Central Springs/East Coast Regional Water Supply Plan

Technical Methods Workshop

St. Johns River Water Management District, Palatka, FL
(also via GoToWebinar)

July 21, 2021
5:05 pm

St. Johns River
Water Management District

Agenda

- Welcome and introductions
- GoToWebinar housekeeping
- Projection methodology
- Groundwater modeling
- Water resource evaluation
  - Minimum flows and levels (MFLs)
  - Groundwater quality
  - Wetlands
- Question/Answer

Welcome and Introductions

Speakers

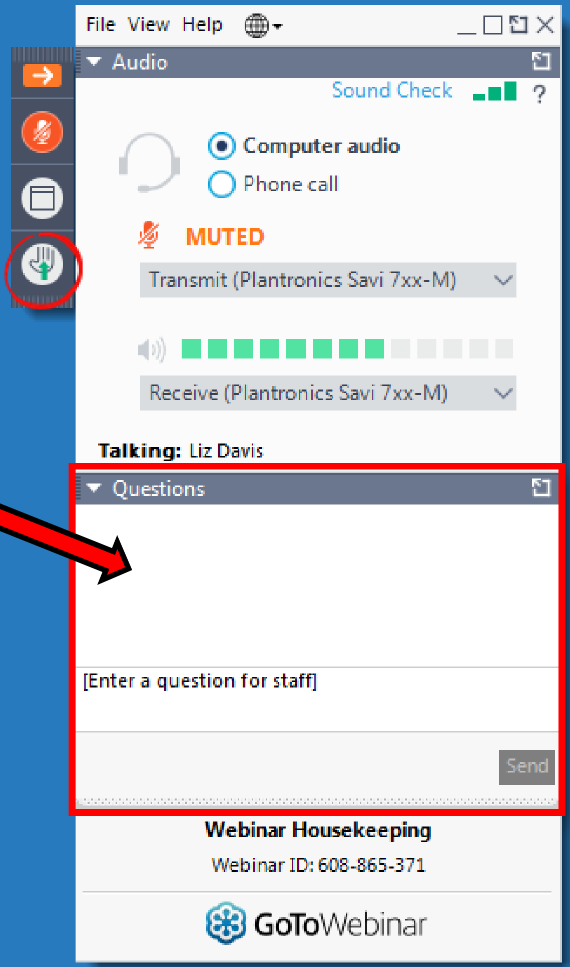
- Joy Kokjohn, Regional Water Supply Coordinator (CSEC)
- Jacy Crosby, Senior Water Use Analyst
- Lanie Sisco, Hydrologist IV
- Nathaniel Mouzon, Technical Program Manager (MFLs)

GoToWebinar Housekeeping

Asking Questions

- Please submit your questions using the Questions panel.
- Provide your name and employer before your question

Note: Today's presentation is being <u>recorded</u> and will be posted online within 48 hours.



Projection Methodology

Jacy Crosby
Bureau of Water Supply Planning

Public Supply and Domestic Self-Supply

Population

- GIS model/parcel distribution
- BEBR medium
- Aggregated to utility service area

Public Supply Demand

- 2011–2015 average gross per capita (utility-specific)

Domestic Self-Supply Demand

- 2011–2015 average residential per capita (county average)

Agriculture

- Must consider agricultural water demand estimates produced by FDACS (ss. 373.709(2)(a), F.S.)
- FDACS publishes 20-year acreage and demand projections in Florida Statewide Agricultural Irrigation Demand (FSAID) reports
- Agriculture projections in CSEC RWSP taken from FSAID IV (2017)

Projections for Other Water Use Categories

- Commercial/Industrial/Institutional and Mining/Dewatering
  - Historic CII and MD per capita (2011-2015) * increase in population
- Landscape/Recreation/Aesthetic
  - Historic LRA per capita (2011-2015) * increase in population
- Power generation
  - 10-year site plans
  - Historic megawatt use per customer * increase in population
  - Future megawatt use * average (2011-2015) gallons per megawatt

Water Conservation Potential

Public Supply and DSS – Scenario 1:

- Percent reduction in water use based on implementation of best management practices (BMPs) with measurable water savings (CFWI 2015)
  - Indoor residential – toilet, showerhead, and faucet replacements
  - Outdoor – irrigation audits with associated improvements and soil moisture sensors
  - CII – pre-rinse spray valve, showerhead, faucet, and urinal replacements and site-specific water audits

Water Conservation Potential

Public Supply and DSS – Scenario 2:

- Calculated average 2011-2015 gross per capita by sub-region
- Applied average gross per capita to utilities with larger per capita
- Corresponding percent reduction for public supply by county was applied to DSS

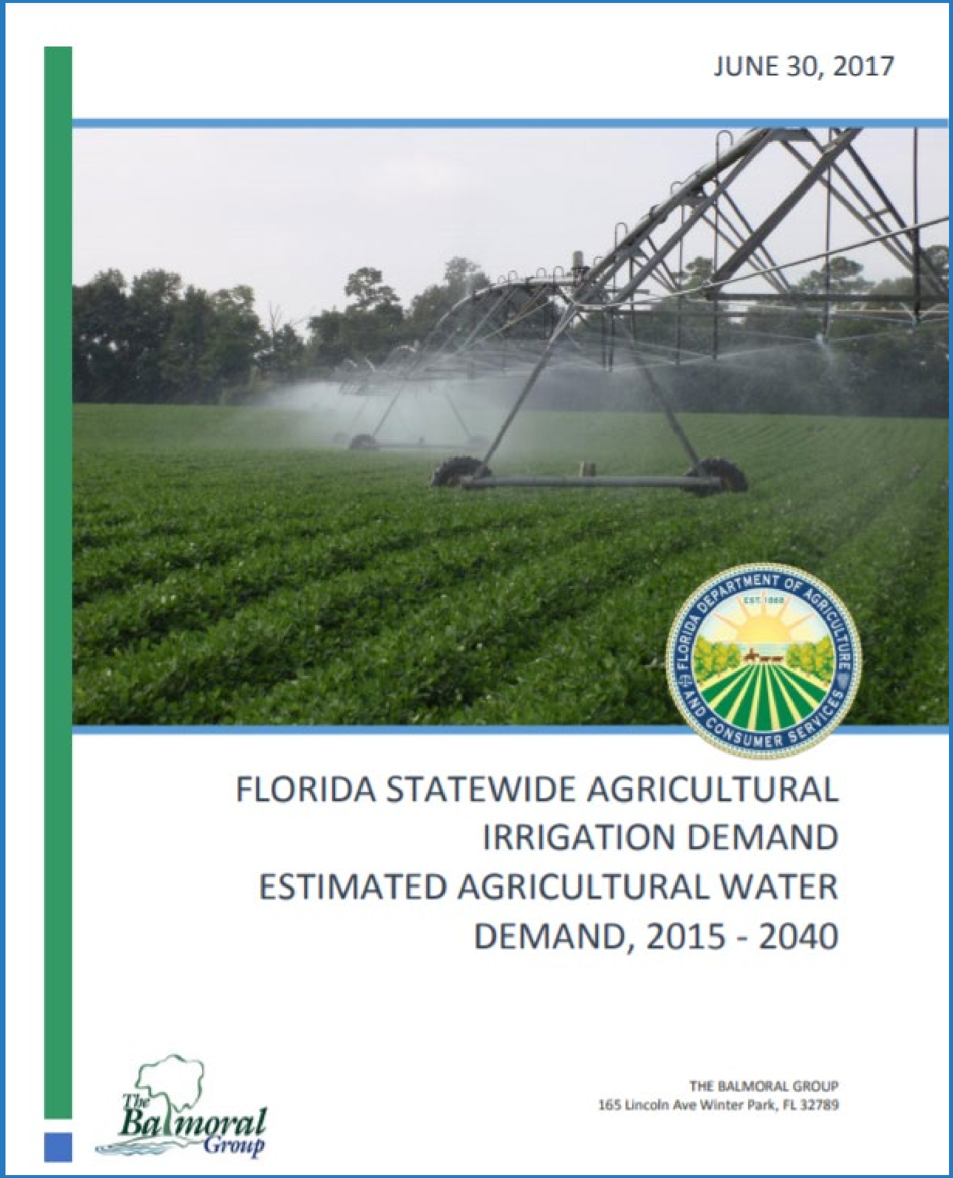
Water Conservation Potential
(for all other non-agricultural use types)

Estimates of conservation potential based on the following BMPs (where applicable):

- Showerheads
- Faucets
- Toilets
- Urinals
- Irrigation audits
- Soil moisture sensors
- Pre-rinse spray valves
- Site-specific C/I/I audits

Agricultural Water Conservation

- Produced by FDACS
- FSAID IV (2017)



Reclaimed Water Availability

Additional current available flow:

- Scenario 1 – apply FDEP reuse goal of 75% to existing flows not utilized beneficially
- Scenario 2 – apply 2015 percent beneficial reuse by facility to existing flows not utilized

Reclaimed Water Availability

Future flow estimates:

- Calculated population growth (from parcel model) for each WWTP service area
- Assumed new wastewater flow of 85 gpcd[1]
  - Scenario 1 – apply FDEP reuse goal of 75% to future flow
  - Scenario 2 – apply 2015 percent beneficial reuse by facility to future flow

