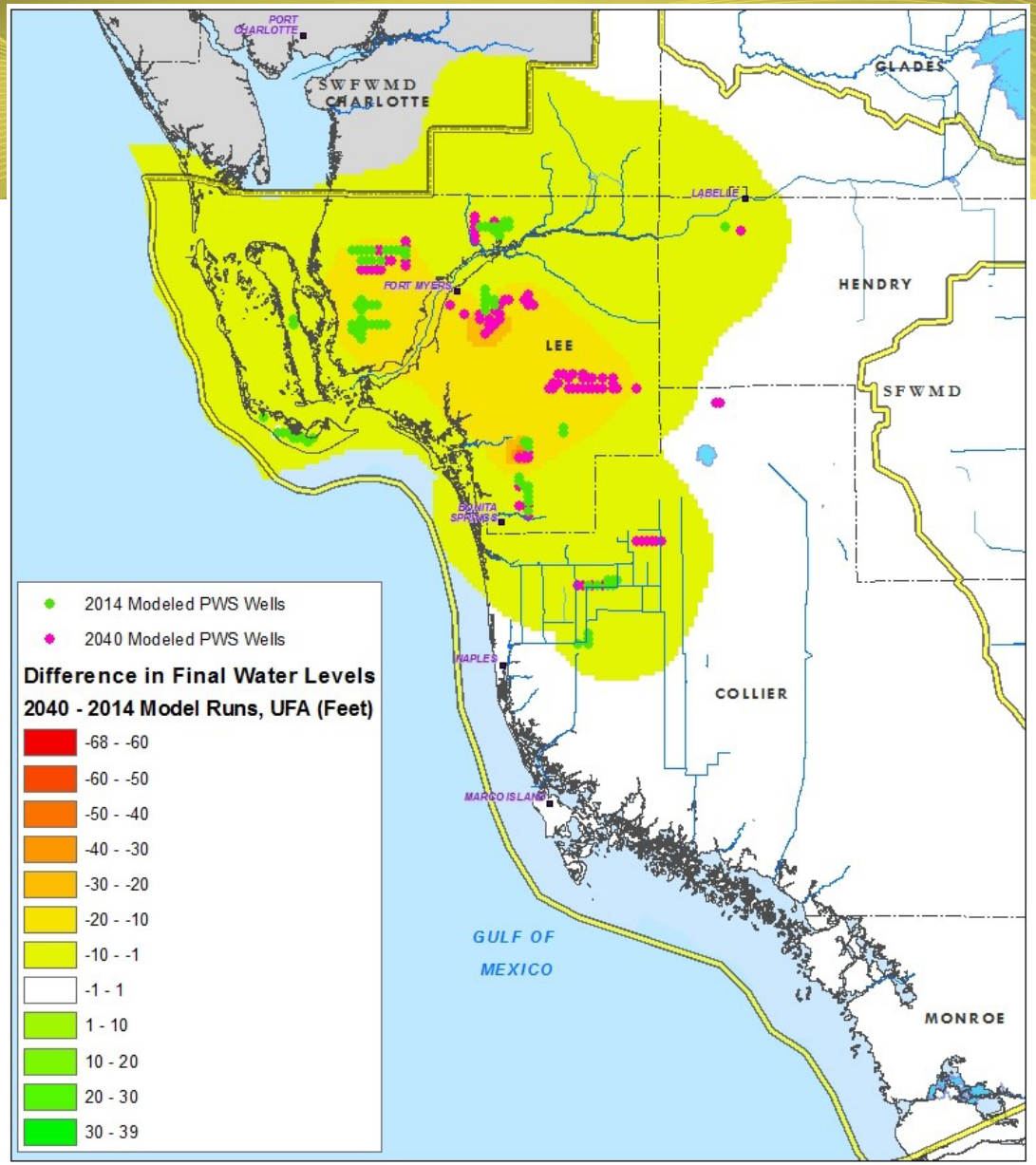
- 0.002 mgd increase

Interpreting the Results

- Model run
  - 2014 final condition
  - 2040 final condition
  - (2040 – 2014) final condition difference map
- Layer
  - UFA
  - APPZ
- Well symbol
- Units and scale
  - ft, mg/L, ft^3/d

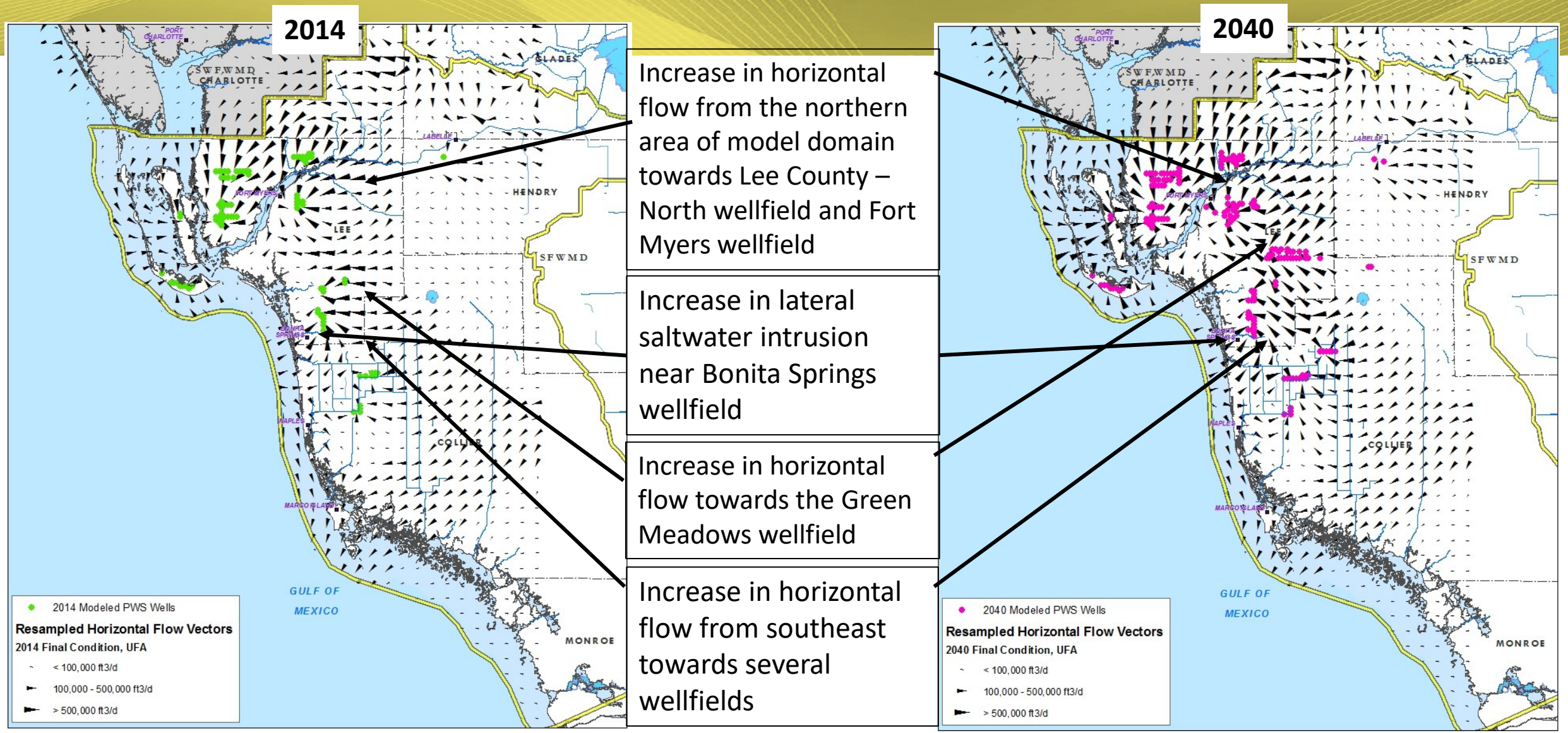


UFA Water Level Difference



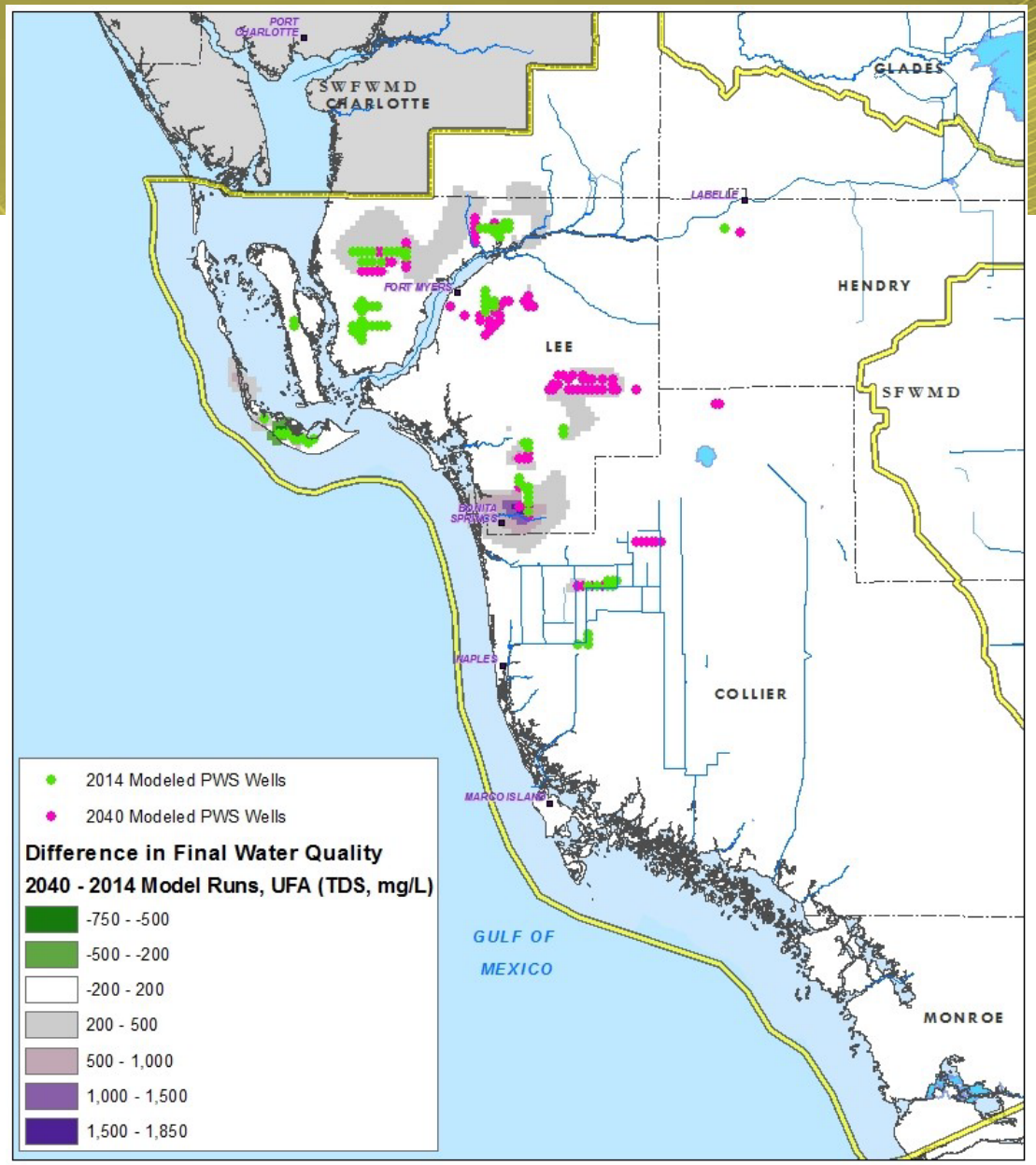
- (2040 – 2014) final condition water level difference
- 20-35 ft of additional drawdown at Cape Coral
- 20-30 ft of additional drawdown at Fort Myers
- Average drawdown at Lee County – Pinewoods approximately 40 ft, with maximum drawdown of 68 ft

UFA Horizontal Flow Vectors

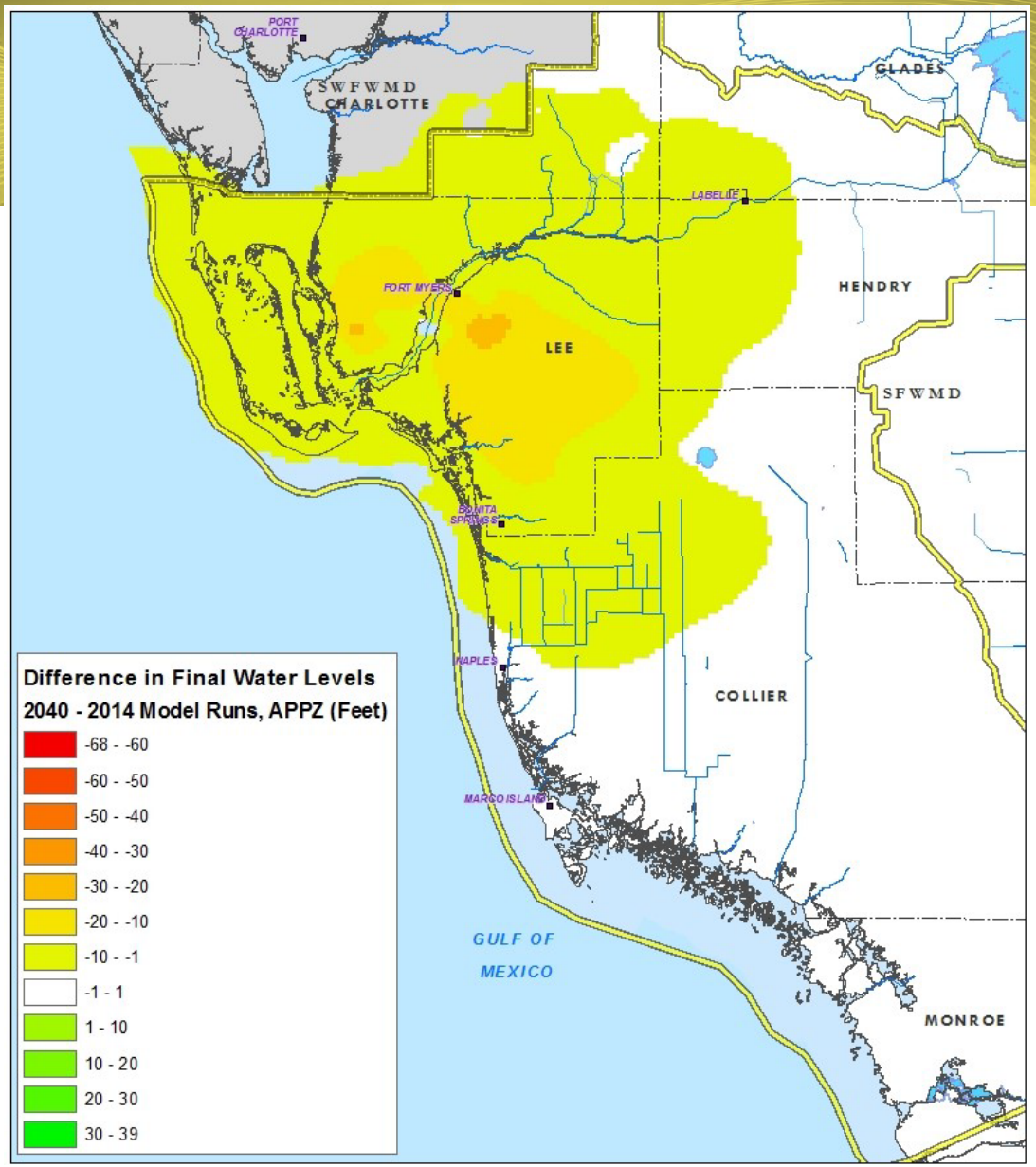


UFA Water Quality Difference

- (2040 – 2014) final condition water quality difference
- Total dissolved solids (TDS) degradation at Cape Coral and Lee County North is <500 mg/L
- TDS degradation at Green Meadows wellfield is <700 mg/L
- TDS degradation at Pinewoods wellfield is <1,000 mg/L
- TDS degradation at Bonita Springs wellfield is <2,000 mg/L

