Lake Prevatt

Draft Minimum Levels

Peer Review Kickoff

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Division of Water Supply Planning and Assessment
2/24/2025

St. Johns River
Water Management District

Agenda

- Overview of Peer Review, Lake Prevatt Basin, and MFLs Process
- Hydrological Analyses
- MFLs Determination and Assessment
- WRVs Assessment
- Recommended Minimum Levels
- Stakeholder questions
- Next Steps – Tentative Schedule
- Site Tour

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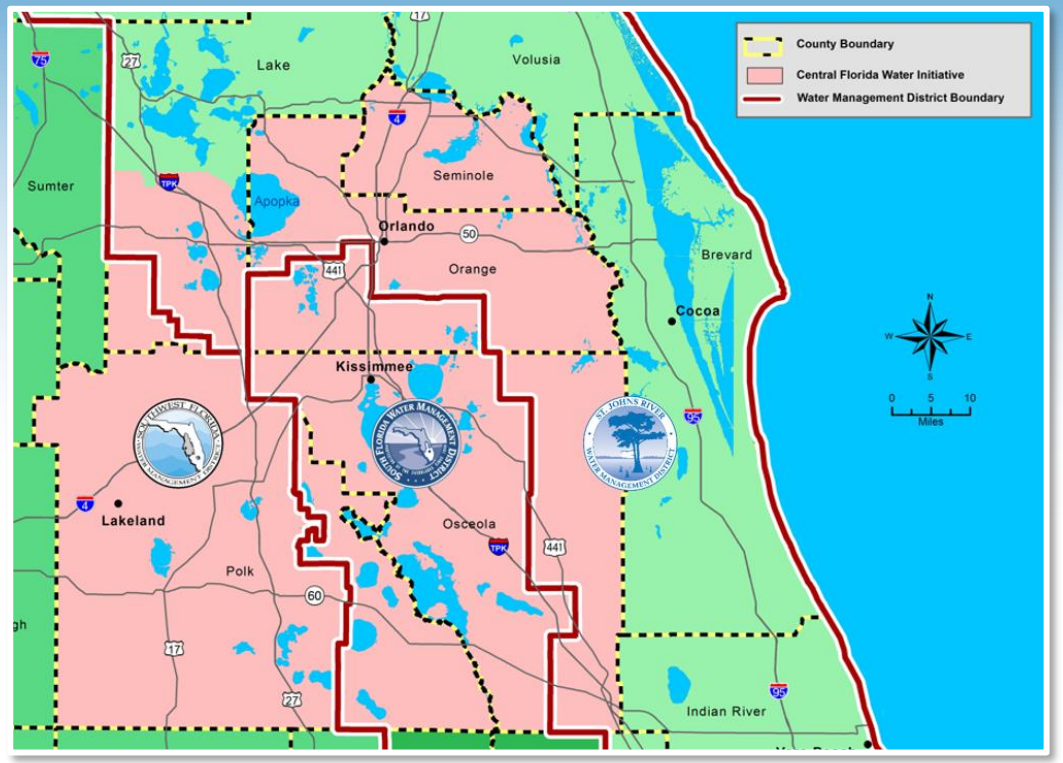
Peer Review Process

- Kick-off meeting – introduce MFLs and clarify scope
- Collaborative CFWI process that involves all interested stakeholders
- Peer reviewers can consider stakeholder input as part of their final comments / recommendations
- HSPF model peer reviewed by ATM (Geosyntec Consultants, Inc.)
- MFL Peer Review by T. Richardson Soils & Environmental (Trihydro Corp.)



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Trihydro

T. Richardson Soils & Environmental LLC

Peer Review Process

Scope of Work

- Determine appropriateness of environmental criteria, hydrological analyses, and recommended minimum levels;
- Determine validity and appropriateness of methods and procedures used for data analyses, assumptions used and conclusions drawn regarding the recommended minimum levels;
- Determine adequacy of data used to support conclusions and recommendations; and
- Identify and make recommendations regarding any deficiencies in development of the draft recommended minimum levels for Lake Prevatt.

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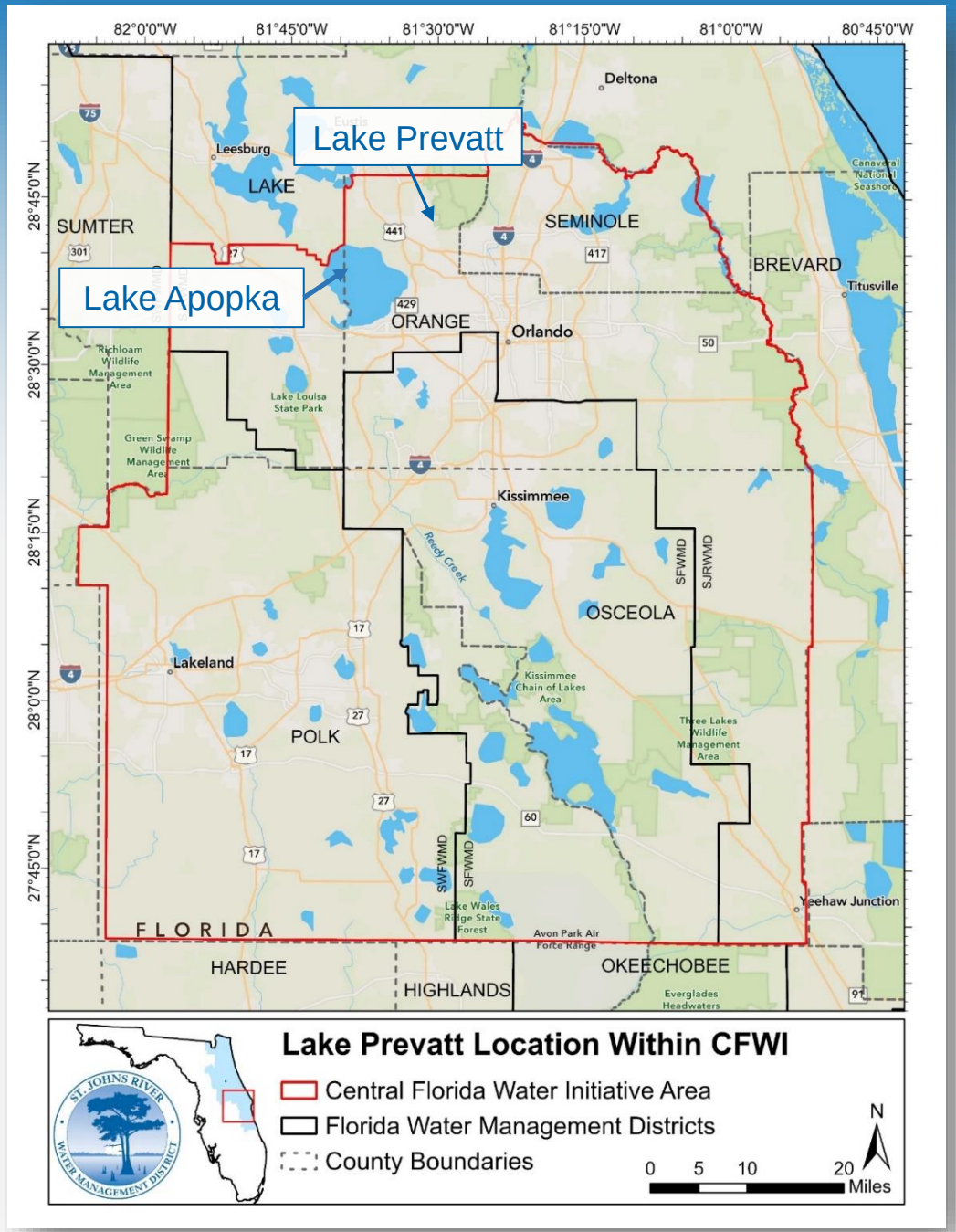
Lake Prevatt

- 2024 MFL Priority System:
  - Reevaluation
  - Original MFL 1997
- CFWI
- Orange County
  - Apopka
  - Wekiwa Springs State Park



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Lake Prevatt

- 2024 MFL Priority System:
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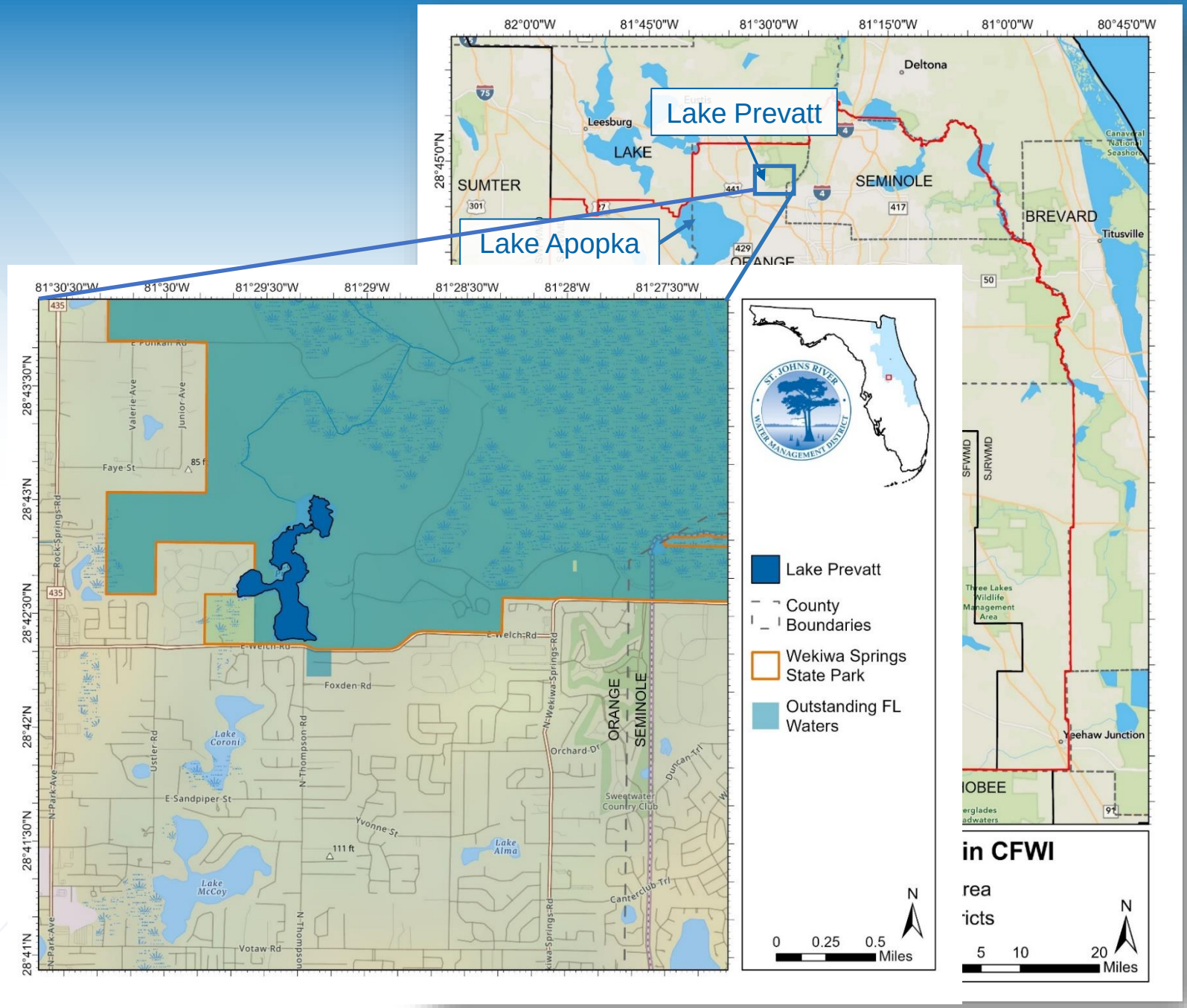
  - Wekiwa Springs State Park
- Outstanding FL Waterbody



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Lake Prevatt

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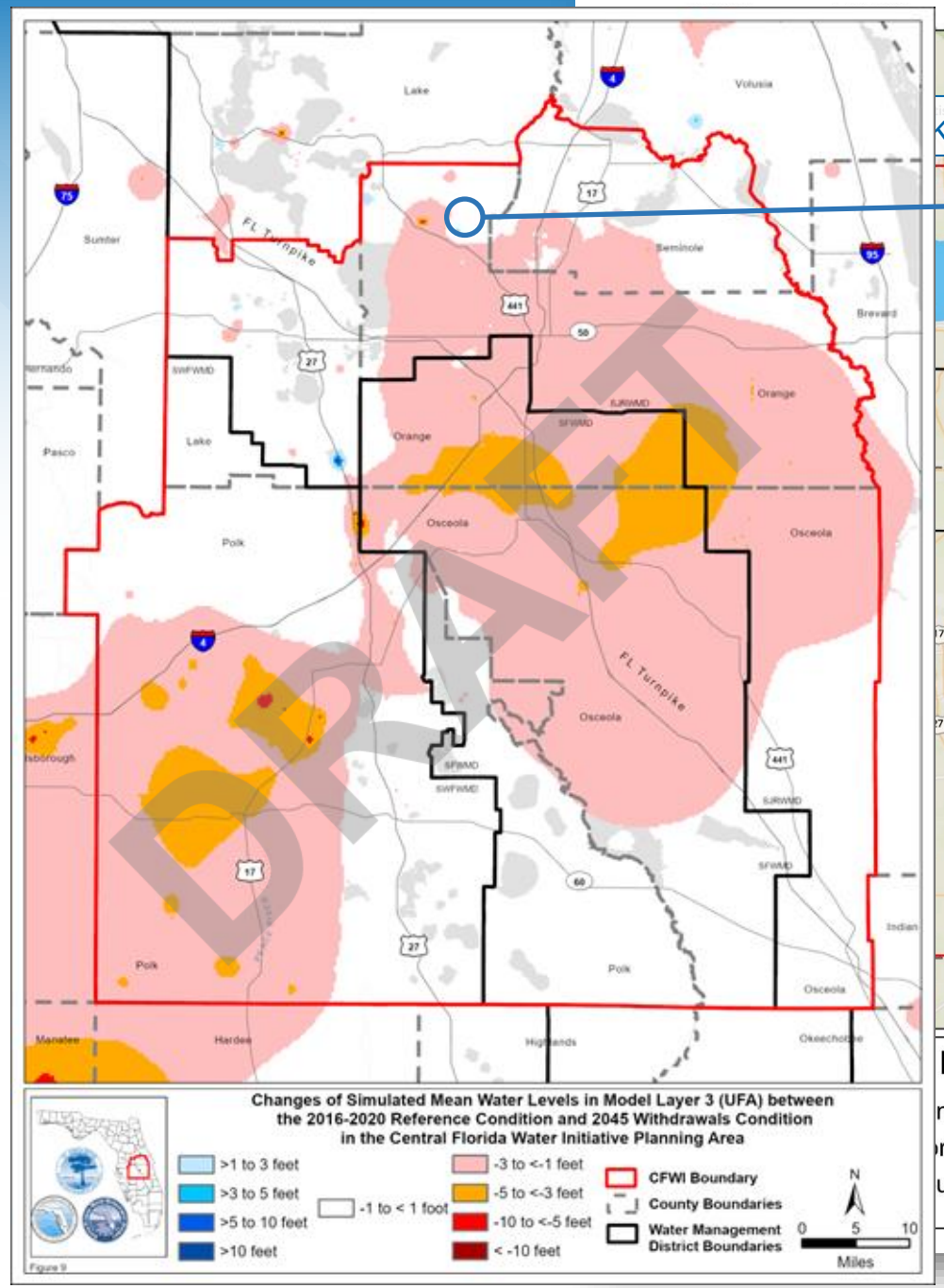

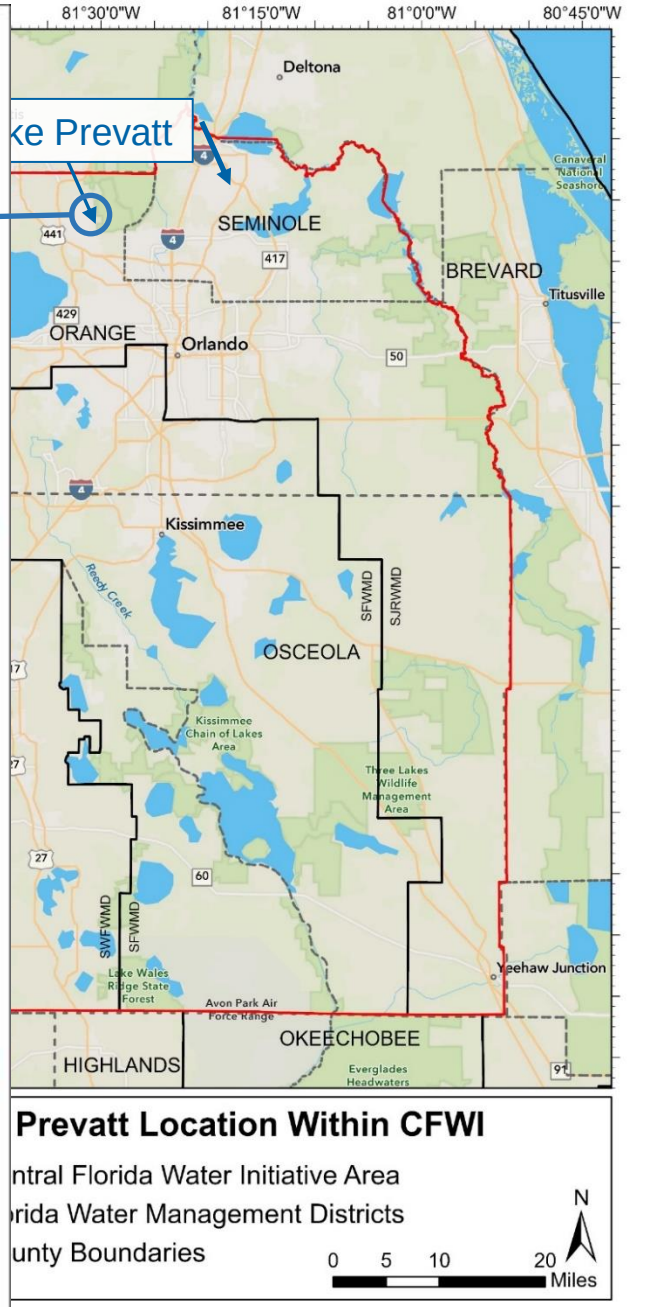

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Why do we set MFLs?

Statutory Directive

Water management districts must establish MFLs that set…

"…the limit at which further withdrawals would be significantly harmful to the water resources or the ecology of the area."

Section 373.042(1), Florida Statutes (F.S.)