[1] Vickers 2001; Mayer 1999; AWWA 1999

Groundwater Modeling

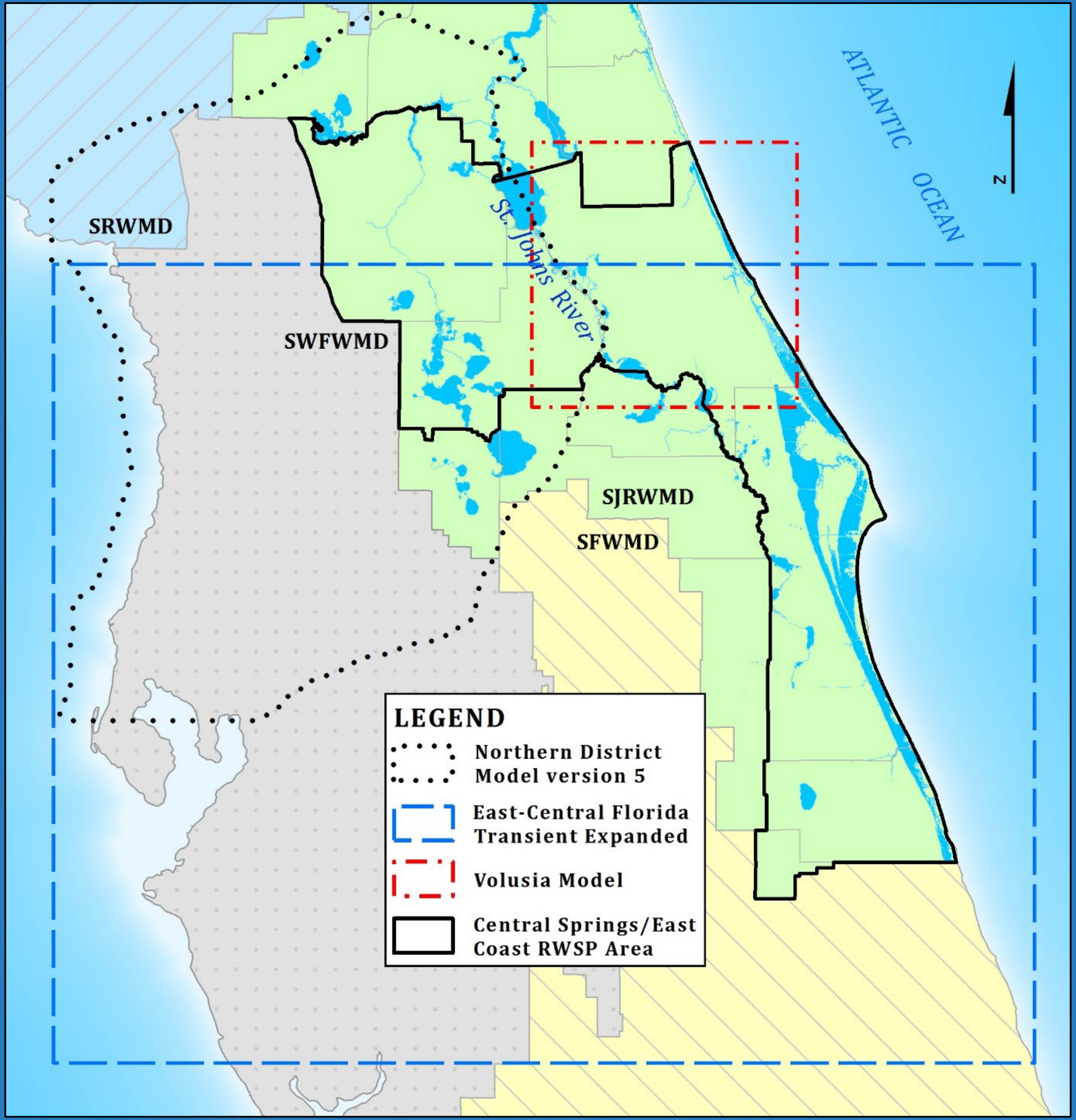
Lanie Sisco
Bureau of Watershed Management and Modeling

Groundwater Model

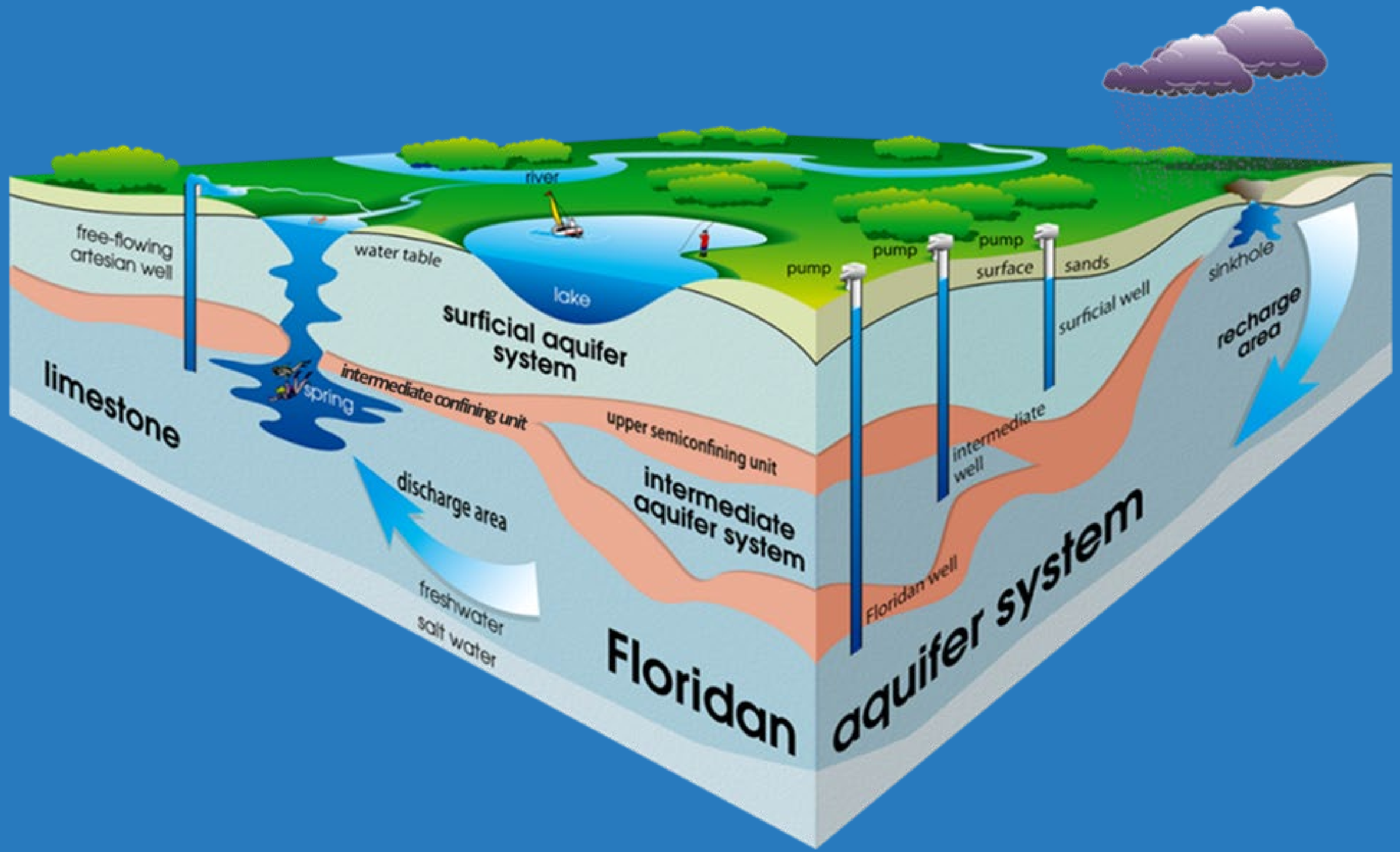
- What?
  - A mathematical representation of groundwater flow through an aquifer system
- How?
  - By using a set of equations that describes the storage and movement of groundwater
- Why?
  - To predict the effects of groundwater withdrawals on natural systems (springs, lakes, wetlands) and evaluate benefits to natural systems from projects

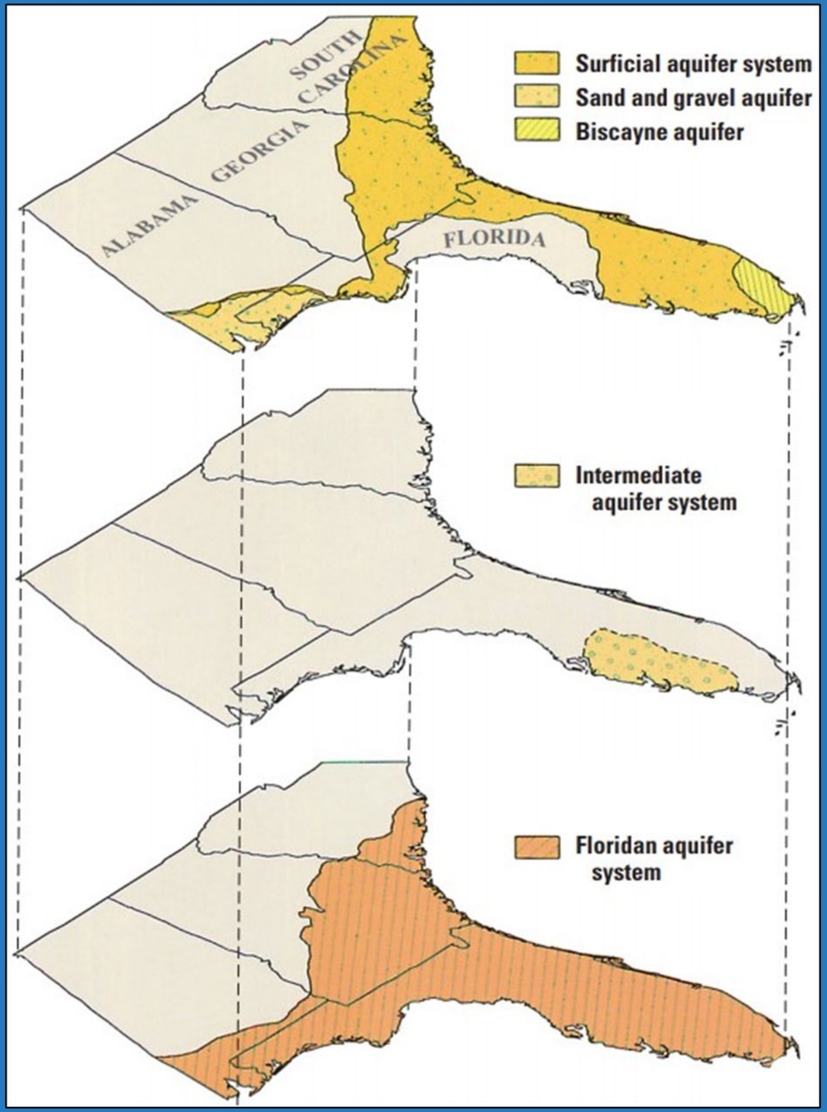
CSEC Groundwater Models

- Volusia Model
- Northern District Model version 5 (NDMv5)
- East Central Florida Transient Expanded Model (ECFTX)



