

# Lake Okeechobee System Operating Manual

**Presentation to UF - Center for Coastal Solutions**

*Sanibel-Captiva Conservation Foundation*

*Conservancy of Southwest Florida*

**DRAFT - January 18, 2021**



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# LOSOM GOALS AND OBJECTIVES

## STUDY GOAL

Incorporate flexibility in Lake Okeechobee operations while balancing congressionally authorized project purposes.



## STUDY OBJECTIVES

There are four study objectives, each with their own sub-objectives:

### Objective 1:

Manage risk to public health and safety, life and property

**1A:** Dam safety

**1B:** Algal bloom risk in Lake Okeechobee

**1C:** Algal bloom risk in Caloosahatchee Estuary

**1D:** Algal bloom risk in St. Lucie Estuary

### Objective 2:

Continue to meet authorized purposes for navigation, recreation, and flood control

**2A:** Navigation

**2B:** Recreation

**2C:** Flood control

### Objective 3:

Improve water supply performance

**3A:** Lake Okeechobee Service Area

**3B:** Seminole Tribe of Florida

**3C:** Lower East Coast Service Area

### Objective 4:

Enhance ecology in Lake Okeechobee, northern estuaries and across the south Florida ecosystem.

**4A:** Lake Okeechobee

**4B:** Caloosahatchee Estuary

**4C:** St. Lucie Estuary

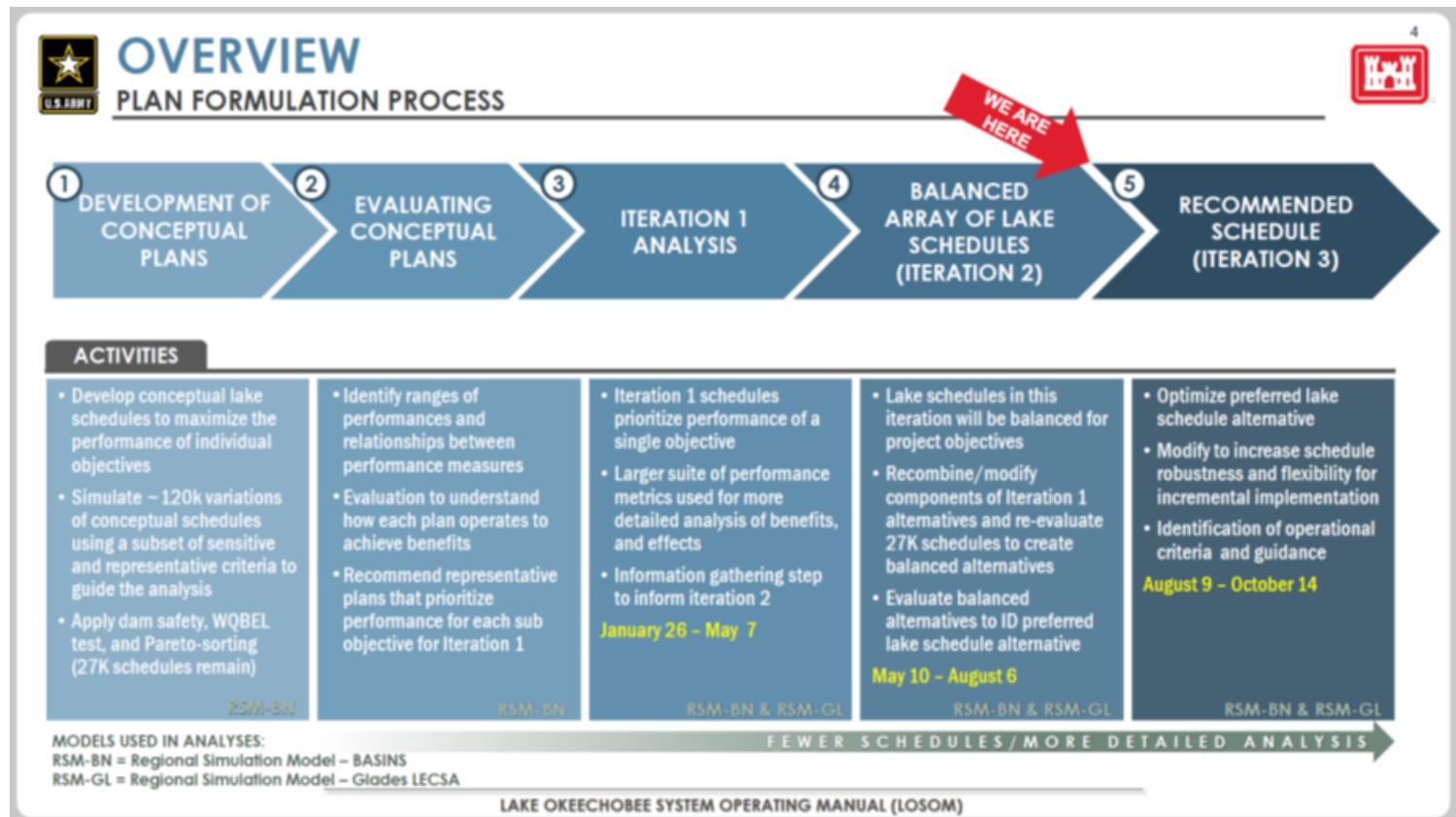
**4D:** South Florida

LAKE OKEECHOBEE SYSTEM OPERATING MANUAL (LOSOM)

*From USACE PDT 16 Nov 2021 meeting presentation*

# LOSOM Process and Timeline

- LOSOM process started with Scoping Meetings - Feb 2019
- LOSOM Public Workshops – Sept 2019



# Iteration 2 Plans

**Alternative AA**



Explores upper and lower lake stages to increase interim storage in the lake to:

- Enhance ecology of St. Lucie Estuary by reducing Lake Okeechobee releases through S-308.
- Improve water supply.
- Enhance Everglades ecology by providing more freshwater south, and
- Enhance Caloosahatchee ecology by providing low and optimal flows.

Favors St Lucie & Flows south with benefits to Water Supply

**Alternative BB**



Improves water supply performance to pre-LORS08 as a priority objective and:

- Reduce algal bloom risk
- Increase low and optimal flows to Caloosahatchee Estuary
- Reduce lake releases to St. Lucie Estuary
- Enhancing Everglades ecology by providing more freshwater south

Favors Recreation & Water Supply

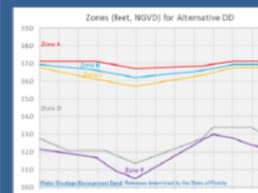
**Alternative CC**



- Enhancing Caloosahatchee ecology by providing low and optimal flows and reducing extreme high flows >6500 cfs
- Enhancing ecology of St Lucie Estuary by reducing Lake O releases
- Enhancing Everglades ecology by providing more freshwater south
- Improving water supply performance as compared to the No Action condition

Favors St Lucie & (to some degree) Caloosahatchee

**Alternative DD**



Honors the perspective on balance that each of the LOSOM objectives should be incrementally improved over LORS08 performance

Similar to LORS08 Favors Lake

**Alternative EE1 & EE2**



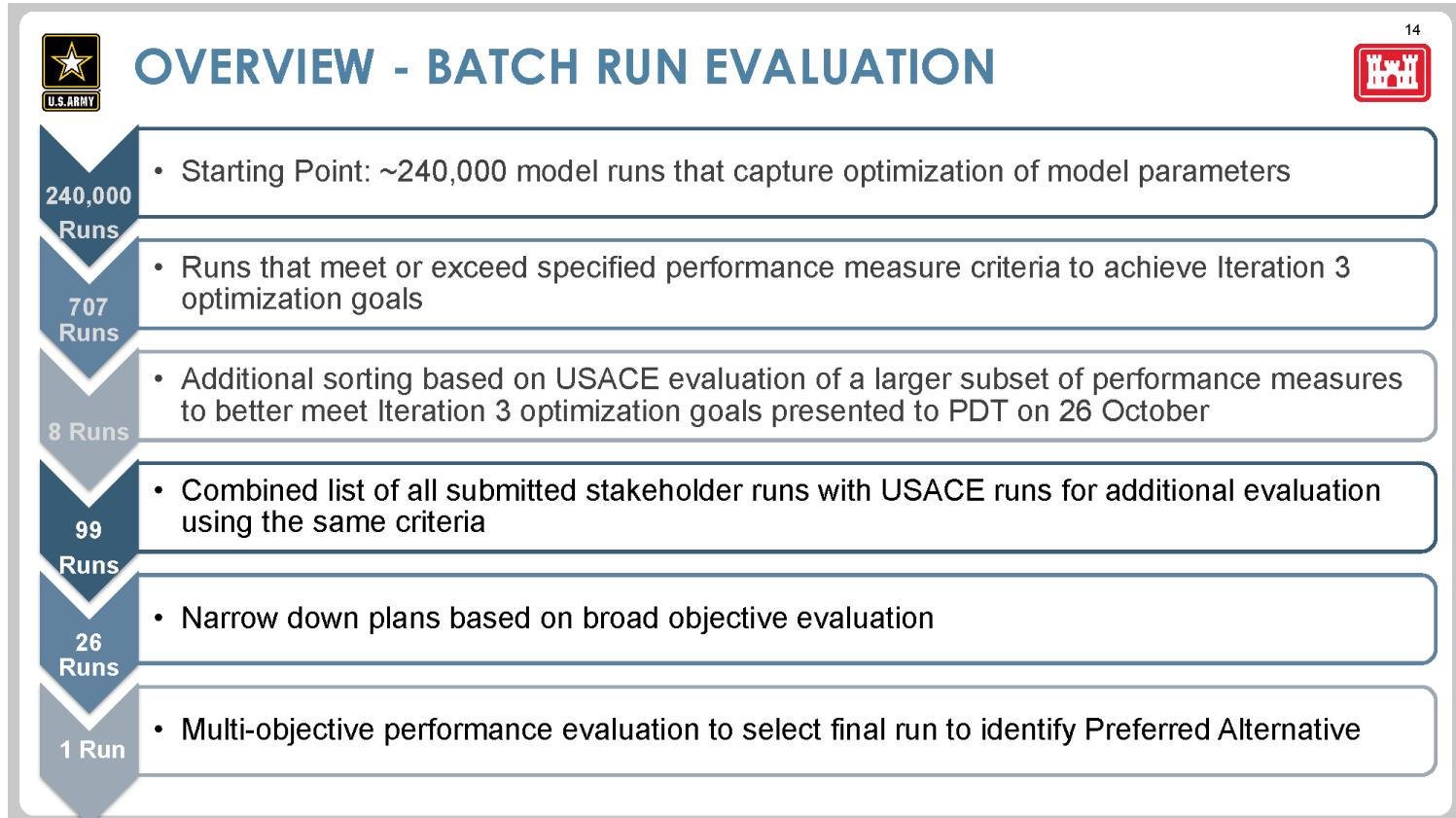
Lake Okeechobee stage target (equation based). Incorporates memory and flexibility by asking key questions at key times to define operational mode:

- Mode 1-Normal
- Mode 2- Conservation
- Mode 3-Recovery

New water management concept – operational flexibility

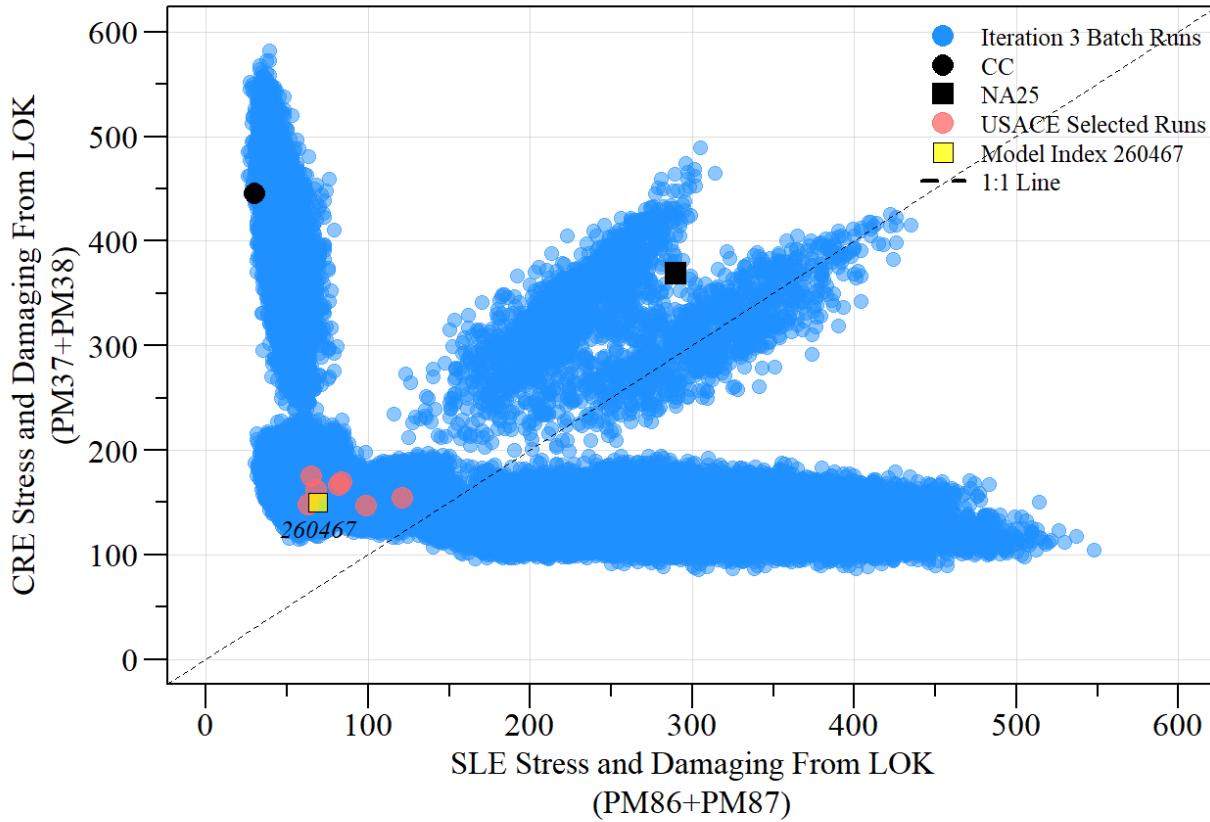
From SFWMD 08 July 2021 Governing Board meeting Presentation

# Iteration 3



From USACE PDT 16 Nov 2021 meeting presentation

## Iteration 3 - Phase 2



Comparison of stress and damaging flow event counts for Caloosahatchee (CRE) and St Lucie (SLE) estuaries of ~240k runs, USACE selected runs and TSP.

# Iteration 3 - Phase 3

## TSP Model runs

Alternative	Description
ECB19 <sup>1</sup>	LOSOM Existing Conditions Baseline 2019 with LORS08
NA22f <sup>2</sup>	LOSOM No Action 2022 (HHD Rehab Complete, C-44 Reservoir & STA) with LORS08
NA25f <sup>3</sup>	LOSOM No Action 2025 (HHD Rehab Complete, C-44 Reservoir & STA, C-43 Reservoir, A-2 STA (grown in only)) with LORS08
PA22	Preferred Alternative 2022. Distinct operational zones and regulatory discharge rates selected based on LOSOM objectives
PA25	Preferred Alternative 2025. Distinct operational zones and regulatory discharge rates selected based on LOSOM objectives

<sup>1</sup> Existing Conditions Baseline 2019

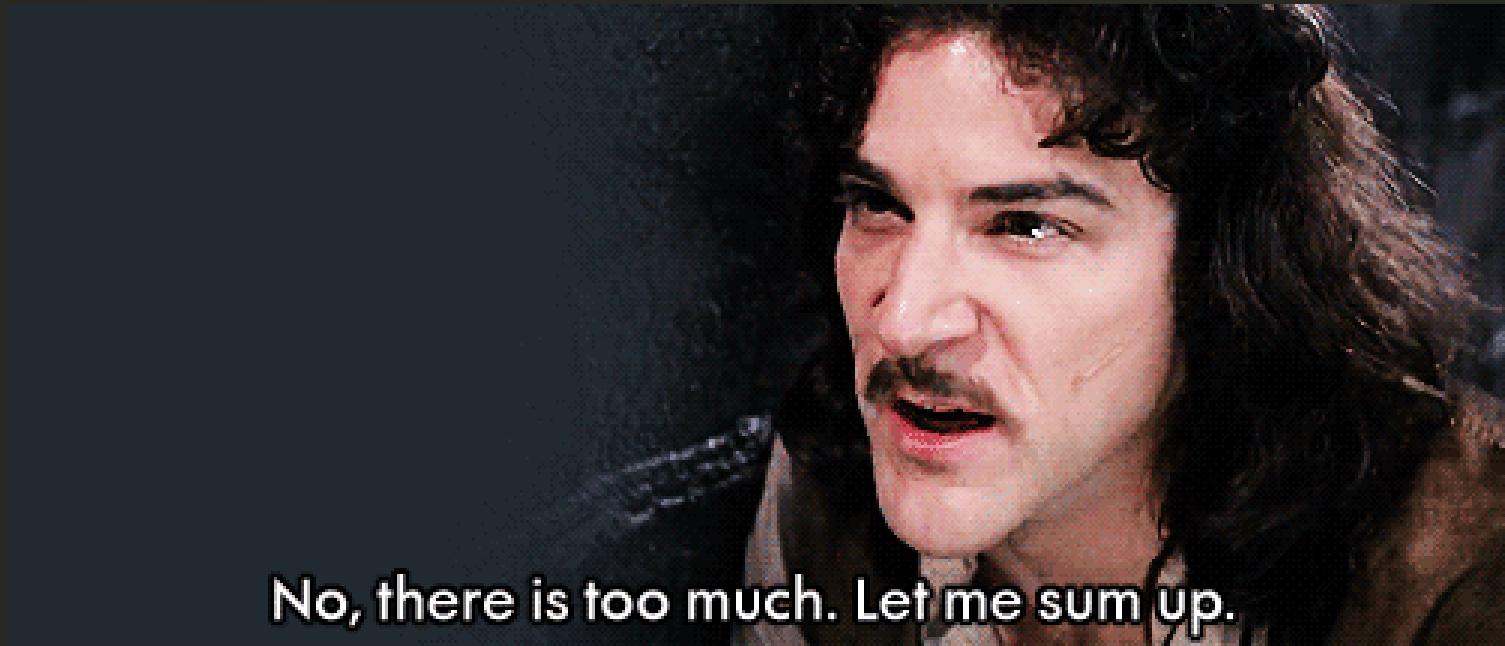
<sup>2</sup> No Action Condition 2022

<sup>3</sup> No Action Condition 2025

- For today's purpose we will focus on the PA2025 (Preferred Alternative 2025 iteration).
  - Comparison of both NA22f/PA22 and NA25f/PA25 can be found here [link](#).
- Modeling done using the Regional Simulation Model Basins (RSM-BN) with extended period of record (1965 - 2016)