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MFLs Process – Overview

MFLs Determination:

- Determine the most critical environmental features to protect and the minimum hydrologic regime required for their protection (MFLs condition)

MFLs Assessment:

- Determine the current impacted hydrologic regime (current-pumping condition)
- Compare the MFLs and current-pumping conditions to determine if water is available (freeboard)

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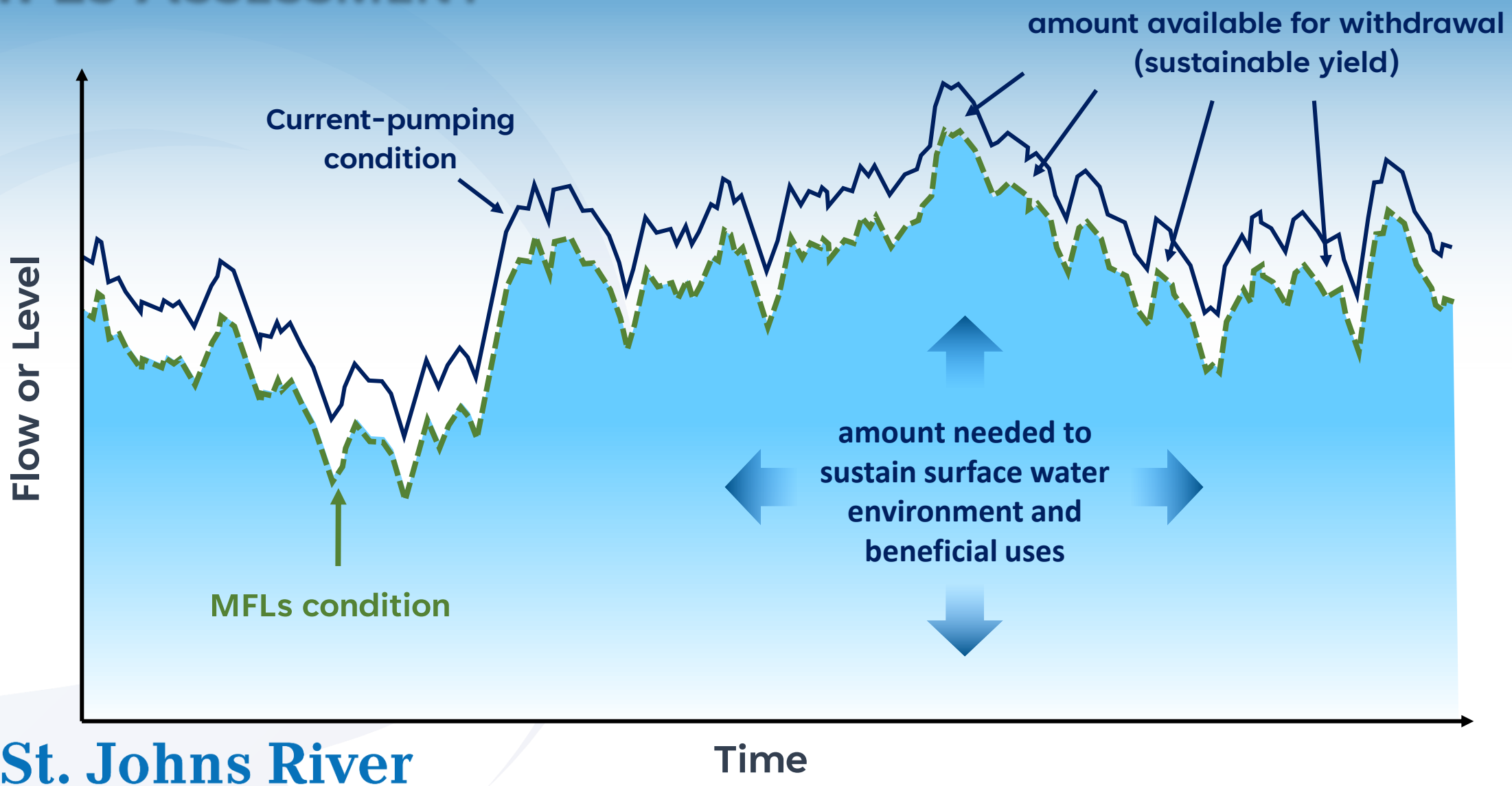
MFLs Assessment



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Hydrological Analysis

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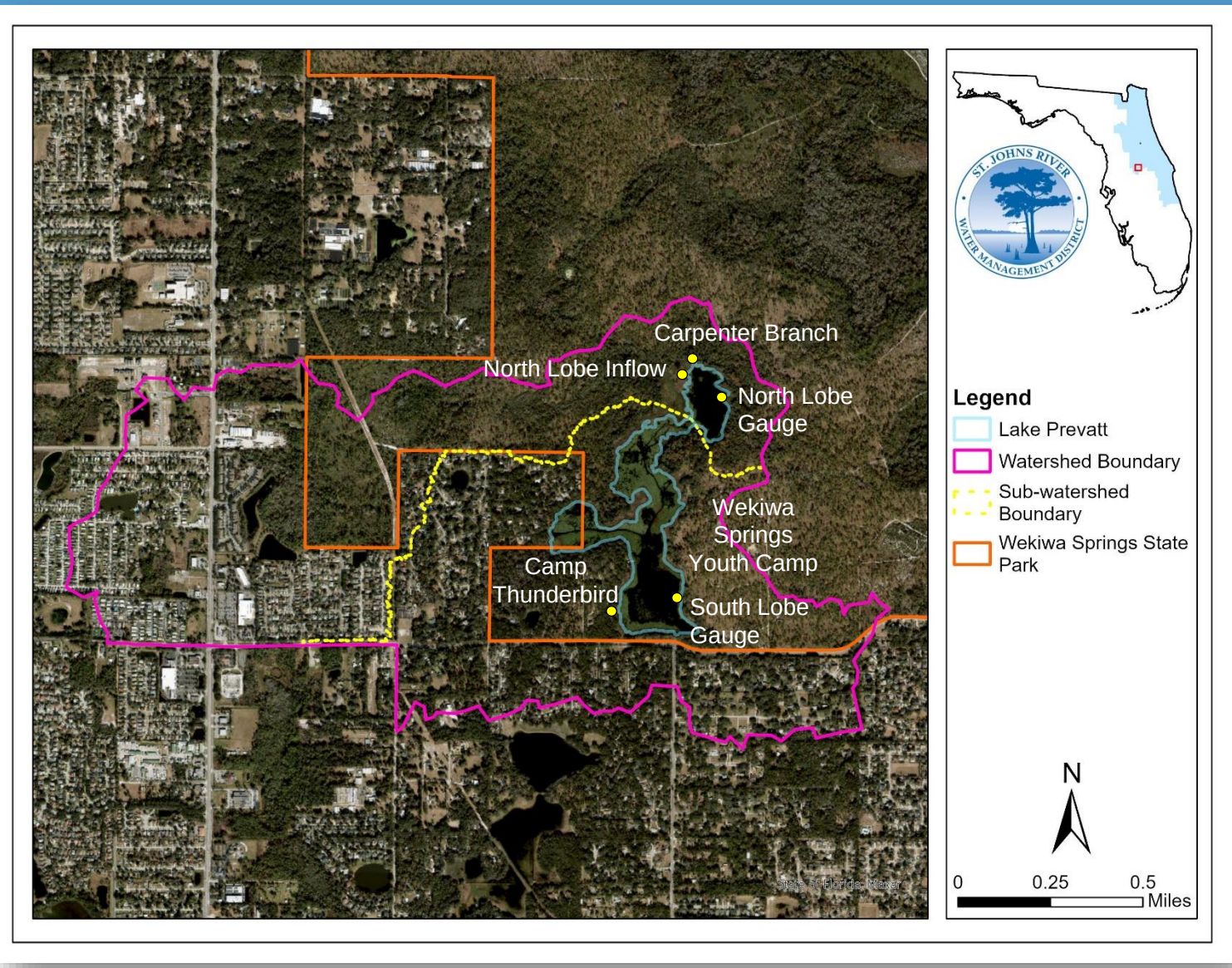
- HSPF model (Hydrological Simulation Program – Fortran)
  - Model Peer Review – January 2024
  - Basin: 1.6 mi^2
  - North subbasin: 508 acres
  - South subbasin: 531 acres
- Simulated long-term lake level dataset conditions (1953-2020):
  - Historical reconstruction
  - No-pumping condition
  - Current-pumping condition
    - 2016-2020 Impacts
  - Use these conditions to assess the MFLs developed from ecological data



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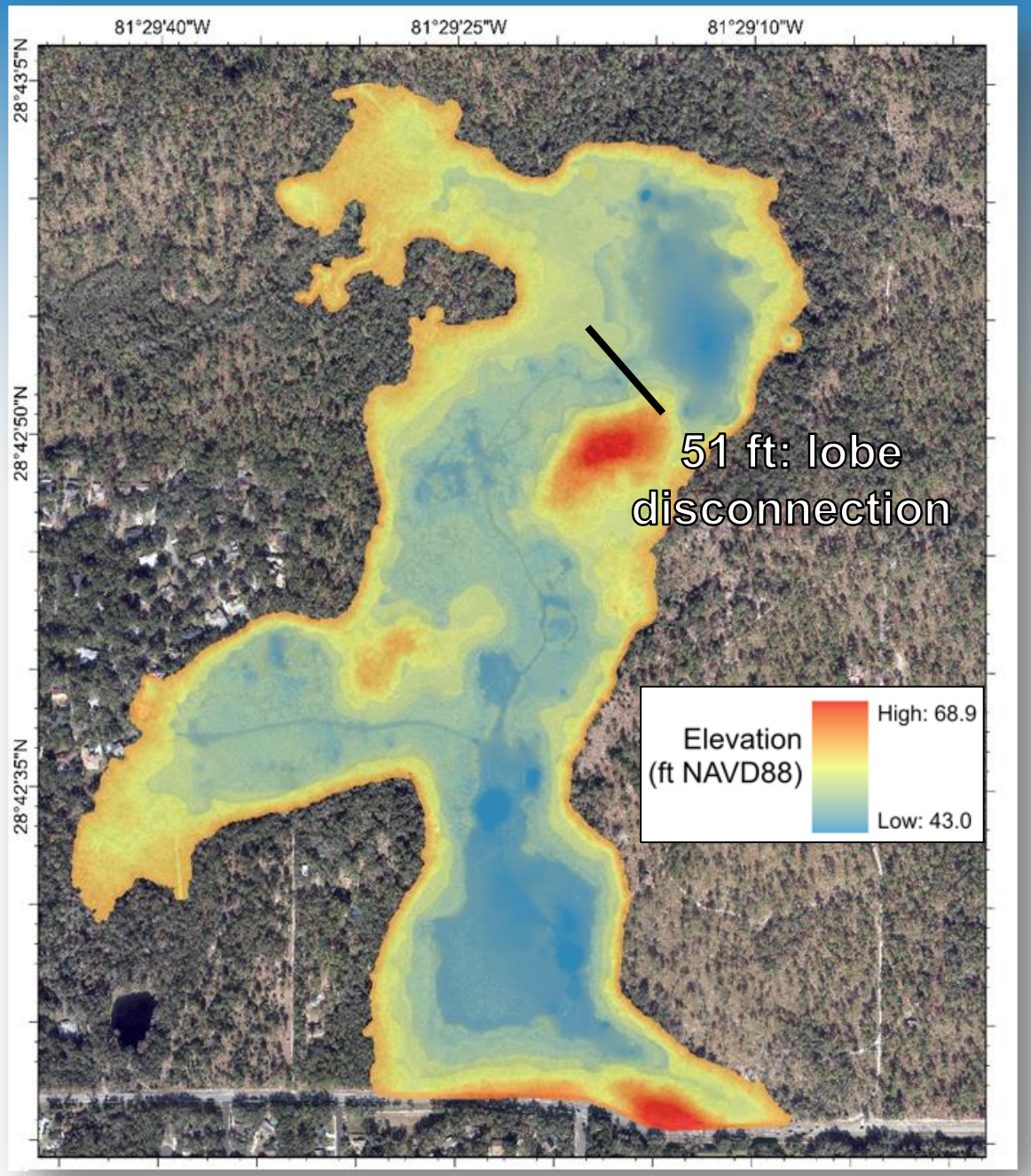
(Sarker et al. 2024)

Topobathymetric DEM

- DEM constructed from survey data, depth soundings, ADCP, and LiDAR data
- North and South Lobes disconnect at 51 ft NAVD88
- Larger fluctuation range in the South Lobe
  - North lobe: 12.1 ft fluctuation, minimum depth 46.8 ft NAVD88
  - South lobe: 15.2 ft fluctuation, minimum depth 44.1 ft NAVD88
  - Analysis focused on South Lobe



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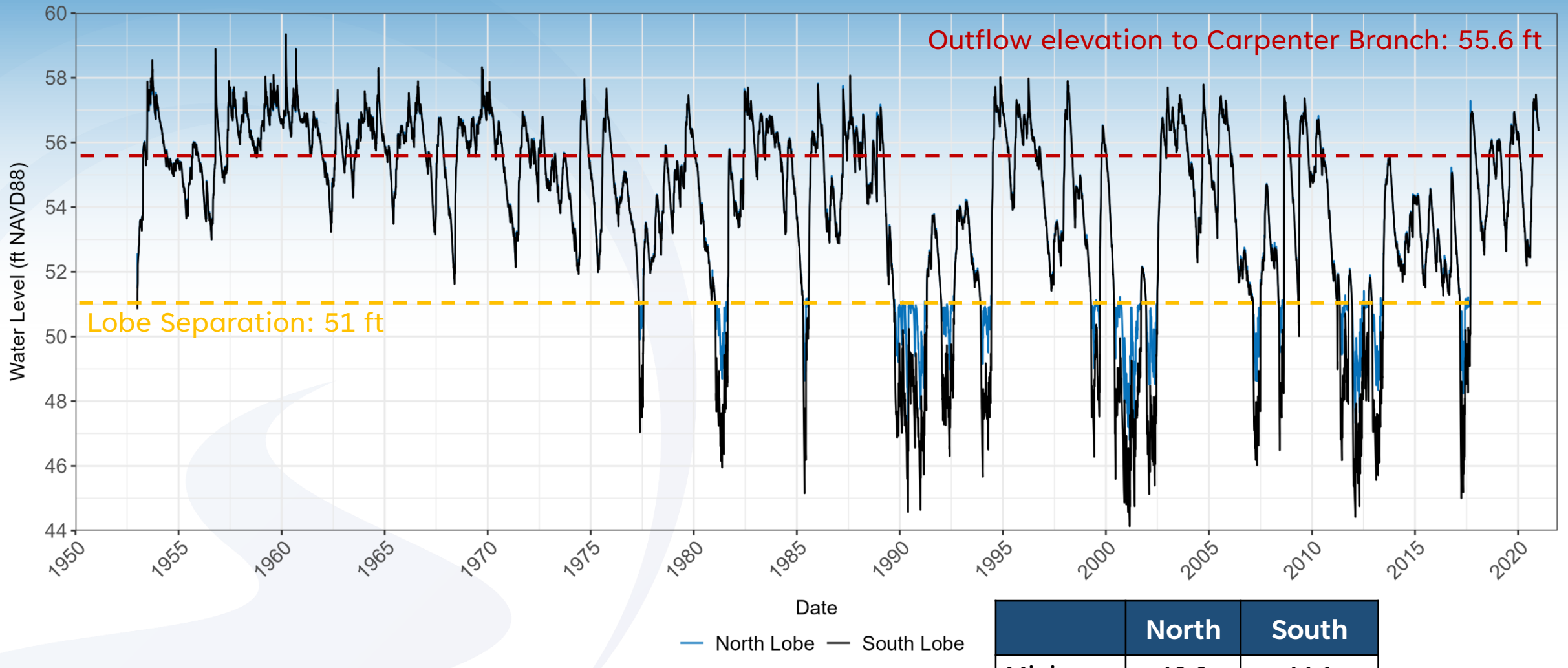
Lake Prevatt North and South Lobe Historic Stage Record



	North	South
Minimum	46.8	44.1
Maximum	58.9	59.4
Mean	54.3	54.0
Median	54.9	54.9

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Lake Prevatt

MFLs Determination

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Field Data Collection

Transects

- 3 ecological transects

Vegetation and Soils

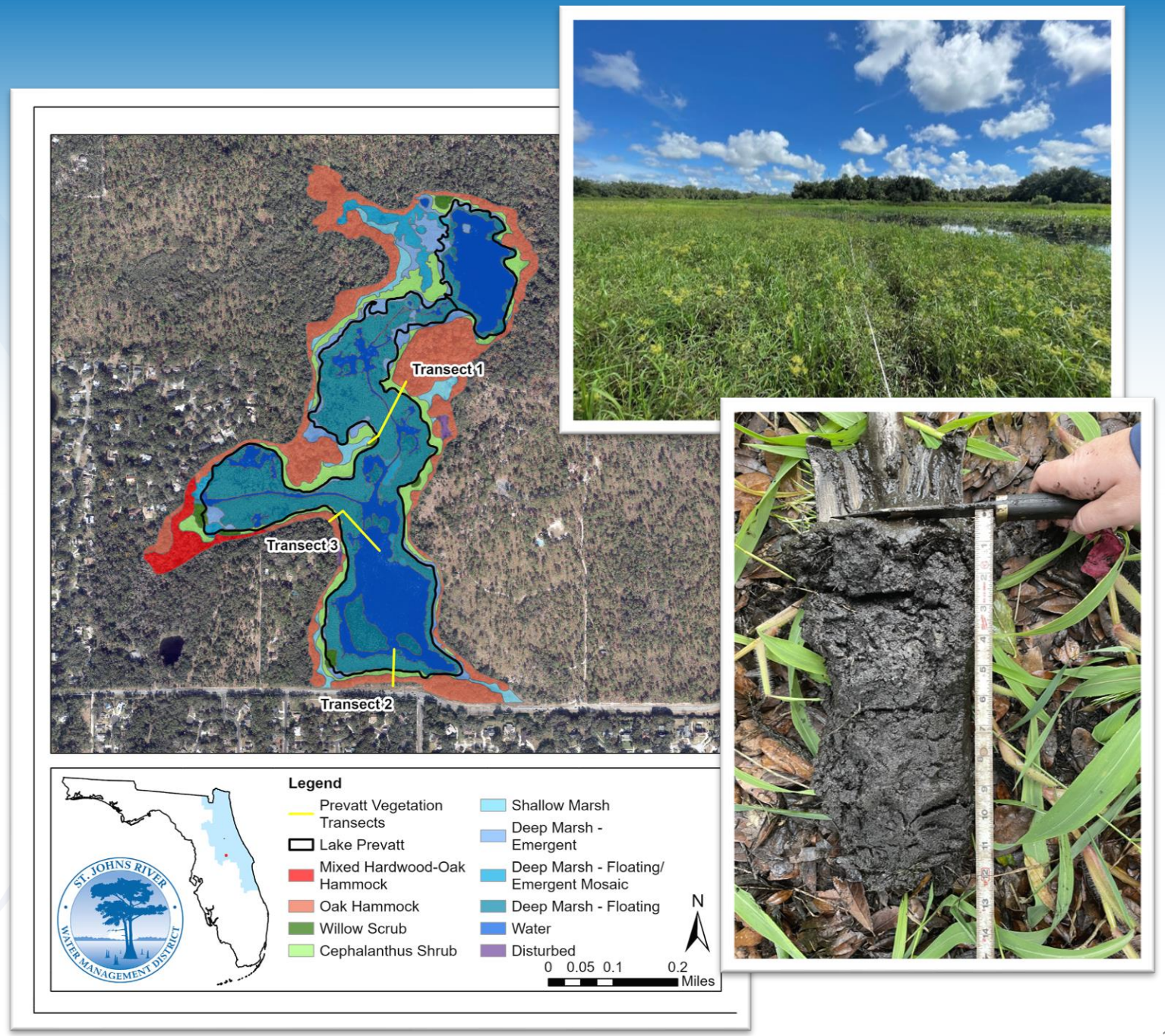
- Location and composition of wetland communities and soils