Groundwater System





Adapted from Williams et al. 2015

Hydrostratigraphy

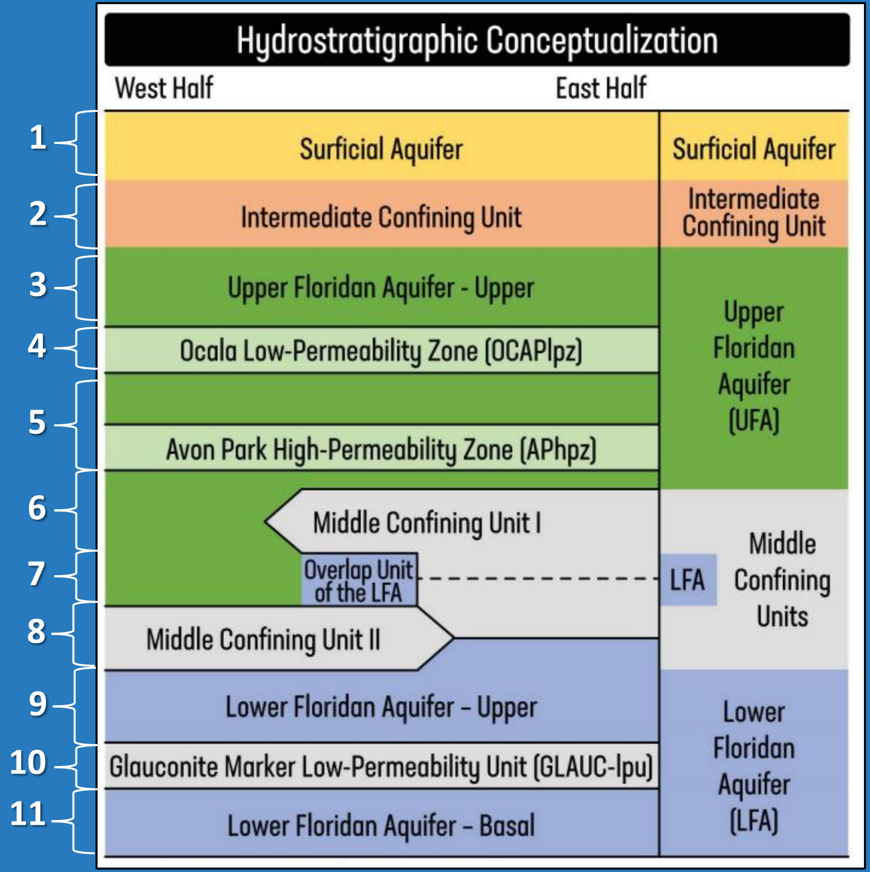
Volusia Model

Hydrostratigraphy	Model Layer
Surficial Aquifer System	1
Intermediate confining unit	NA (implicit)
Upper Floridan Aquifer	2
Middle semiconfining unit	NA (implicit)
Lower Floridan Aquifer	3

NDMv5

Formation	Aquifers: East-central Florida	Aquifers: West-central Florida	Aquifers: Southwest Florida	Model Layer
Undifferentiated	Surficial Aquifer			1
Hawthorn	Upper Confining Unit			2
Tampa Limestone (where permeable)	Upper Floridan			3
Suwannee Limestone	Upper Floridan			3
Ocala Limestone	Upper Floridan			4
Avon Park Formation	Upper Floridan			5
Avon Park Formation	Middle semiconfining unit	Middle confining unit		6
Avon Park Formation	Lower Floridan			7
Oldsmar Formation	Lower Floridan			

ECFTX

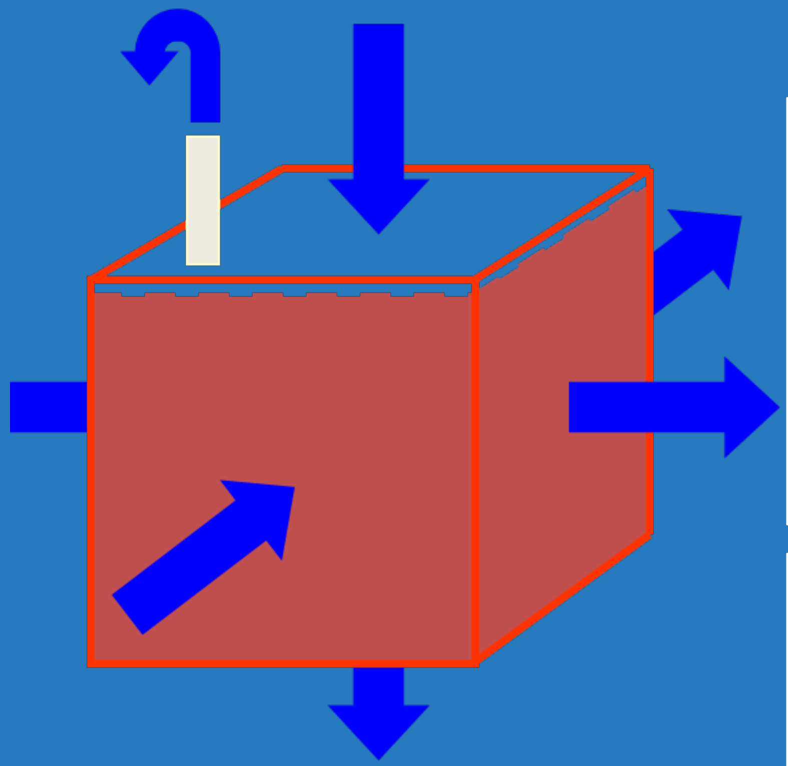


Groundwater Modeling

- Data required to develop a groundwater model:
  - Aquifer and confining-unit properties (e.g., top/bottom elevation, conductivity, storage)
  - Evapotranspiration
  - Recharge
  - Water levels (aquifer and lakes)
  - Spring discharge
  - River baseflow
  - Lake seepage rates
  - Groundwater pumping

Groundwater Modeling

Water budget equation: Inflow – Outflow = Δ Storage



Model Inflows
- Recharge
- Irrigation
- Groundwater pumping (Injection, RIBs)
- Surface water loss
- Lateral boundaries

Model Outflows
- Spring flow
- Evapotranspiration
- Groundwater pumping
- Surface water discharge
- Lateral boundaries

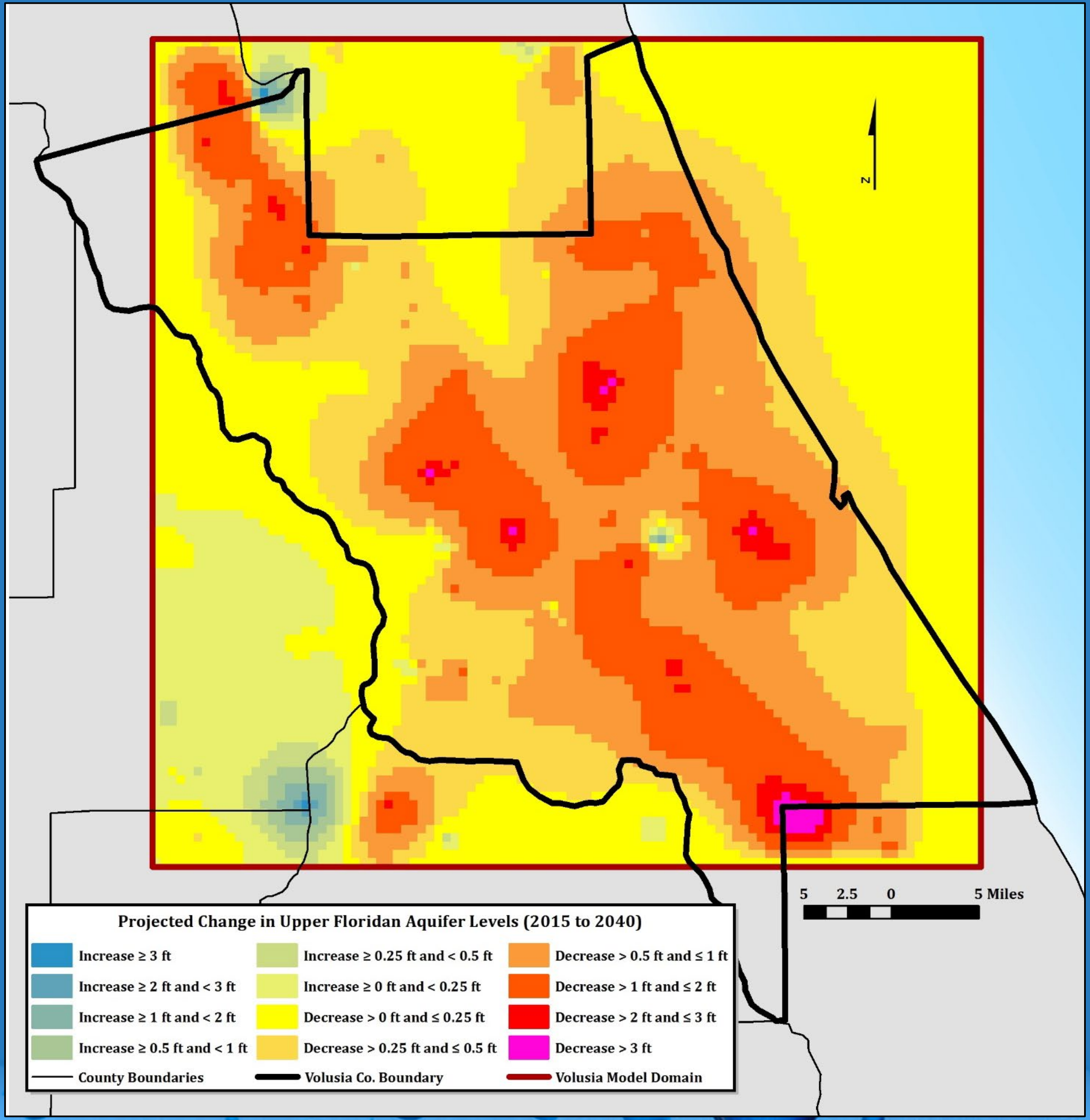
Δ Storage

Aquifer level decline or rise

Groundwater Model Output Example

Volusia Model

Shows predicted changes in aquifer levels due to changes in pumping



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Water Resource Evaluation

Minimum Flows and Minimum Levels
Water Quality
Wetlands

Division of Water Supply Planning

Water Resource Evaluation

- Assumes that all water needed to meet projected demand will come from existing sources
- Predicts location and magnitude of impacts from future groundwater withdrawals
- Demands must be reduced or alternative sources must be developed to meet demand that would cause unacceptable impacts

Minimum Flows and Minimum Levels

Nathaniel Mouzon
Joy Kokjohn

Minimum Flows and Minimum Levels (MFLs)