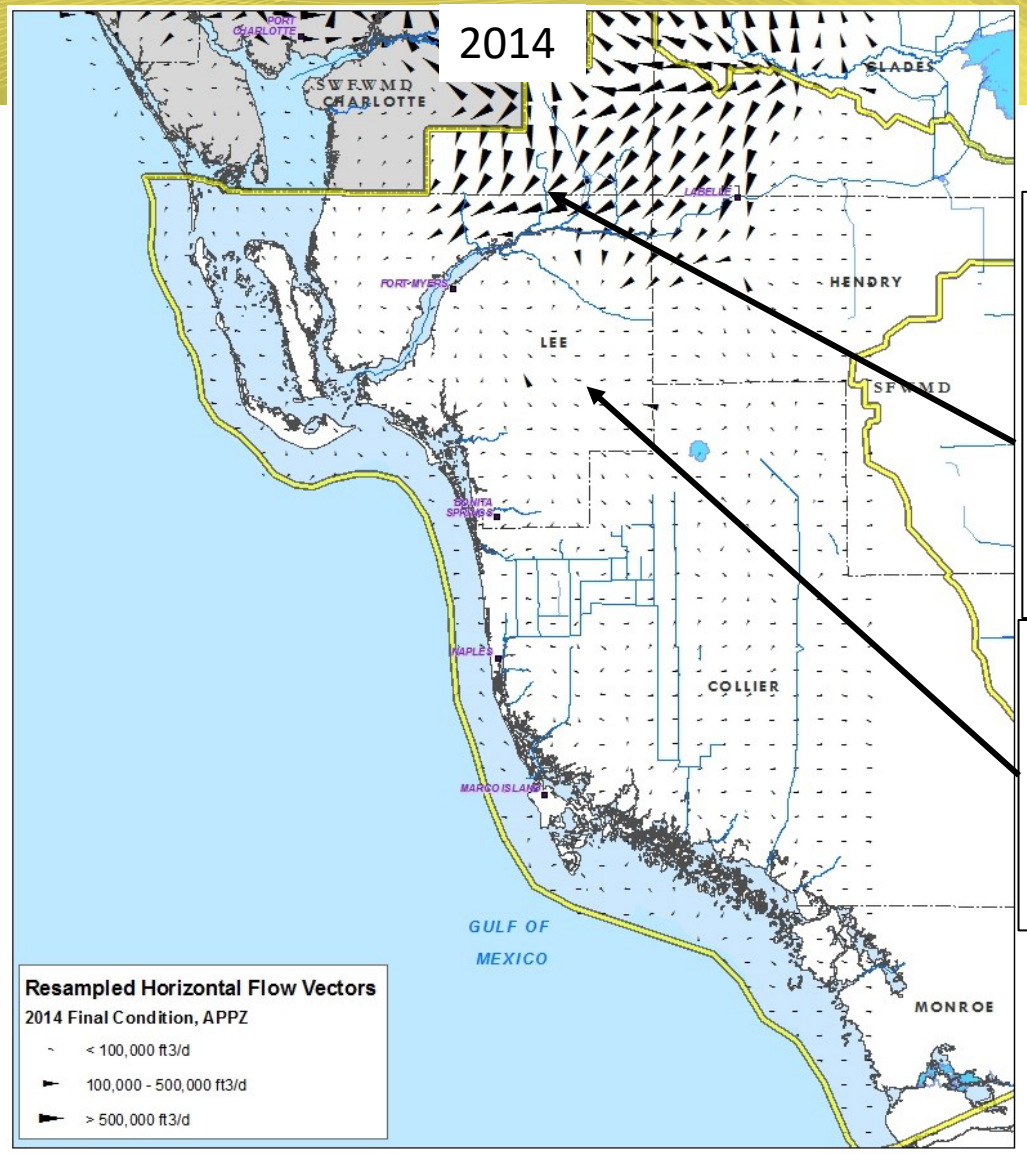


APPZ Water Level Difference



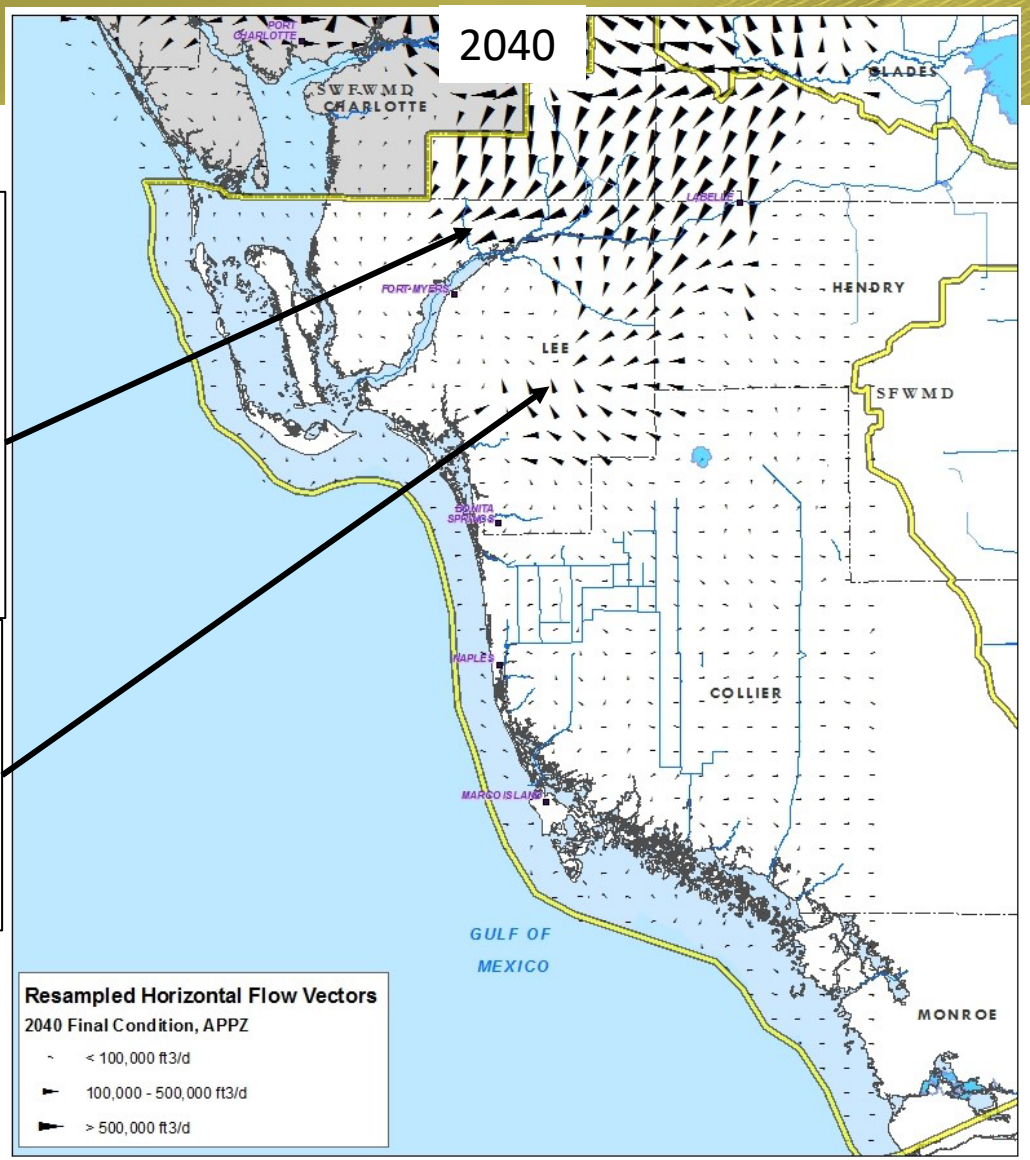
- (2040 – 2014) final condition water level difference
- 25 ft of additional drawdown at Cape Coral due to increased withdrawals from the UFA
- 22 ft of additional drawdown at Fort Myers due to increased withdrawals from the UFA

APPZ Horizontal Flow Vectors



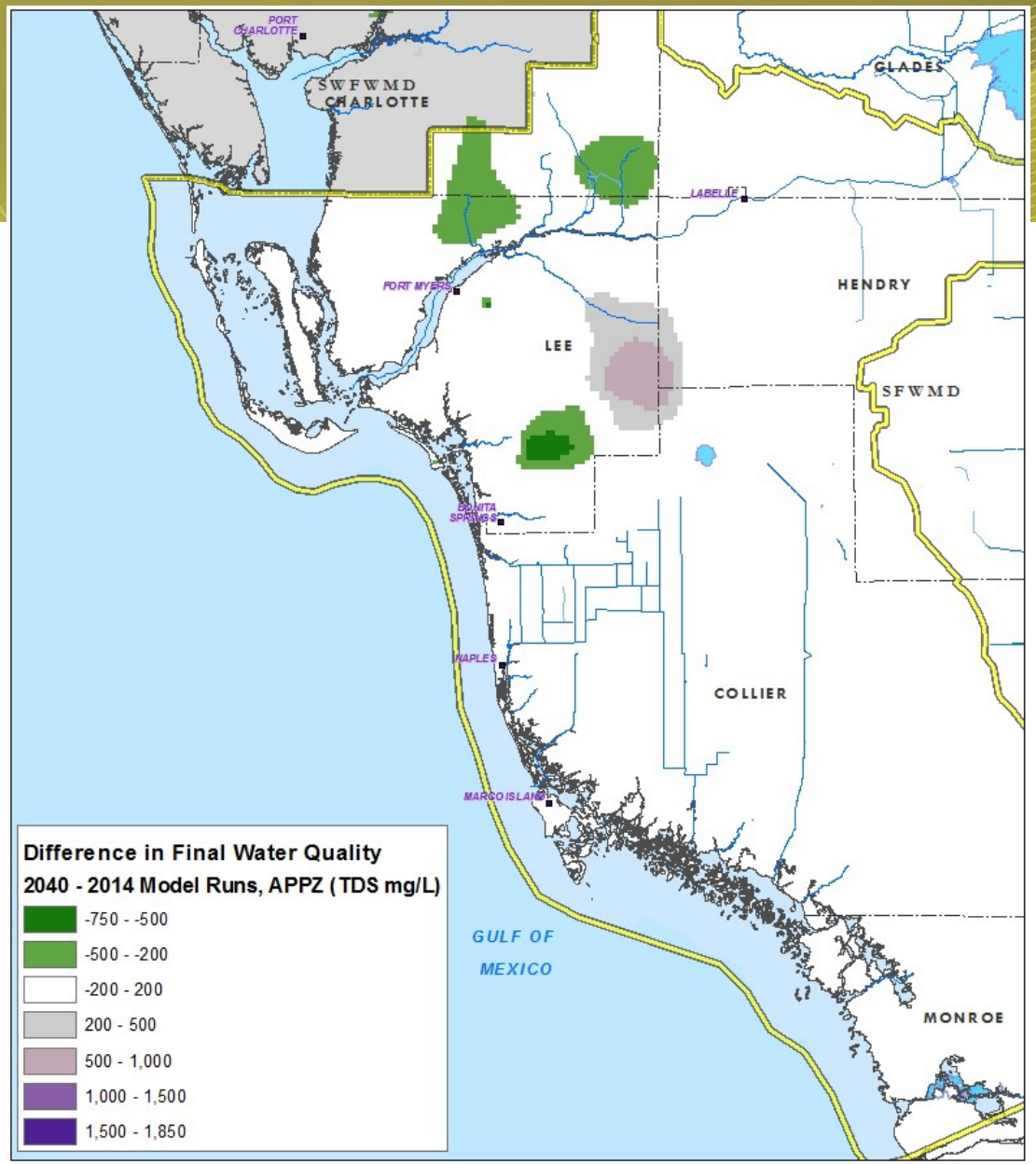
Increase in horizontal flow from the north due to additional withdrawal in UFA near Lee County North wellfield

Increase in horizontal flow due to the Green Meadows wellfield in the UFA



APPZ Water Quality Difference

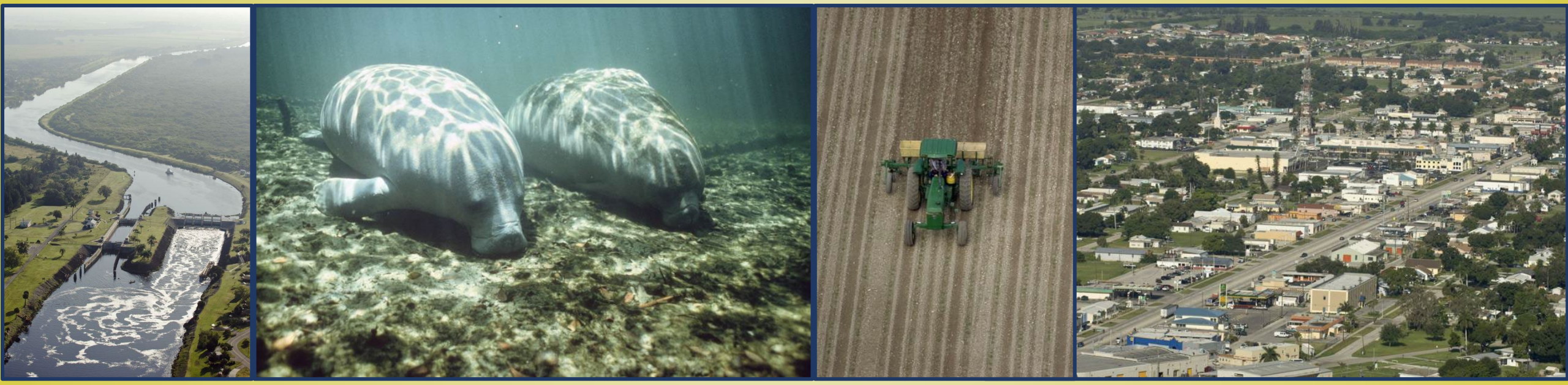
- (2040 – 2014) final condition water quality difference
- TDS degradation between 200 and 1,000 mg/L near Lee County's Green Meadows wellfield