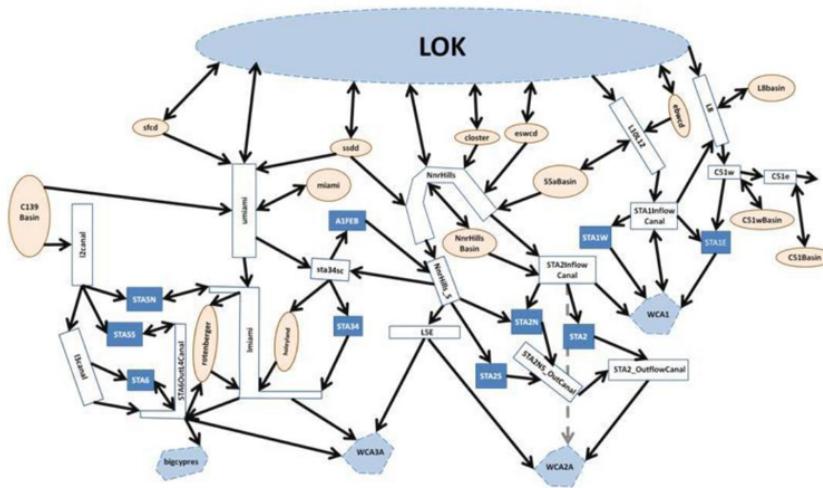
# RSM

The RSM-BN model is ...



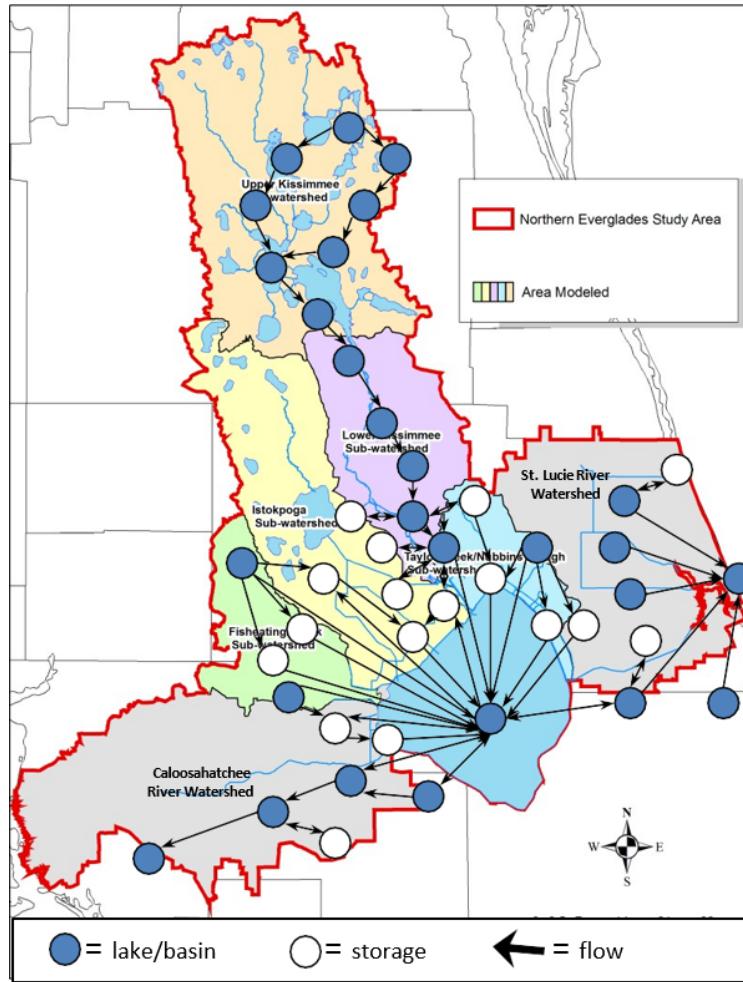
# Regional Simulation Model - Basins (RSMBN)

- A link-node application of the Regional Simulation Model (RSM) specific to Lake Okeechobee and Basins.
    - >100 basins/lakes/canals represented
    - >150 connections represented
  - Used in prior planning efforts.



RSMBSN Link-Node Routing Diagram: Initial Operating Regime Baseline Simulation

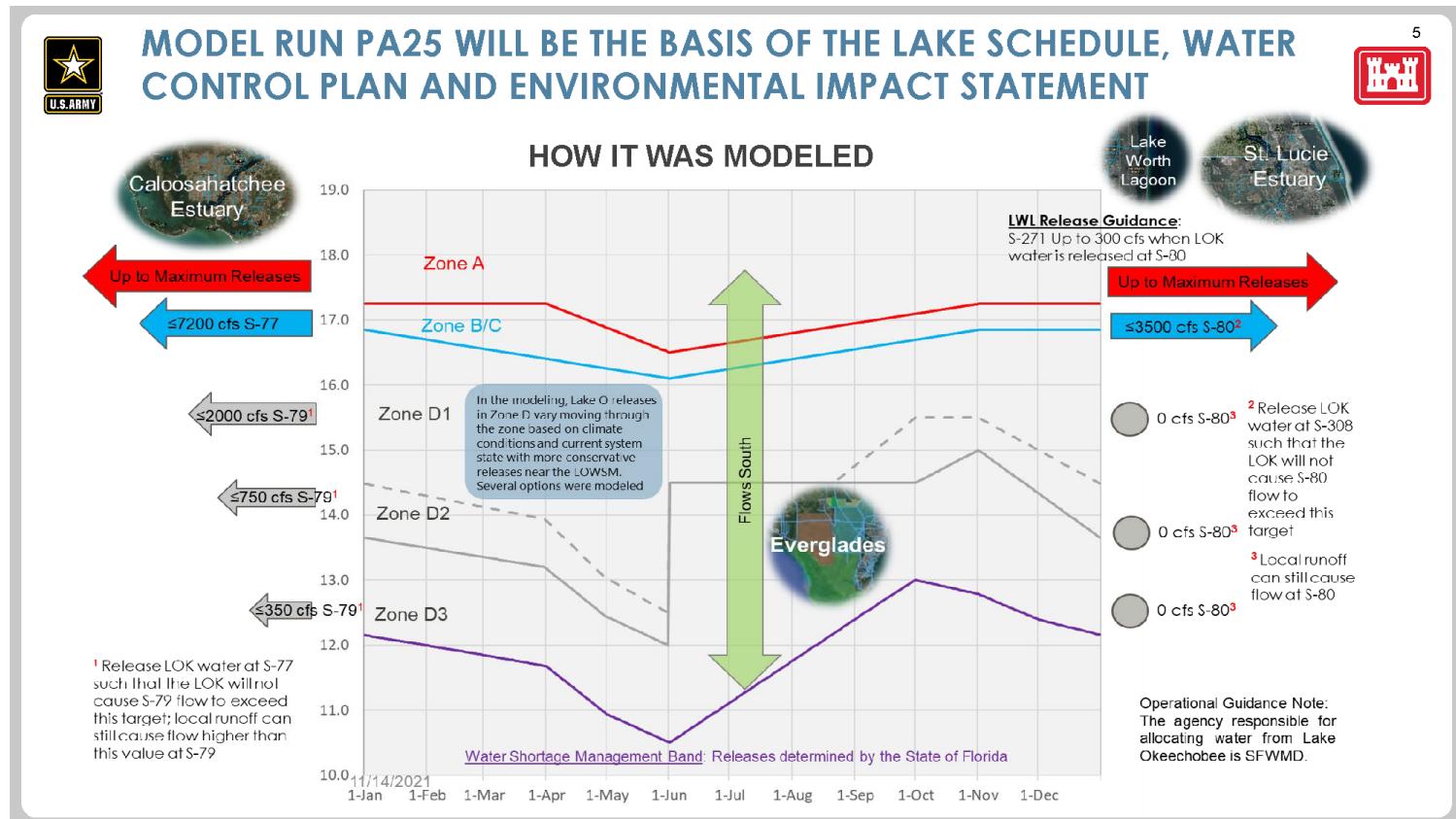
## Link-node representation of RSM-BN model



Geographical representation of RSM-BN

- RSM-BN outputs are used in downstream processes (RSM-GL, DMSTA, etc.)