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

Section 373.042(1), *Florida Statutes*

MFLs Process Overview

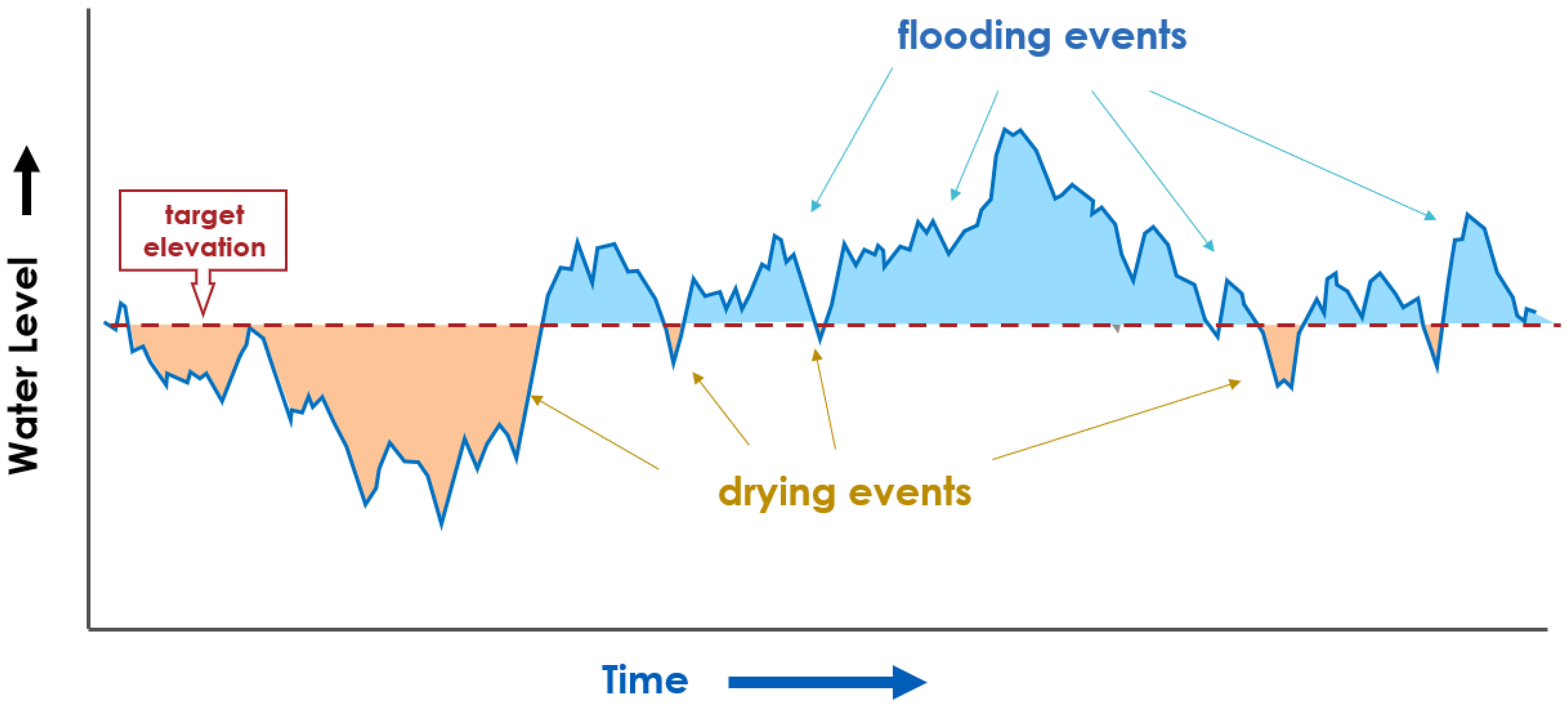
MFLs Determination

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

MFLs Assessment

- Determine the current-pumping condition that represents current impacted conditions
- MFL and current conditions compared to determine available water

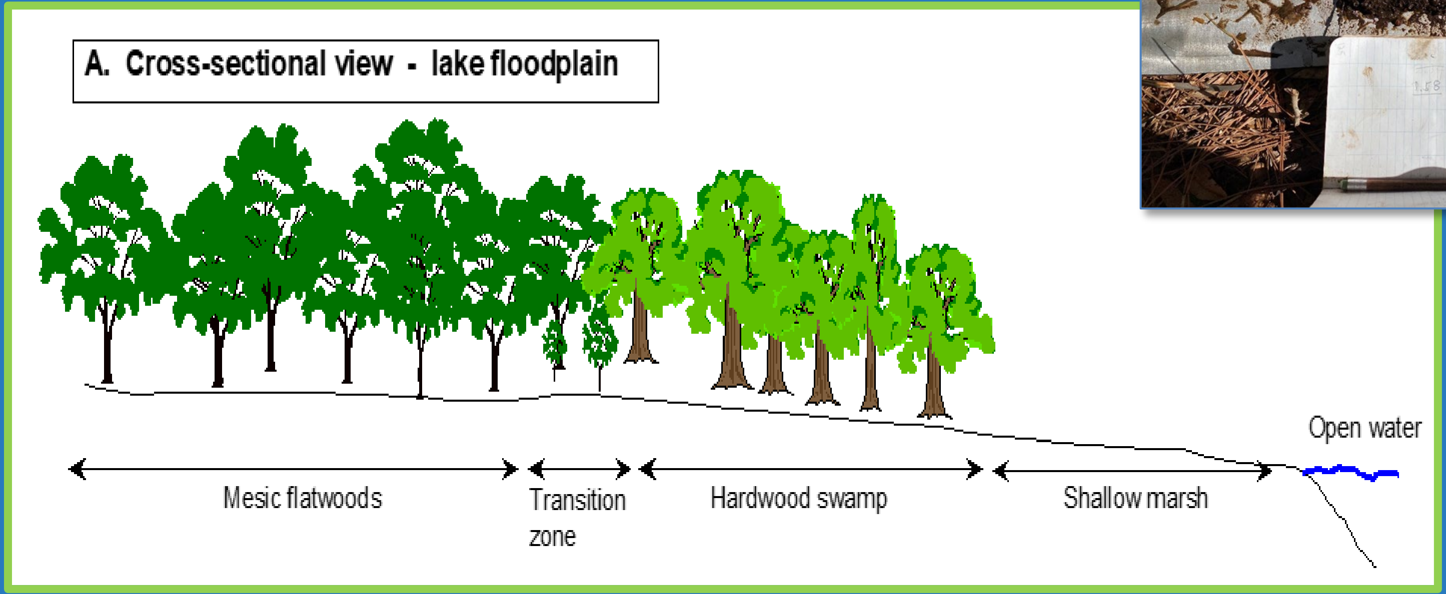
Hydrograph: *series of events of varying duration and frequency*