Conclusions of WCFM Results

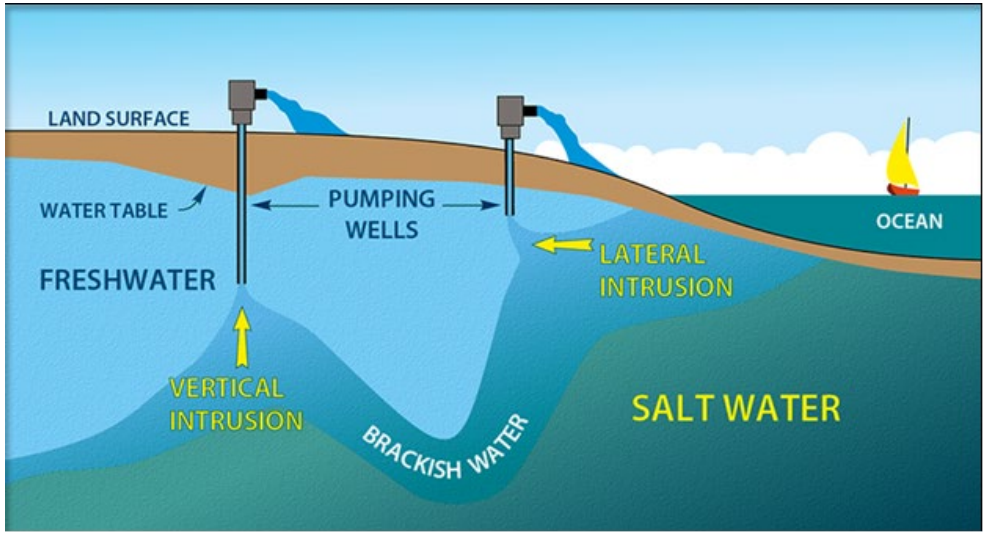
- Spatial expansion of wellfields in Fort Myers and Cape Coral, combined with lateral recharge from the northeast, minimized drawdown impacts despite significant increase in demands. Wellfield expansion also minimized potential water quality degradation.
- Although Lee County – Pinewoods increases the number of production wells, the wells are clustered, which accounts for 20 to 68 ft of additional drawdown in the area. The utility has a demand increase of 3.91 mgd.
- Water quality degradation in Bonita Springs is a result of lateral saltwater intrusion and lateral movement of water from northern Collier County, which has higher salinity.
- Based on planning projections, with wellfield management, the 2040 model results do not indicate a significant adverse impact to groundwater levels and quality, indicating prolonged use of the FAS is sustainable.

Five-Year Saltwater Intrusion Mapping Update

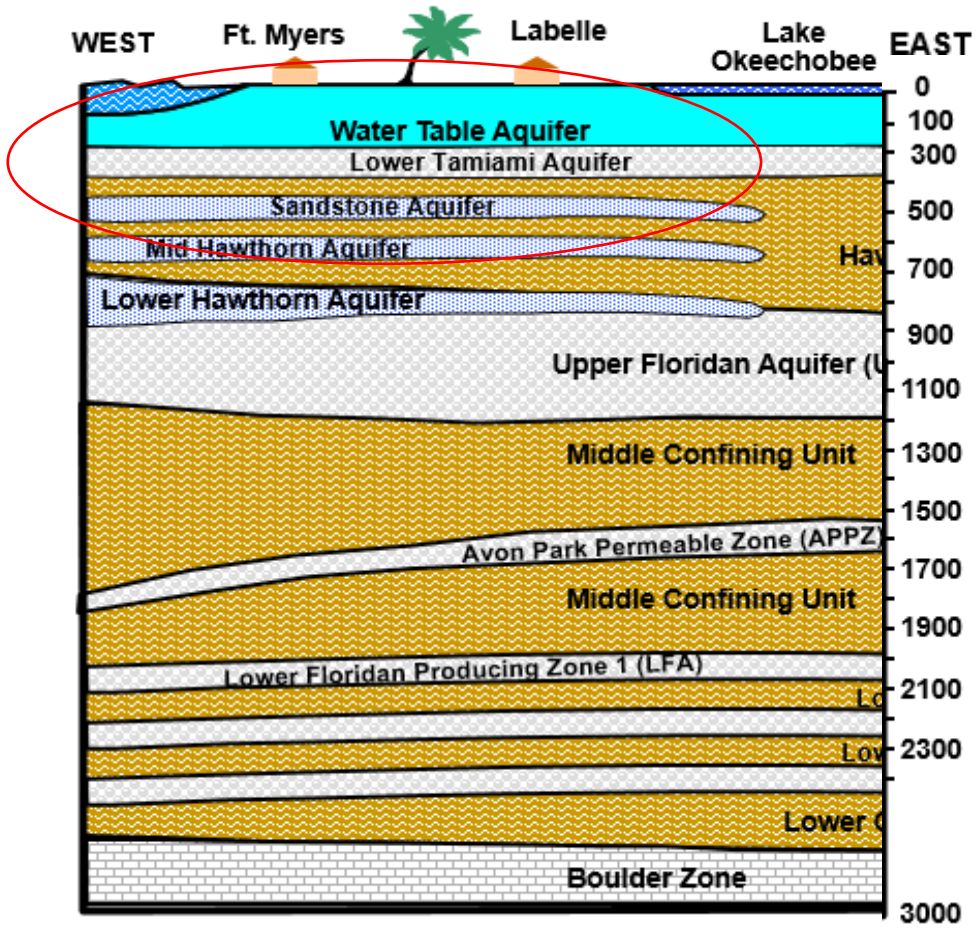


Common Sources of Saltwater Intrusion

- Lateral intrusion from the coast
- Vertical Intrusion (upconing from saltwater below)
- Surface Infiltration – estuaries, boat basins, saltwater marshes, saltwater canals, etc.
- Ancient (relict) seawater trapped in low permeability aquifers

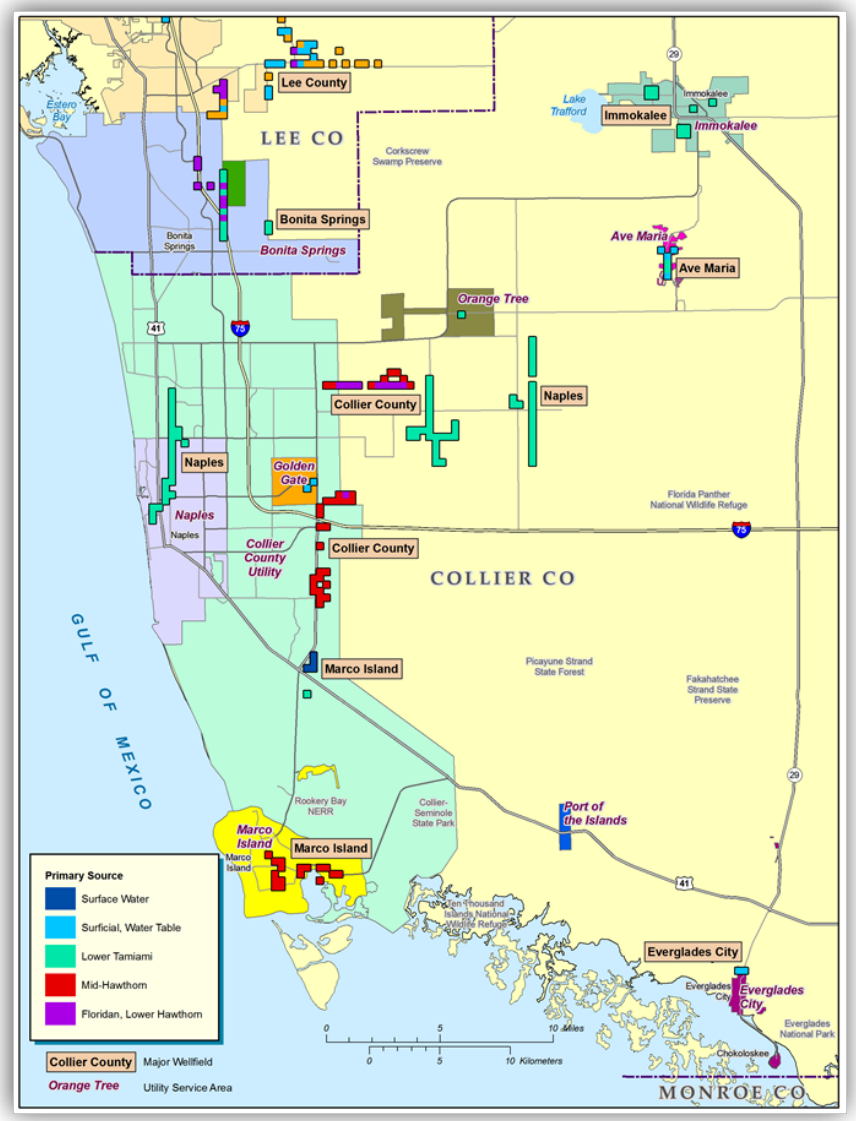


Generalized Hydrogeology, Lower West Coast



Why Is This Important?

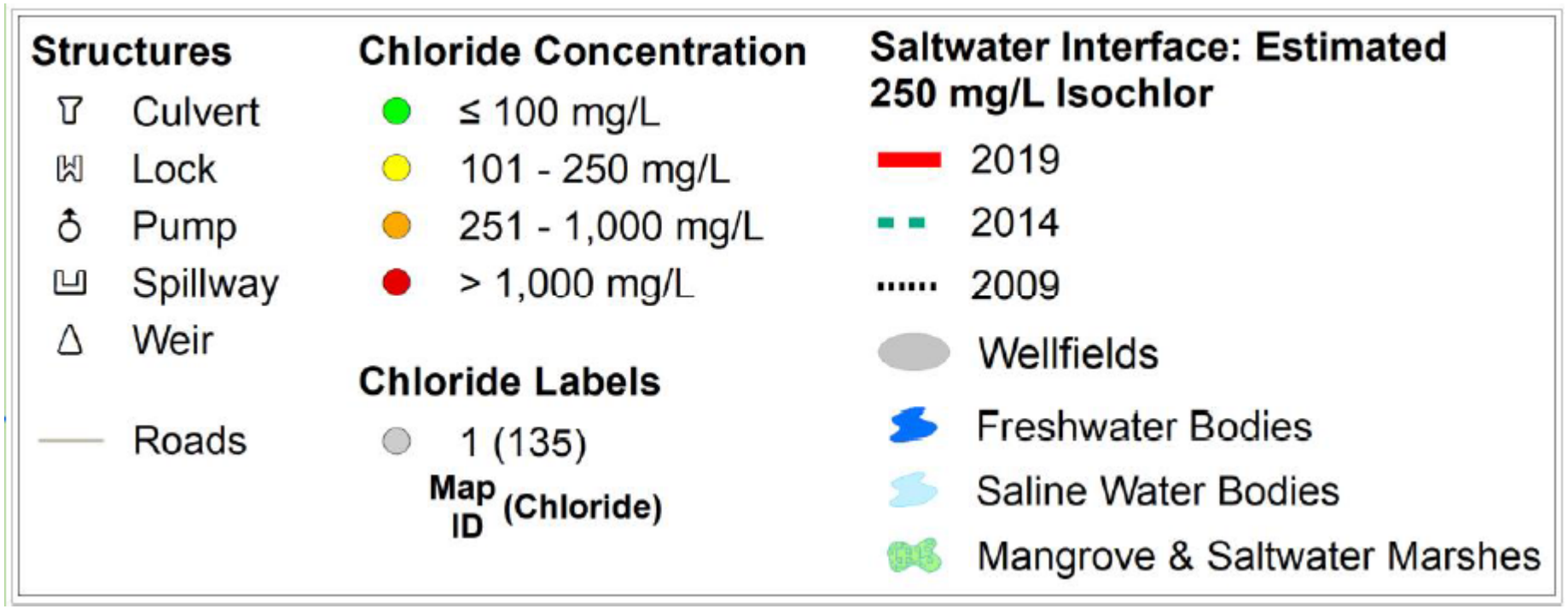
- Wellfields are a major water supply source – protect water resource and investment
- Once saltwater enters wells, very difficult – if not impossible – to reverse
- Very expensive to relocate wellfields and associated infrastructure (pipelines, treatment plants and processes, etc.)
- Other sources of water more expensive to treat (e.g., Floridan aquifer – reverse osmosis)



SFWMD Saltwater Interface Mapping Project

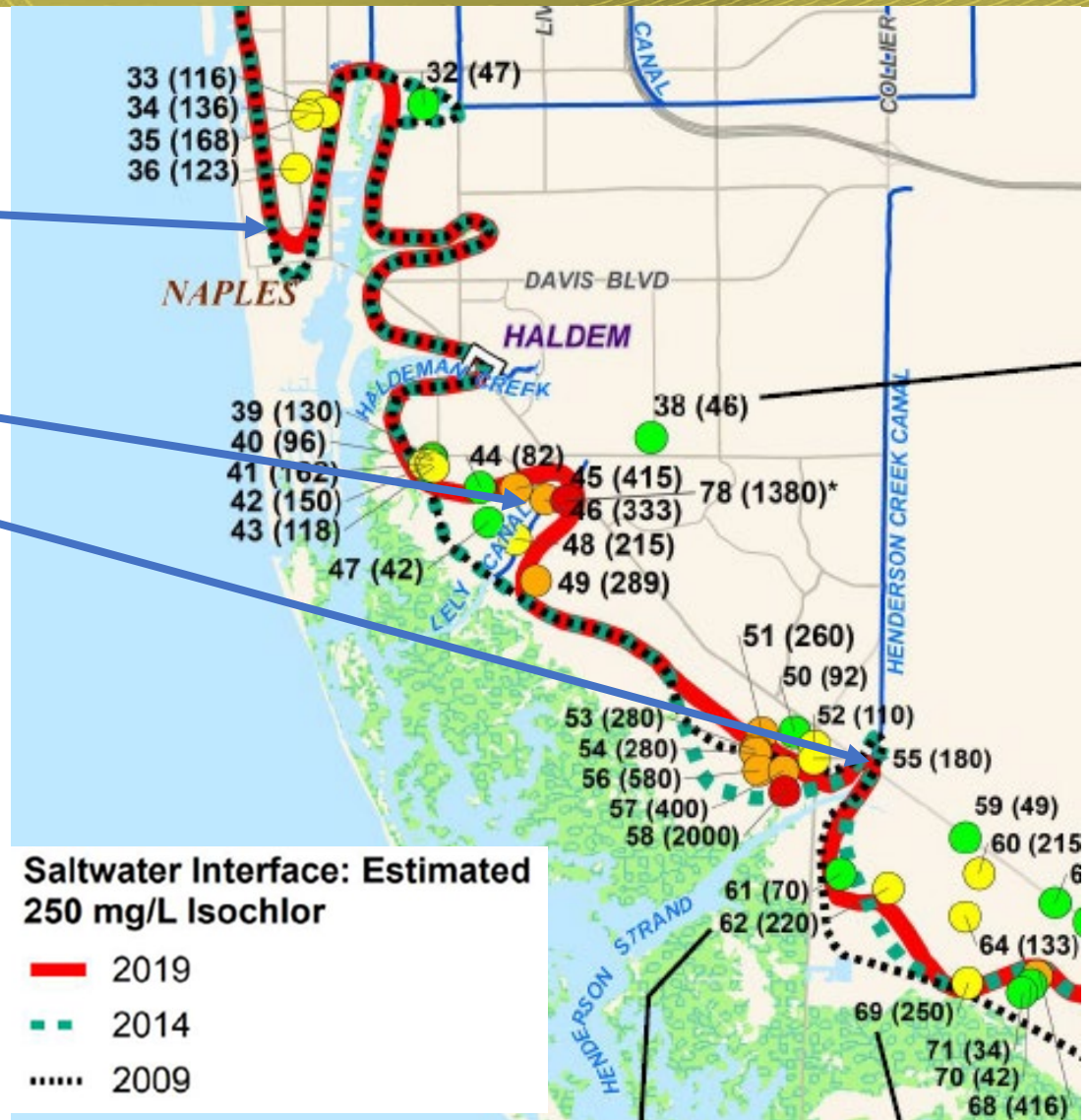
- Strategy – Compare interface positions (i.e., 2009, 2014, 2019), note areas of concern, and adjust monitoring as necessary
- Update Maps Every 5 Years
- Use all available data (USGS, SFWMD, Counties, Water Use Permittees)
- Furthest Inland Extent – Dry Season
- Maximum chloride value March/April/May 2019 (with some exceptions)
- 250 milligrams per liter (mg/L) chlorides – Drinking water standard
- Coastal aquifers: Water Table (Biscayne aquifer), Lower Tamiami, Sandstone, Mid-Hawthorn