Elevation / Depths

- Elevations along transects
- Bathymetry

Metrics

- Event-based
- Hydroperiod Tool



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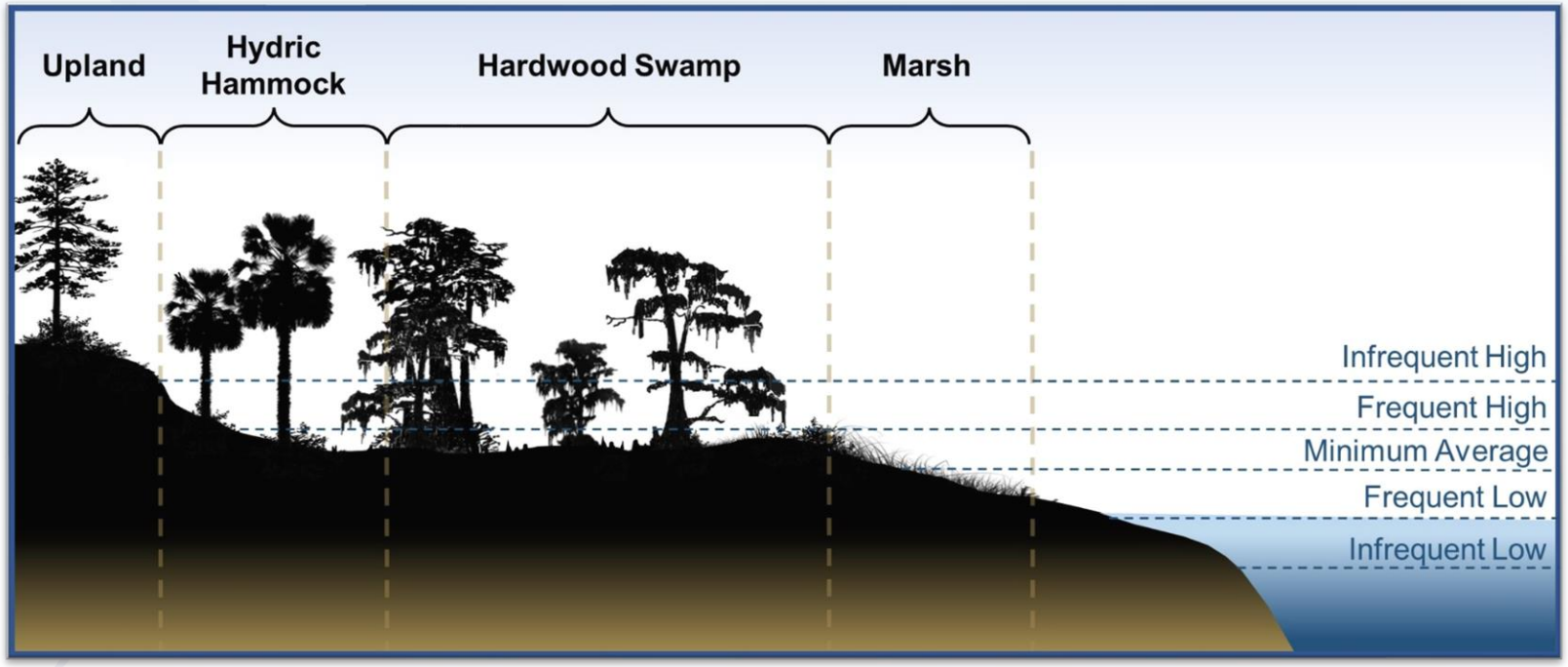
Event-based Metrics

- Protect a minimum hydroperiod necessary for maintenance of specific environmental values
  - Magnitude (elevation, ft NAVD88)
  - Duration (# of days)
  - Return Interval
- Event-Based Metrics assessed at Lake Prevatt
  - Minimum Average (MA)
  - Frequent High (FH)
- Frequency Analysis of these events with the long-term lake level conditions



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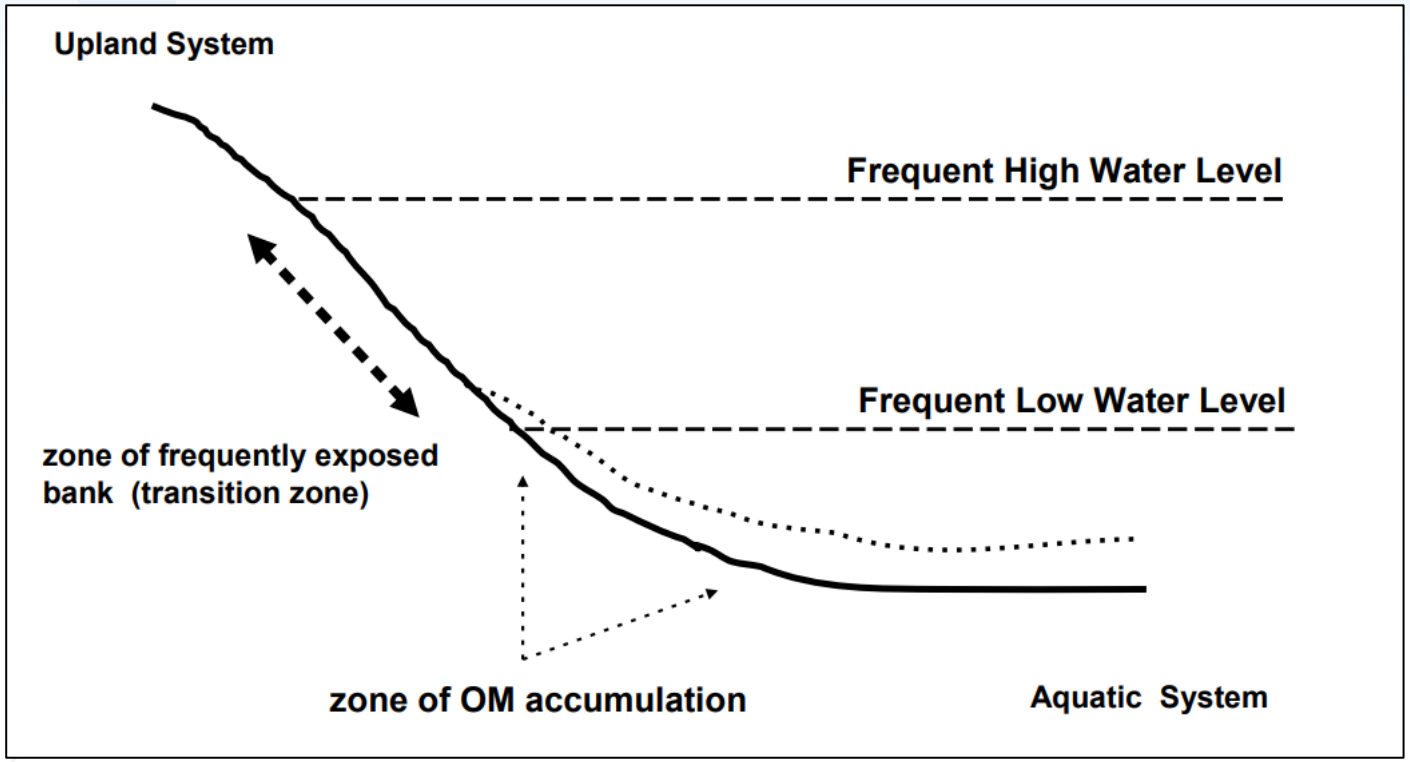

(JEA Inc. 2006)

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Minimum Average

- **Magnitude:**
  - Average elevation of deep organic soils (≥8 in) minus 0.3 ft
  - 49.7 ft NAVD88 (based on Transect 1)
- **Duration:** 180-day mean non-exceedance
- **Return Interval:** SWIDS Process

Hydric, no deep organics | Histic epipedon (≥ 8 in organic) | Histosol (≥ 16 in organic in top 32 in)

(Stephens 1974; Reddy et al. 2006; Osborne et al. 2014)

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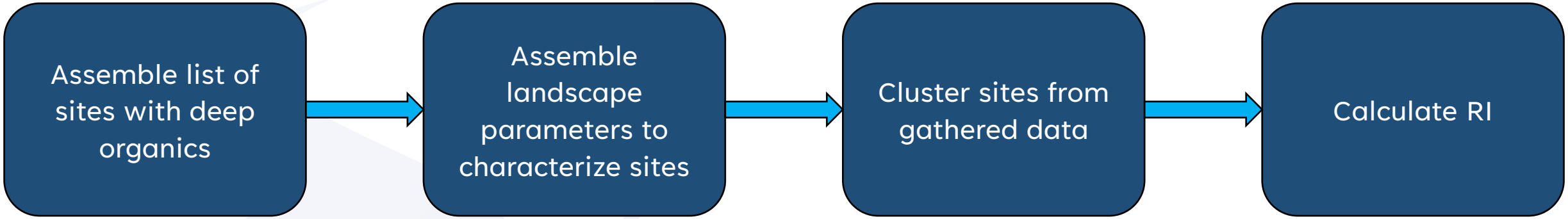
Minimum Average: Return Interval (RI) Calculation

Surface Water Inundation and Dewatering Signatures (SWIDS)

- For metrics:
  - Magnitude (elevation): from transect data
  - Duration: derived from literature and professional judgement
  - RI: variable depending on site and metric
- Goal: Protect a minimum hydroperiod necessary for maintenance of specific environmental values
- Reduce range in calculated RIs by using only sites that share hydrologic and landscape characteristics that may influence local ecological patterns



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Minimum Average: Return Interval (RI) Calculation

Assemble list of sites with deep organics

Assemble landscape parameters to characterize sites

Spatial variables

28 MFL Sites

Tabular variables: 20-year POR

Within 500 m of every lake:

- Landscape Soil Drainage Class (high, moderate, low % area)
- Soil permeability (high, moderate, low % area)
- Median depth to water table

UFA connection:

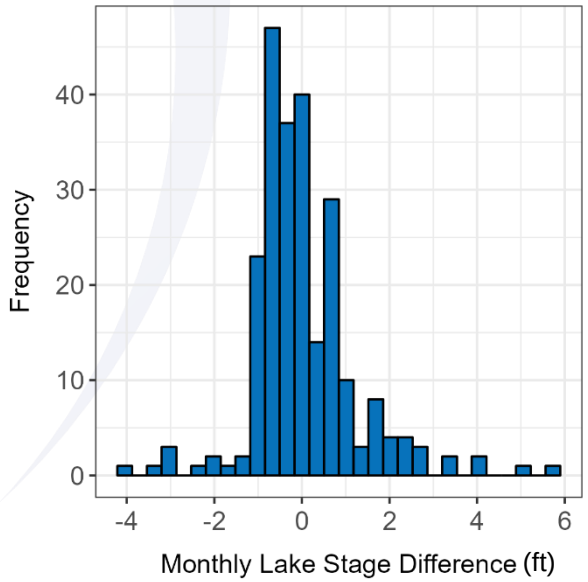
- Lake-UFA correlation strength
- Maximum Cumulative Fluctuation

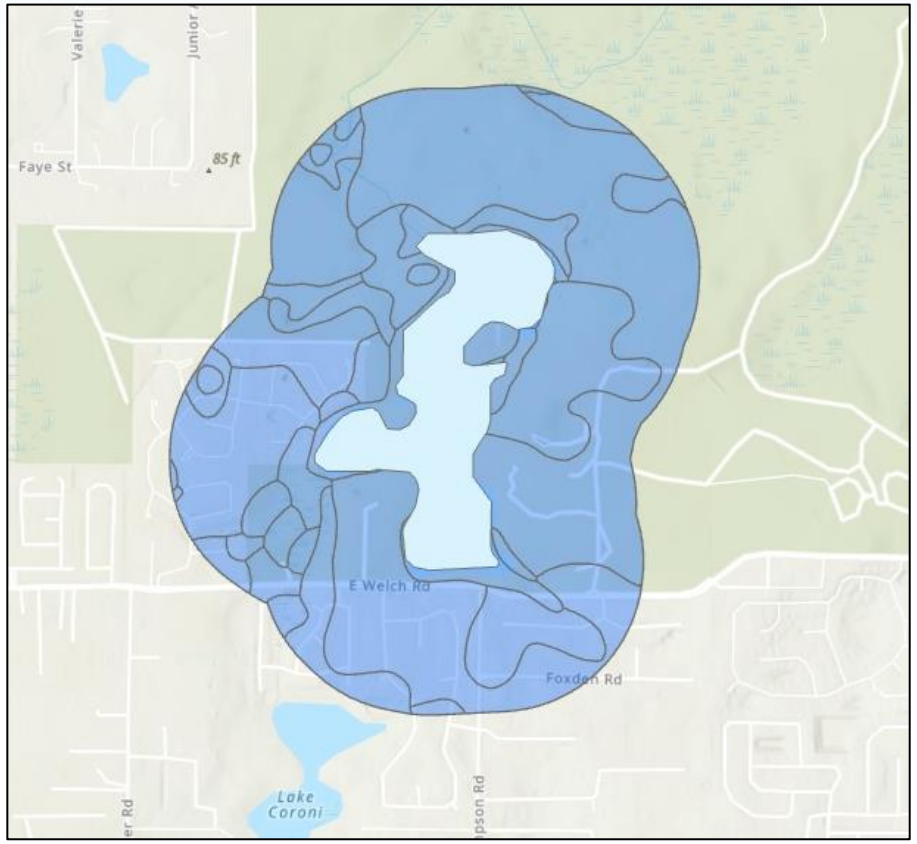
Water level range:

- Lower P80 – P50
- Upper P50 – P20
- Total P90 – P10

Monthly Water Level Change Symmetry

- Skewness
- Kurtosis





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Minimum Average: Return Interval (RI) Calculation

Assemble list of sites with deep organics

Assemble landscape parameters to characterize sites

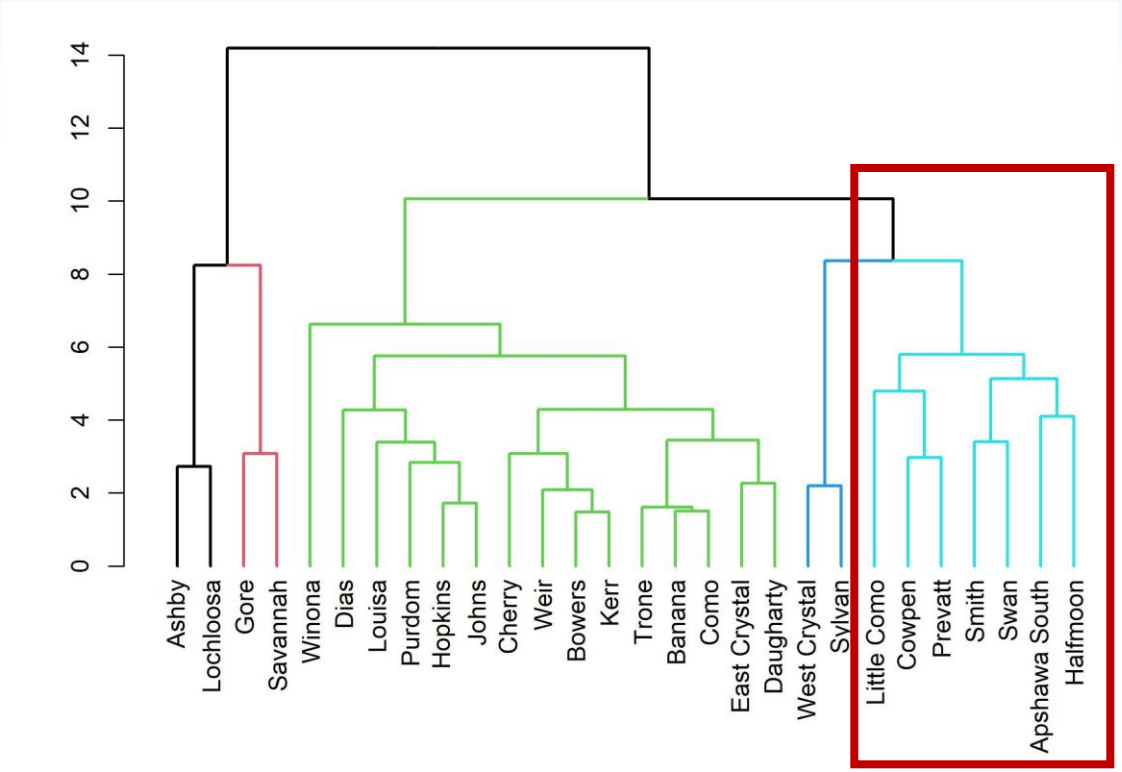
Cluster sites from gathered data

28 MFL Sites

14 landscape and hydrologic variables

Lake Cluster

- Variables standardized to z-scores
- Ward's Method of hierarchical clustering
- Significance tests to determine the number of significant cluster groups



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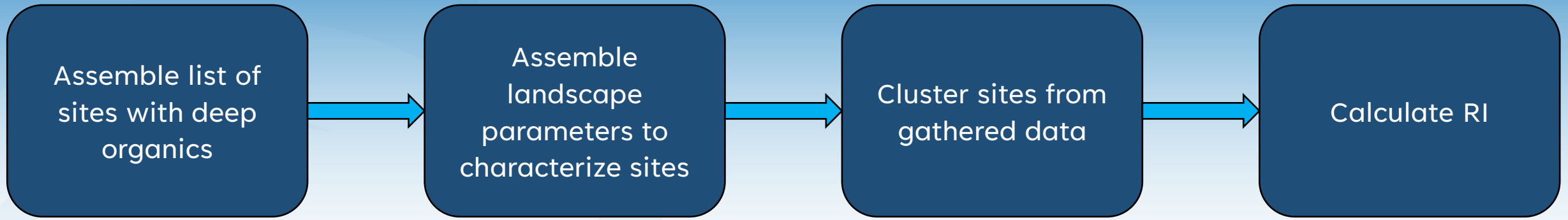
(Ward 1963; Murtagh & Legendre 2014; Charrad *et al.* 2014)