# How it (TSP) was modeled...

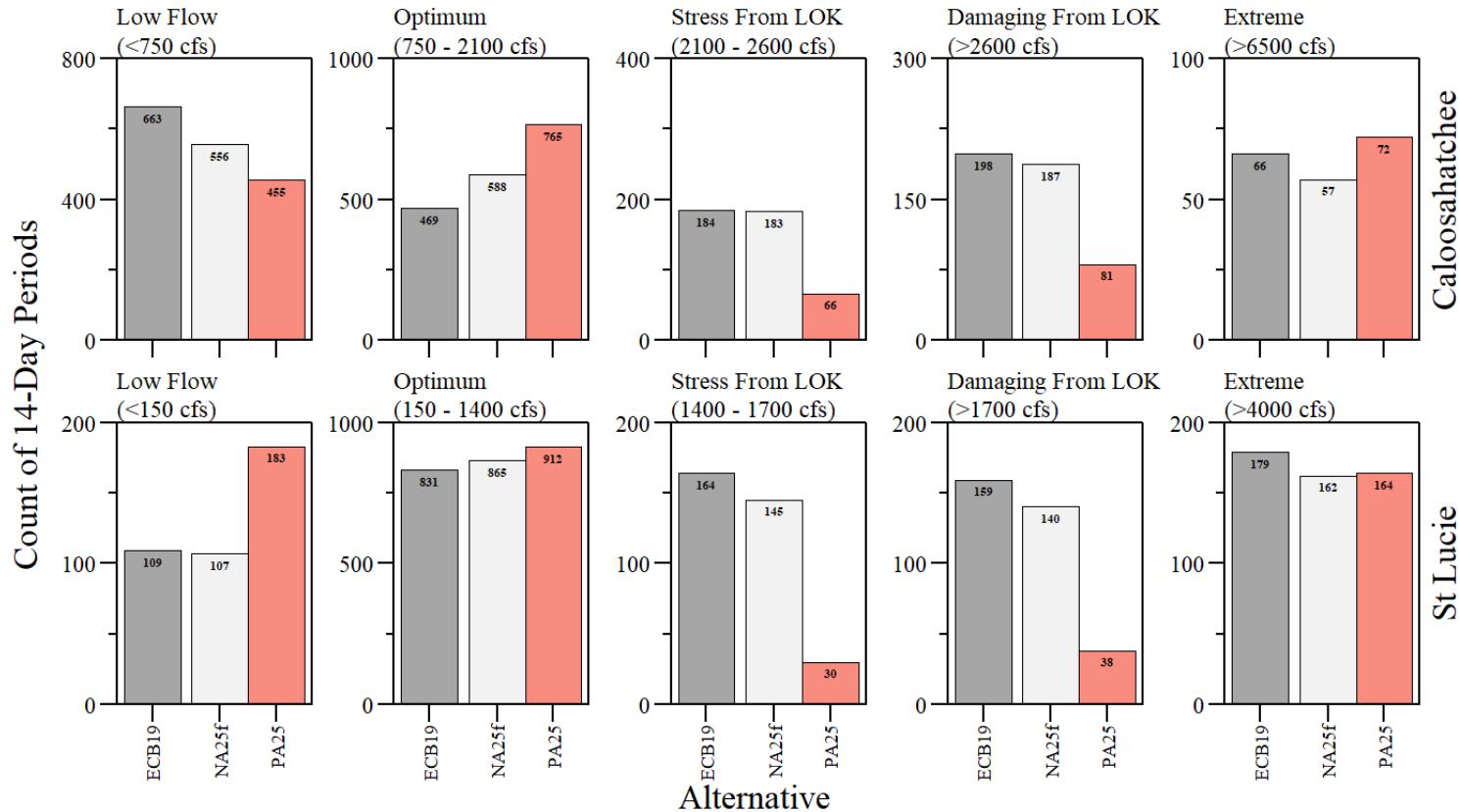


From USACE PDT 12 Jan 2022 meeting presentation

# Focus

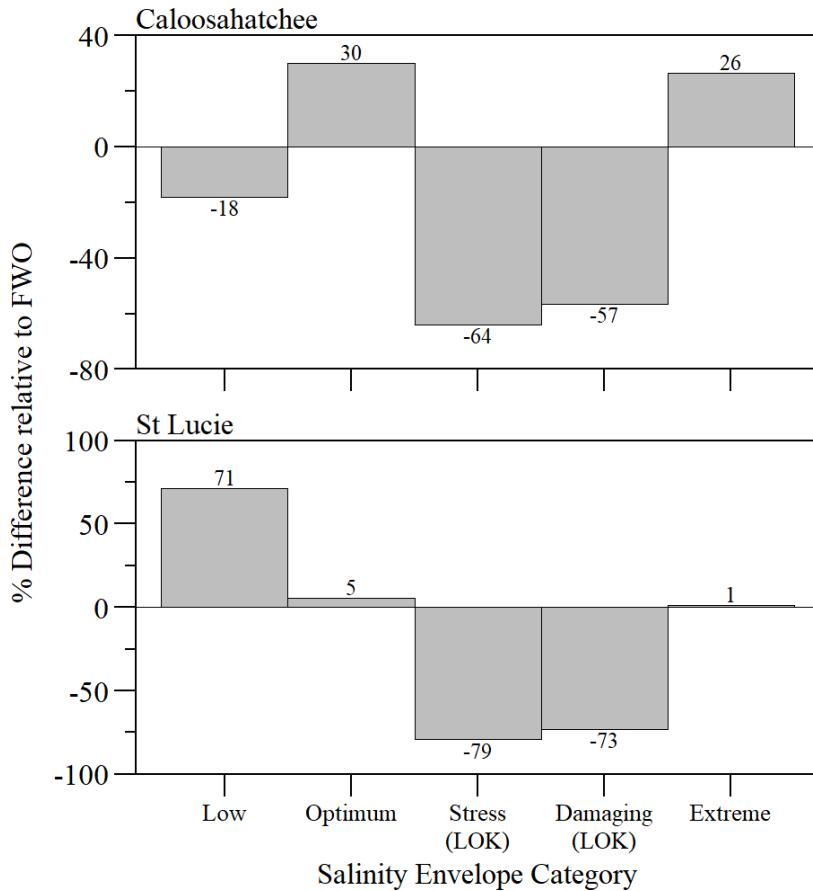
- Estuary Salinity Envelope Scores
  - Based on CERP RECOVER salinity envelope evaluation
- Estuary Discharges
  - Extreme discharge event and duration
  - CRE Extreme discharge event
- Regulatory Discharge
- Lake Okeechobee
  - Extreme stage metrics (> 16 Ft NGVD29, >17 Ft, < 10 Ft)
  - Ecological Stage Envelope
  - Extreme event and duration
  - Weekly Recession rates (Snail Kite PM)
- New regulation schedule

# Salinity Envelope



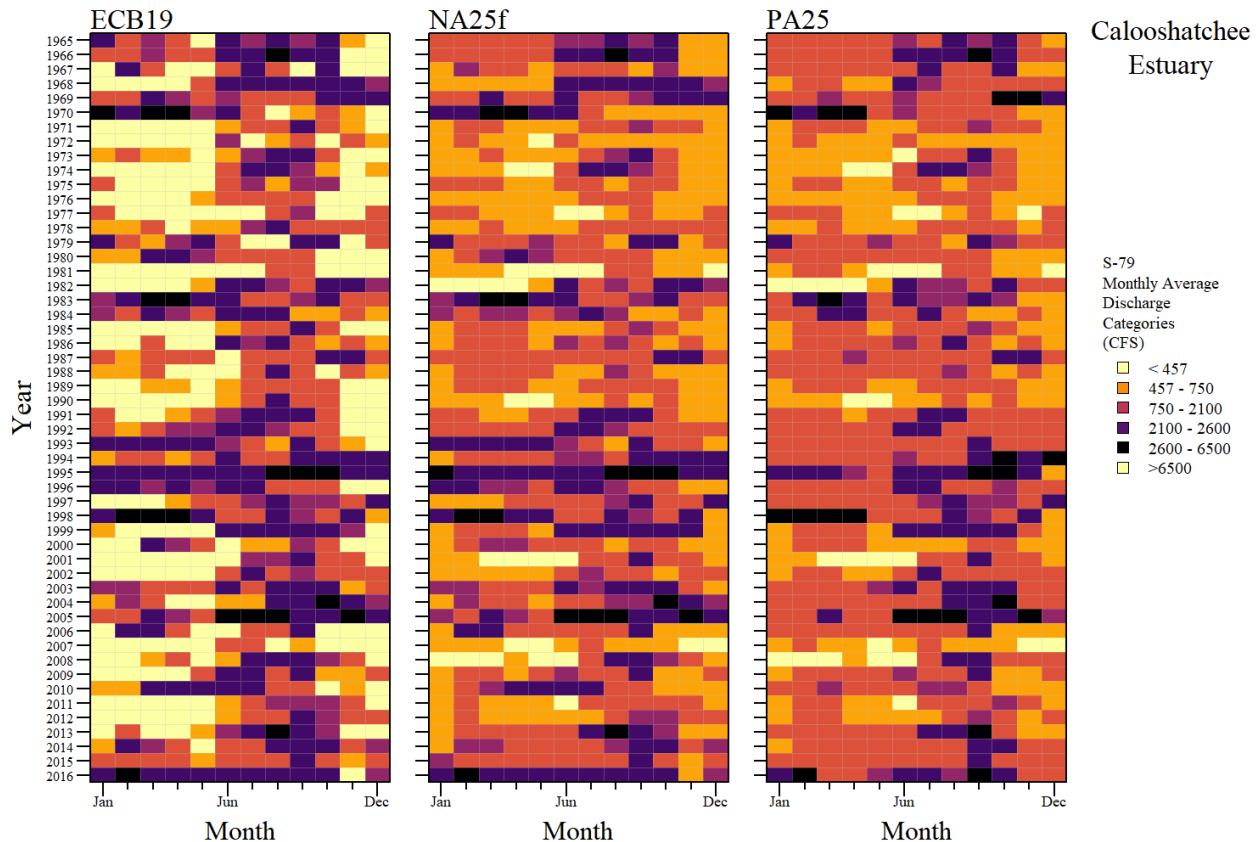
Estuary salinity envelope 14-day event counts for each flow category for Caloosahatchee (top) and St. Lucie (bottom).