Legend


Structures
Culvert
Lock
Pump
Spillway
Weir
Roads
Chloride Concentration
≤ 100 mg/L
101 - 250 mg/L
251 - 1,000 mg/L
> 1,000 mg/L
Chloride Labels
1 (135)
Map ID (Chloride)
Saltwater Interface: Estimated 250 mg/L Isochlor
2019
2014
2009
Wellfields
Freshwater Bodies
Saline Water Bodies
Mangrove & Saltwater Marshes

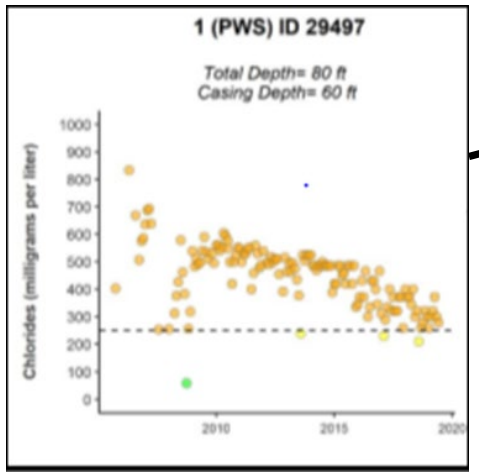
Water Table Aquifer-Collier County

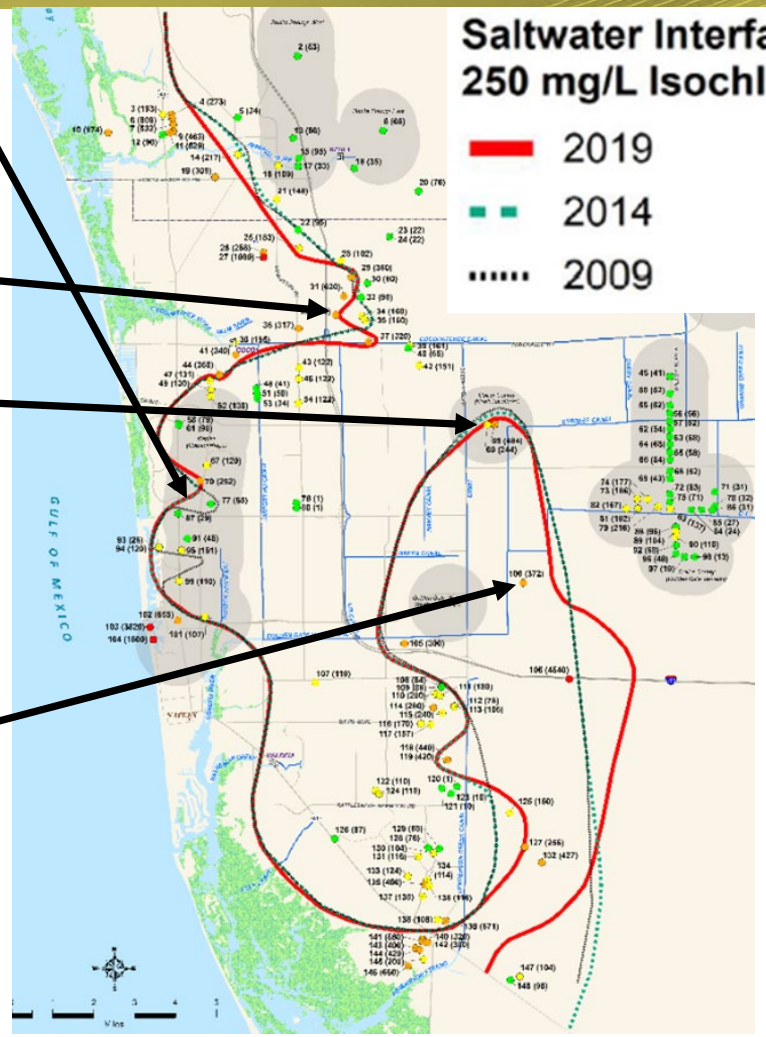
- Relatively stable in the Naples area
- Inland movement observed near Lely Canal and Henderson Creek area
- New development proximal to coast. Surface water is tidal and ranges from fresh to saline. Permittees monitor for chloride concentration in groundwater



Lower Tamiami Aquifer - Lee & Collier Counties

- Relatively stable near Naples Coastal Ridge wellfield
- Interface retreated in Bonita Springs and northern Collier County
- Movement in southern Collier County
- Example of relic seawater





Conclusions

- Water Table Aquifer – Noticeable inland movement in Lely Canal and Henderson Creek areas
- Lower Tamiami Aquifer – Interface retreated in northern Lee and southern Collier counties; advanced in southern Collier County
- Interface is dynamic – advanced and retreated, depending on wellfield pumpage, reclaimed water use, tidal, sea-level rise, etc.
- Saltwater intrusion is occurring, emphasizing the importance of continued monitoring (laterally and vertically) and wellfield management
- Additional, localized monitoring may be required at select projects and wellfields by permittees to protect water supplies

2009, 2014 & 2019 maps available:

https://www.sfwmd.gov/documents-by-tag/saltwaterinterface

Merged Isochlor 2019: https://geo-sfwmd.hub.arcgis.com/datasets/merged-isochlor-2019

Chloride Data, 2019: https://geo-sfwmd.hub.arcgis.com/datasets/chloride-data-2019

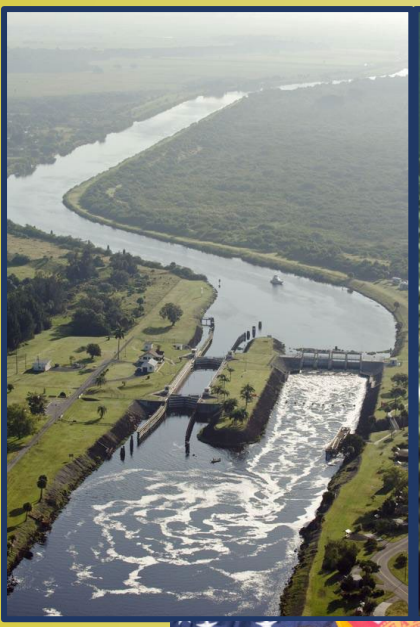
Peter J. Kwiatkowski, P.G.
Section Administrator, Resource Evaluation
pkwiat@sfwmd.gov

Questions and Public Comment

Estero Bay

- If you are participating via Zoom:
  - Use the Raise Hand feature
- If you are participating via phone:
  - *9 raises hand
  - *6 mutes/unmutes your line
- When you are called on, please state your full name and affiliation prior to providing comments and/or questions.

Resiliency Updates



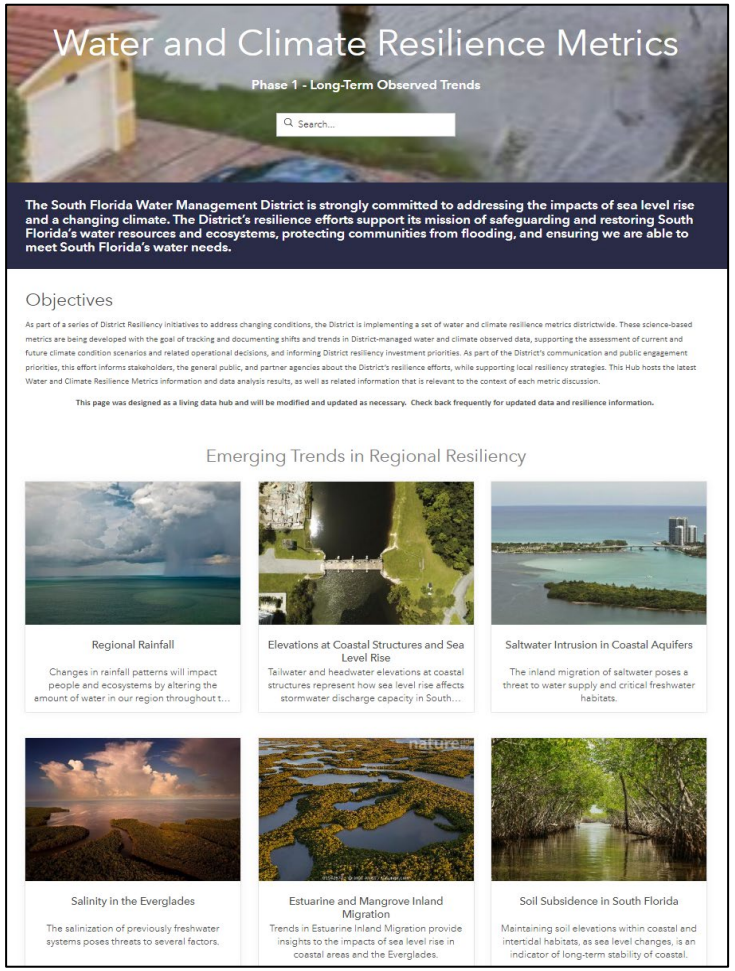

Carolina Maran, P.E., Ph.D.
District Resiliency Officer

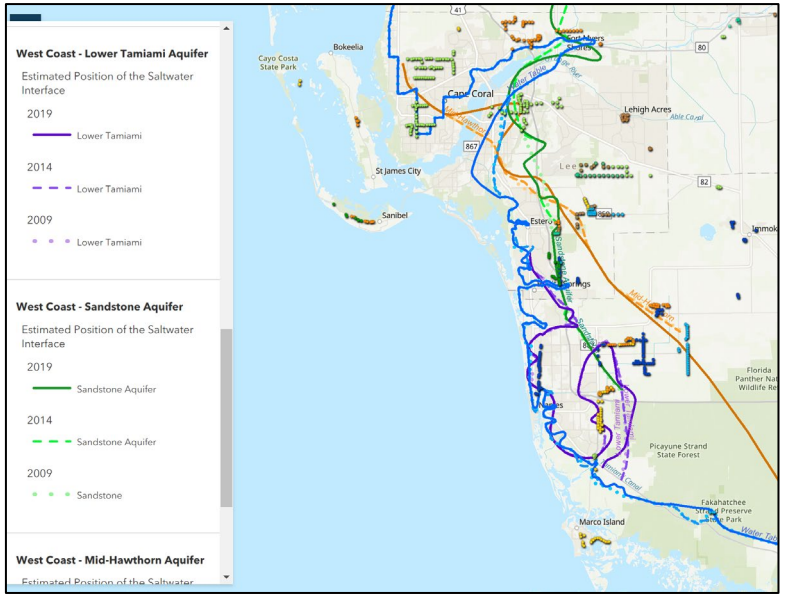
2022 LWC Stakeholder Meeting 2
May 25, 2022

Overview

1. Understanding our resiliency through Data & Modeling
2. District efforts that enhance the resiliency of our water supply
3. Vision for the future

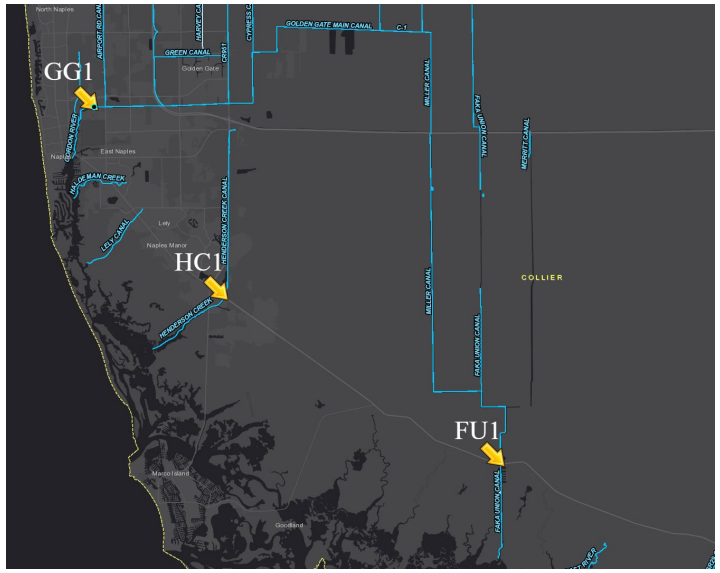
Water and Climate Resilience Metrics Hub

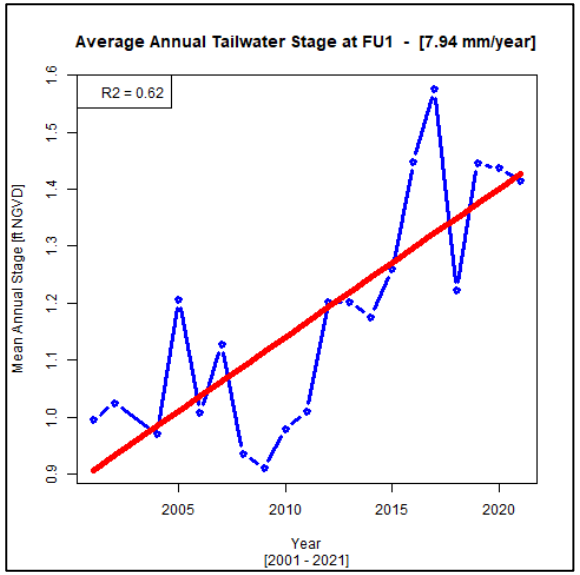


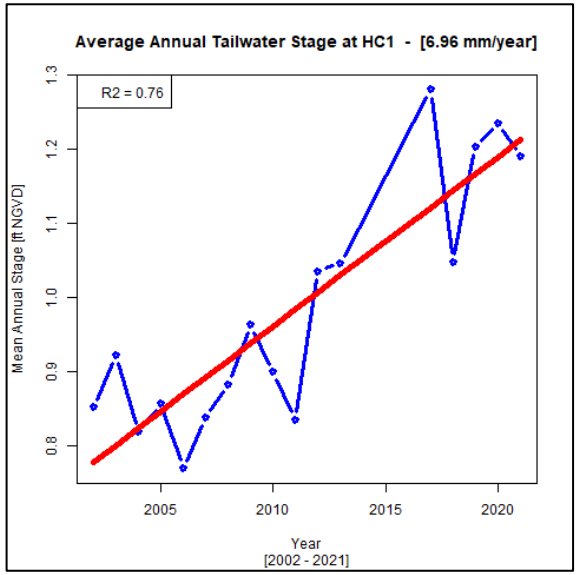


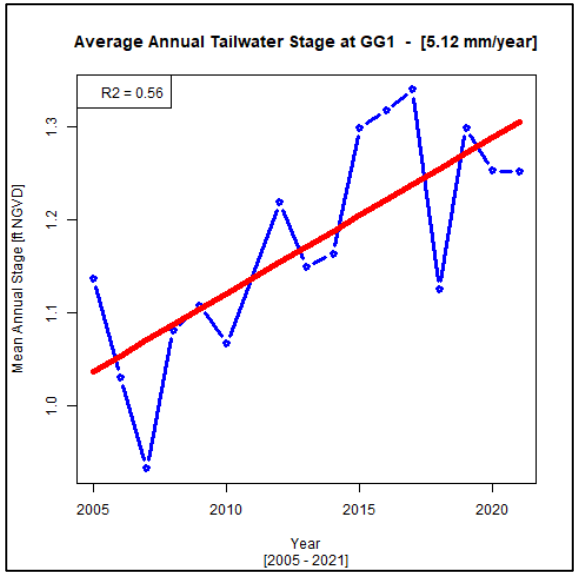
Saltwater intrusion cross-section and map featured on the [Water and Climate Resilience Metrics Hub]