Minimum Average: Return Interval (RI) Calculation



Site	% Mean Non-exceedance	Return Interval (yr)
Cowpen	34.5	2.9
Prevatt	21.2	4.7
Smith	21.0	4.8
Apshawa South	26.1	3.8
Halfmoon	23.5	4.3
Swan	52.4	1.9
Little Como	20.8	4.8
Mean		3.9
Mean - SE		3.5

- **Use hydroperiod tables to determine the 180-day mean non-exceedance percentage of the deep organic elevation – 0.3 ft per site.**
- **The return interval is the number of times an event happens in 100 years (100 / % non-exceedance)**
- **Mean – standard error for the group used as the return interval for the metric**

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Minimum Average: Return Interval (RI) Calculation

Result of using the cluster group:

- Little change in mean – SE of probability of non-exceedance
- Reduction in overall exceedance range for 180-day event of **13.2%**
- Reducing the overall exceedance range = reducing overall uncertainty

Site	% Mean Non-exceedance	Return Interval (yr)
Cowpen	34.5	2.9
Prevatt	21.2	4.7
Smith	21.0	4.8
Apshawa South	26.1	3.8
Halfmoon	23.5	4.3
Swan	52.4	1.9
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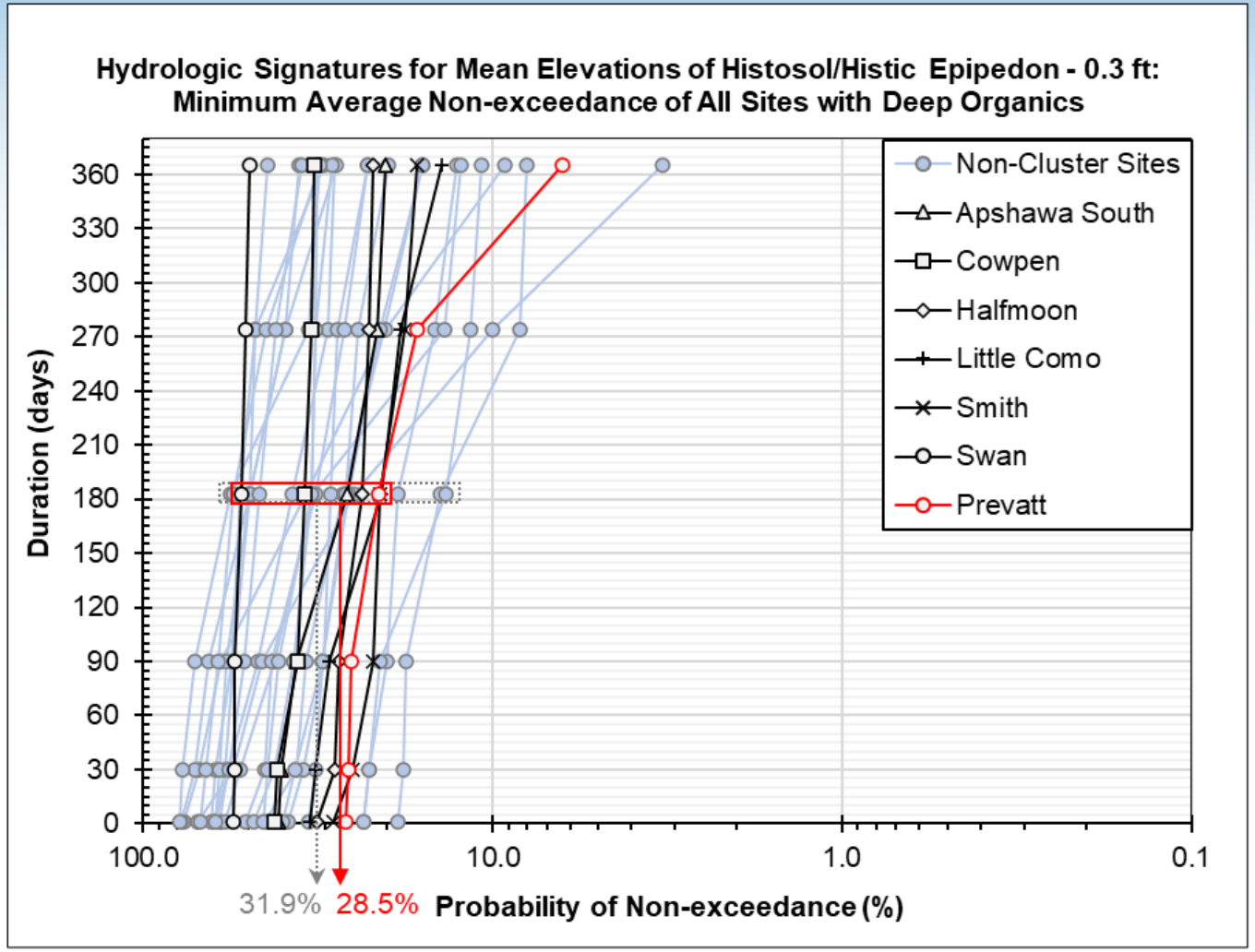
Cluster vs Non-cluster comparison



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Minimum Average

- **Magnitude:**
  - Average elevation of deep organic soils (≥8 in) minus 0.3 ft
  - 49.7 ft NAVD88 (based on Transect 1)
- **Duration:** 180-day mean non-exceedance
- **Return Interval:** 3.5 years

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Minimum Frequent High

- **Magnitude:**
  - Mean elevation of transitional shrub swamp across all transects
  - 53.8 ft NAVD88
- **Duration:** 30-day exceedance
- **Return Interval:** SWIDS Process

Processes that drive formation of deep organics are not the same as those affecting vegetation composition

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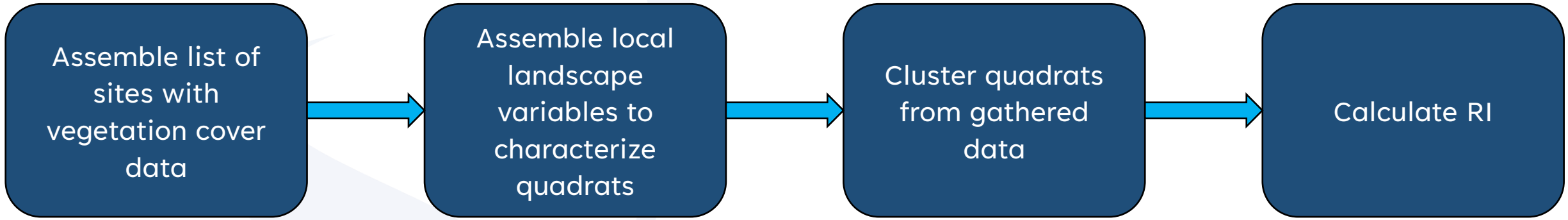
Minimum Frequent high: Return Interval (RI) Calculation

- Vegetation may be characterized by local site characteristics rather than large-scale basin characteristics
- Not all vegetation communities are comparable despite naming (community composition matters)
- Goal: to calculate an event return interval while reducing the event uncertainty across sites analyzed
- Establishes a framework on which to add variables in the future



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Minimum Frequent high: Return Interval (RI) Calculation

Assemble list of sites with vegetation cover data

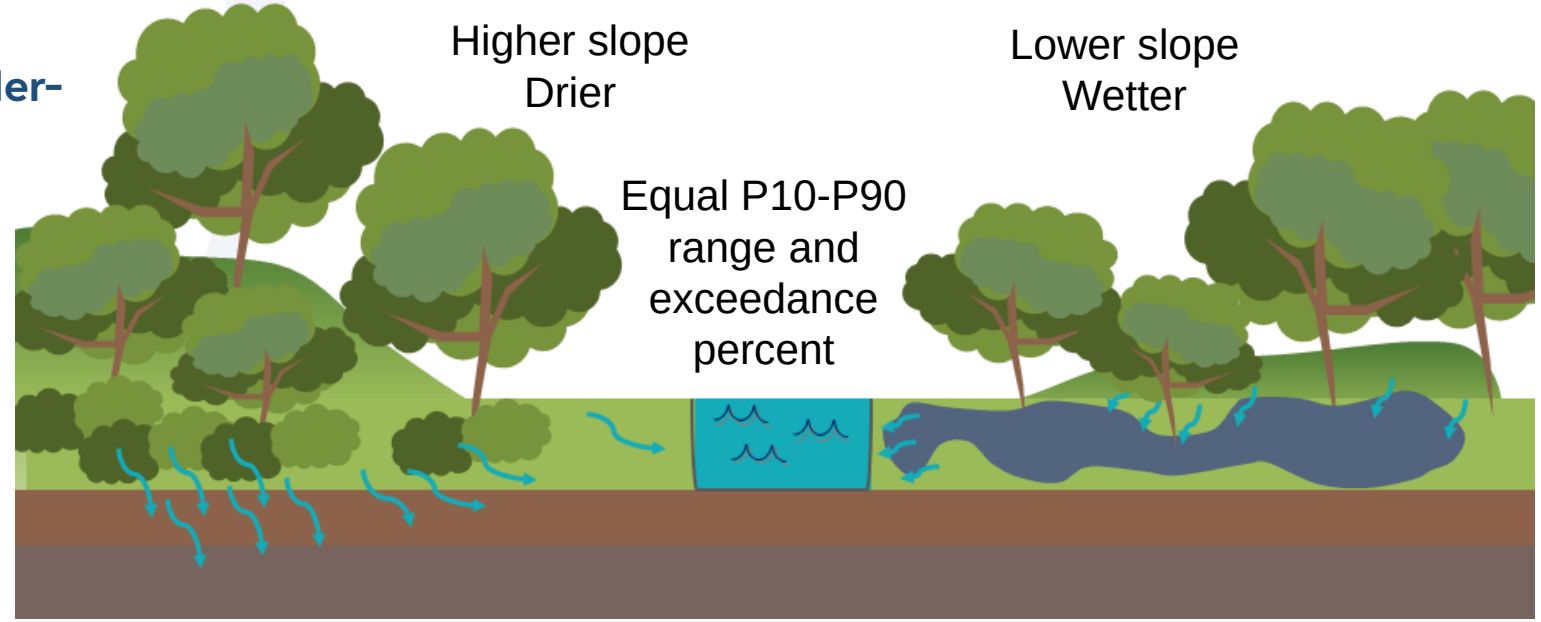
Assemble local landscape variables to characterize quadrats

29 MFL Sites

- Approach is quadrat based, using the vegetation quadrats collected as part of the normal MFL data collection
- Variables included:
  - P10 – P90 range (site level): overall water level variability
  - Prevalence Index (PI) of vegetation in quadrat: hydrologic preference of vegetation community
  - Quadrat slope: Tendency of water to sit or drain
  - Percent exceedance of mean quadrat elevation: percent of time mean quadrat level inundated

Local characteristics can inform smaller-scale hydrologic trends impacting community presence/composition

Approached purely from a hydrologic perspective for MFL linkage



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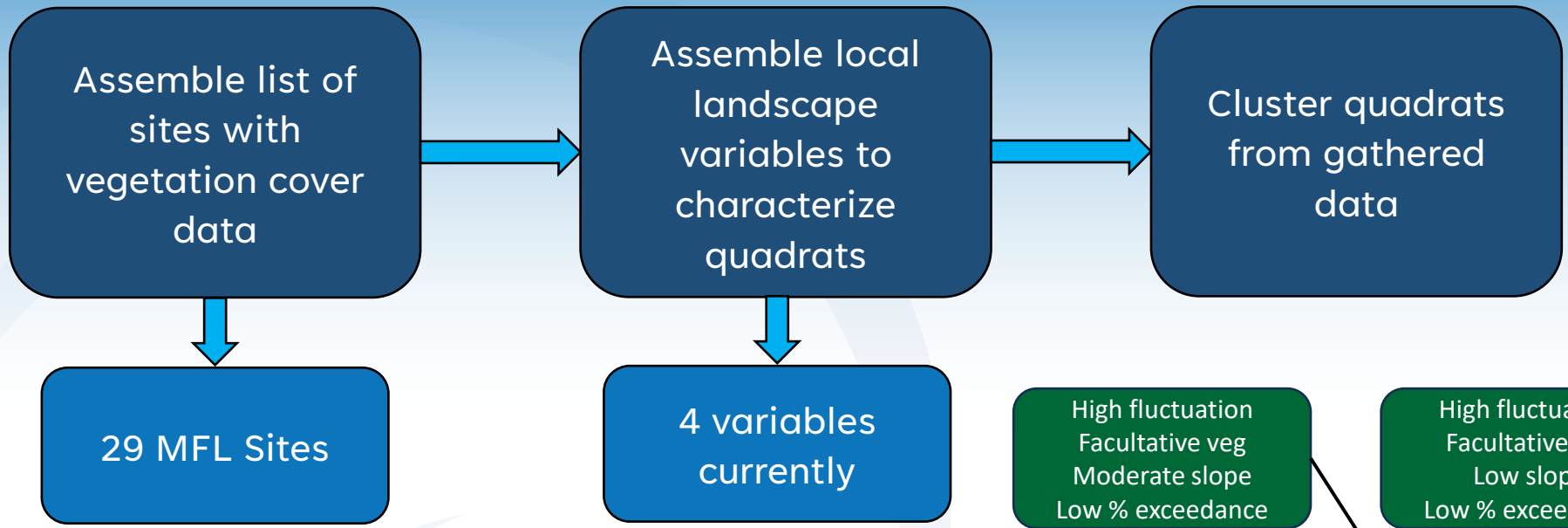
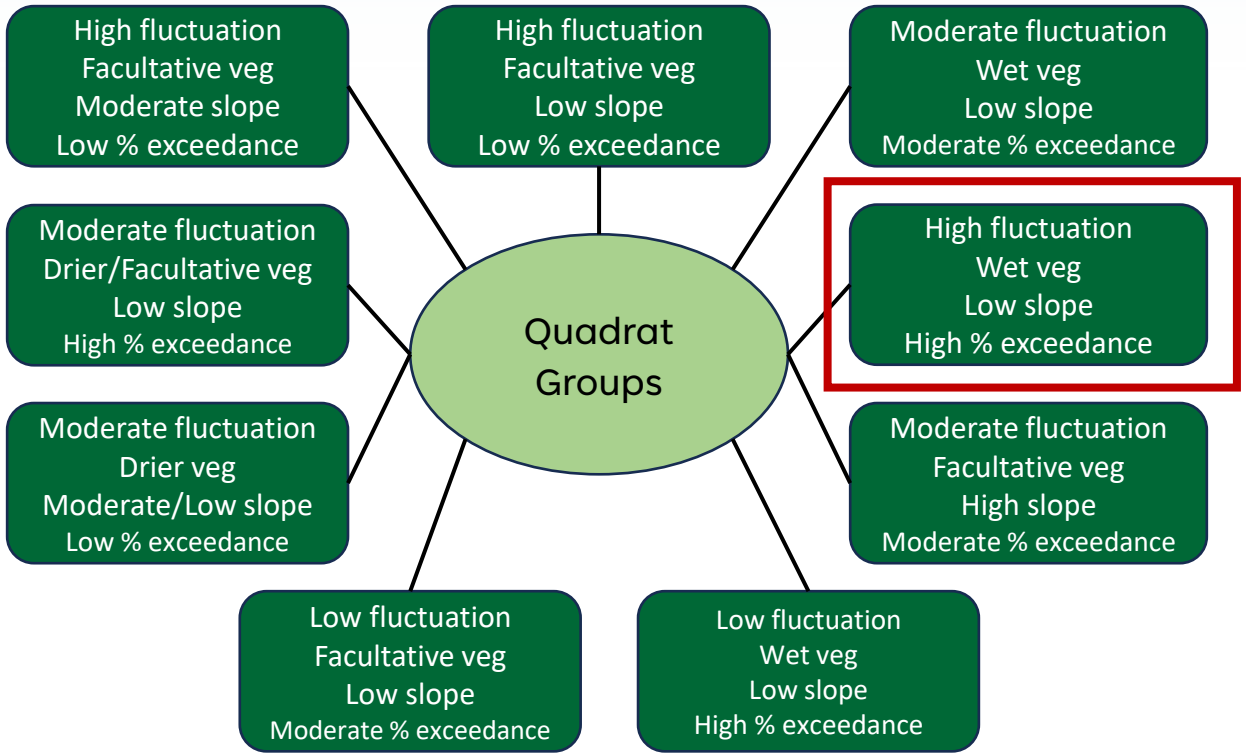
Minimum Frequent high: Return Interval (RI) Calculation



- **Principle Components Analysis (PCA) on variable z-scores**
- **Ward's D cluster on principle components**
- **Groups similar quadrats rather than similar sites: clusters into 9 groups with current data**



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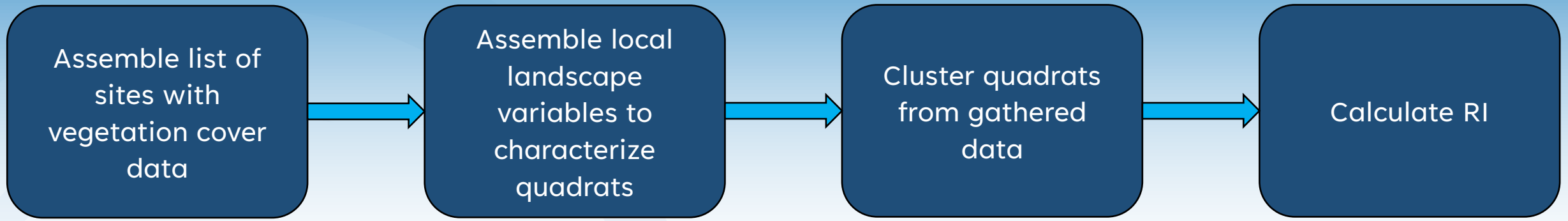

Site	% Exceedance	Return Interval (yr)
Butler	62.9	1.6
Doyle	69.3	1.4
Cowpen	95.2	1.1
Swan	89.9	1.1
Johns	97.1	1.0
Prevatt	96.4	1.0
Mean		1.2
Mean + SE		1.3

- Calculate elevations per site based on within-group quadrats
- Use hydroperiod tables to determine the 30-day exceedance percentage of the Transitional Shrub Swamp
- The return interval is the number of times an event happens in 100 years (100 / % exceedance)
- Mean + standard error for the group used as the return interval for the metric

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Minimum Frequent high: Return Interval (RI) Calculation

Result of using the cluster group:

- Mean exceedance increase by 29% (56.1% pre-cluster, 85.1% post cluster)
- Reduction in overall exceedance range for 30-day event of **49.3%**
- Reducing the overall exceedance range = reducing overall uncertainty