# Salinity Envelope



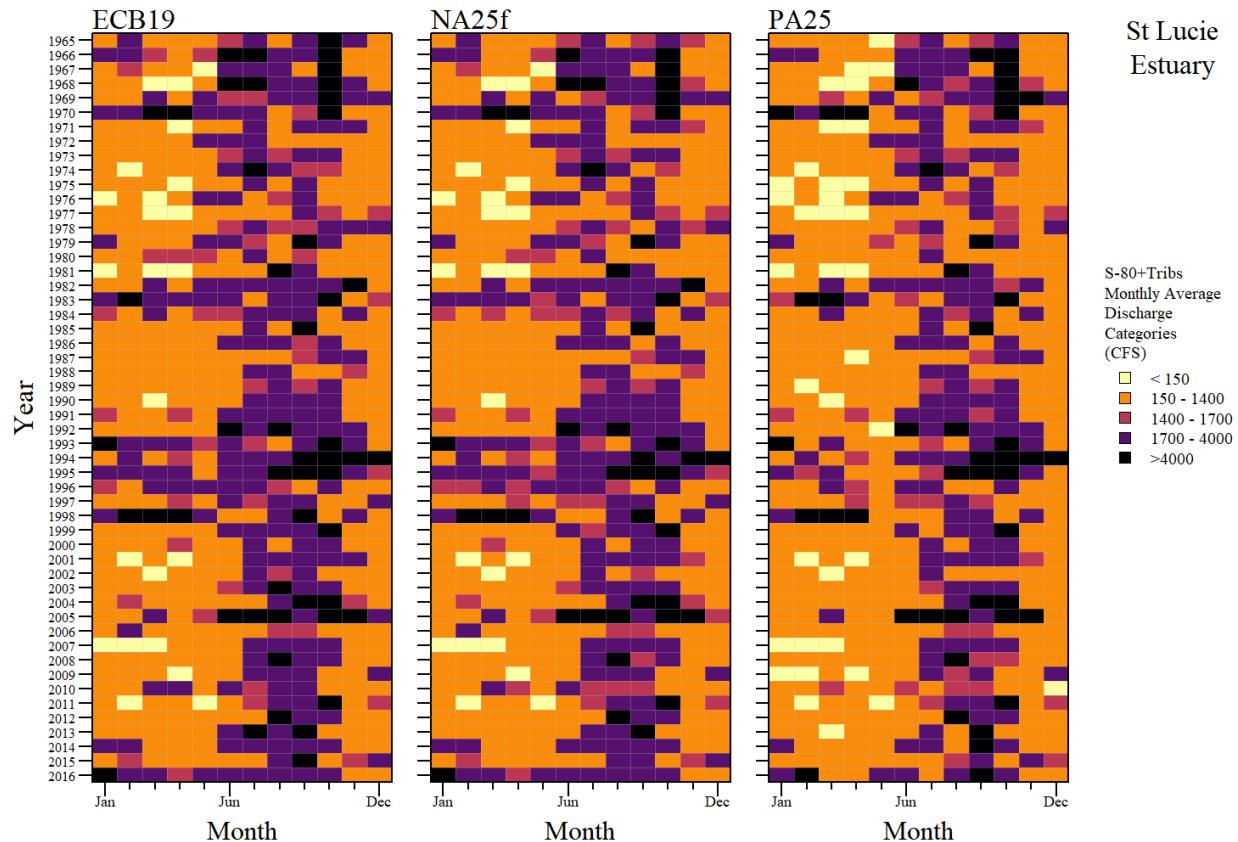
Percent difference of estuary salinity envelope 14-day event counts for each flow category relative to FWO (NA25f) for Caloosahatchee (top) and St. Lucie (bottom).

# CRE Discharge



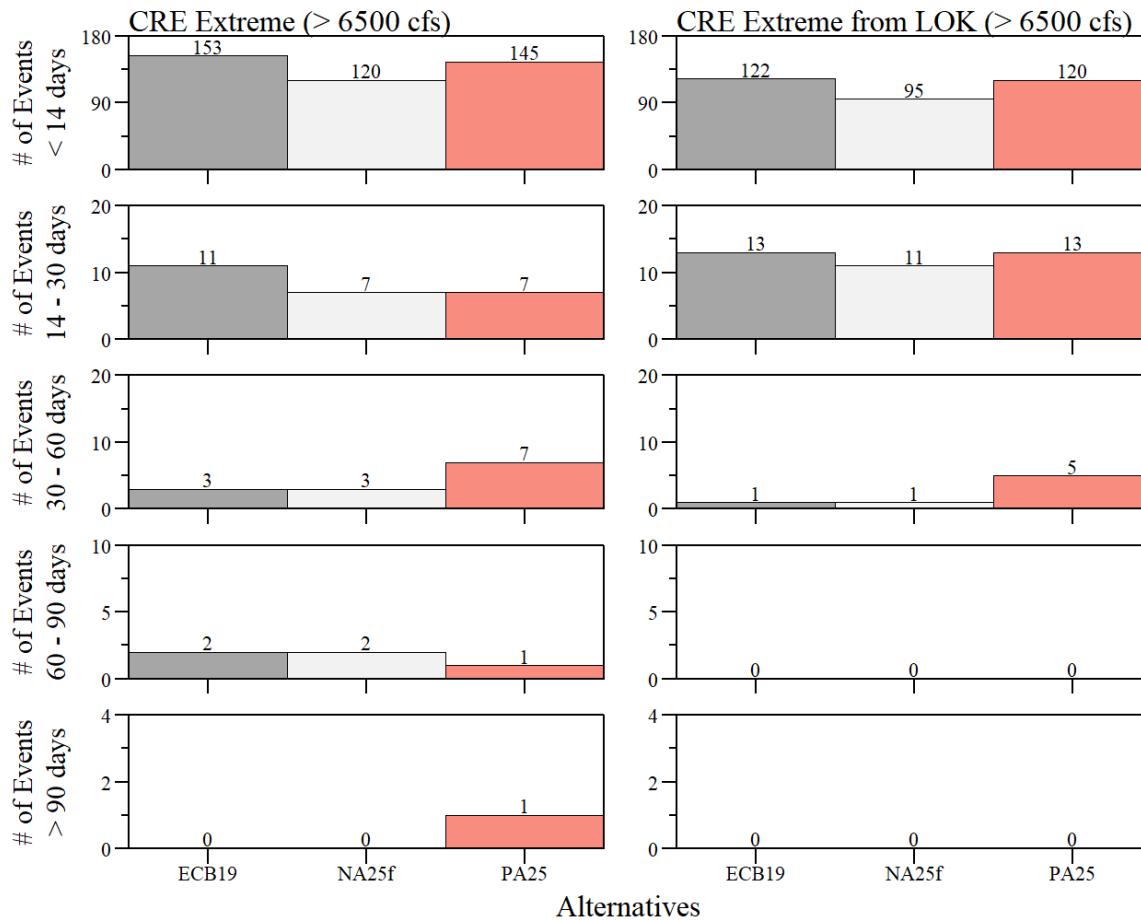
Calendar plot of monthly mean discharge from S-79 (to CRE) for existing condition (ECB19), future without (NA25f) and preferred alternative (PA25).

# SLE Discharge



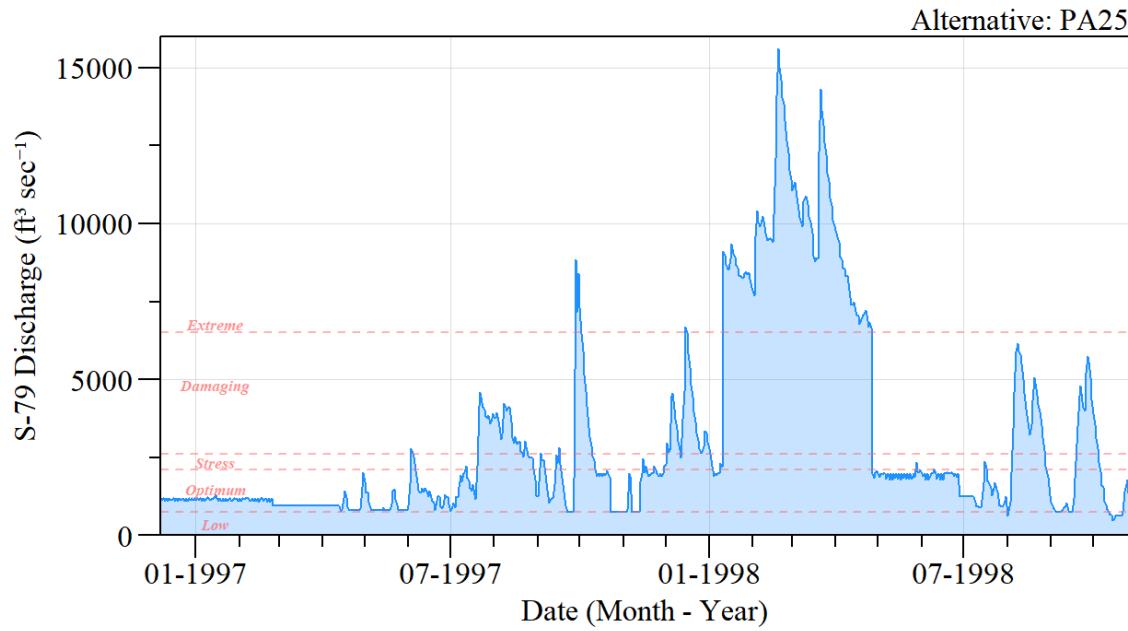
Calendar plot of monthly mean discharge from S-80 + other tributaries (TMC, C24 & C23; to SLE) for existing condition (ECB19), future without (NA25f) and preferred alternative (PA25).