Observations – Tailwater Stages





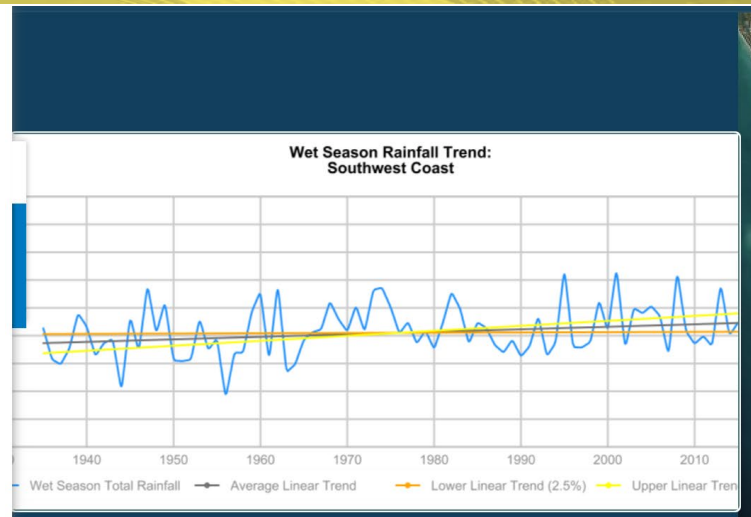




Average annual tailwater stage at selected stations along South Florida's west coast. (Blue line is the average annual tailwater stage. Red line is the linear trend of average annual tailwater stage.)

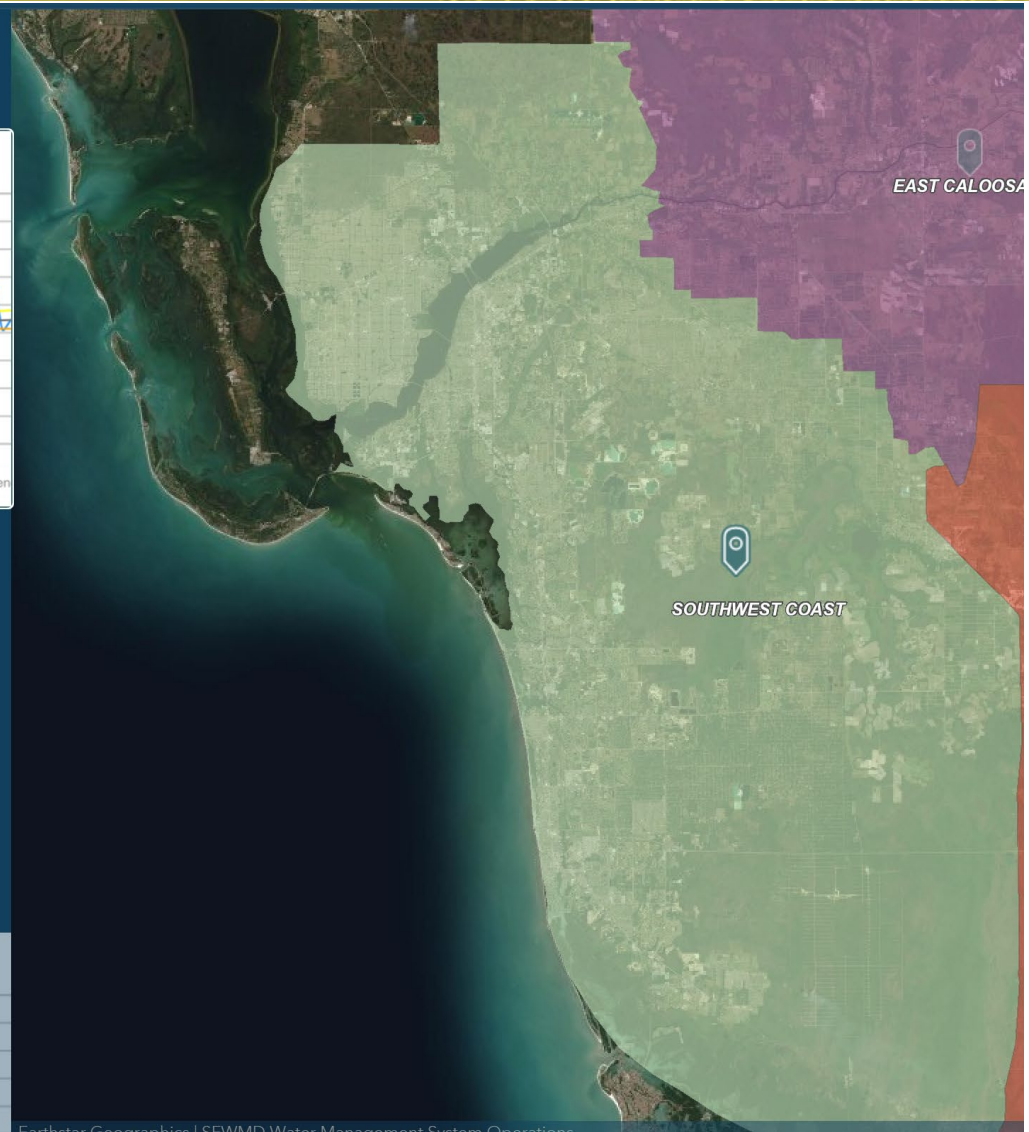
Observations – Average Wet Season Rainfall

Southwest Coast Rainfall Trends featured in the Water and Climate Resilience Metrics Hub



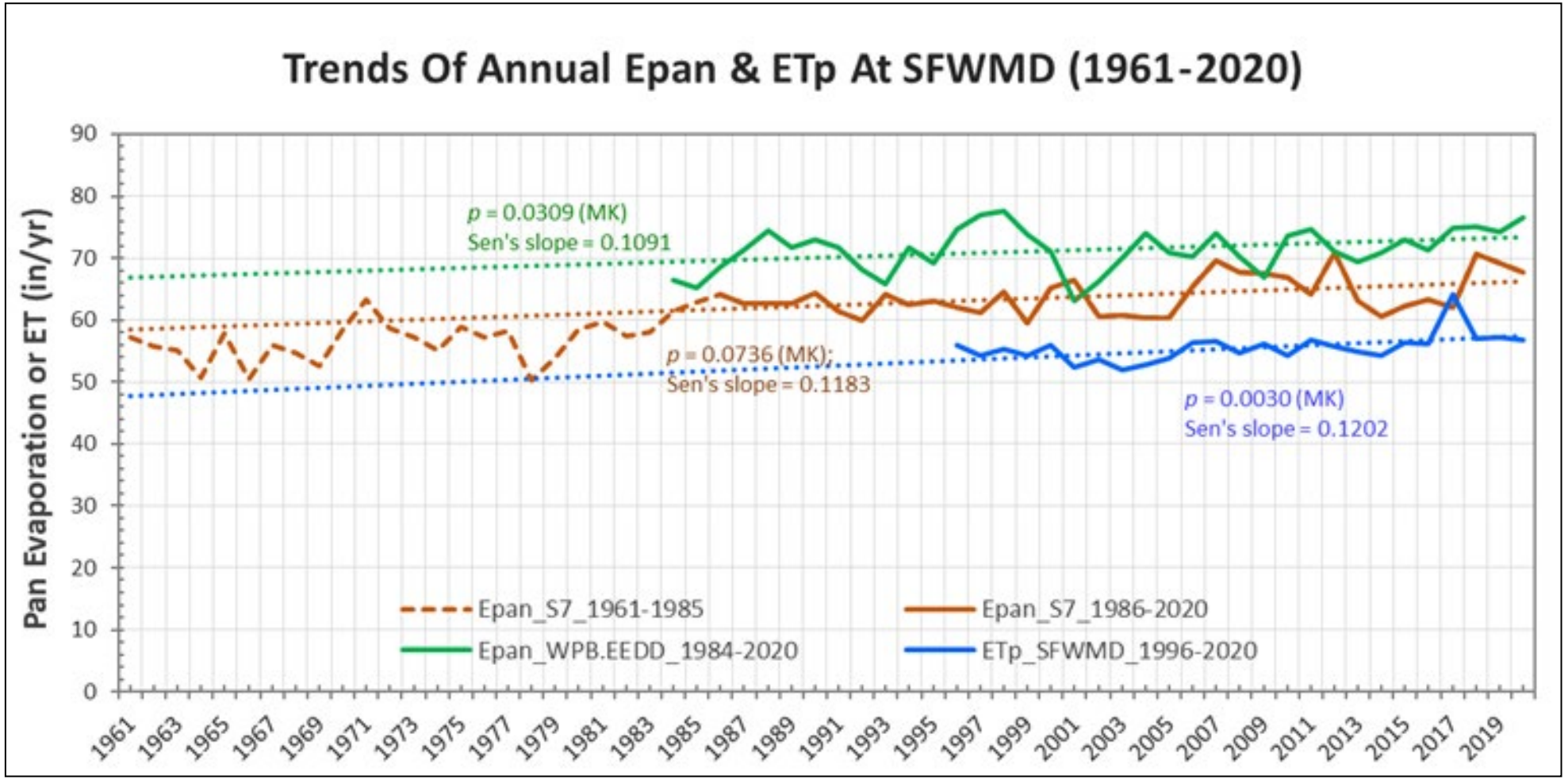
Southwest Coast Rainfall Trends

Trend analyses of average rainfall during the wet season in the Southwest Coast rainfall basin shows a statistically significant upward trend.



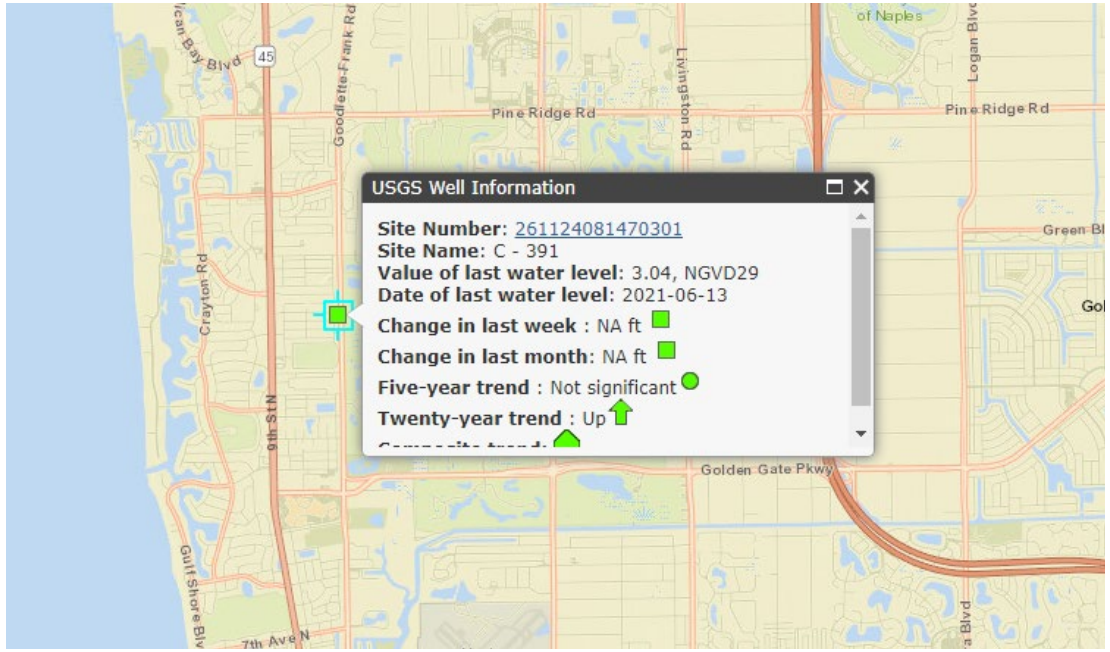
https://sfwmd-district-resiliency-sfwmd.hub.arcgis.com/