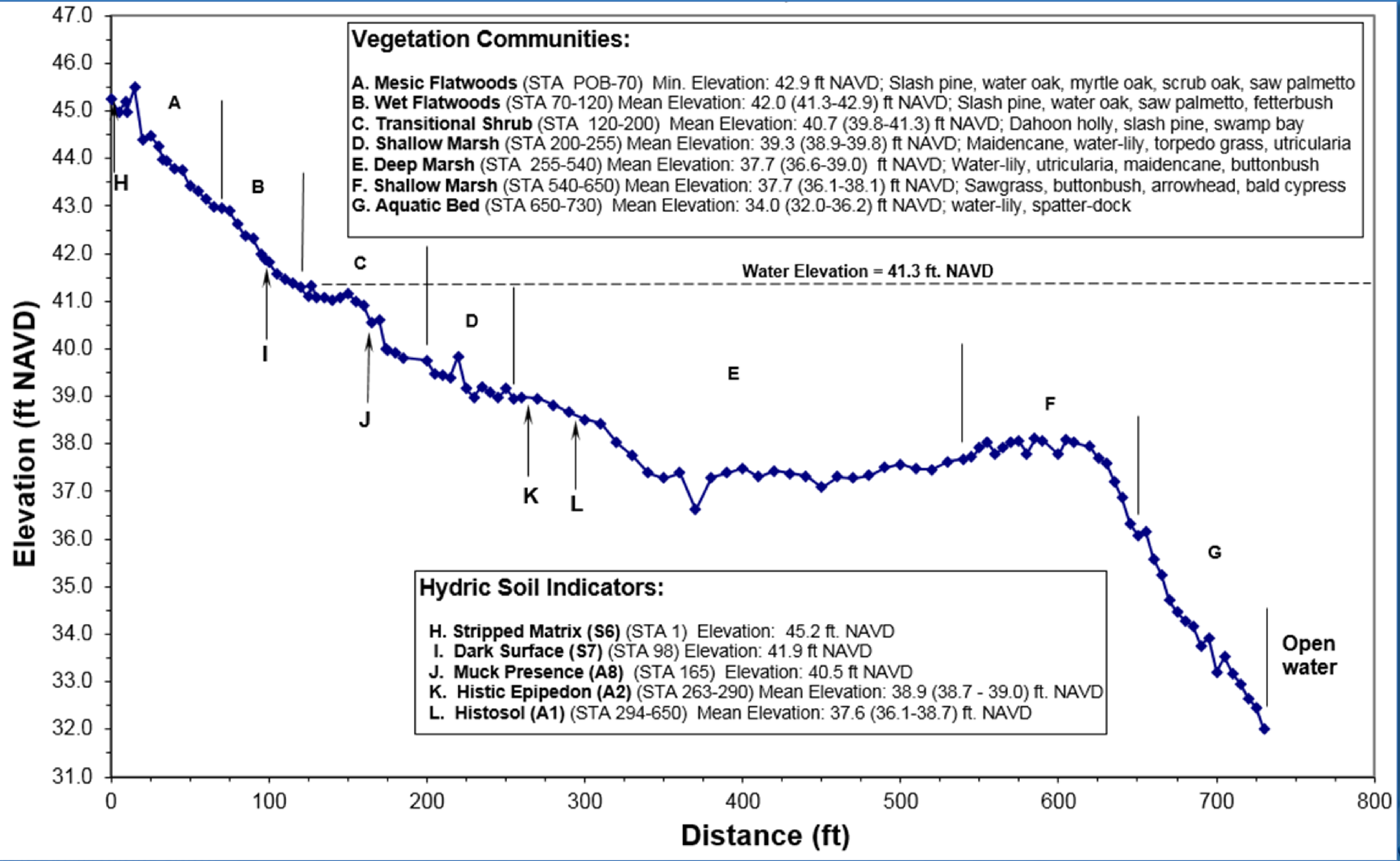


WETLAND DATA COLLECTION

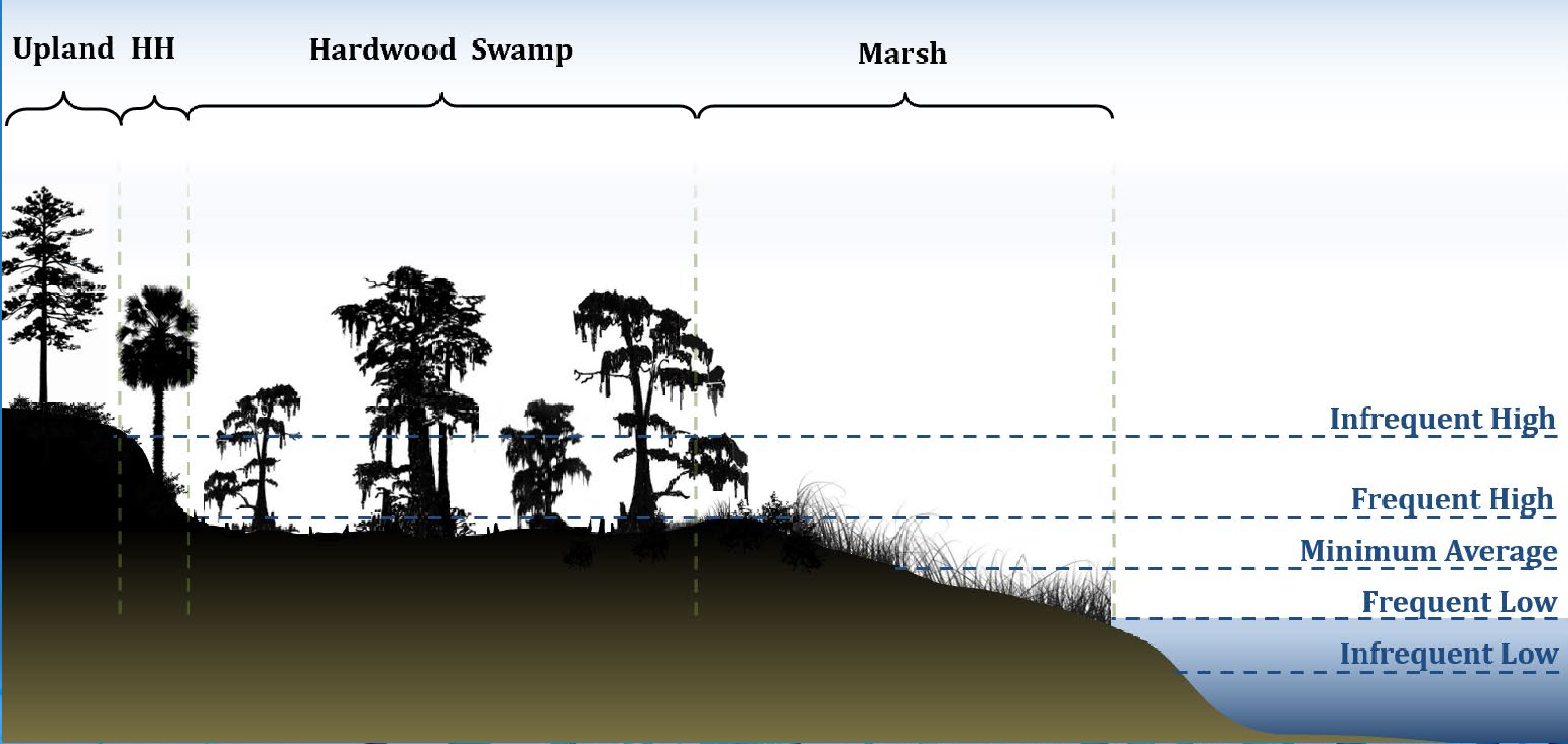
Field data collection along multiple transects

- Characterize and survey vegetation and soils




Vegetation Communities:
A. Mesic Flatwoods (STA POB-70) Min. Elevation: 42.9 ft NAVD; Slash pine, water oak, myrtle oak, scrub oak, saw palmetto
B. Wet Flatwoods (STA 70-120) Mean Elevation: 42.0 (41.3-42.9) ft NAVD; Slash pine, water oak, saw palmetto, fetterbush
C. Transitional Shrub (STA 120-200) Mean Elevation: 40.7 (39.8-41.3) ft NAVD; Dahoon holly, slash pine, swamp bay
D. Shallow Marsh (STA 200-255) Mean Elevation: 39.3 (38.9-39.8) ft NAVD; Maidencane, water-lily, torpedo grass, utricularia
E. Deep Marsh (STA 255-540) Mean Elevation: 37.7 (36.6-39.0) ft NAVD; Water-lily, utricularia, maidencane, buttonbush
F. Shallow Marsh (STA 540-650) Mean Elevation: 37.7 (36.1-38.1) ft NAVD; Sawgrass, buttonbush, arrowhead, bald cypress
G. Aquatic Bed (STA 650-730) Mean Elevation: 34.0 (32.0-36.2) ft NAVD; water-lily, spatter-dock
Water Elevation = 41.3 ft. NAVD
Hydric Soil Indicators:
H. Stripped Matrix (S6) (STA 1) Elevation: 45.2 ft. NAVD
I. Dark Surface (S7) (STA 98) Elevation: 41.9 ft NAVD
J. Muck Presence (A8) (STA 165) Elevation: 40.5 ft NAVD
K. Histic Epipedon (A2) (STA 263-290) Mean Elevation: 38.9 (38.7 - 39.0) ft. NAVD
L. Histosol (A1) (STA 294-650) Mean Elevation: 37.6 (36.1-38.7) ft. NAVD
Open water
Elevation (ft NAVD)
Distance (ft)
A
B
C
D
E
F
G
H
I
J
K
L
47.0
46.0
45.0
44.0
43.0
42.0
41.0
40.0
39.0
38.0
37.0
36.0
35.0
34.0
33.0
32.0
31.0
0
100
200
300
400
500
600
700
800

Multiple MFLs Events: Protecting the Hydrologic Regime



MFLs: Event Statistics

- **Magnitude**
  (how high or low)
- **Duration**
  (how long)
- **Return interval**
  (how often)

Minimum Levels	Environmental criteria	Minimum Level Components		
		Level (ft NAVD88)	Duration (days)	Return Interval (years)
Frequent High	Transitional shrub communities; Fish and wildlife habitat	40.2	30	4.3
Minimum Average	Organic soils; Seasonally flooded wetland habitat	37.9	180	1.7
Frequent Low	Shallow and deep marsh habitat; Organic soils	35.7	120	7.5

MFLs Process Overview

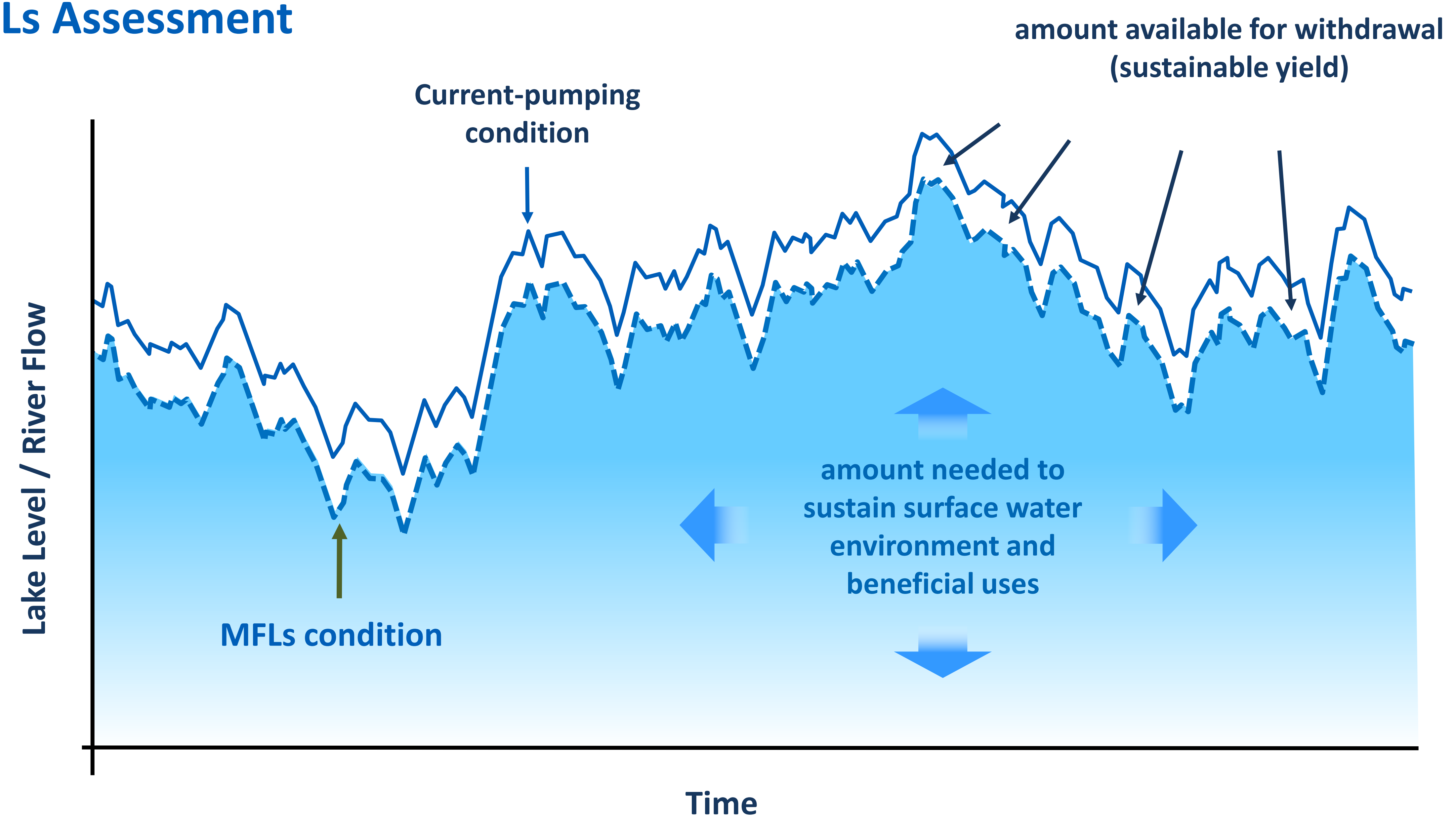
MFLs Determination

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

MFLs Assessment

- Determine the current-pumping condition that represents current impacted conditions
- MFL and current conditions compared to determine available water

MFLs Assessment



MFLs Assessment

Estimate Groundwater Pumping Impact

Estimate monthly UFA drawdown due to historical pumping

Develop No-pumping condition UFA levels

Add estimated monthly UFA drawdown to UFA observed levels

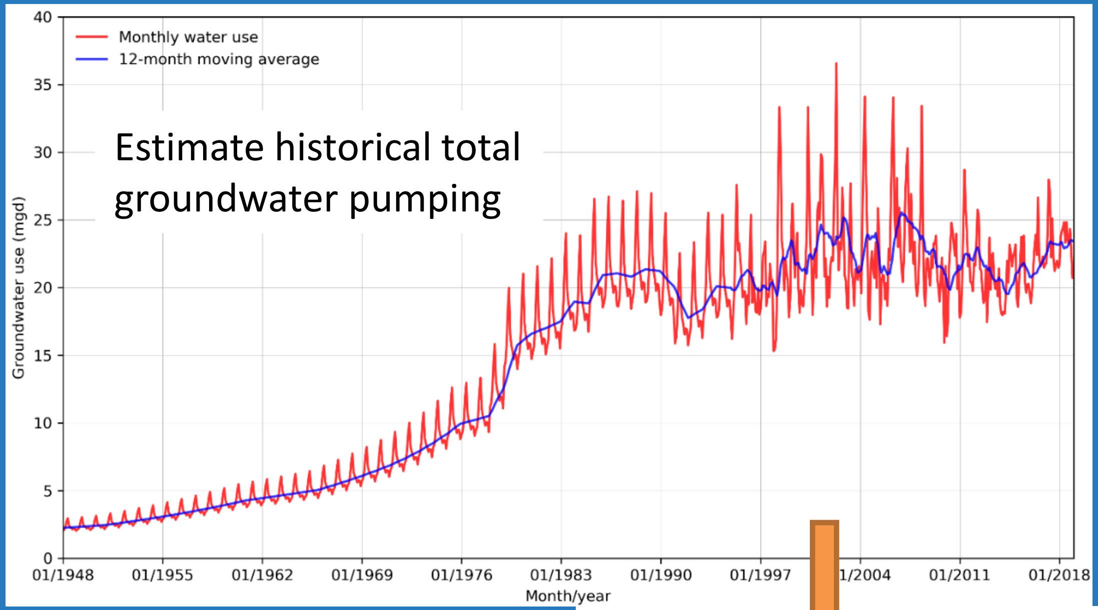
Develop Current Pumping condition UFA levels