Site	% Exceedance	Return Interval (yr)
Butler	62.9	1.6
Doyle	69.3	1.4
Cowpen	95.2	1.1
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Prevatt	96.4	1.0
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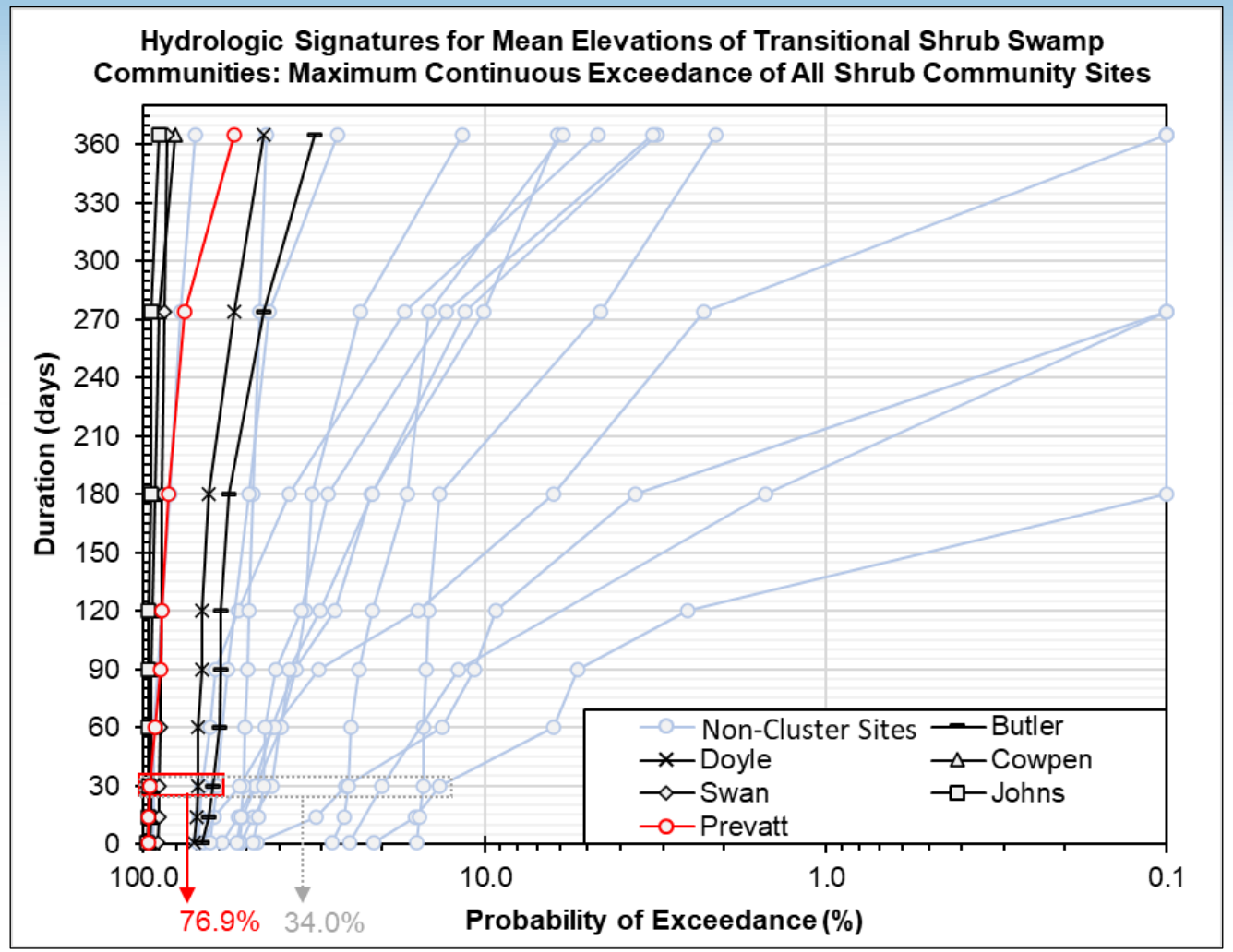

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Minimum Frequent High

- **Magnitude:**
  - Mean elevation of transitional shrub swamp across all transects
  - 53.8 ft NAVD88
- **Duration:** 30-day exceedance
- **Return Interval:** 1.3 years

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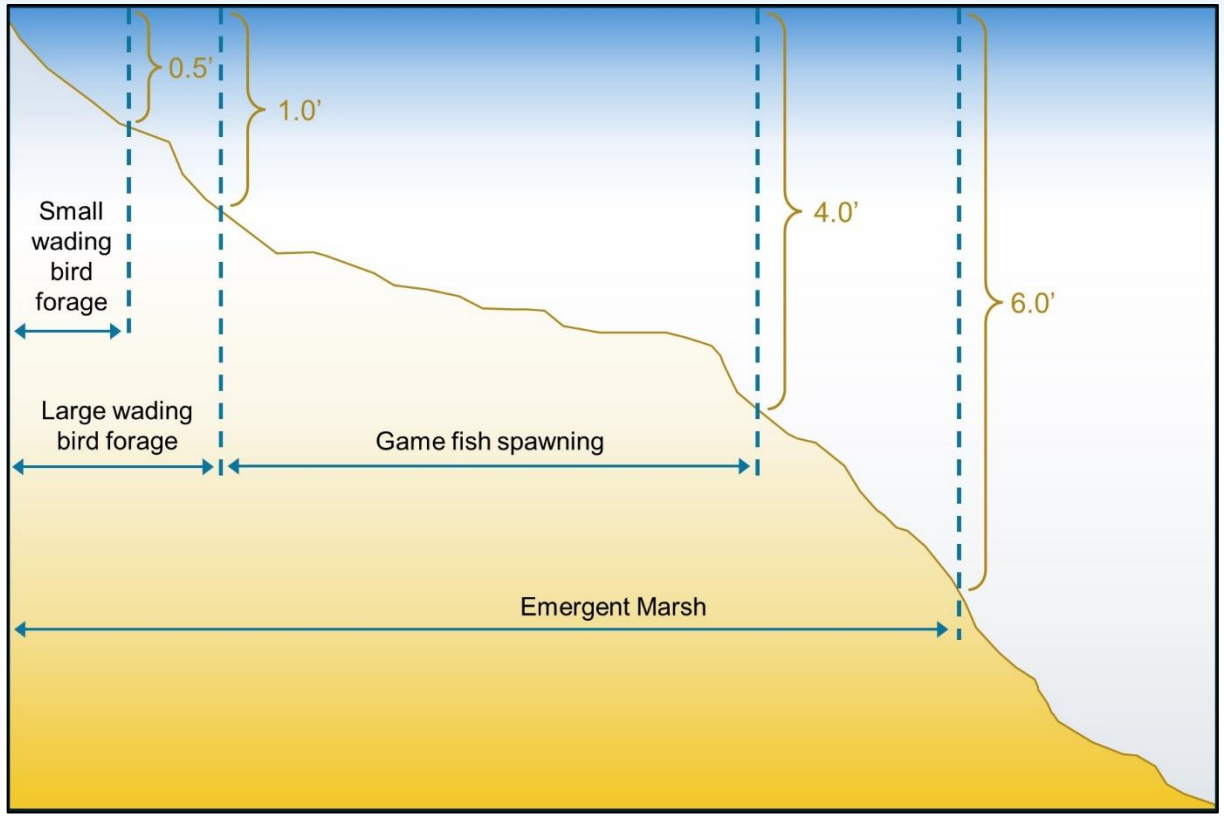
Hydroperiod Tool Metrics

- Stage-Habitat Area Relationship
  - Utilizes a detailed DEM with raster representations of the environment
  - Compare the no-pumping and current-pumping conditions
    - Average Habitat Area for each day in the POR
- > 15% Change from no-pumping condition

Habitat and Lake Characteristics	Minimum depth (ft)	Maximum depth (ft)
Open Water	5	NA
Canoe	1.67	NA
Emergent Marsh	0.1	6
Game Fish Spawning	1	4
Large Waders	0.1	1
Small Waders	0.1	0.5



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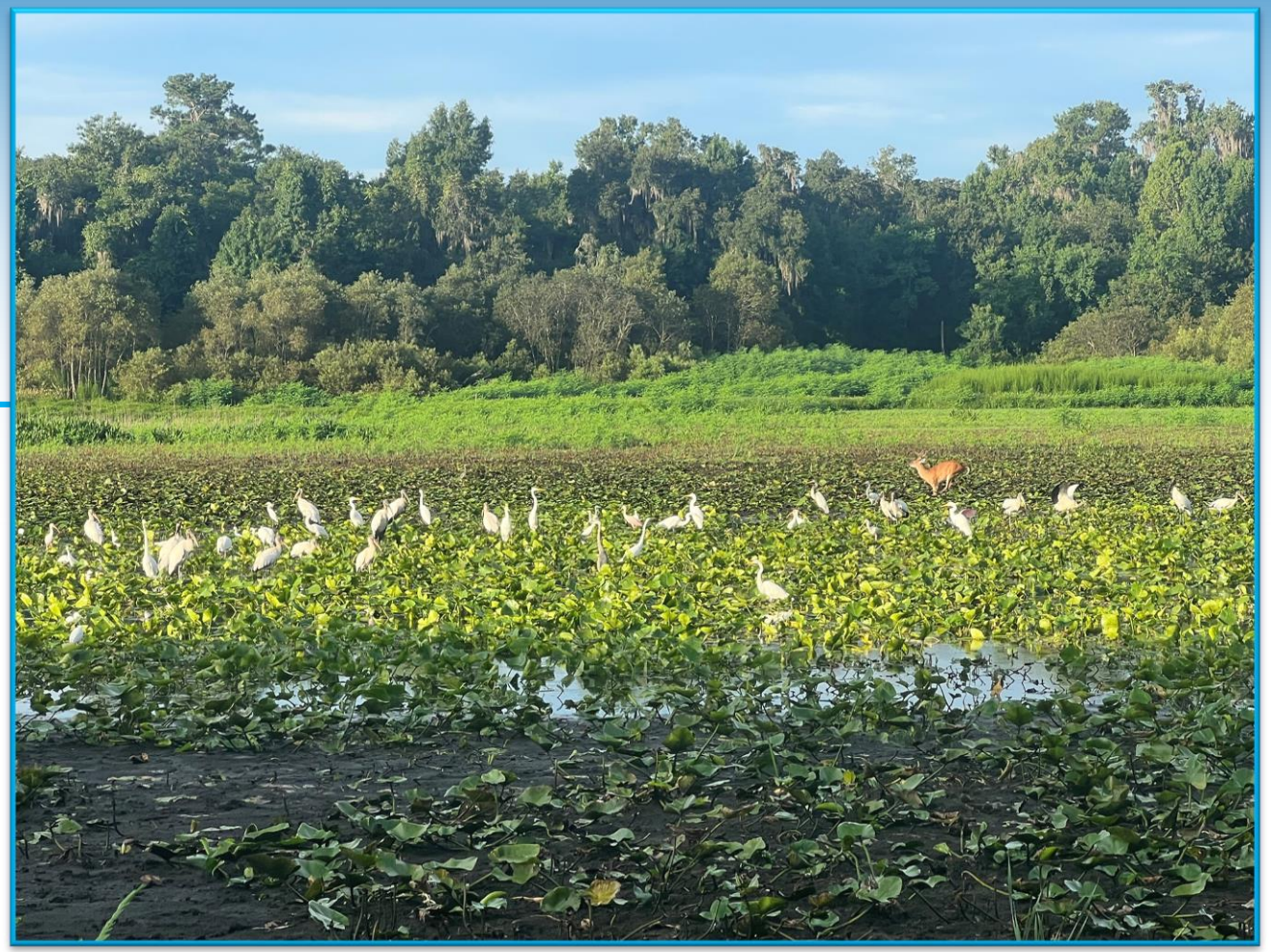
Lake Prevatt

MFLs Assessment



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MFLs Assessment

Dataset

Long-term water levels or flows

Pumping Impact Assessment

Determine the impact from pumping on levels and/or flows

Current-Pumping Condition Levels

Develop no-pumping and current-pumping condition levels/flows

Current Status of MFLs

Estimate freeboard or deficit in the levels/flows under current pumping condition to assess current status of MFLs

Future Status of MFLs

Estimate freeboard or deficit in the levels/flows under future pumping condition

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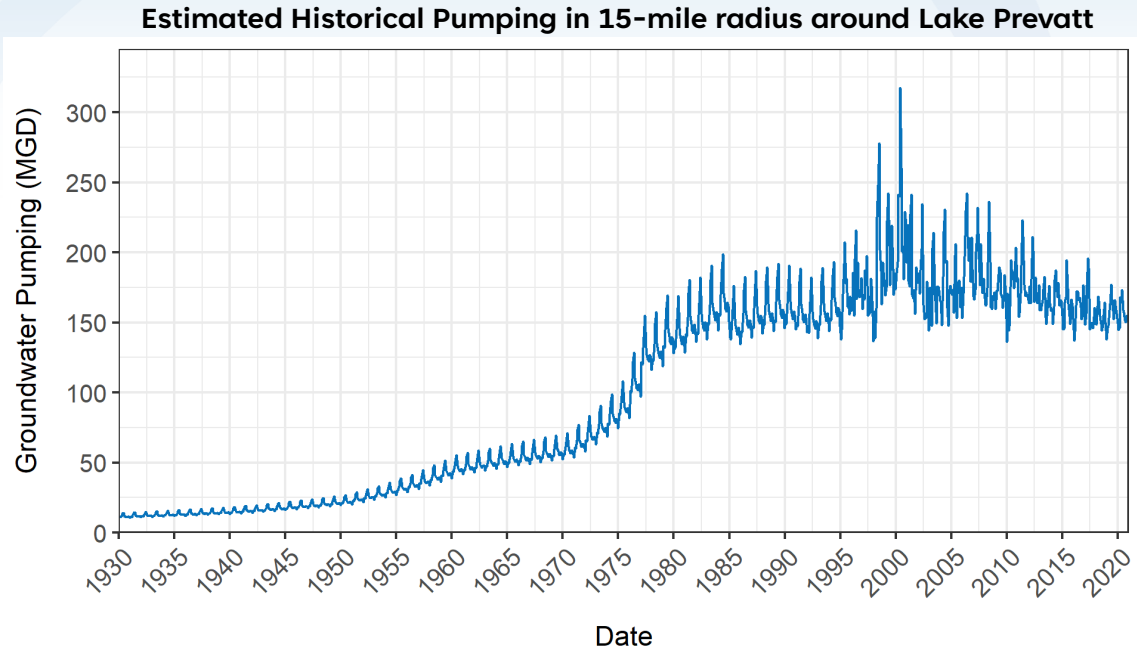
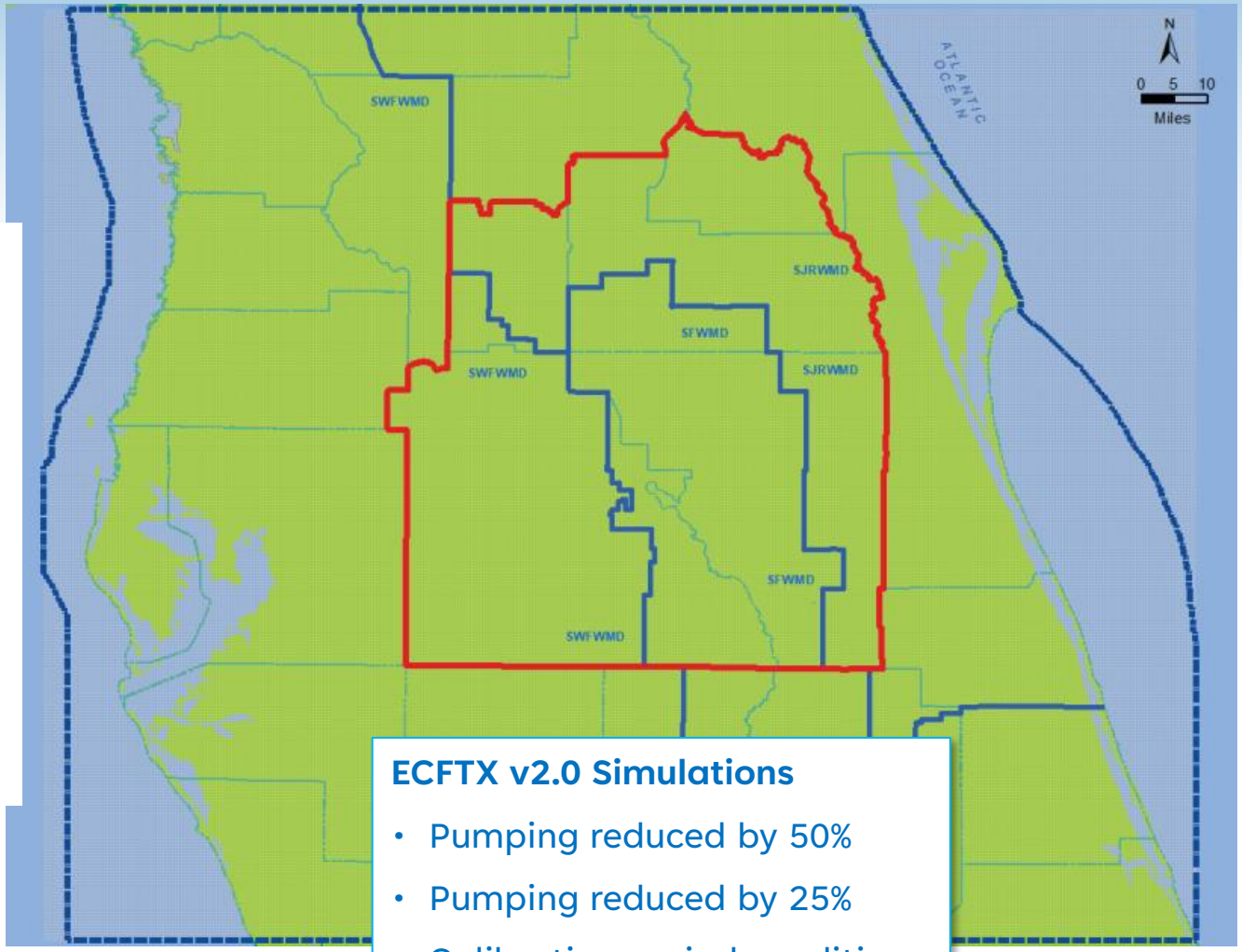
MFLs Assessment: Pumping Impact Assessment

- ECFTX v2.0
- Historical pumping





ECFTX v2.0 Simulations

- Pumping reduced by 50%
- Pumping reduced by 25%
- Calibration period condition
- Pumps off