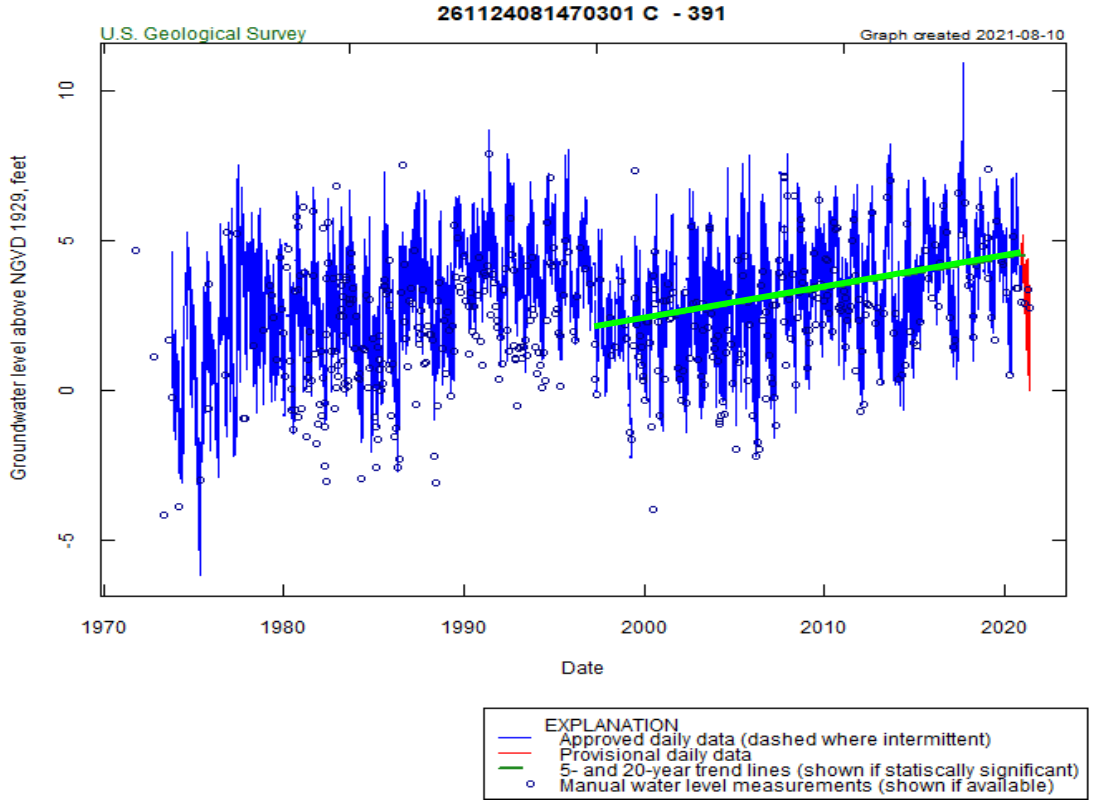
Observations – Evapotranspiration



https://sfwmd-district-resiliency-sfwmd.hub.arcgis.com/

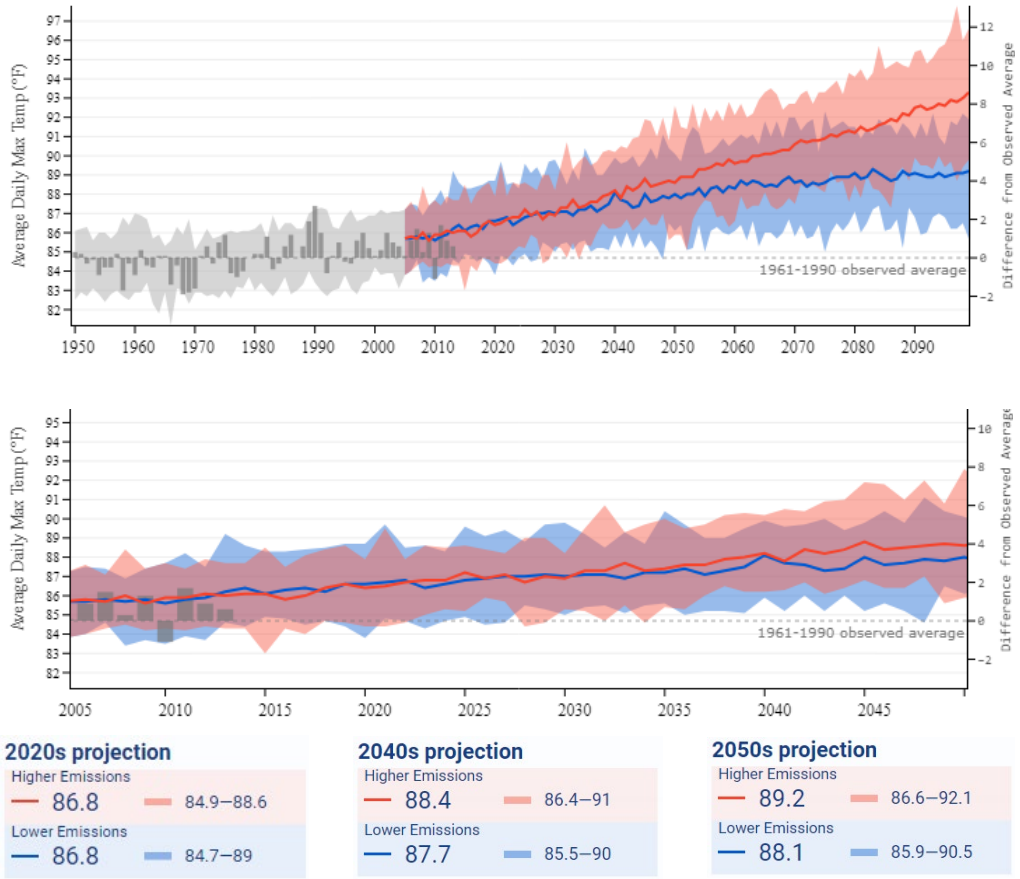
Observations – Groundwater Stages



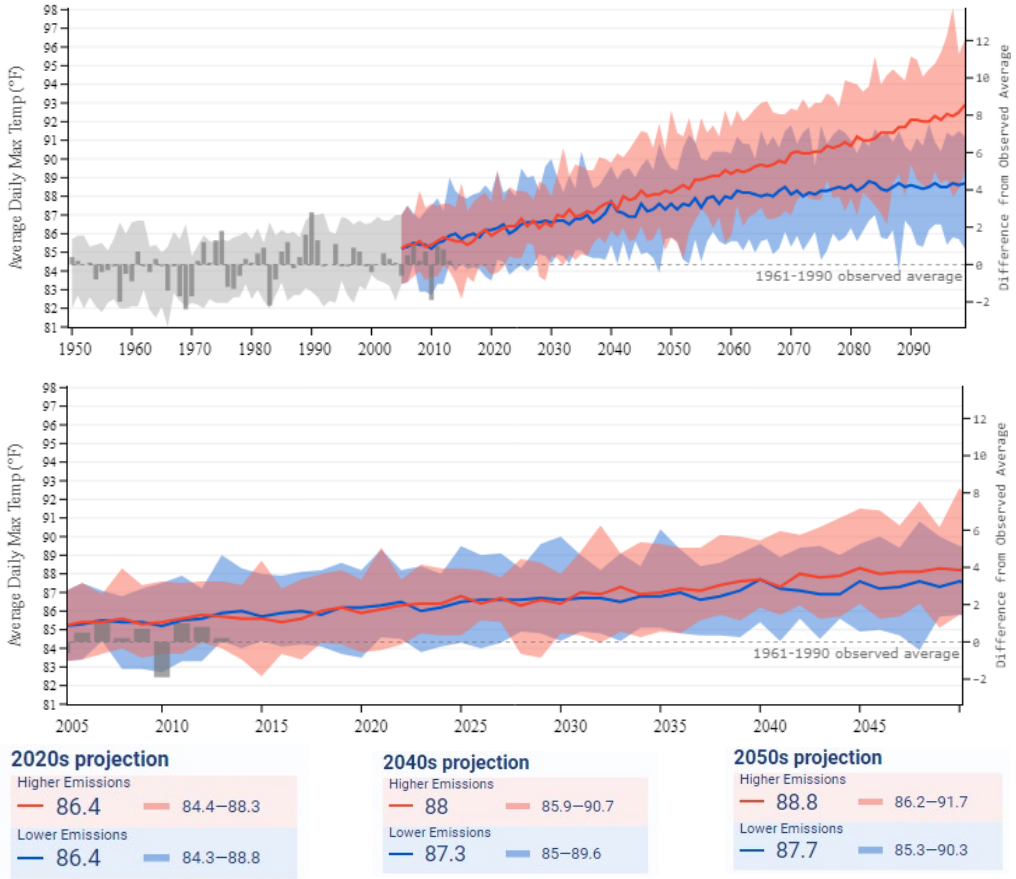


USGS well data showing groundwater stages where we can see an upward trend.

Projections – Temperature Changes

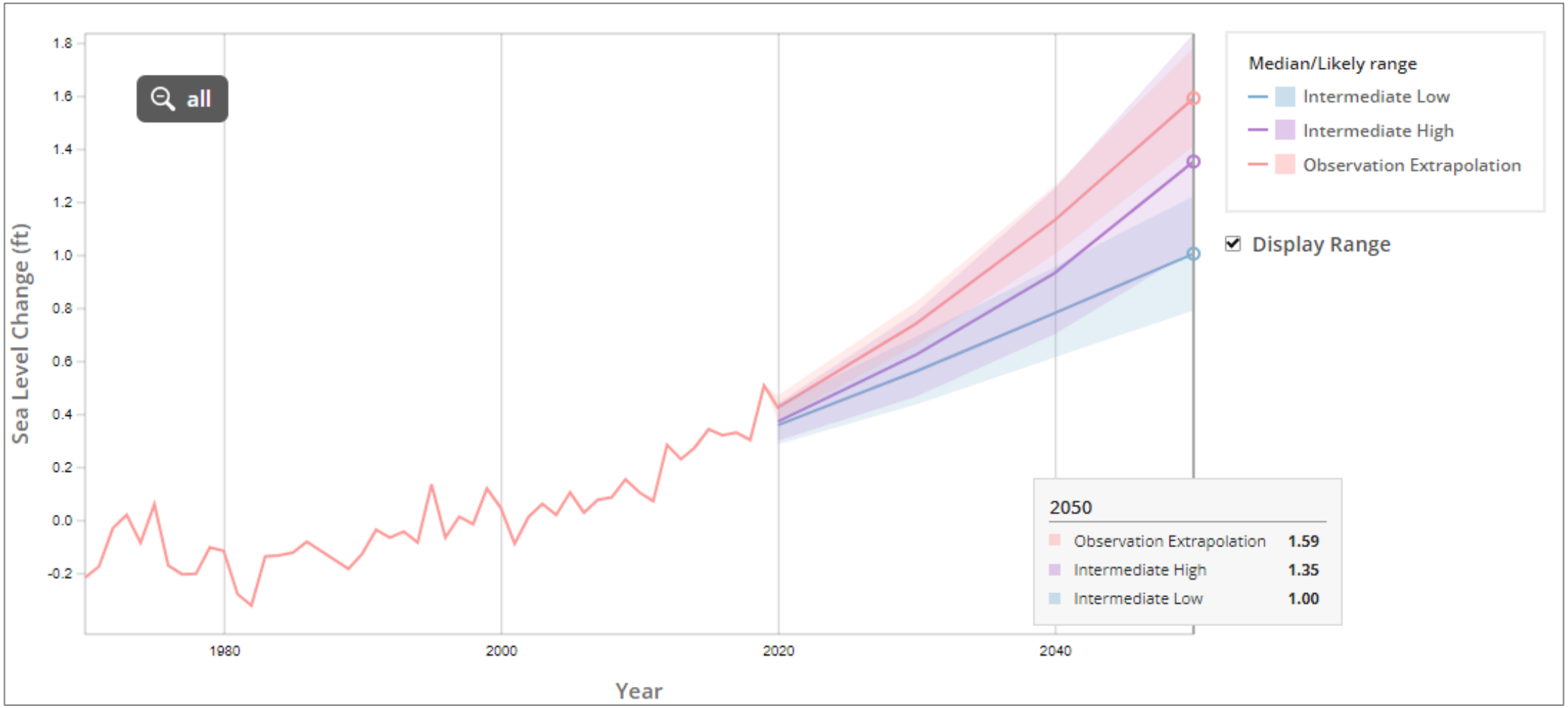


Projected average daily maximum temperature in Collier County (The Climate Explorer 2022, NOAA)



Projected average daily maximum temperature in Lee County (The Climate Explorer 2022, NOAA)

Projections – Sea Level Rise



Future Sea Level Rise Projections for Fort Myers and Naples (2022 NOAA Projections, NASA)