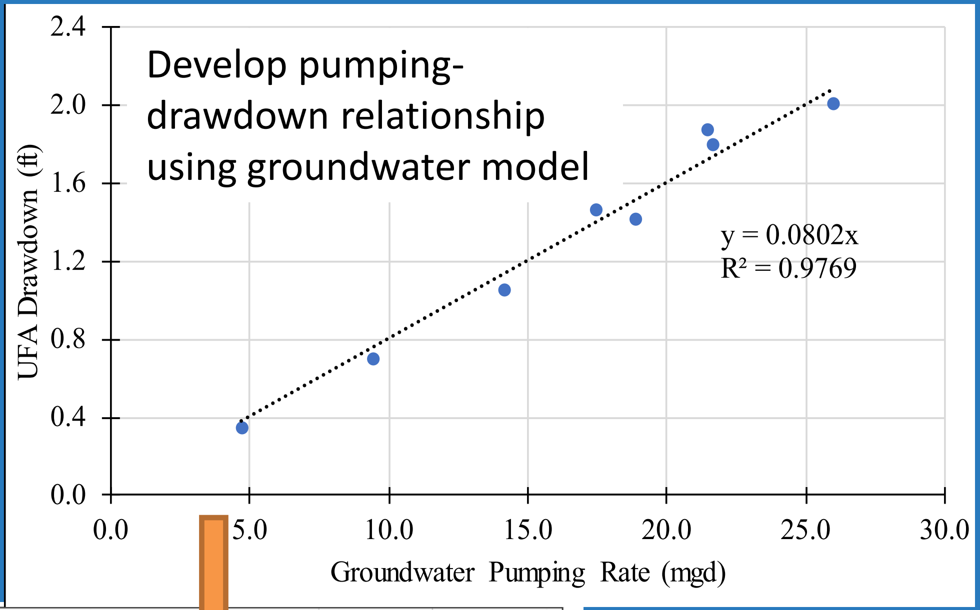
Substract estimated UFA drawdown (due to current pumping) from no-pumping UFA levels

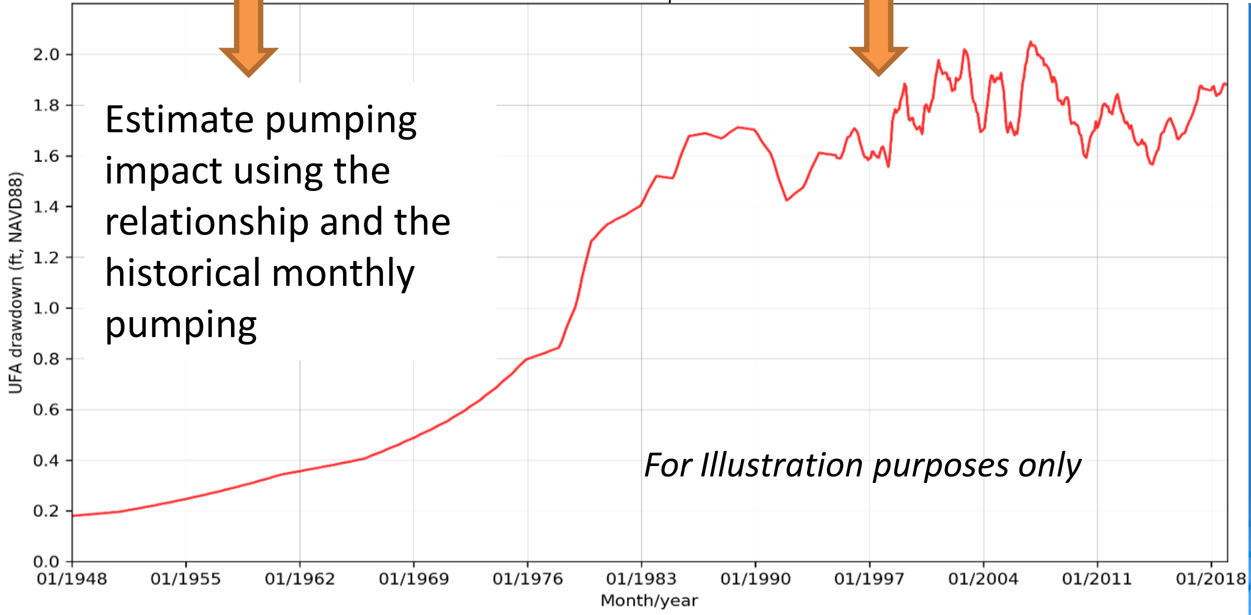
Develop No-and Current-Pumping conditions lake levels

Run surface water model with no- and current-pumping conditions UFA levels

Impact Assessment: Historical Monthly Pumping Impact







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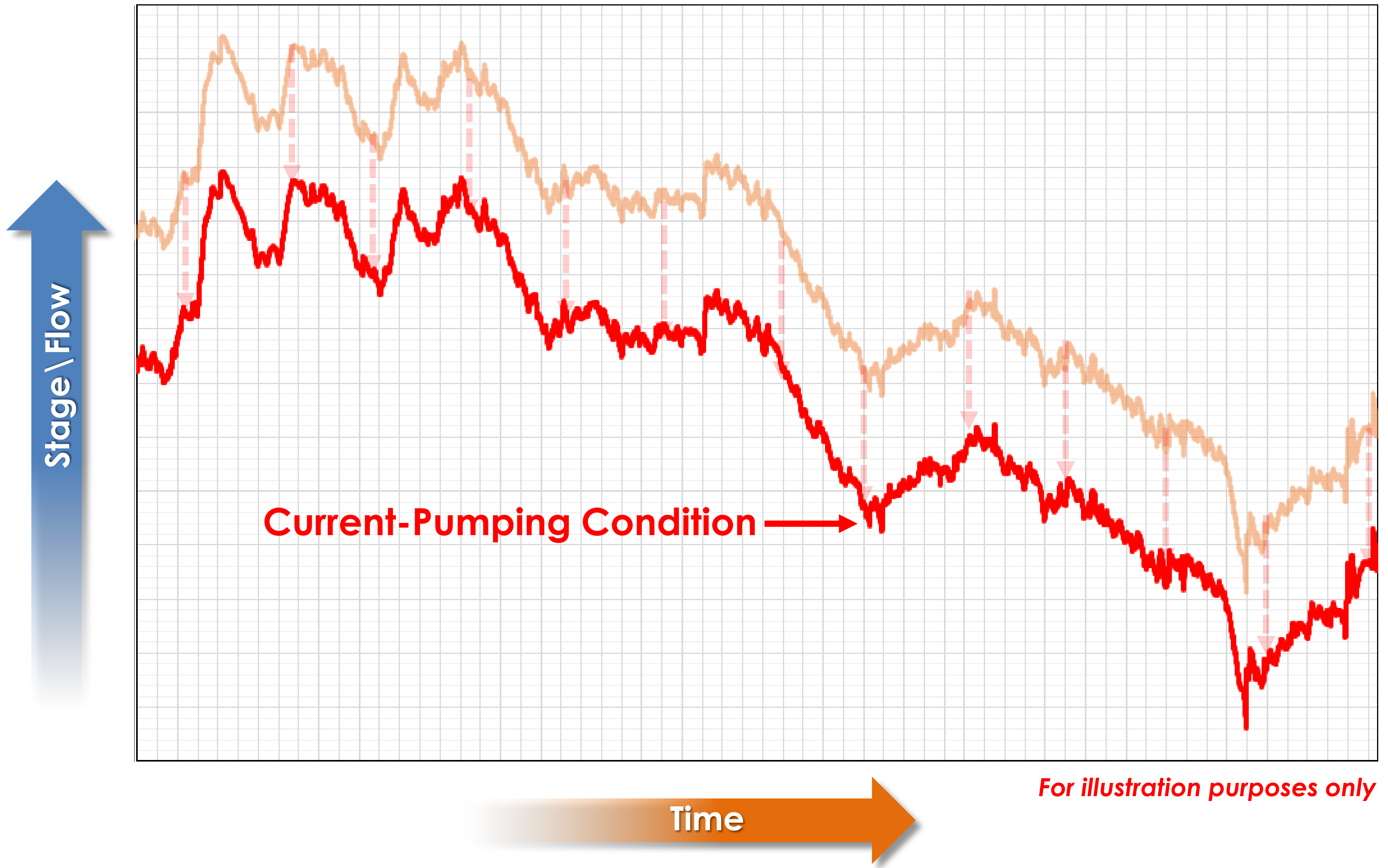
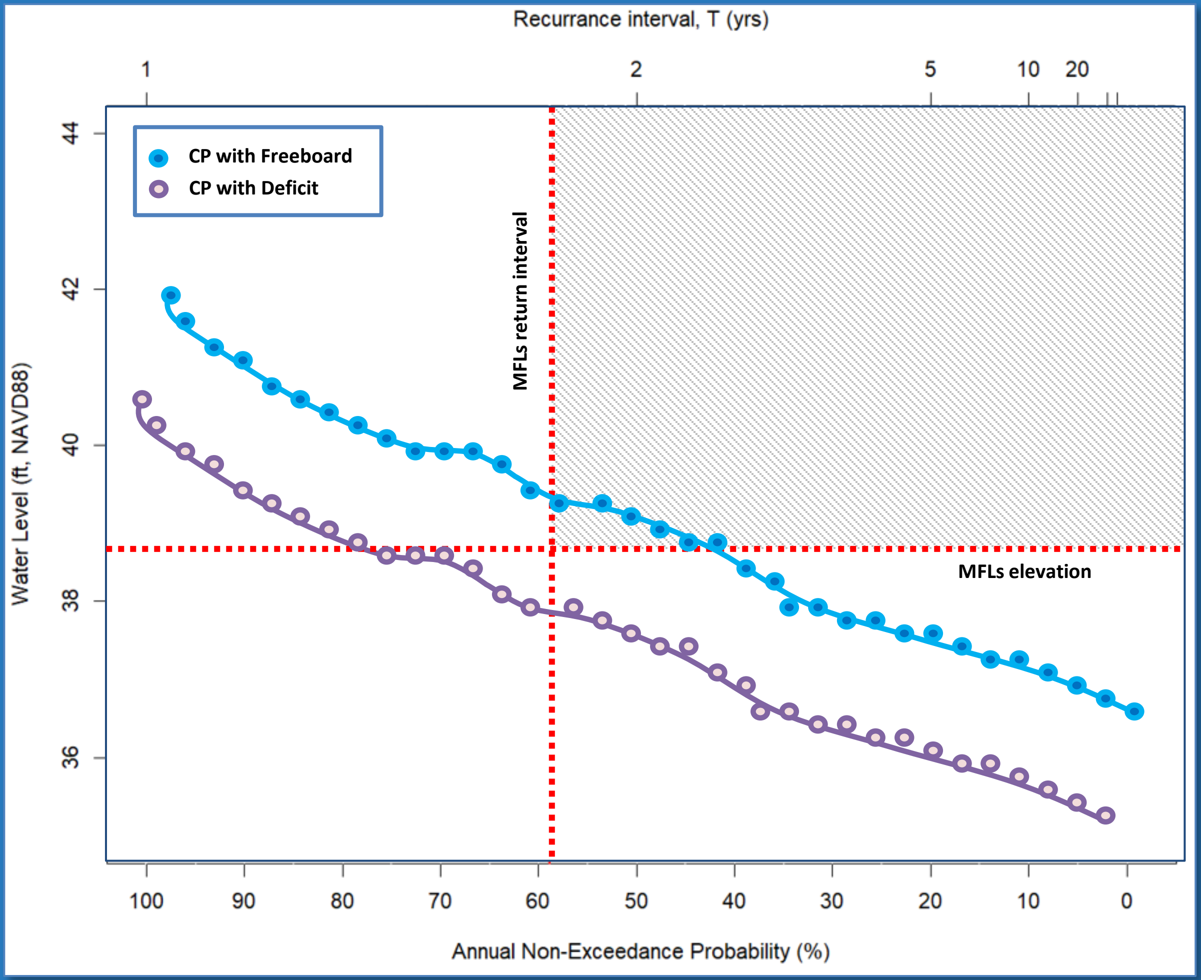
No-Pumping and Current-Pumping timeseries