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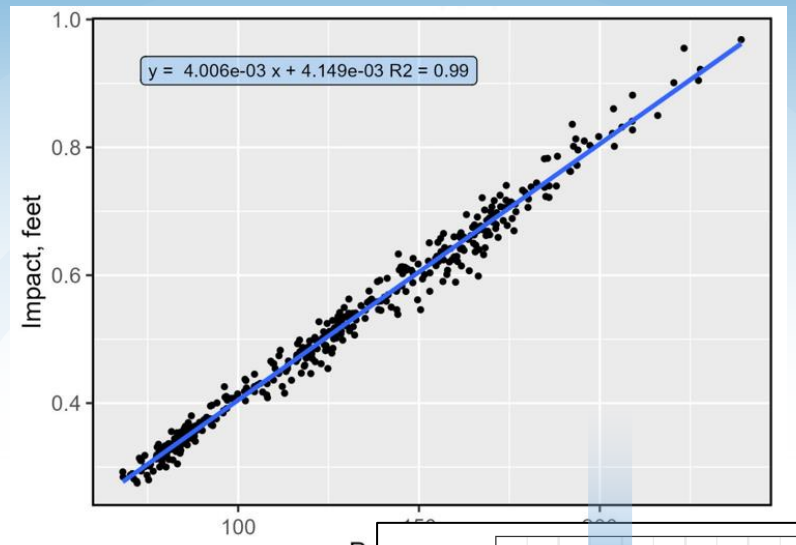
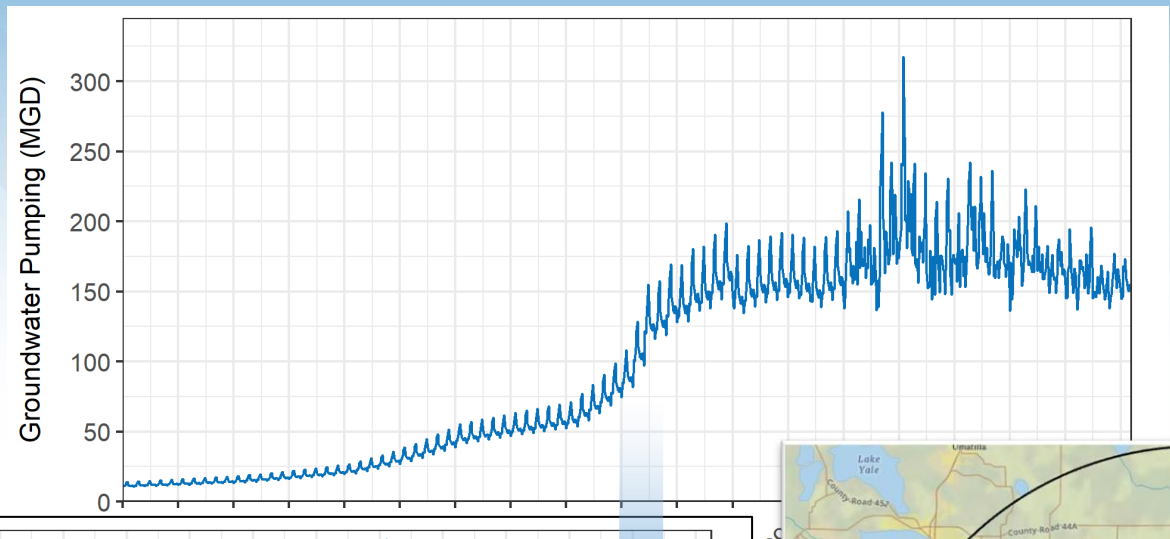
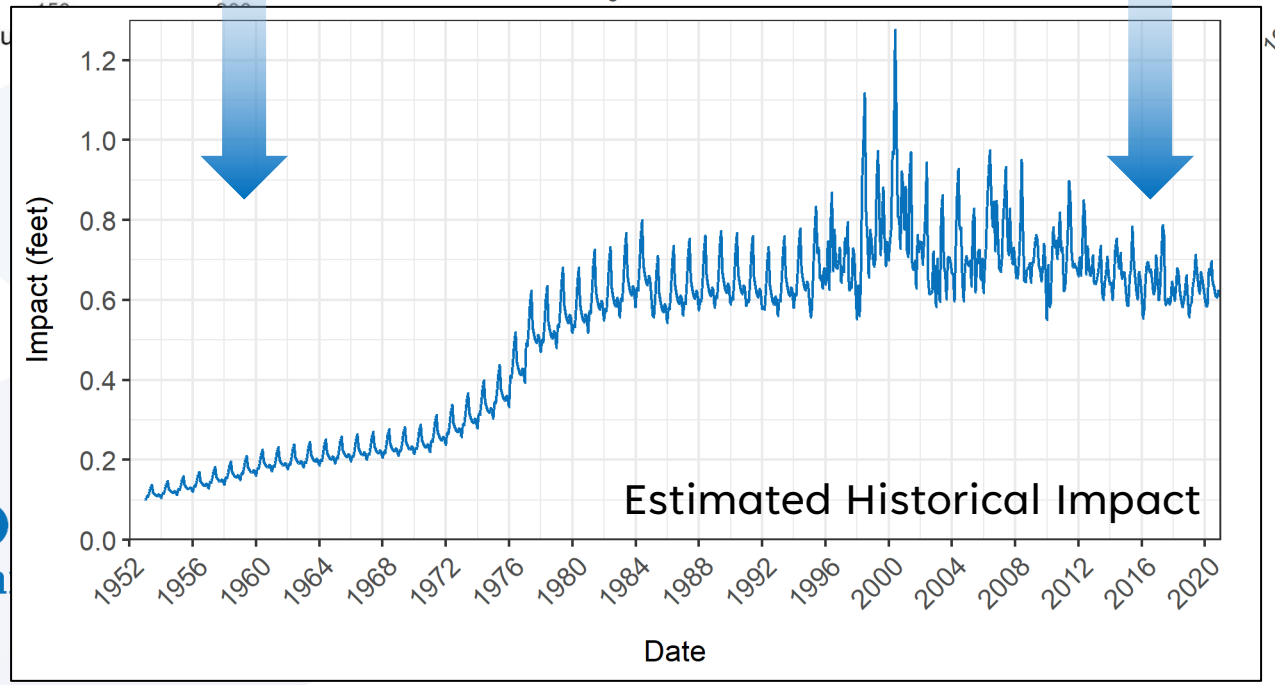
Groundwater Pumping Impact

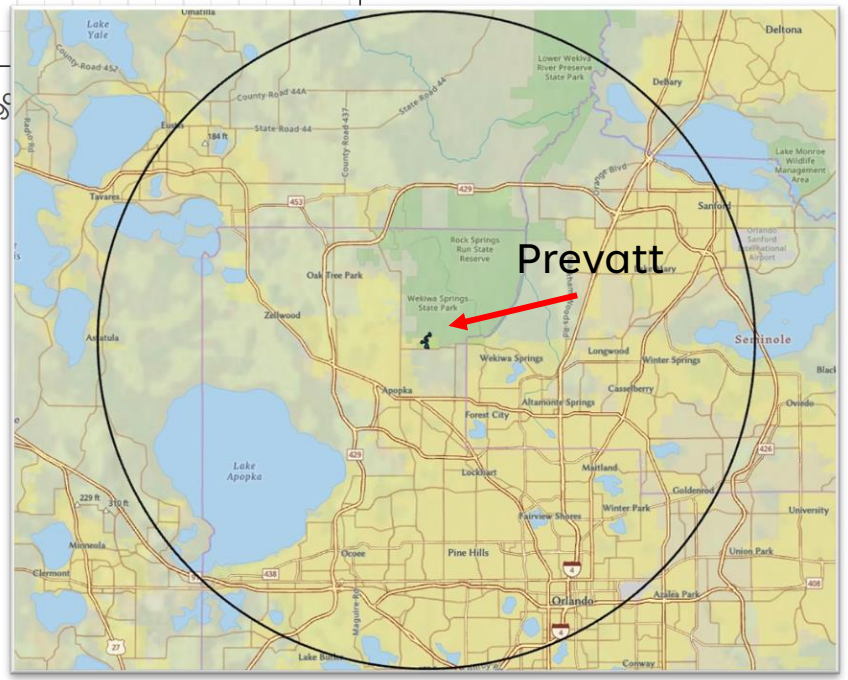
Pumping Impact (ft) at Lake Prevatt vs Pumping (mgd)



Estimated Historical Pumping in 15-mile radius around Lake Prevatt







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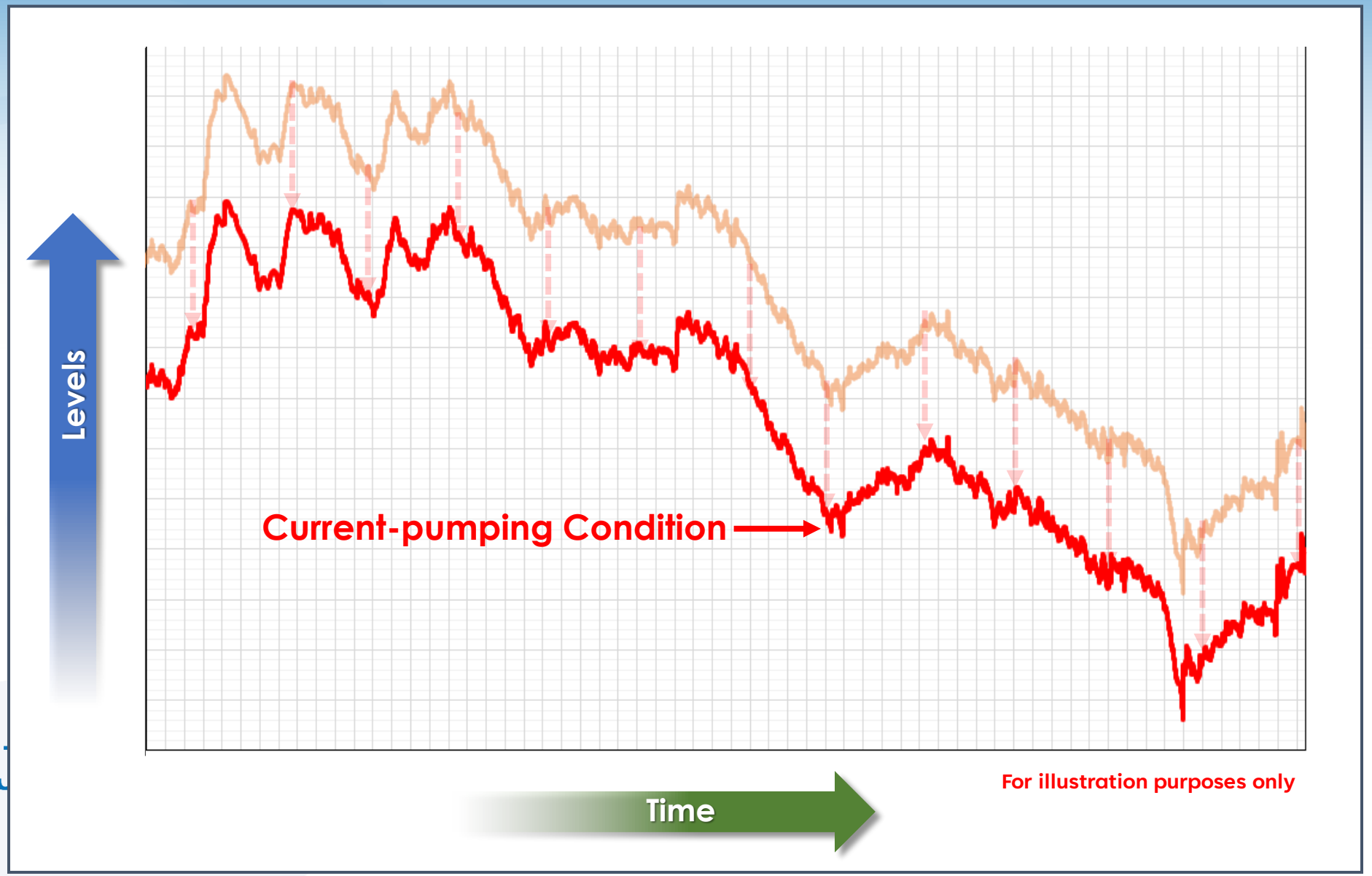
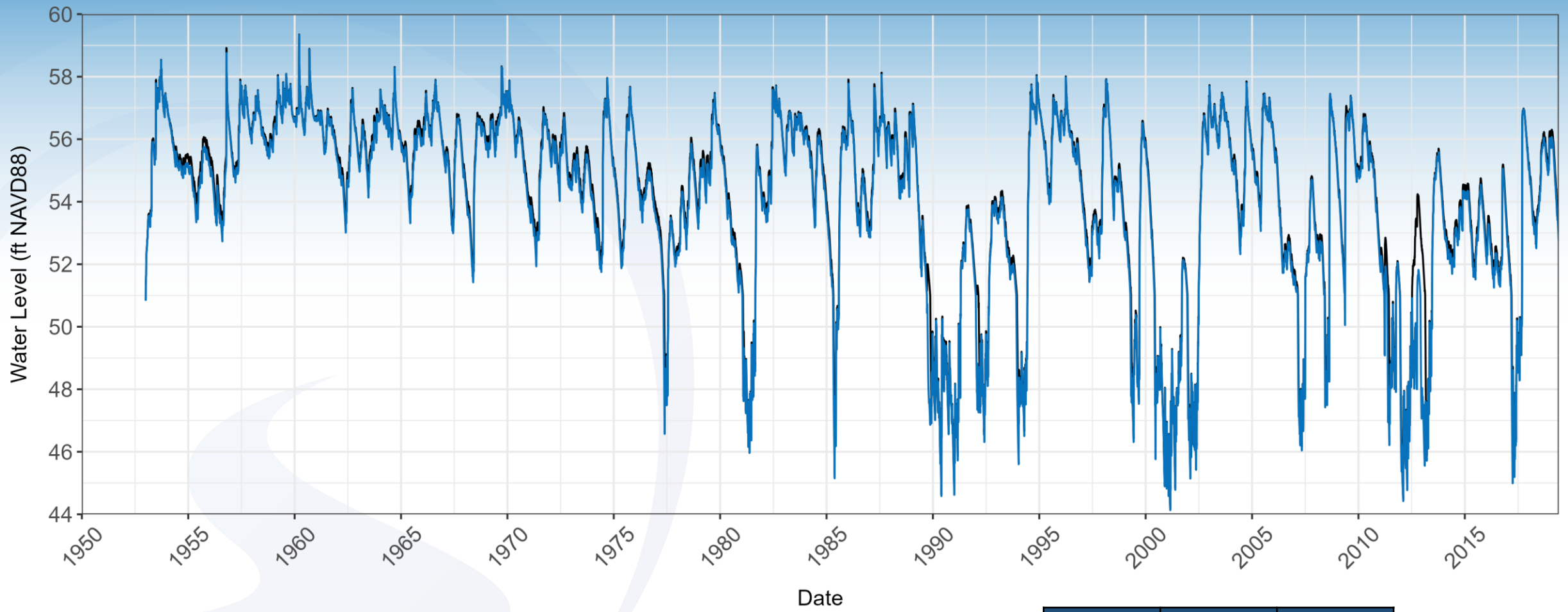
No-pumping and Current-pumping Lake Levels



St. J
Water

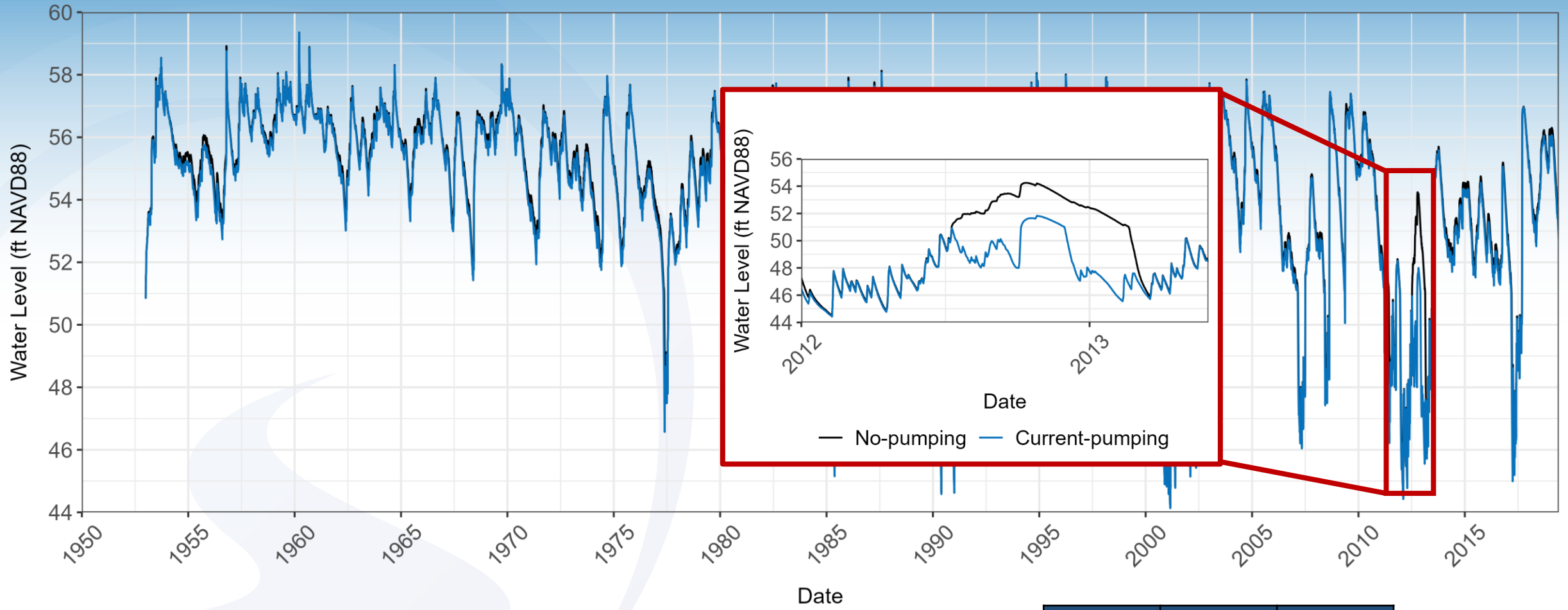
Lake Prevatt South Lobe No-pumping and Current-pumping