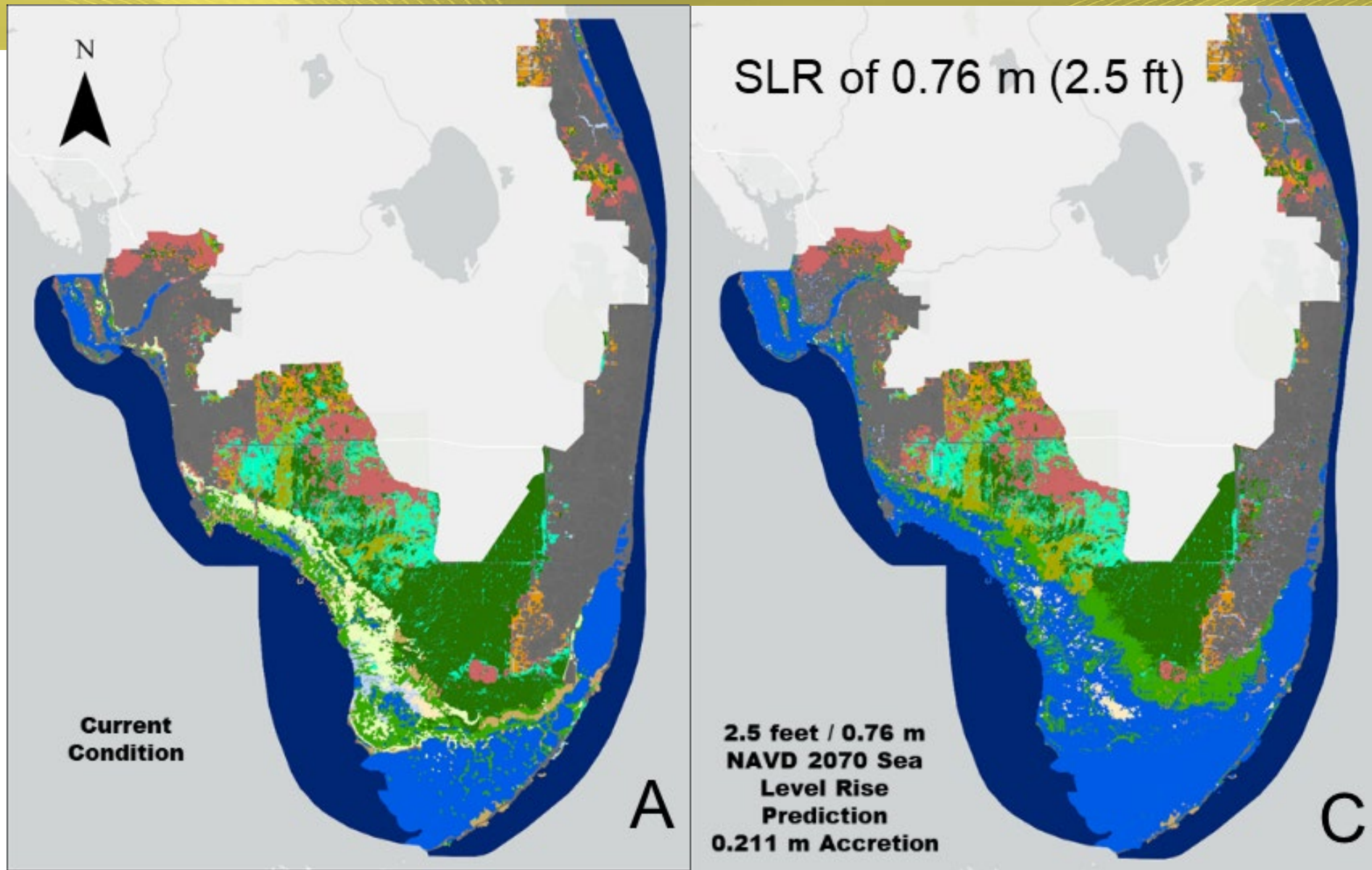
Sea Level Rise Inundation

"Bathtub" Model of Saltwater Intrusion

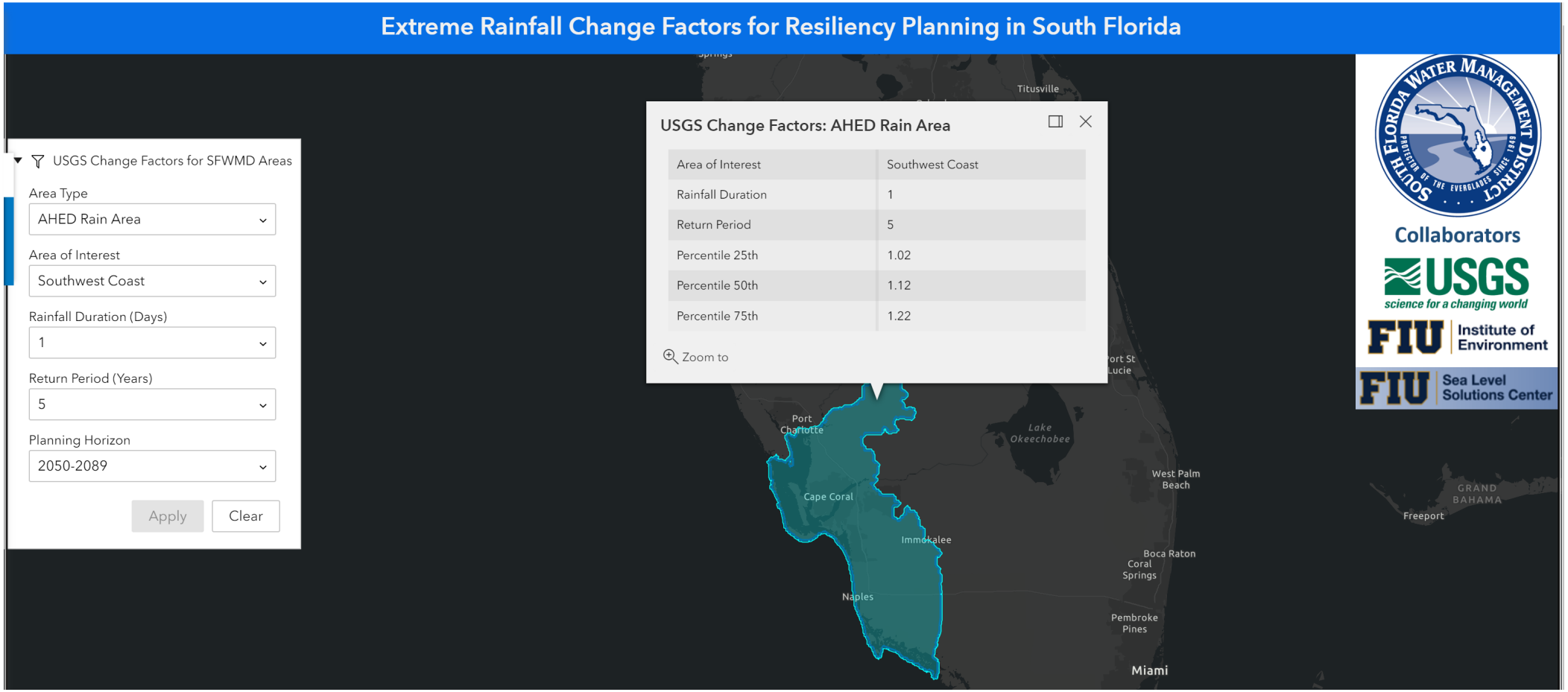
Sklar, F.H., C. Carlson, C. Coronado-Molina, and A.C. Maran. 2021. Coastal ecosystem vulnerability and sea level rise (SLR) in South Florida: A mangrove transition projection. Front. Ecol. Evol. 9:646083. doi: 10.3389/fevo.2021.646083

Habitat Transition with an Accretion Rate of 4.2 mm yr-1 (0.211 m by 2070).

- Agriculture
- Barren Land
- Estuarine Water
- Mangrove Swamp
- Marine
- Open Water
- Palustrine Cypress
- Palustrine Marsh
- Palustrine Swamp
- Saltwater Marshes
- Saltwater Ponds
- Terrestrial
- Tidal Flats
- Urban



Projections – Extreme Rainfall

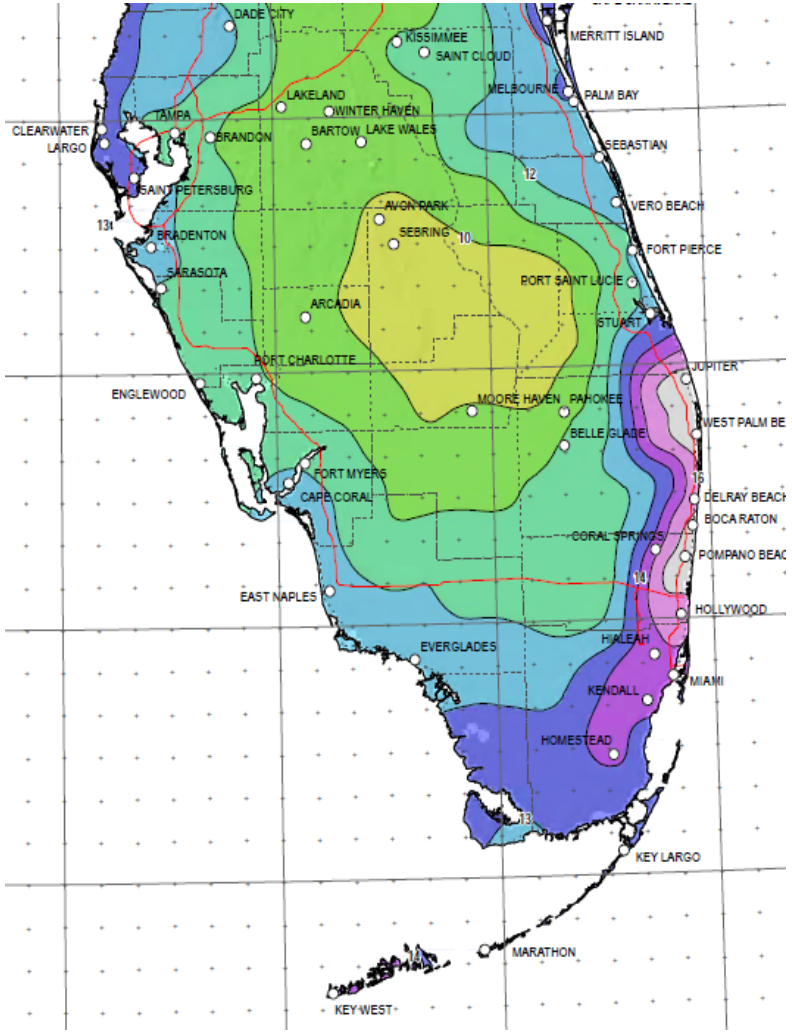


Web App Link:
https://sfwmd-district-resiliency-sfwmd.hub.arcgis.com/apps/future-extreme-rainfall-change-factors-for-flood-resiliency-planning-in-south-florida/explore

Technical Memorandum Link:
https://apps.sfwmd.gov/sfwmd/gsdocs/TPubs/2022_SFWMD_TM_Adoption_of_Future_Extreme_Rainfall_Change_Facotrs_for_Resiliency_Planning_in_South_Florida_rev2.0.pdf

Estimating Future Rainfall

- SFWMD partnership with USGS & FIU
- Global climate model downscaling datasets
- Review of the latest science and refined evaluation of predicted rainfall
- Estimate **change factors in extreme rainfall** by 2070, districtwide, compared to NOAA Atlas 14 observations
- Develop **future intensity-duration-frequency curves** for the 16-counties area
- Strengthen District's planning capacity



Change factors to derive projected future precipitation depth-duration-frequency (DDF) curves at 174 National Oceanic and Atmospheric Administration (NOAA) Atlas 14 stations in central and south Florida - ScienceBase-Catalog

Planning for Climate Change Sea Level Rise

- Commitment to determine the best short- and long-term strategies for water resource management
- Continue to develop and improve data analysis, surface and ground water, coastal and inland, with focus on saltwater intrusion
- Advanced groundwater models being designed to support the evaluation of sea level rise and climate change scenarios, anticipate demand and availability impacts and simulate future saltwater inland movement.
- To be expanded to the Lower West Coast planning region for subsequent water supply plans
- Incorporation of future project recommendations as part of the District's Resiliency Plan

"…hard to recognize, but there used to be a canal somewhere in the foreground." – Merritt Canal Plugged

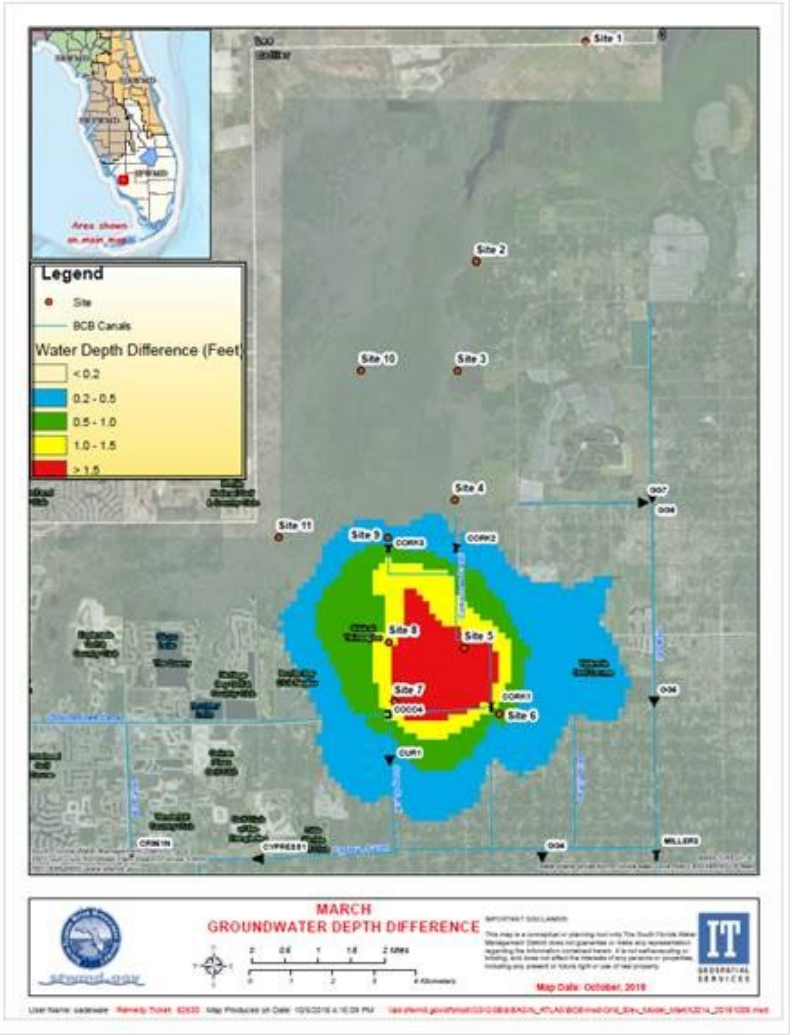
Ecosystem Restoration supports mitigation against sea level rise and other impacts from a changing climate.

CERP goals are aligned with the adaptation strategies needed to build Resiliency in South Florida.

Updated Structures at Big Cypress Basin

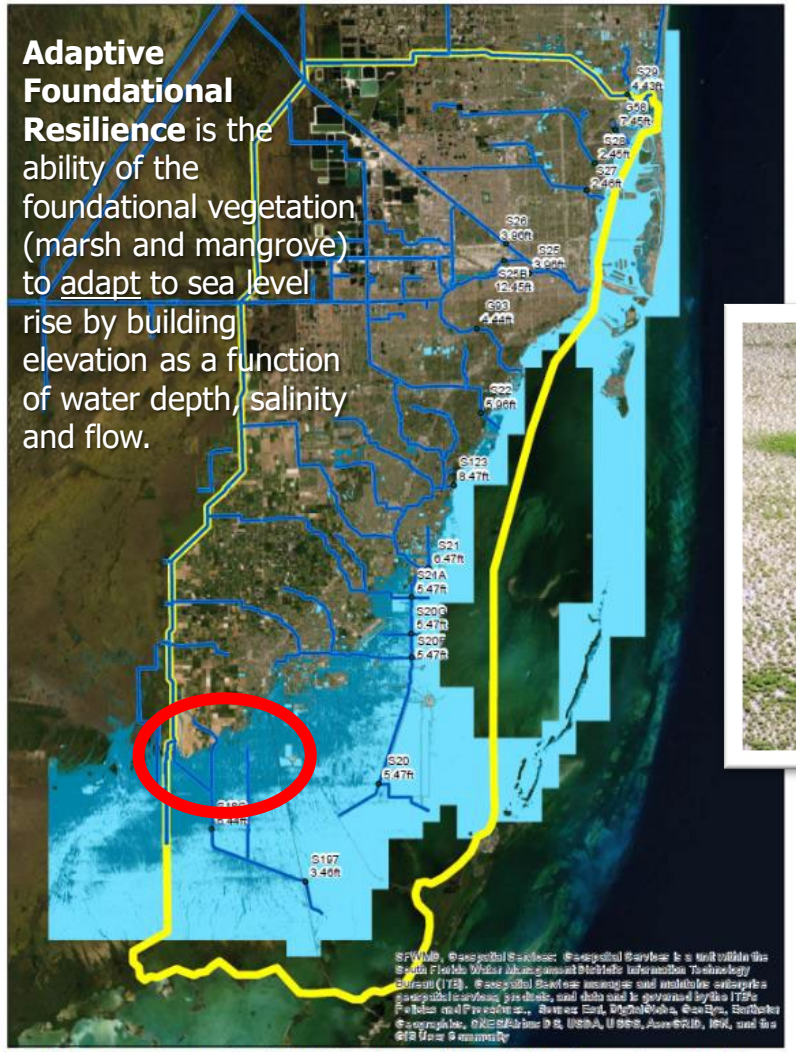
Updated Structures at Collier County/Big Cypress Basin are holding more water back, keeping groundwater tables higher, protecting inland wetlands and water supply, maintaining downstream salinity, and reducing late dry season wildfire risks:

- 8 structures (past 10-15 years)
- CYP1 currently under construction
- CUR1 increased late dry season (average March) water table by over 1.5 ft



Everglades Mangrove Migration Assessment Study

- NEED: Increases in sea level rise (SLR) rate and saltwater intrusion contribute to the collapse of marsh peat soils. Without sufficient freshwater restoration, landward migration of mangroves will be hindered by reducing seedling establishment in deeper, sulfide-rich water
- GOAL: Increase coastal zone functionality in face of SLR through understanding of biological vs. physical controls on capacity of coastal (marl-forming) wetlands to persist under increased SLR, using thin layer placement



Inundation Map Representing USACE SLC Intermediate and High Curves Assuming 50-year Planning Horizon to Year 2080, Absolute Elevations of 0.67 ft. and 2.85 ft. NAVD88, Respectively. Coastal Structures with Bypass Elevation (ft. NAVD88) for Reference.