# Salinity Envelope - Extreme



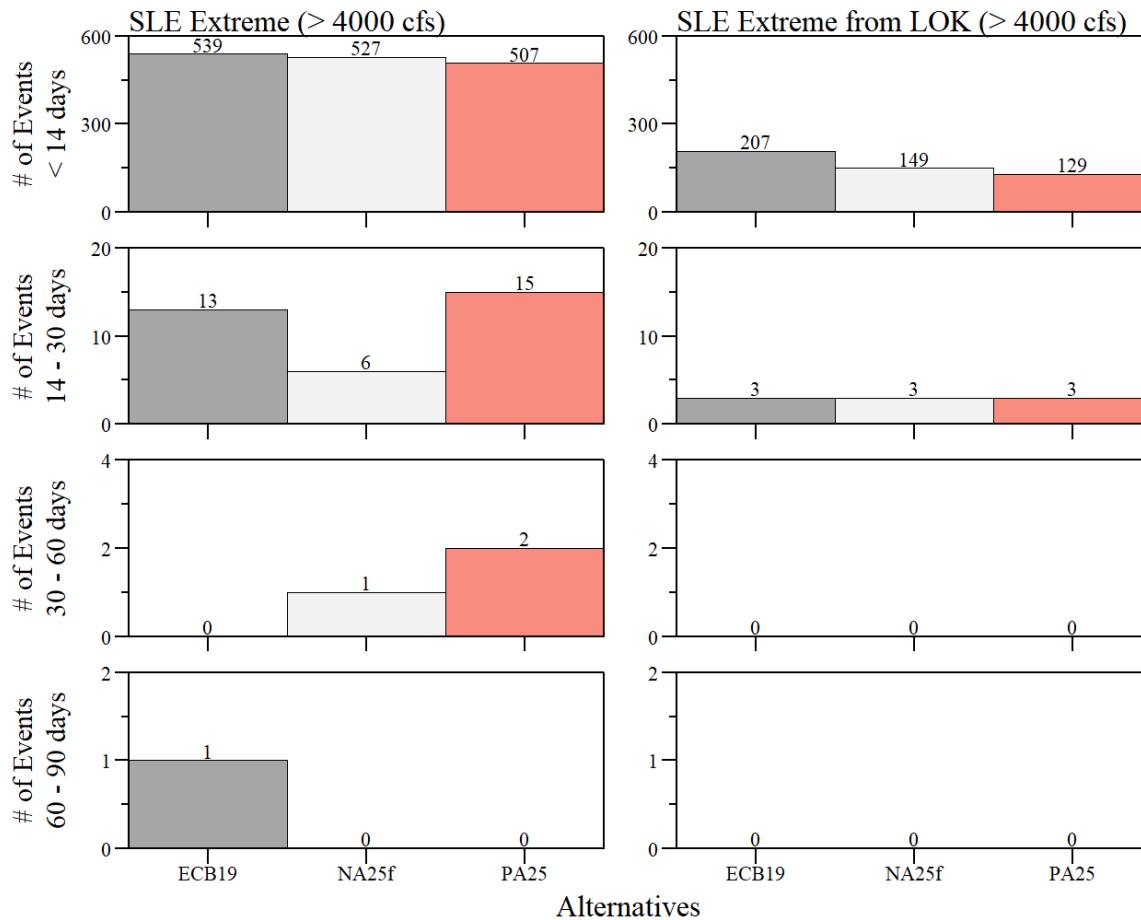
Total (left) and Lake derived (right) extremem discharge events and duration for the Caloosahatchee River Estuary.

# Salinity Envelope - Extreme



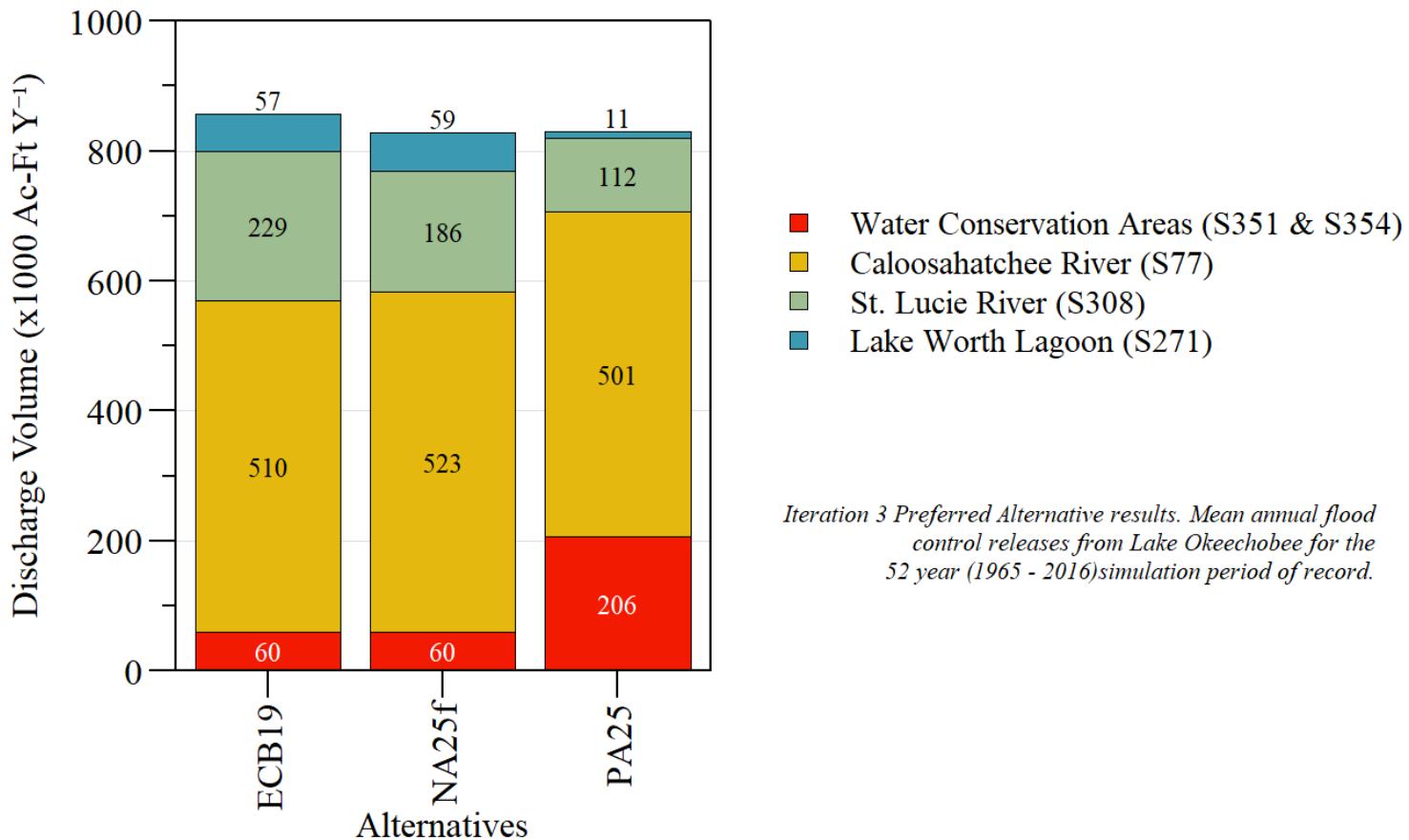
Example of >90 Day (106 days) extreme event observed in the simulation period of record.