	NP	CP
Minimum	44.2	44.1
Maximum	59.4	59.3
Mean	54.2	54.0
Median	55.0	54.8

St. Johns River Water Management District

Lake Prevatt South Lobe No-pumping and Current-pumping



	NP	CP
Minimum	44.2	44.1
Maximum	59.4	59.3
Mean	54.2	54.0
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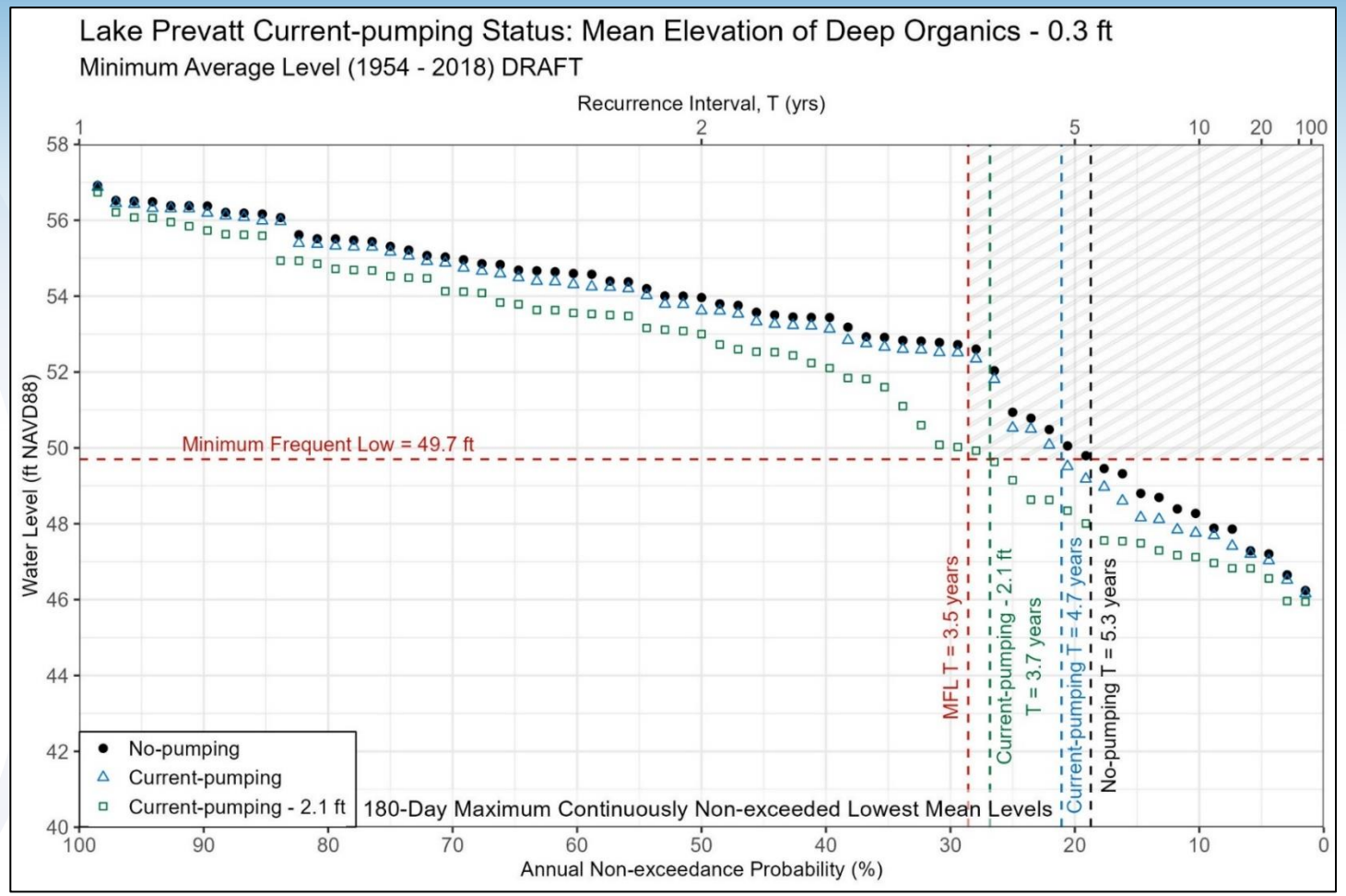
St. Johns River Water Management District

DRAFT Minimum Average – Assessment

Frequency Analysis – Weibull Plot

- Determine level event probabilities;
- Rank annual probability (current-pumping) data;
- Compare MFL frequency (RI) to current frequency;
- Iteratively reduce (if there is freeboard) or increase (if there is deficit) boundary condition (**water levels**) in HSPF model until MFL is just met;
- Use most constraining MFL for the freeboard/deficit = **MFLs Condition**



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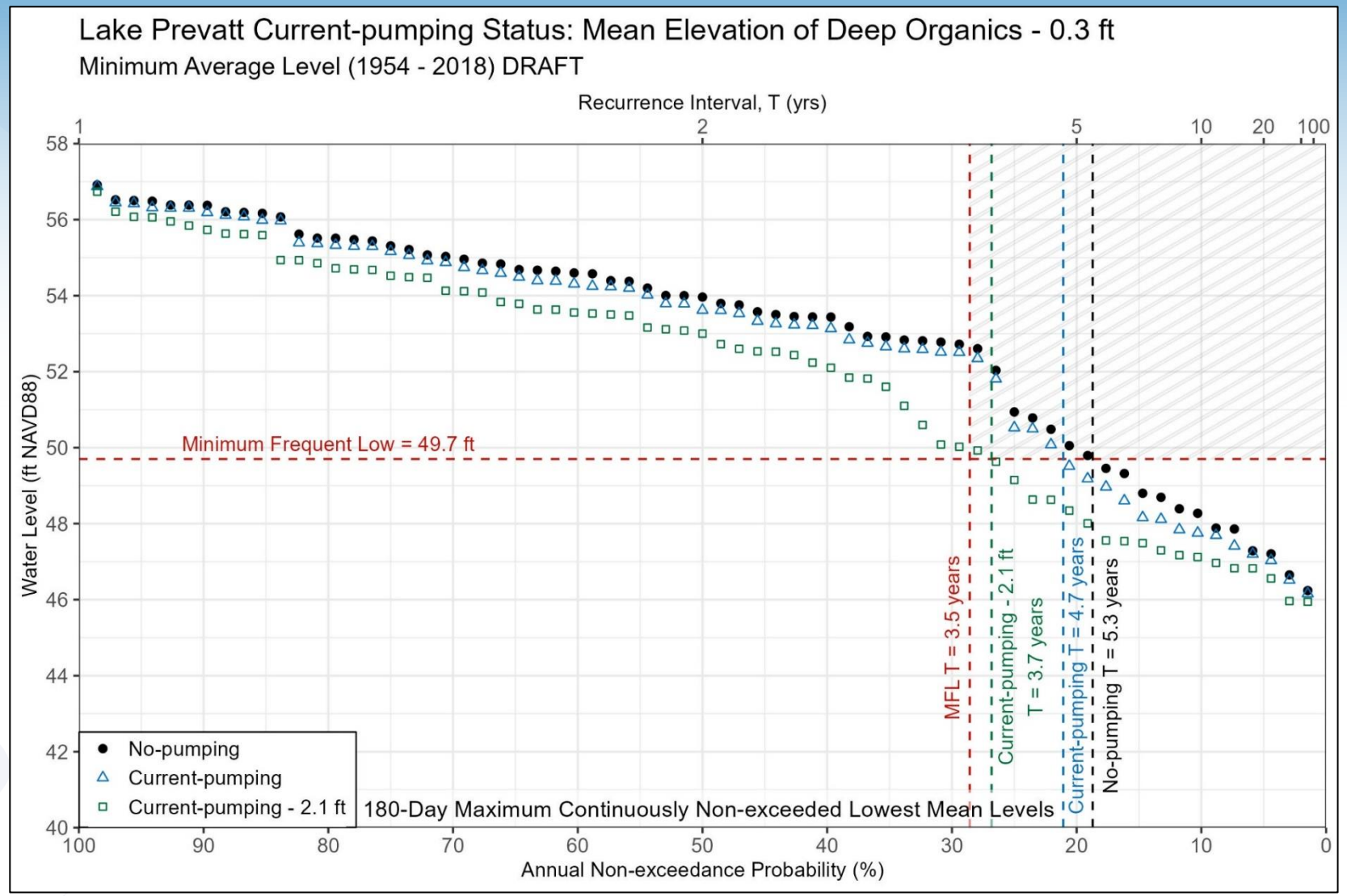
DRAFT Minimum Average – Assessment

Surface Water: Status – critical value (ft)	
No-pumping	+3.0
Current-pumping	+2.7
CP - 2.1 ft in UFA	0.3
CP - 2.2 ft in UFA	-0.1 ft

UFA Freeboard: 2.1 ft



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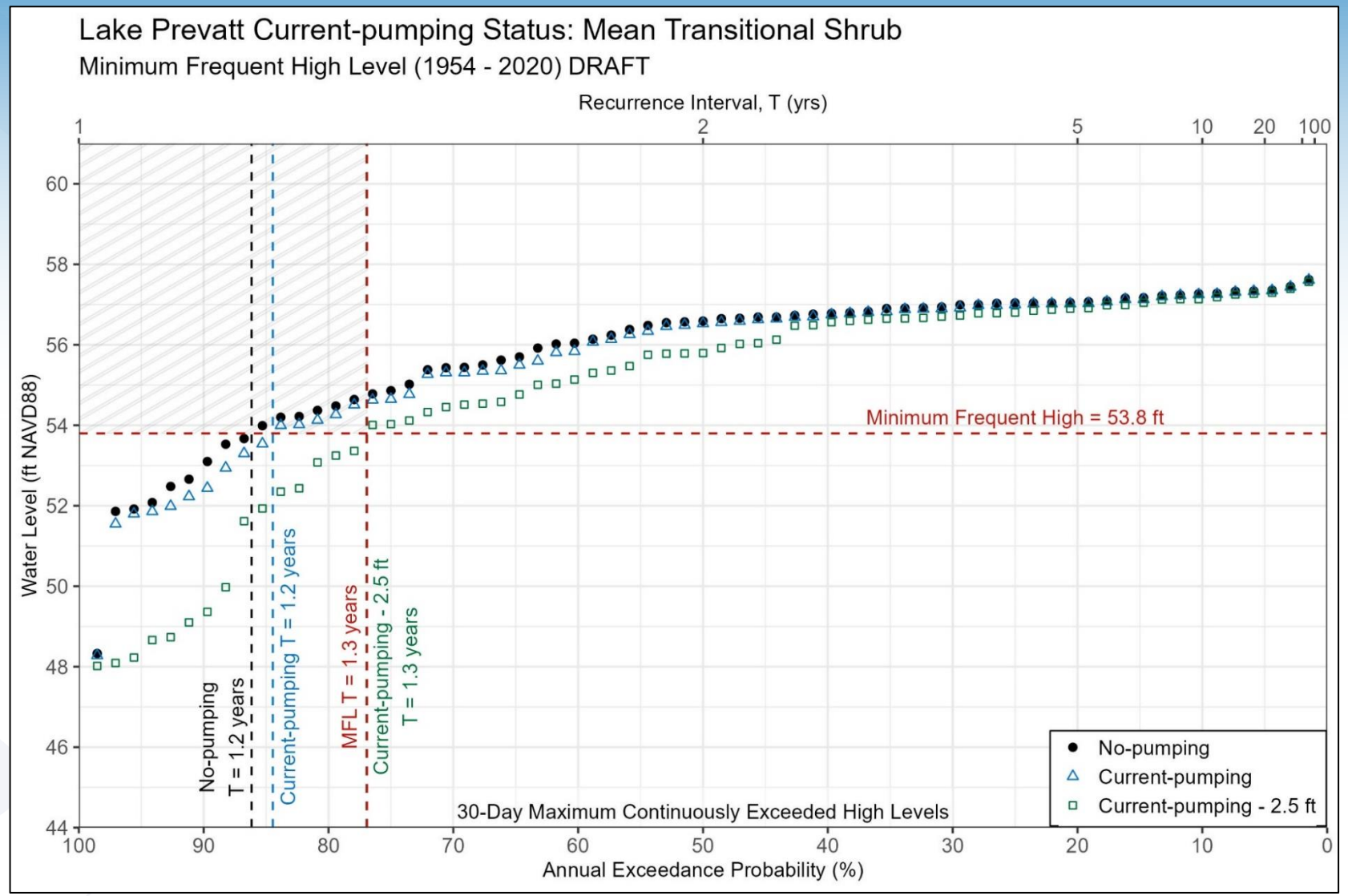
DRAFT Minimum Frequent High - Assessment

Surface Water: Status – critical value (ft)	
No-pumping	+0.9
Current-pumping	+0.8
CP - 2.5 ft in UFA	0.0

UFA Freeboard: 2.5 ft



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DRAFT Hydroperiod Tool Metrics – Assessment

Hydroperiod Tool Habitat and Lake Characteristics	Percent Area Reduction from No-pumping condition	UFA Freeboard (ft)
Small Waders	-0.3	> 3.5
Large Waders	0.5	> 3.5
Game Fish Spawning	1.4	> 3.5
Emergent Marsh	2.3	2.5
Canoe	3.7	1.7
Open Water 5 ft	6.2	0.9
Lake Area	3.0	2.2

> 15% reduction from no-pumping condition = metric not met

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DRAFT Prevatt Metric Summary

Environmental Criterion	Environmental Value(s) Protected	Freeboard (ft)
Event - Based Metrics		
FH – Average elevation of transitional shrub swamp communities	Shrub swamp communities/associated wildlife values	**2.5**
MA – Average elevation of deep organics	Deep organic soils/associated wildlife values	**2.1**
Hydroperiod Tool Metrics		
Small Waders	Fish and wildlife habitat	**> 3.5**
Large Waders	Fish and wildlife habitat	**> 3.5**
Game Fish Spawning	Fish and wildlife habitat	**> 3.5**
Emergent Marsh	Fish and wildlife habitat	**2.5**
Canoe	Recreation/Aesthetics/Water Quality/Fish Habitat	**1.7**
Open Water 5ft	Recreation/Aesthetics/Water Quality/Fish Habitat	**0.9**
Lake Area	Recreation/Aesthetics/Water Quality/Fish Habitat	**2.2**

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Lake Prevatt

Water Resource Values (WRVs) Assessment

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Water Resource values (WRVs) Assessment

"...consideration shall be given to... non-consumptive uses, and environmental values..."

62-40.473, F.A.C.

- Recreation in and on the water
- Fish & wildlife habitats and the passage of fish
- Estuarine resources
- Transfer of detrital material
- Maintenance of freshwater storage & supply
- Aesthetic and scenic attributes
- Filtration / absorption of nutrients & pollutants
- Sediment loads
- Water quality
- Navigation

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Water Resource values (WRVs) Assessment

"...consideration shall be given to... non-consumptive uses, and environmental values..."

62-40.473, F.A.C.

- Recreation in and on the water
- Fish & wildlife habitats and the passage of fish
- ~~Estuarine resources~~ Lake is land-locked
- Transfer of detrital material
- Maintenance of freshwater storage & supply
- Aesthetic and scenic attributes
- Filtration / absorption of nutrients & pollutants
- ~~Sediment loads~~ relevant only in flowing systems
- Water quality
- ~~Navigation~~ not accessible to large watercraft

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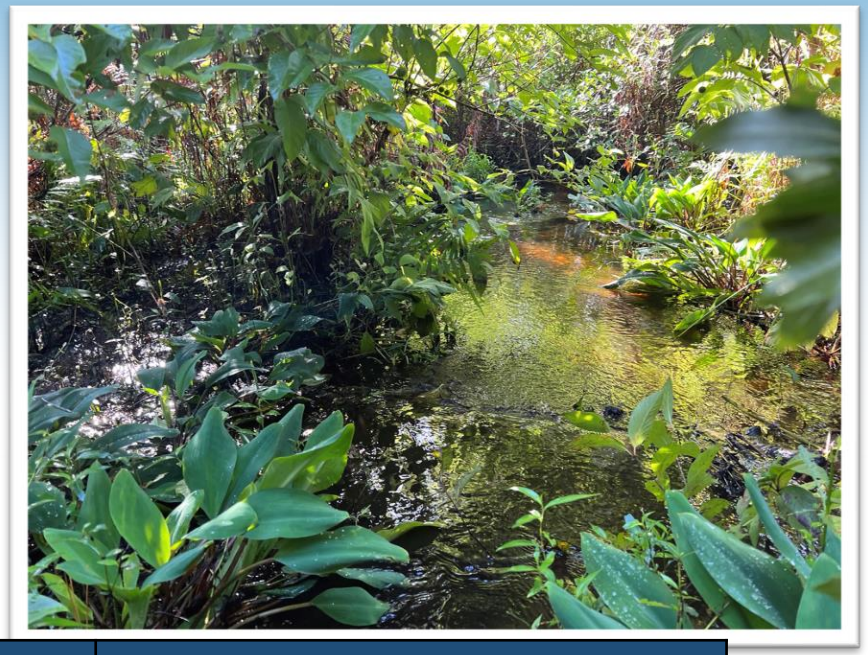
Water Resource values (WRVs) Assessment

WRVs associated with ecological functions of wetland communities:

- **Fish & wildlife habitats and the passage of fish:** hydroperiod tool habitat metrics
- **Transfer of detrital material:** Flooding events from FH
- **Maintenance of freshwater storage & supply:** MFL condition protects all other environmental values
- **Filtration / absorption of nutrients & pollutants:** MFL condition protects flooding events necessary for maintenance of wetland communities



Environmental Criterion	NP Condition area (acres)	Percent change in NP condition area based on most constraining metric
Small wading bird forage habitat	4.6	0.3
Large wading bird forage habitat	10.7	1.1
Game fish spawning habitat	36.0	2.5
Emergent marsh vegetation	70.0	4.8
Open water (≥ 5 ft)	27.2	14.2