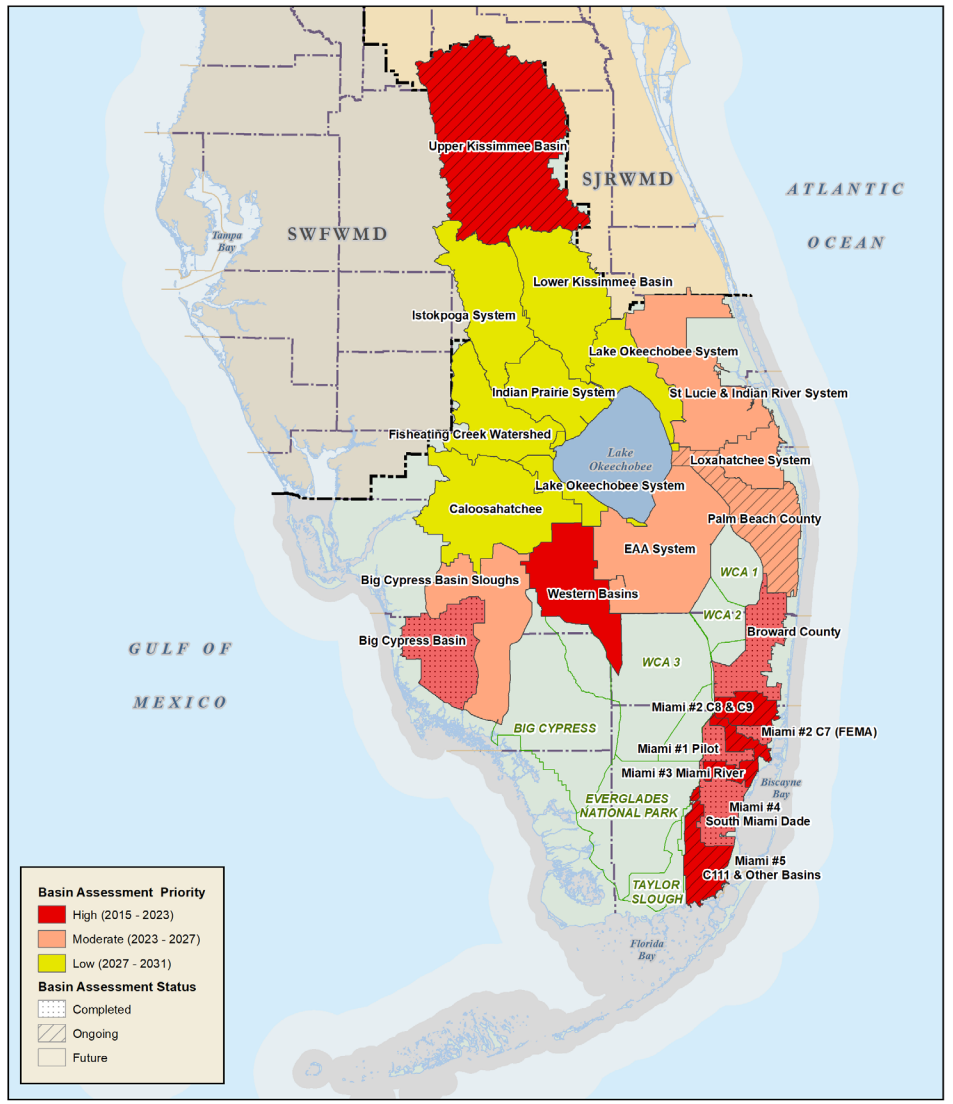
Flood Protection Level of Service Program

From Data Analysis to Robust Hydrology & Hydraulics Modeling Assessments

Critical District's strategy for assessing and addressing the impacts of development and climate change on flood control

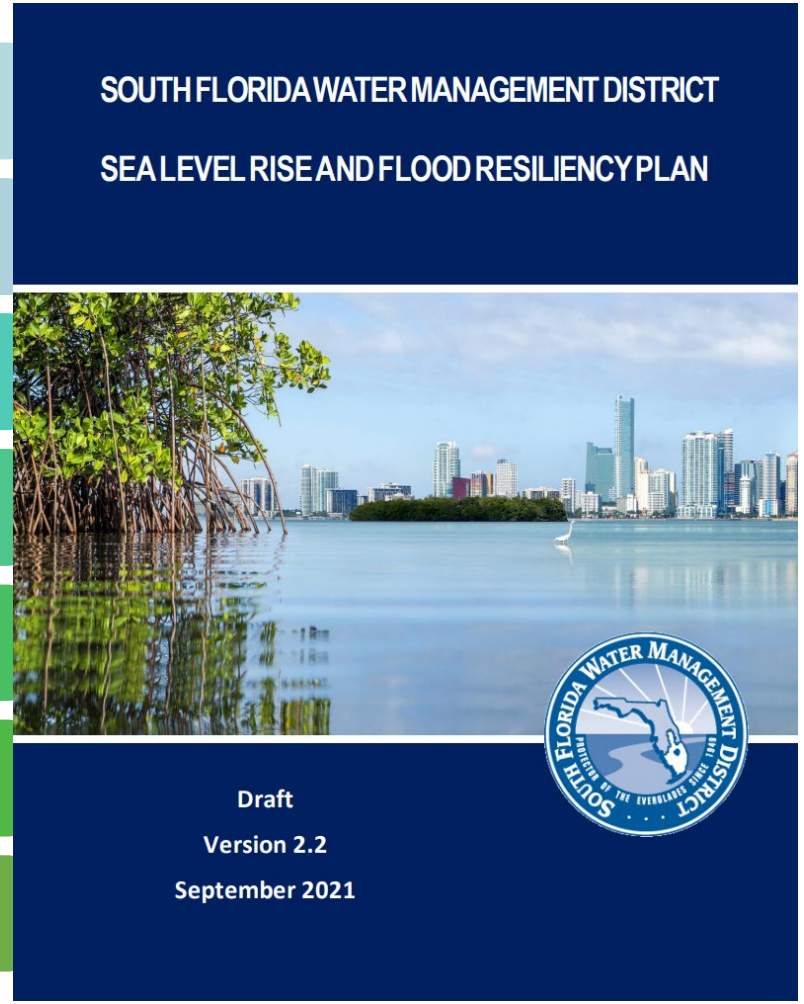
- Evaluate current and future flood risk in the canal system and communities basinwide
  - Considers rainfall, tide, storm surge, and sea level rise
- Support decision making on prioritizing investment for improvements and adaptation

www.sfwmd.gov/our-work/flood-protection-level-service



Our Resiliency Vision

- Risk Reduction / Effectiveness
- Implementation Resources
- Anticipated Future Conditions
- Critical Infrastructure and Disadvantaged Population Impacted
- Public Engagement & Leveraging Partners
- Ongoing Ecosystem Restoration Efforts
- Innovative Green/Nature-Based Solutions



Resiliency Initiatives Coordination

Integrating Inland and Coastal Flood Mitigation Strategies

Counties Projects

Local Municipalities Projects

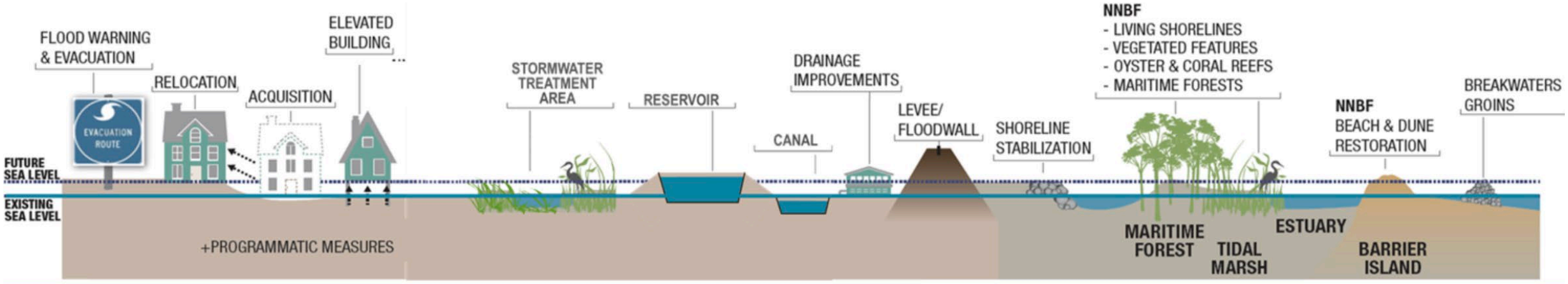
USACE Studies/ Projects

Regional **Climate Compacts**

Other Partners

POTENTIAL MEASURES TO IMPROVE RESILIENCE AND SUSTAINABILITY

Graphic modified from https://ewn.el.erdc.dren.mil/nnbf/other/5_ERDC-NNBF_Brochure.pdf



Source: USACE

Thank You

Carolina Maran, P.E., Ph.D., SFWMD, District Resiliency Officer
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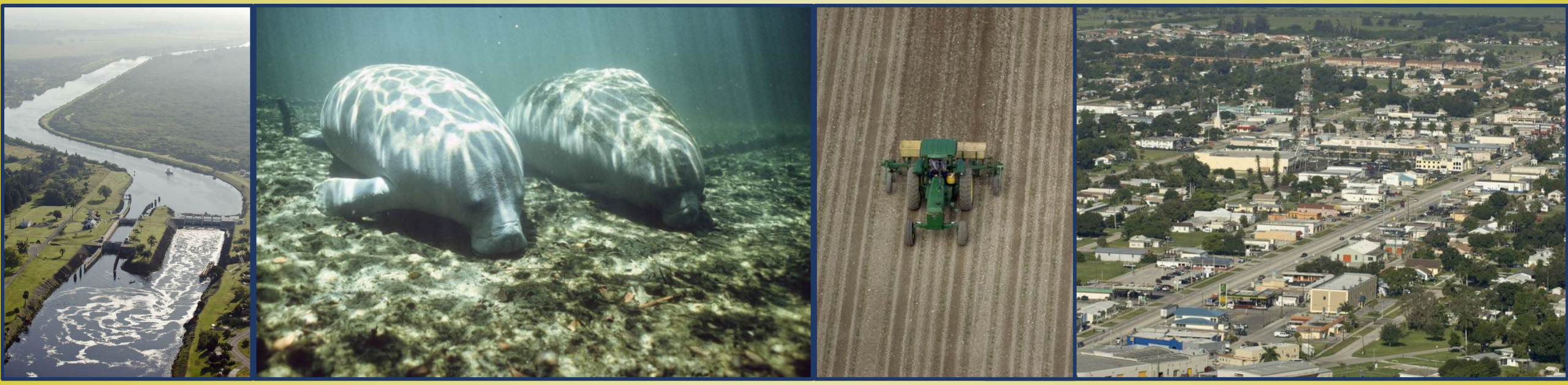
Photo by Paul Krashefski

Questions and Public Comment

Caloosahatchee River Fort Myers

- If you are participating via Zoom:
  - Use the Raise Hand feature
- If you are participating via phone:
  - *9 raises hand
  - *6 mutes/unmutes your line
- When you are called on, please state your full name and affiliation prior to providing comments and/or questions.

Next Steps



Bob Verrastro, P.G.

Principal Hydrogeologist, LWC Water Supply Plan Manager

2022 LWC Stakeholder Meeting 2

May 25, 2022

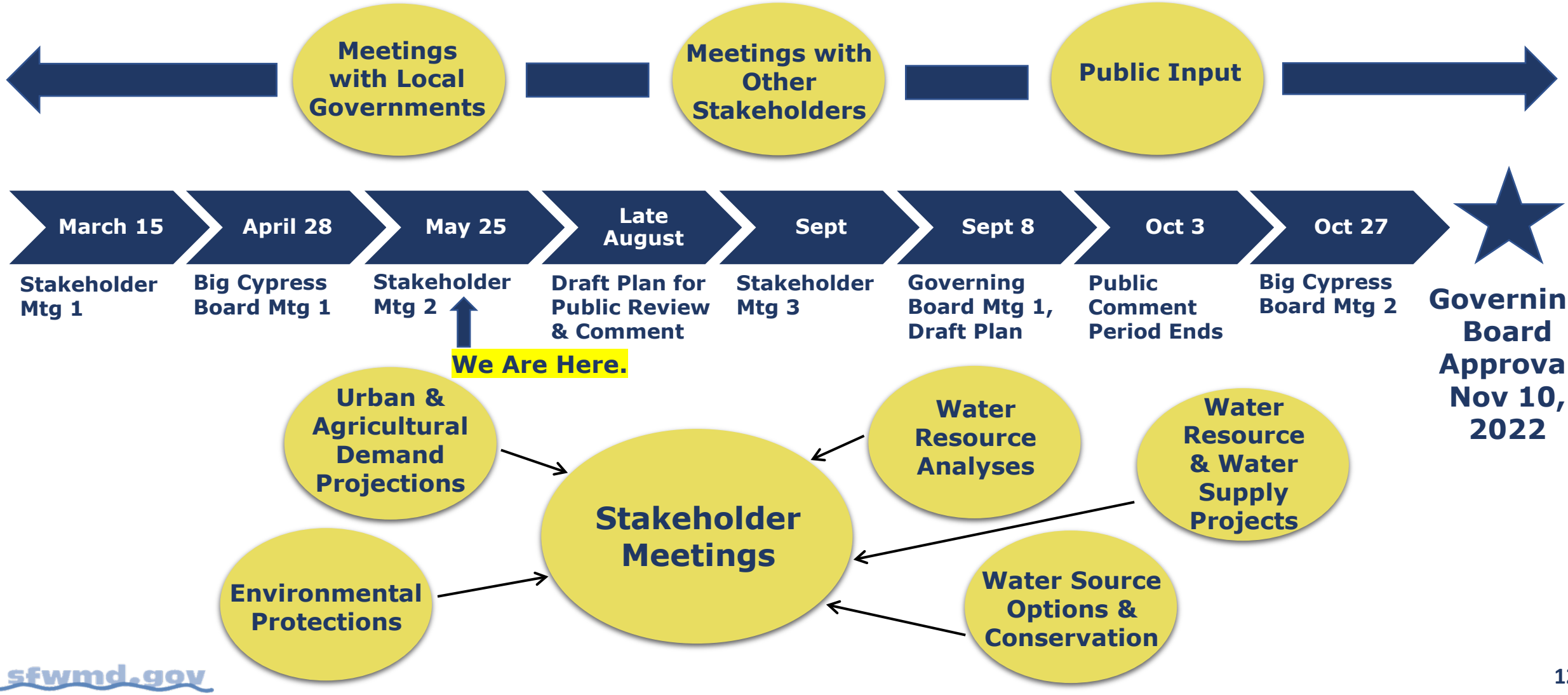
Draft Chapters Are Available for Public Comment

- Draft versions of Chapters 1, 3, and 4 of the 2022 LWC Plan Update are now available for early viewing and comment at www.sfwmd.gov/lwcplan.
- Please submit your written comments to Bob Verrastro, LWC Plan Update Manager, at bverras@sfwmd.gov by **Wednesday, June 8, 2022**.
- We strongly encourage your input and comments to ensure the plan update addresses the needs of the region.

Early Draft Chapters

- Lower West Coast Chapter 1: Introduction – DRAFT
- Lower West Coast Chapter 3: Demand Management: Water Conservation – DRAFT
- Lower West Coast Chapter 4: Water Resource Protection – DRAFT

Water Supply Plan Update Timeline



Thank You

Questions?

- Plan information can be found at www.sfwmd.gov/lwcplan
- Workshop announcements sent via email

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Mark Elsner, Bureau Chief
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