# Salinity Envelope - Extreme



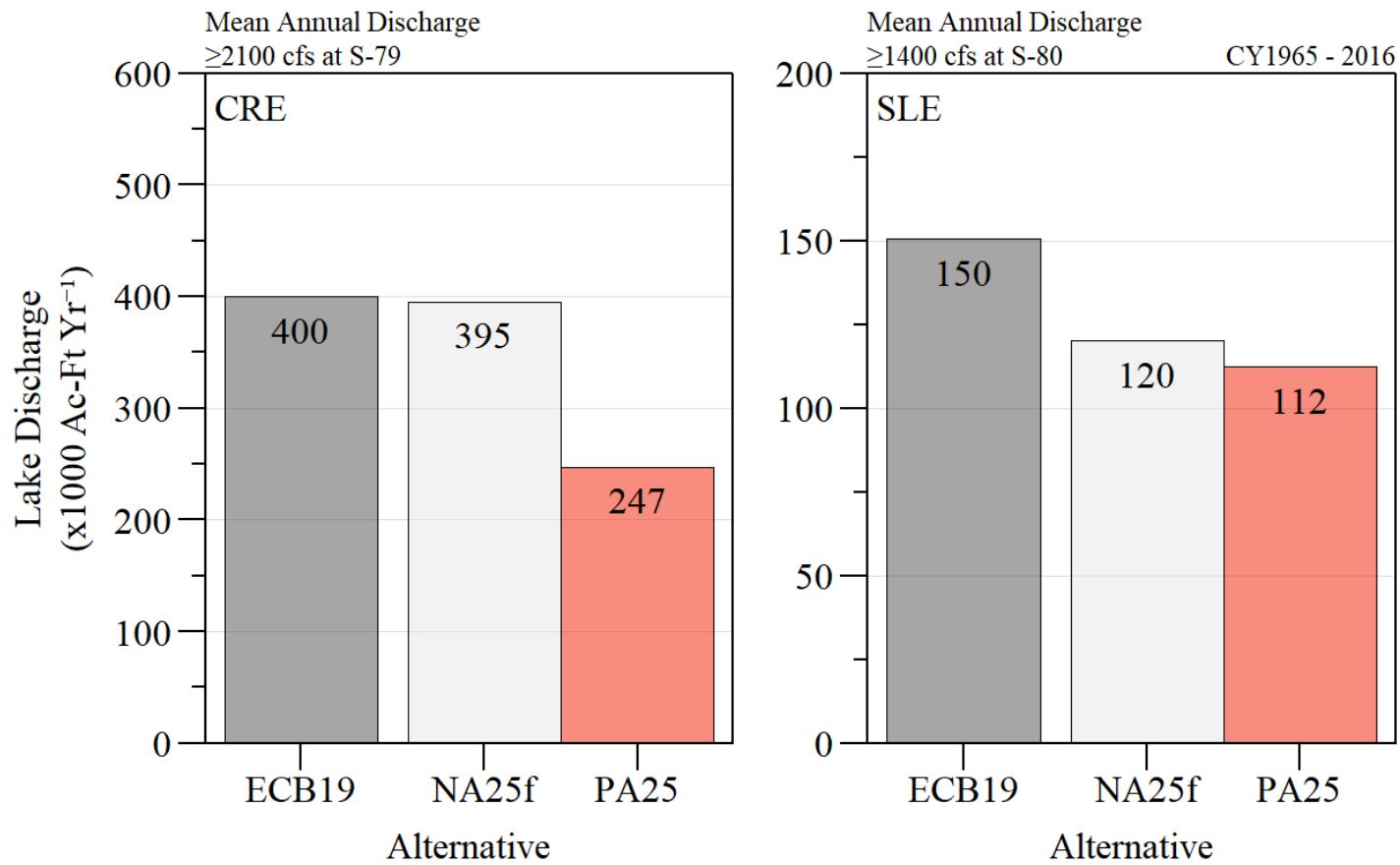
Total (left) and Lake derived (right) extreme discharge events and duration for the St Lucie River Estuary.

# Regulatory Discharges



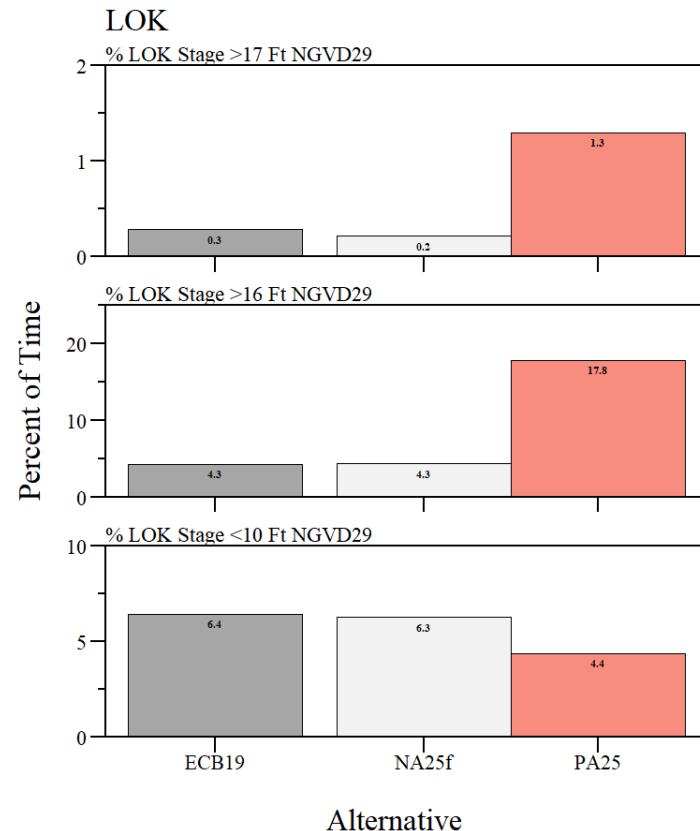
Regulatory/Flood control discharge for major Lake Okeechobee outlets.

# Regulatory Discharges



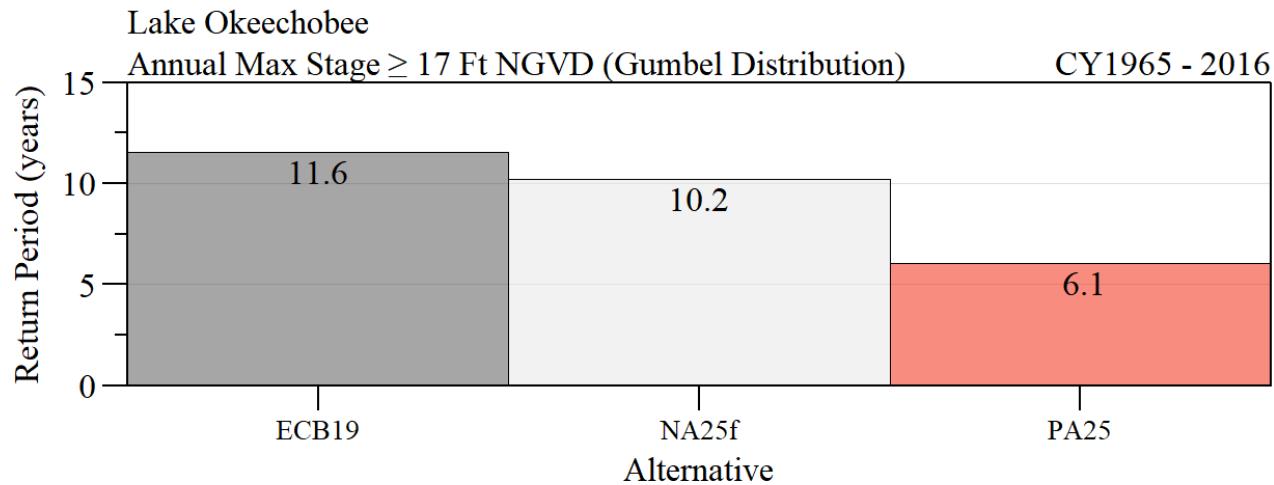
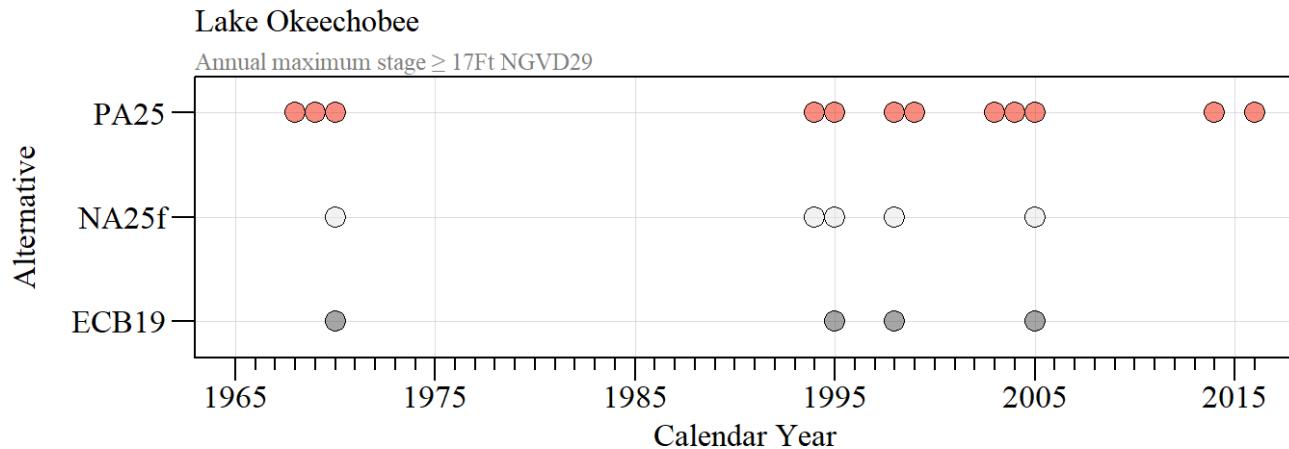
Lake sourced discharge to CRE (left) and SLE (right) during stress and damaging flow events.