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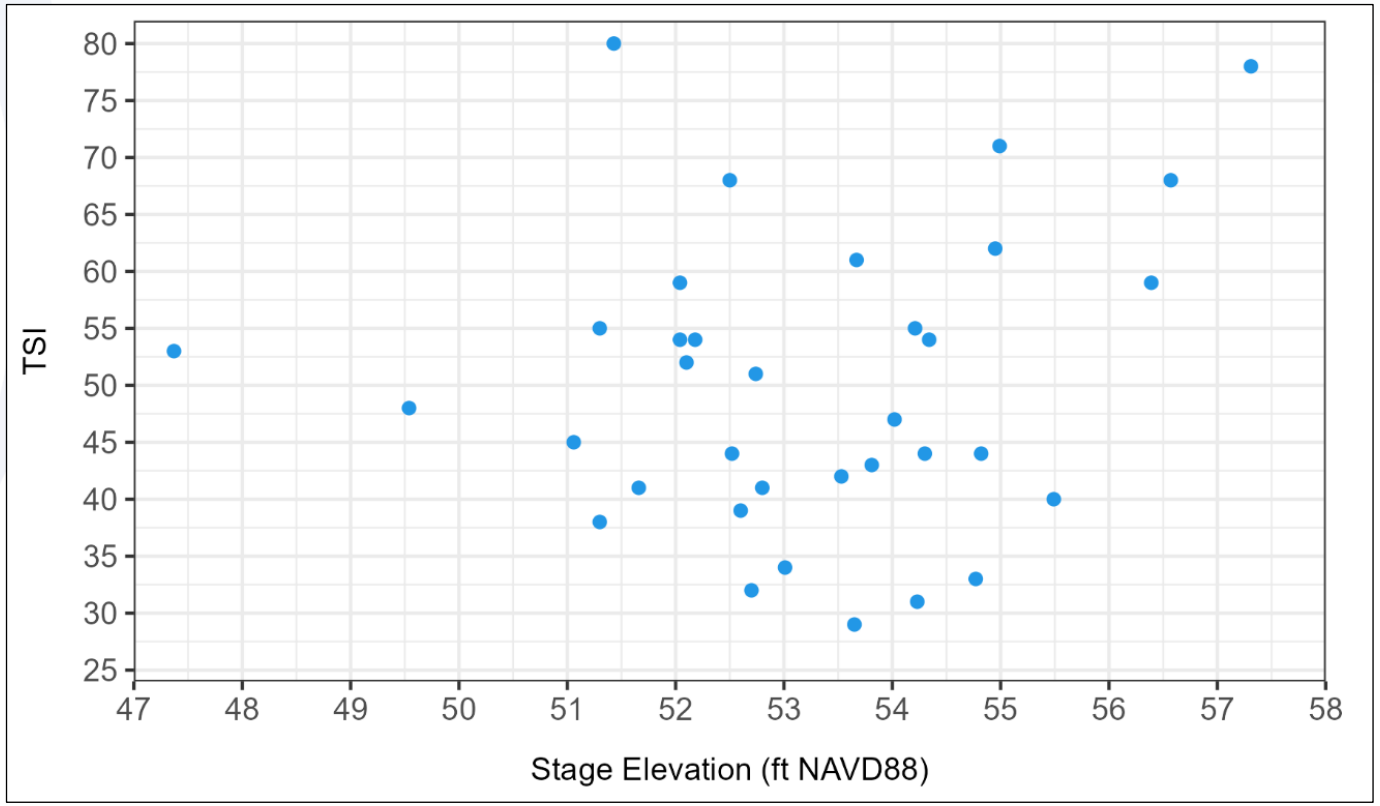
Water Resource values (WRVs) Assessment

WRVs associated with lake area and depth:

- **Recreation in and on the water:** canoe paddling depth protected by MFLs condition
- **Aesthetic and scenic attributes:** total lake area reduction supported by open water metric
- **Water quality:** No trends in water quality with water levels



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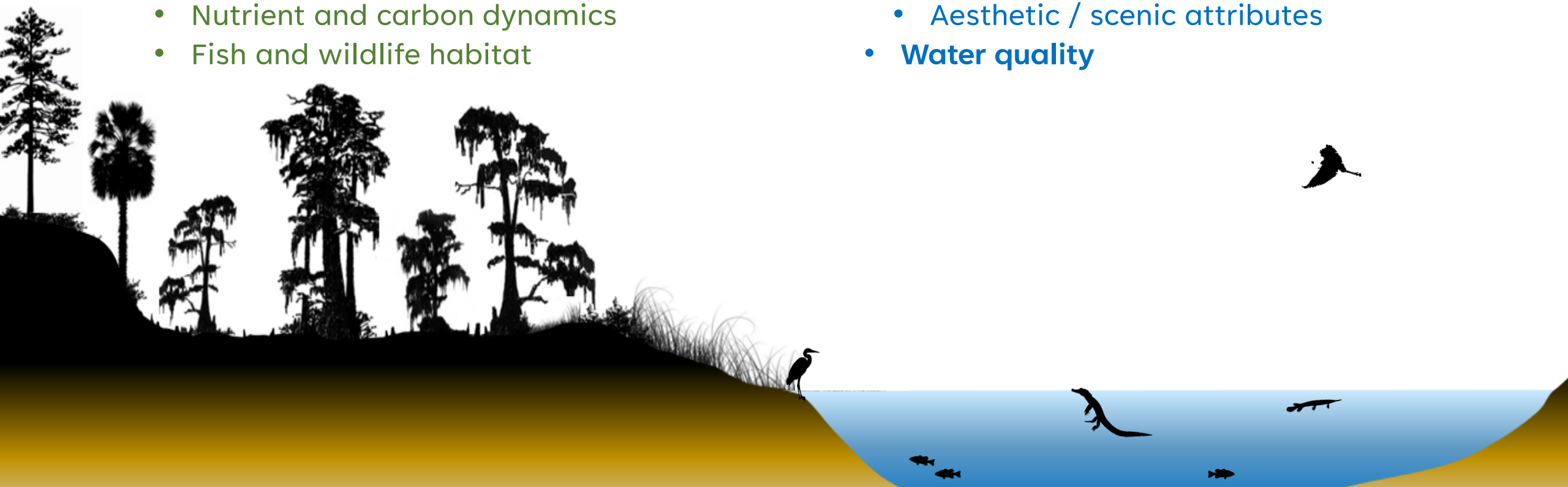
Ecological Functions of Wetland Communities

Floodplain / basin

- **Vegetation community composition / location**
- **Deep organic soils maintenance**
- **Wetland inundation**
- **Flooding functions / values:**
  - Nutrient and carbon dynamics
  - Fish and wildlife habitat

In-lake

- **Wildlife habitat**
  - Wading bird forage
  - Fish spawning
- **Human uses**
  - Canoe paddling depth
  - Aesthetic / scenic attributes
- **Water quality**



WRVs Assessment: Summary

WRV	Environmental Criteria Evaluated	Protected by the MFLs Condition?
Recreation in and on the water	Canoe Paddling depth	Yes
Fish and wildlife habitats and the passage of fish	FH, MA, small wader habitat, large wader habitat, game fish spawning habitat, emergent marsh vegetation, and open water	Yes
Transfer of detrital material	FH provides flooding events necessary for transfer of detrital material	Yes
Maintenance of freshwater storage and supply	Other WRVs protected by the MFLs condition, provide balance between consumptive and non-consumptive uses.	Yes
Aesthetic and scenic attributes	Lake area and open water metrics	Yes
Filtration, absorption of nutrients and pollutants	FH and MA	Yes
Water quality	Open water metric	Yes

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MFLs Status

- MFLs Condition = 2016 – 2020 avg. impact condition
- UFA Freeboard = 0.9 ft at 2016 – 2020 avg.
- Projected drawdown to 2045 = 0.2 ft
- Therefore, Lake Prevatt is NOT in prevention

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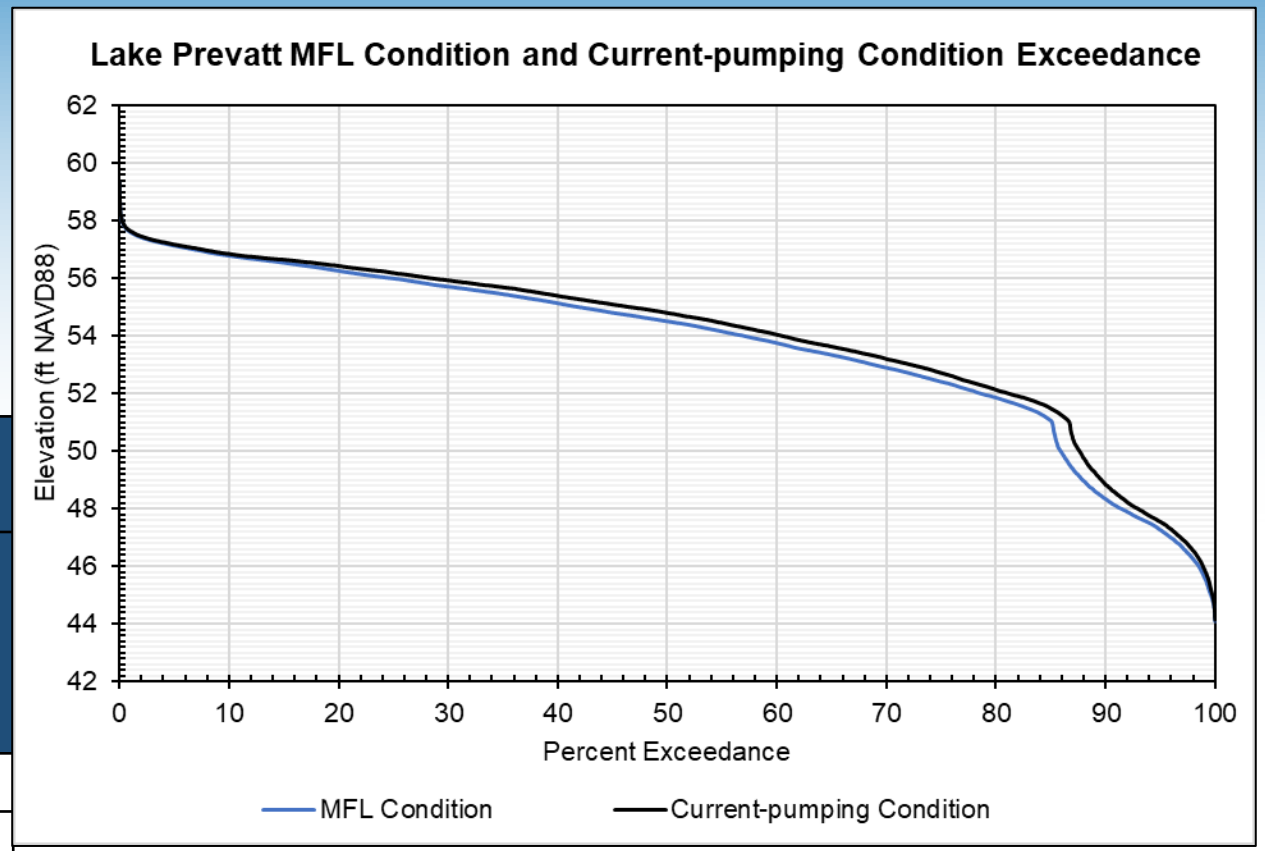
DRAFT MFL Status

Current Status:

- Lake Prevatt has freeboard
- MFL is meeting at planning horizon

1997 Adopted (ft NAVD88)		Recommended Minimum Levels (ft NAVD88)		
		Percentile	Current Pumping Condition	DRAFT Recommended Minimum Lake Level
FH	55.0	25	56.2	56.0
MA	52.0	50	54.8	54.5
FL	49.9	75	52.7	52.4



MFLs Condition: Lake level timeseries resulting from 0.9 ft of UFA drawdown

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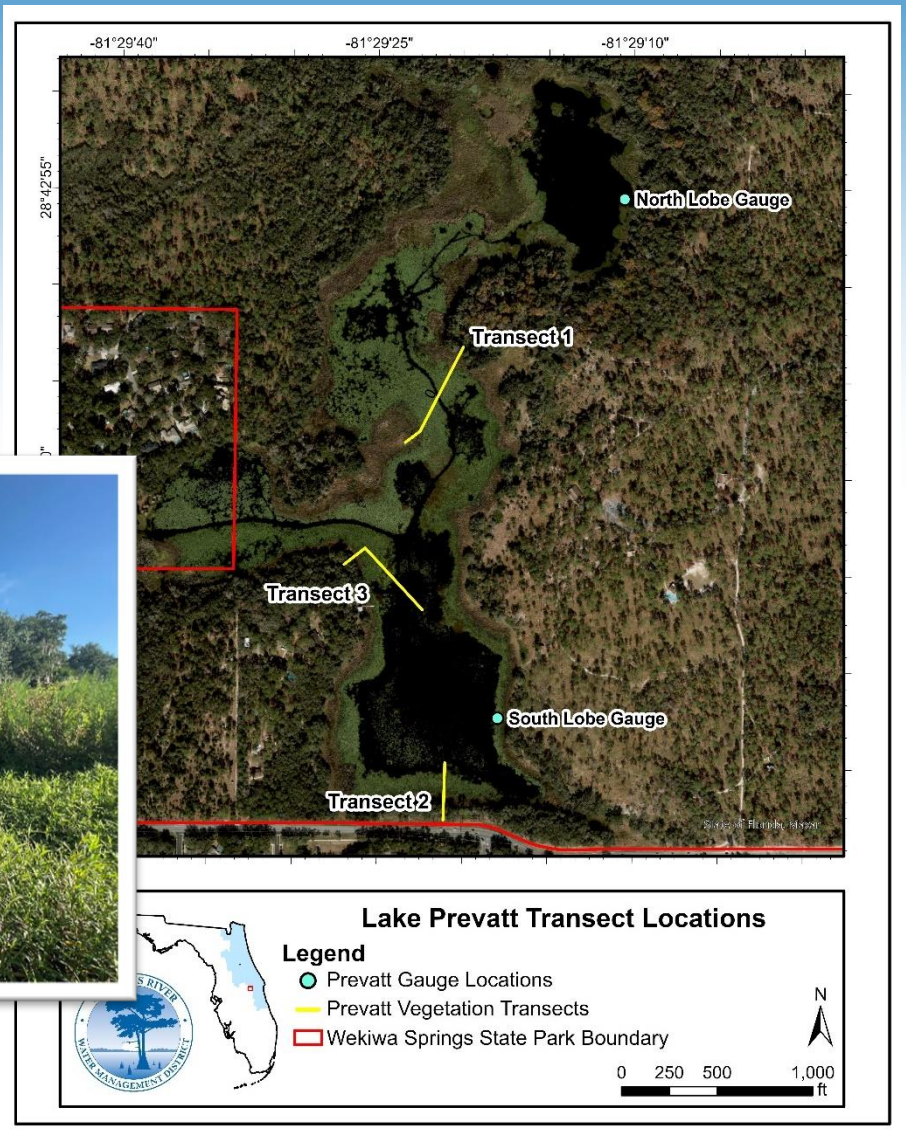
ONGOING STATUS / ADAPTIVE MANAGEMENT

Monitoring

- Status of adopted P25, P50, and P75
- Metrics upon which MFLs are based
- Groundwater level trends
- Alongside regional water supply planning efforts or as needed

Adaptive Management

- If the MFLs are not meeting, a more detailed analysis will be triggered
- Rainfall and uncertainty analyses
- Determine if min levels not meeting is due to pumping



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Please also submit all questions and comments in writing to Courtney Shadik at:

cshadik@sjrwmd.com

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Peer Review Schedule and Next Steps

Corrections from kickoff presentation

Task	Date
Kick-off Meeting and site visit	February 24, 2025
Presentation of initial findings at public teleconference	~~March 25, 2025~~ April 10, 2025
Draft Technical Memorandum Presentation of Draft TM – Public Teleconference	~~April 15, 2025~~ April 23, 2025
Final Technical Memorandum	~~April 21, 2025~~ May 15, 2025
Notice of Rule Development	Mid to Late 2025?

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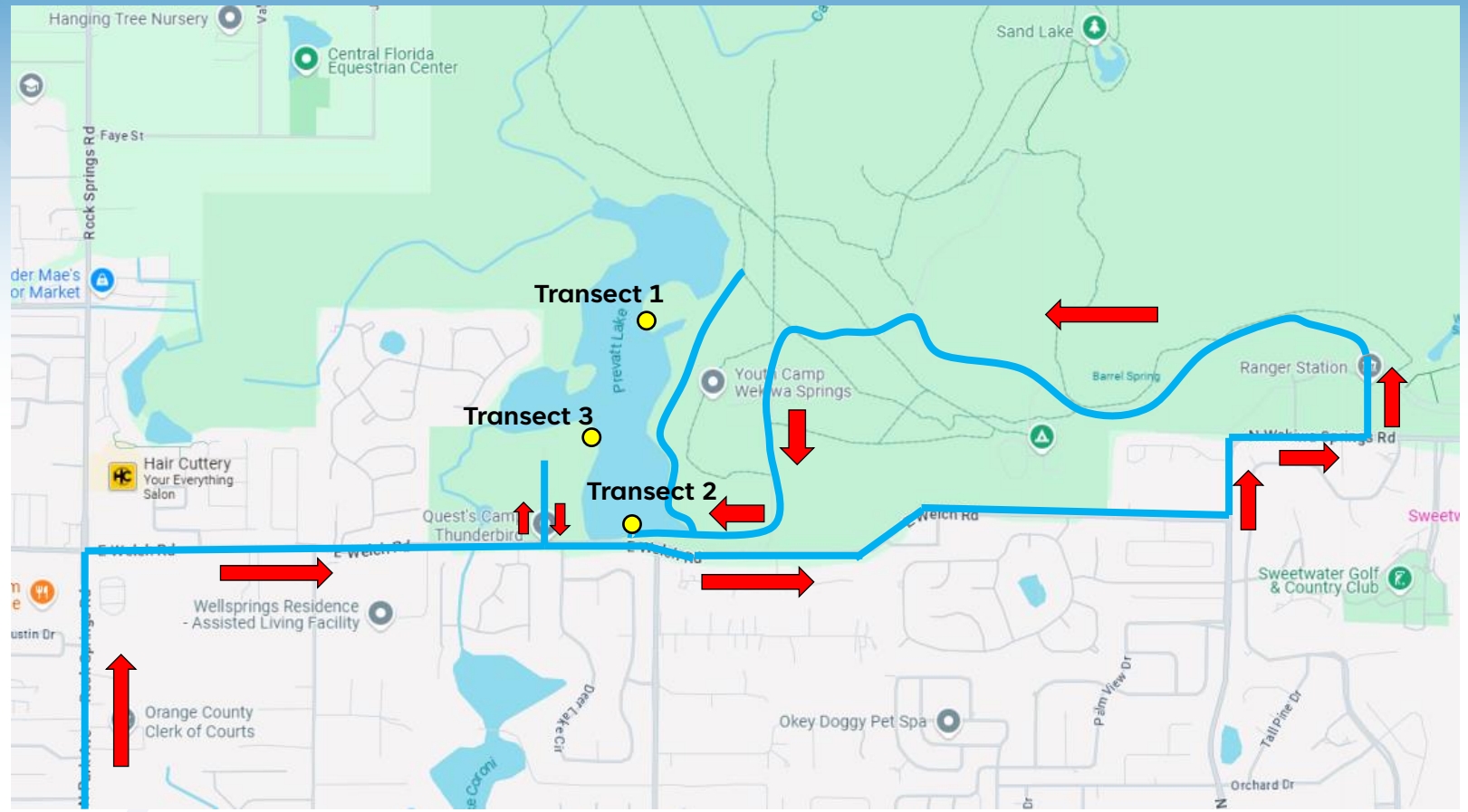
Lake Prevatt Site Tour

- 30 minutes for lunch
- Drive over to Camp Thunderbird (Transect 3)
- Drive to Wekiwa Springs State Park
  - NOTE: Tell Security Guard "I'm with the SJRWMD tour"
- Left at the fork near the Ranger Station
- Access roads to Transects 2 and 1



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For more information on the Lake Prevatt MFLs go to:

https://www.sjrwmd.com/minimumflowsandlevels/lake-prevatt/

...or email Courtney Shadik at:

cshadik@sjrwmd.com

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