Frequency Analysis: UFA Freeboard or Deficit

- Comparison of current-pumping condition (CP) vs MFLs frequency for each event
- Weibull plotting position formula; annual maxima or minima
- Iterative decrease or increase from CP of UFA using surface water model
- Stop at point where further withdrawal would violate MFLs
- Increase from CP = Recovery
- Decrease from CP = Freeboard



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MFLs Status: Strategy Required?

Are MFLs met under current water demands?

No → Recovery strategy

Yes ↓

Are MFLs met under future water demands?

No → Prevention strategy

Yes → No action required

CSEC MFLs Assessment

- **Bring MFL freeboard/deficit forward to base year (2015)**
  - Use groundwater model to calculate change in aquifer level or spring flow from MFL condition to 2015 and apply to original MFL freeboard/deficit
  - Results in CSEC "current" MFL status
- **Determine freeboard/deficit for end of planning horizon (2040)**
  - Use groundwater model to calculate change in aquifer level or spring flow from 2015 to 2040 and apply to CSEC "current" freeboard/deficit
  - Results in CSEC "future" MFL status

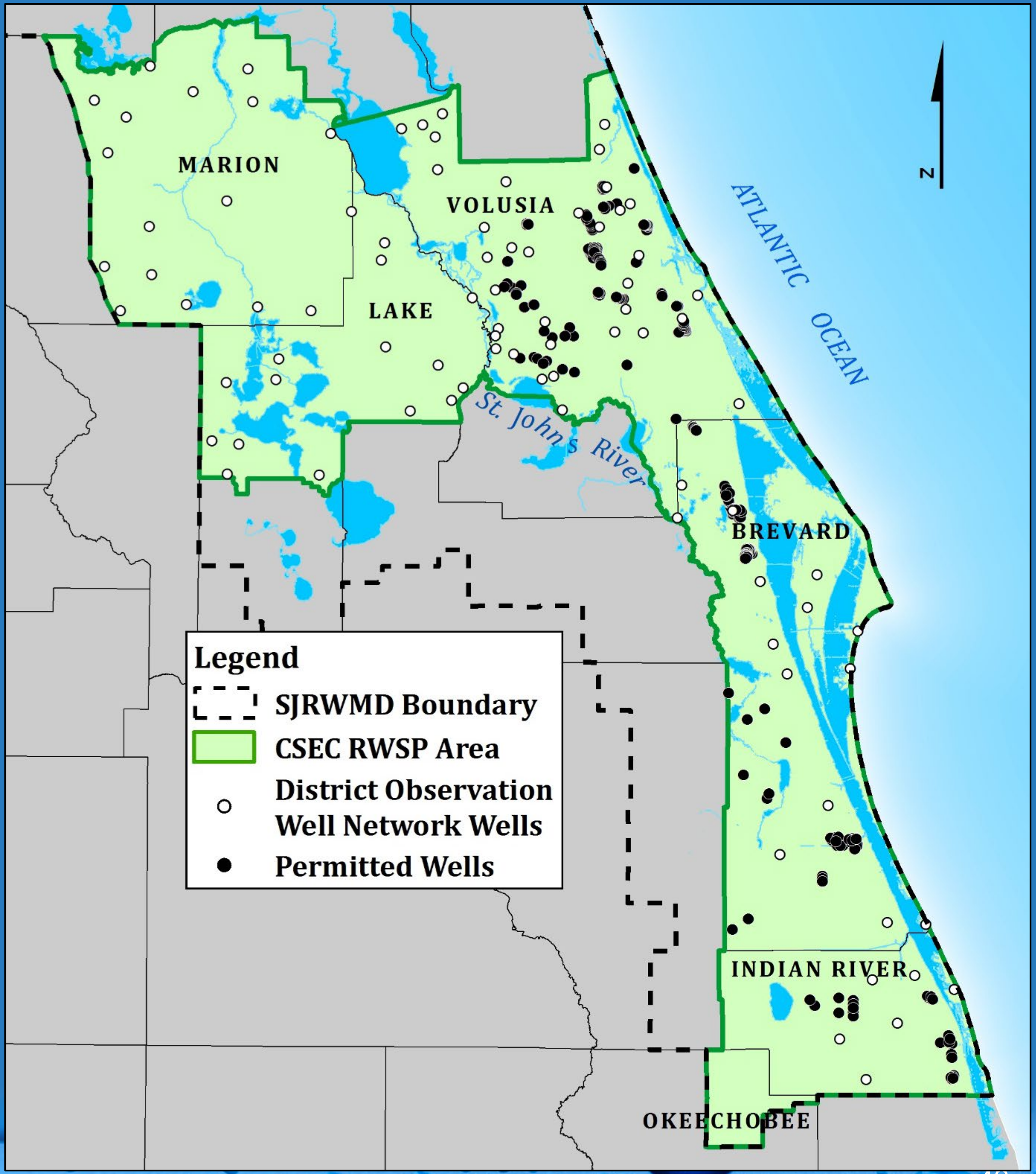
Groundwater Quality

Jacy Crosby

Groundwater Quality

Evaluated chloride data from DOWN and permitted wells:

- 89 DOWN (UFA)
- 300 Permitted Wells (UFA and SAS)



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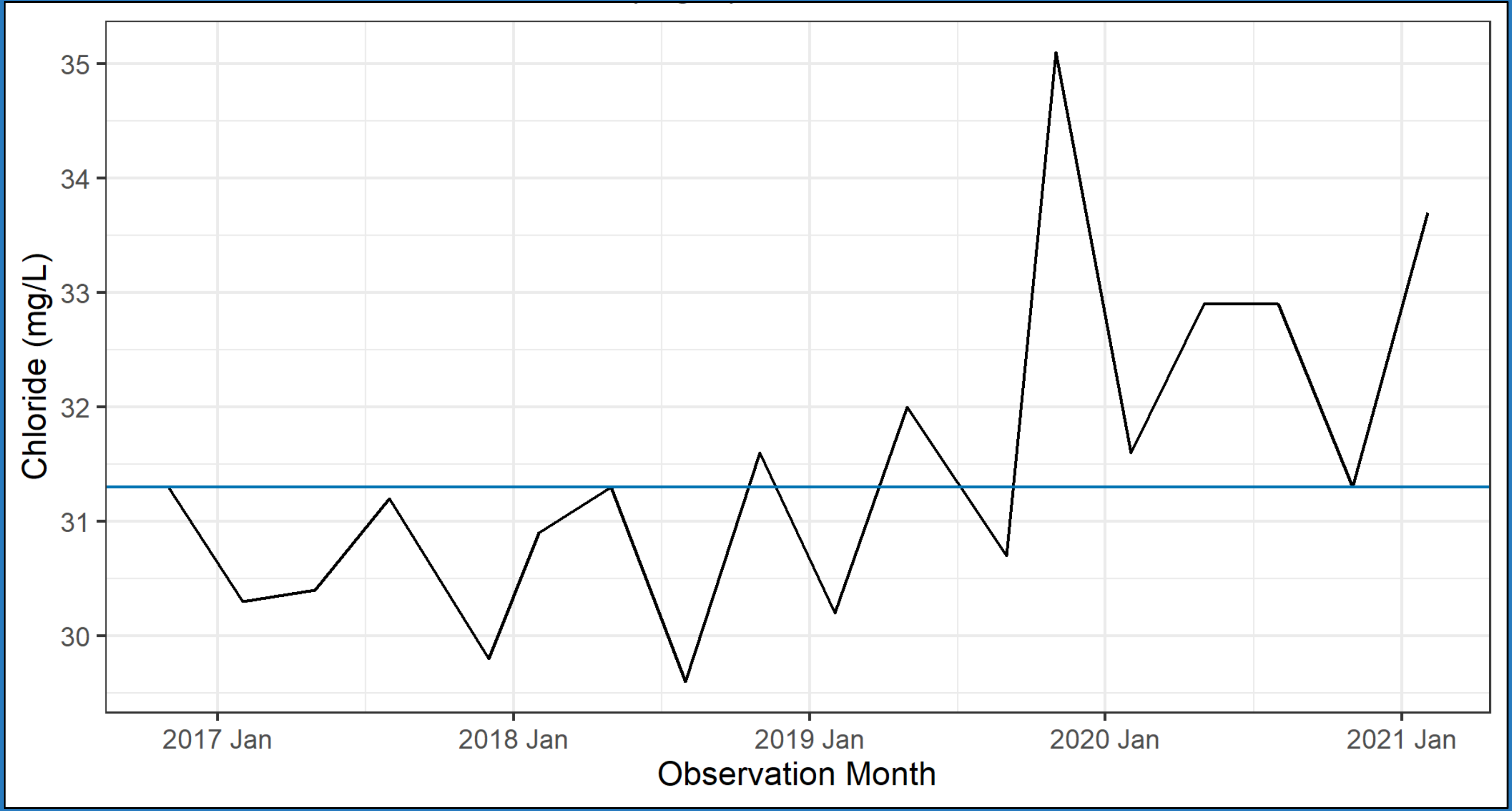
Example: Testing for a Trend in Chloride



- Period of record: 2016 to 2021
- Median = 31.3 mg/L Cl^-
- Are chloride levels significantly increasing?
- What is the predicted level in 2040?

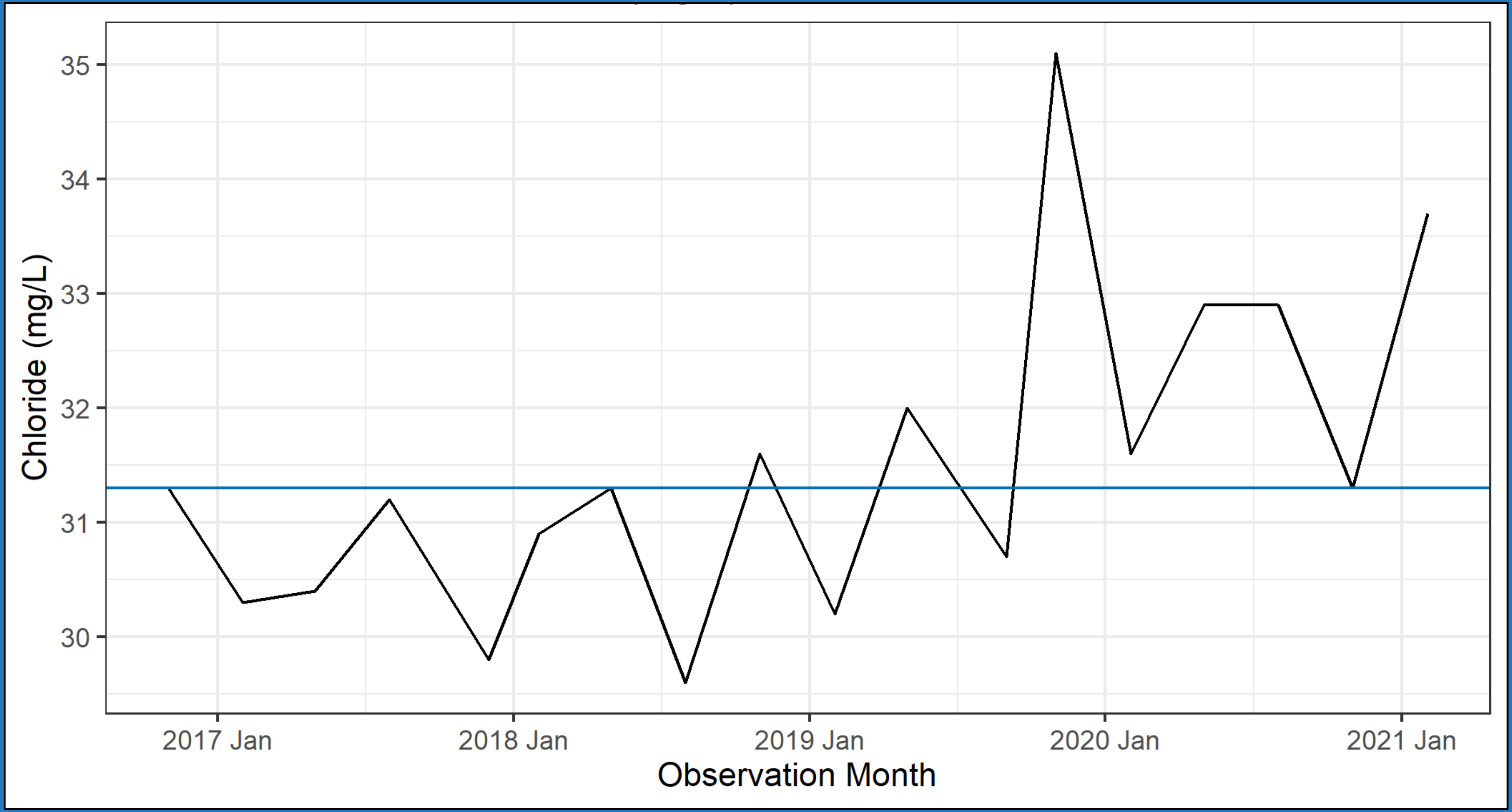
Testing for a Trend in Chloride

- Nonparametric Mann-Kendall and Theil-Sen trend analysis
  - Resistant to outliers and missing data
  - Tested at the 95% significance level (p-value below 0.05)
  - Rate of changing chloride levels are estimated by the Sen's slope

- If significant, categorize the changing concentration (mg/L/year):
  - Greater than 3 = high rate of change
  - Between 1 and 3 = medium rate of change
  - Between 0 and 1 = low rate of change
  - Less than 0 mg/L/year = decreasing rate of change (improving quality)

- Determine wells of interest:
  - Wells with a significant medium or high rate of change in chloride levels (>1 mg/L/year)
  - Wells projected to exceed 250 mg/L chloride by 2040

Example: Testing for a Trend in Chloride



- Period of record: 2016 to 2021
- Median = 31.3 mg/L Cl-
- Sen's Slope = 0.76 mg/L/yr Cl^-
  - "low" rate of change
- p-value = 0.01
- Predicted concentration at 2040 = 48.3 mg/L Cl^-

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Wetlands

Joy Kokjohn

Estimating Future Potential of Adverse Change to Wetlands

Kinser-Minno method

- GIS-based model
  - Soil permeability
  - Sensitivity of plant community to drawdown
  - Projected surficial aquifer decline

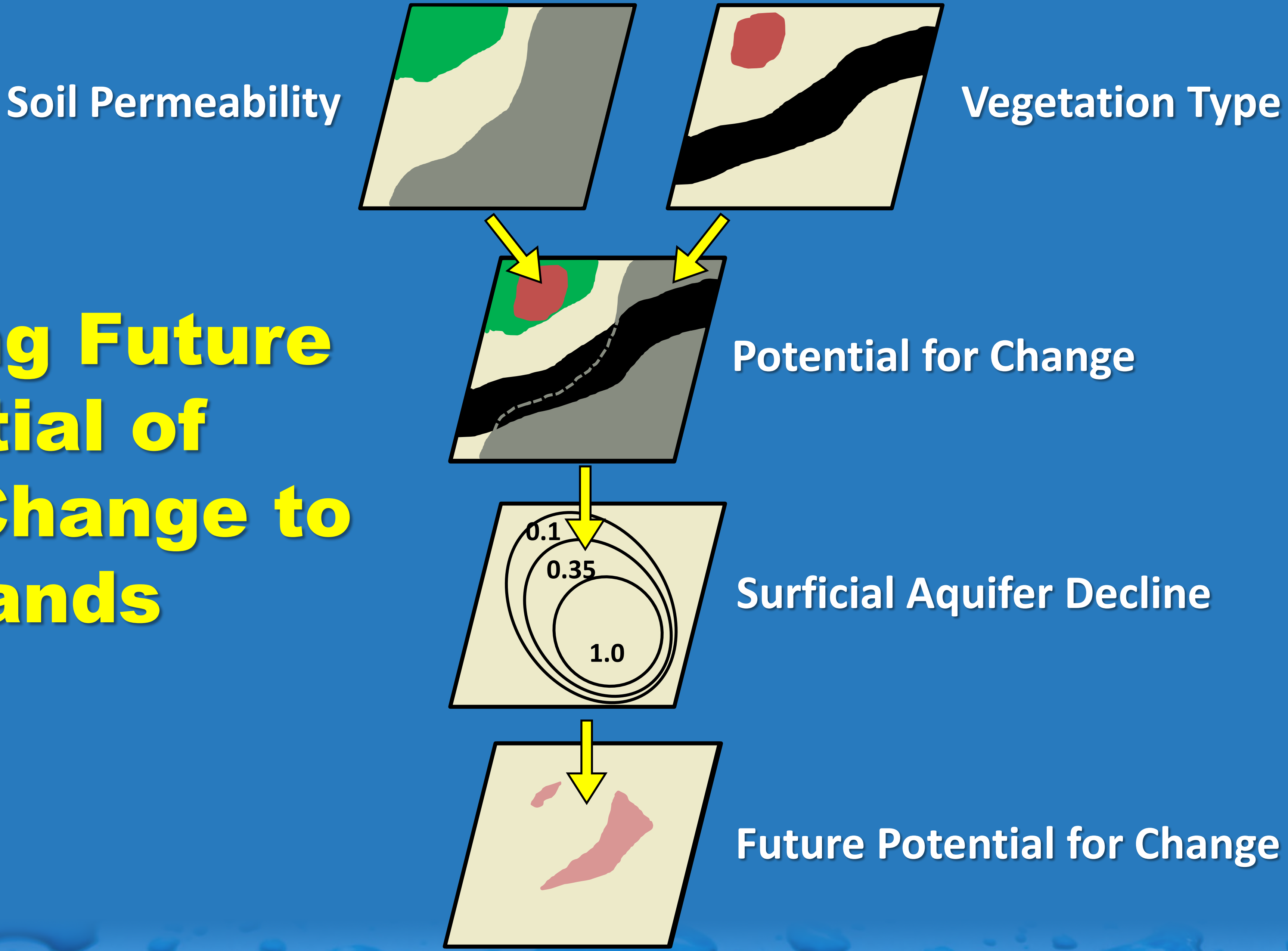
Estimating Potential of Adverse Change to Wetlands

- Soil permeability
  - NRCS permeability rate (inches/hour)
  - Grouped into high, medium, low drawdown sensitivity
- Vegetation sensitivity
  - Hydric = highly sensitive; Xeric = less sensitive
  - Grouped by sensitivity
- Wetland communities on permeable soils = high potential for harm

Estimating Future Potential of Adverse Change to Wetlands

Potential For Change	Surficial Aquifer Decline		
	High	Medium	Low
High	High	High	Low
Medium	High	Medium	Low
Low	Low	Low	Low

Estimating Future Potential of Adverse Change to Wetlands



Question/Answer

CSEC RWSP Workshops

- Monday, July 26, 2021, at 5:30 pm
  Volusia County Council Chambers
- Wednesday, July 28, 2021, at 5:30 pm
  Indian River County Admin. Complex
- Thursday, July 29, 2021, at 5:30 pm
  Lake County Admin. Building

For more information,
visit www.sjrwmd.com/water-supply/planning/csec-rwsp/
or contact Joy Kokjohn at (386)329-4223 or jkokjohn@sjrwmd.com