# Lake Okeechobee

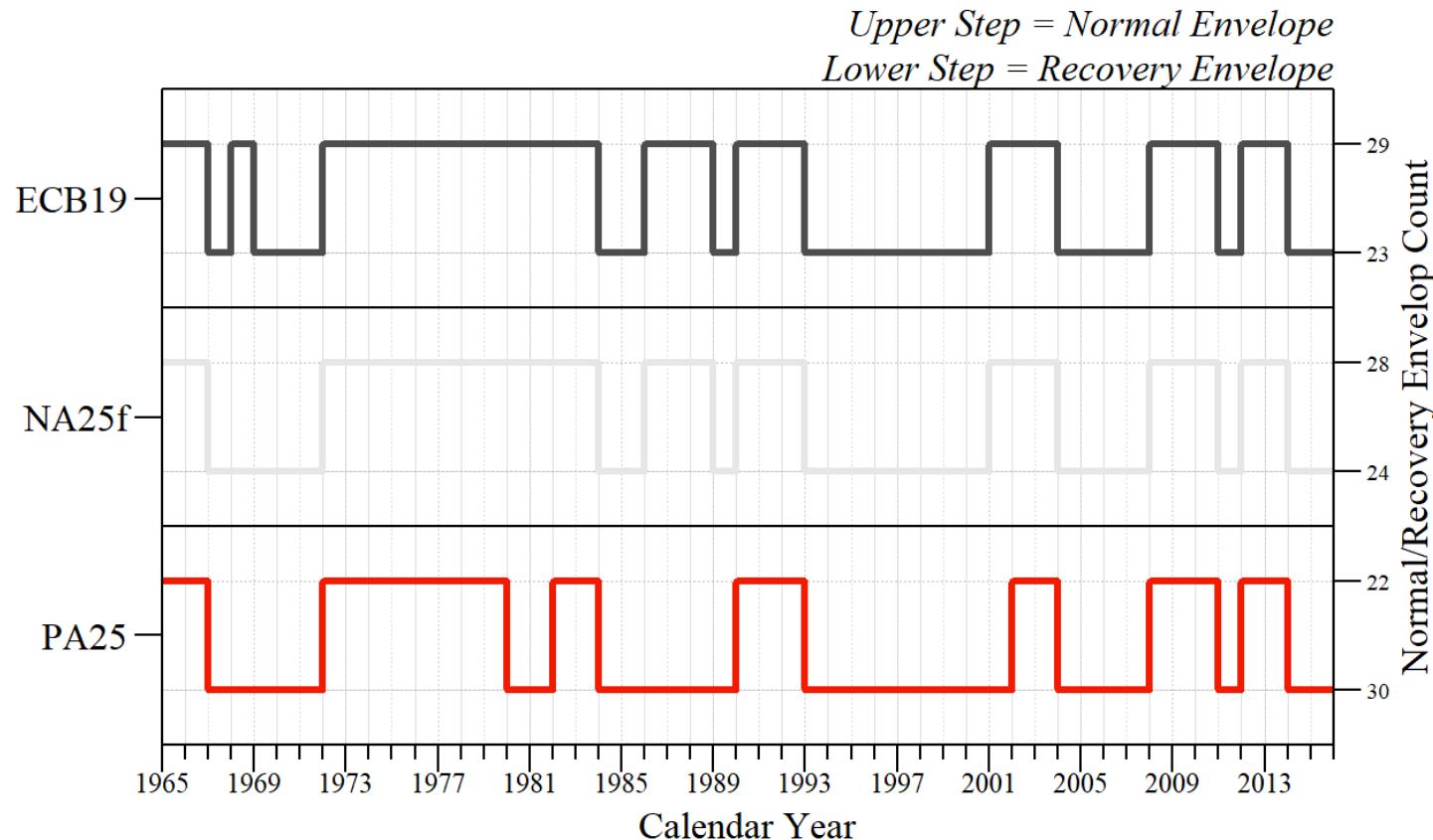


Percent of time >17, >16 and <10 Ft NGVD during period of simulation

# Lake Okeechobee

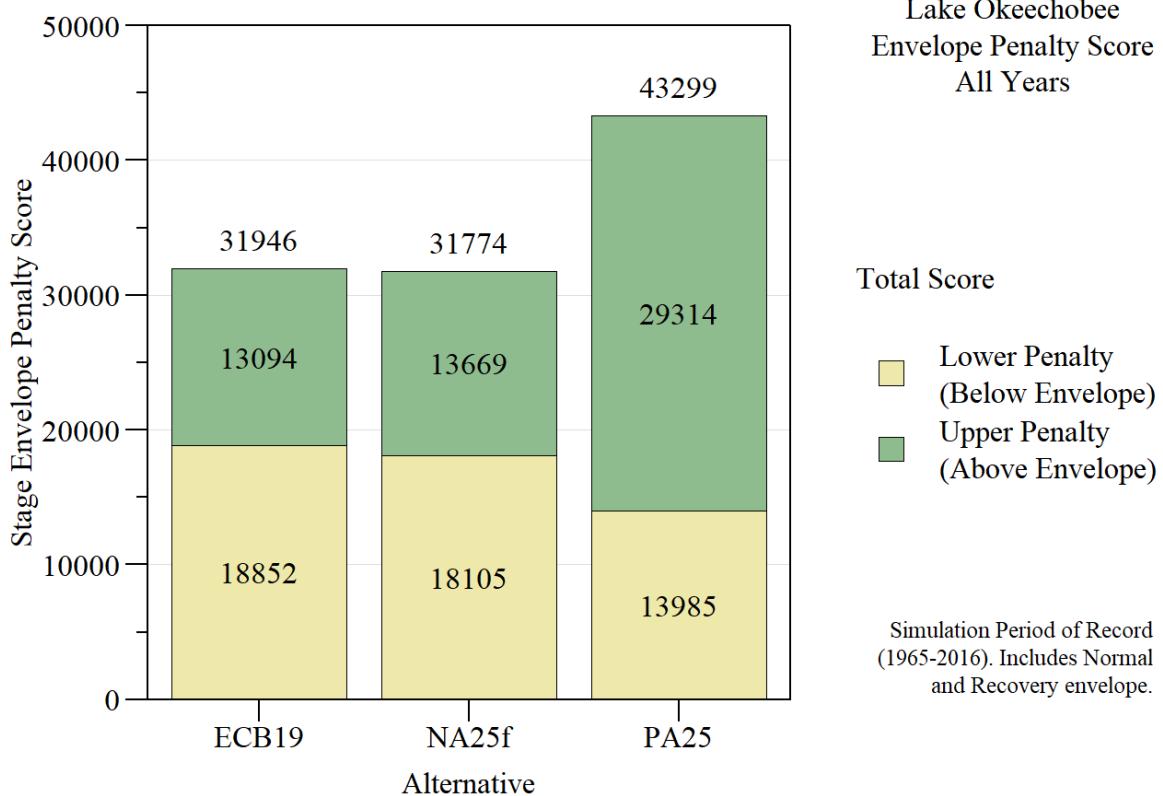


# Lake Okeechobee - Stage Envelope



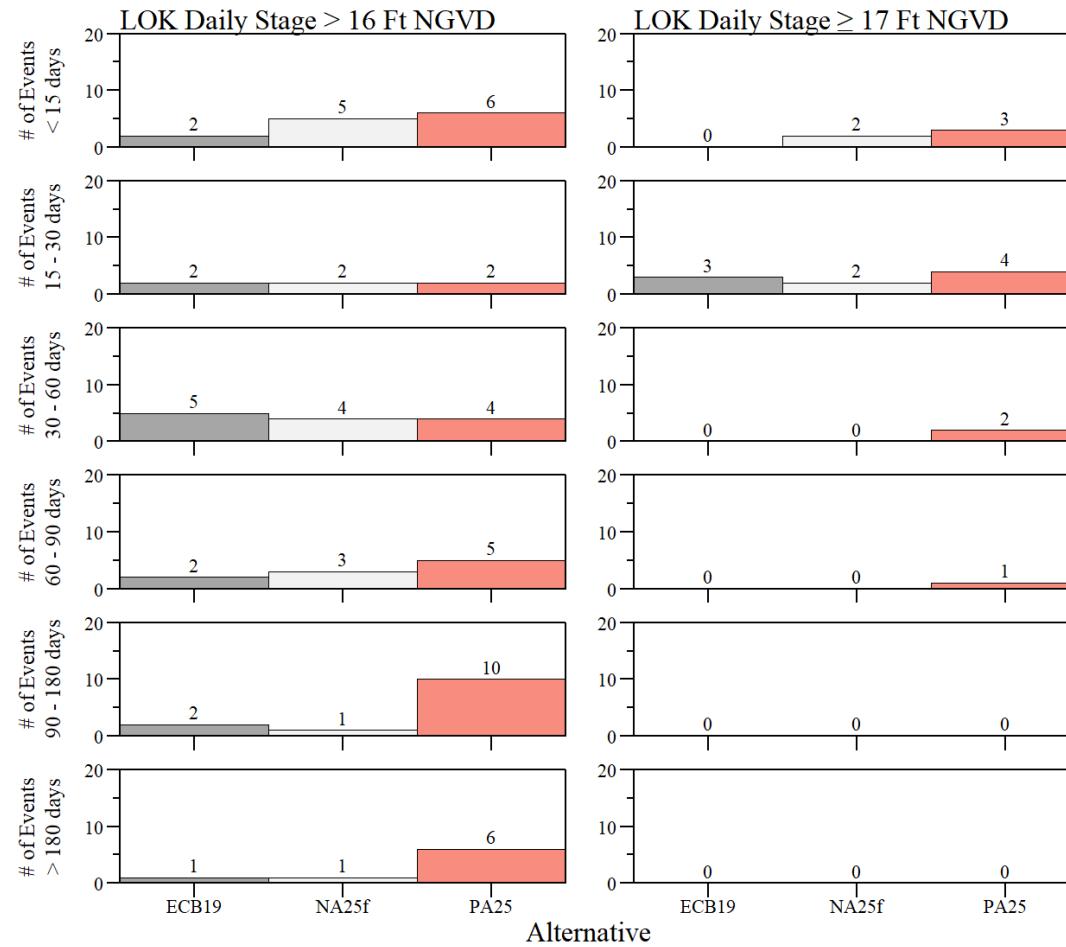
Normal and recovery ecological stage envelope timeline for each alternative.

# Lake Okeechobee - Stage Envelope



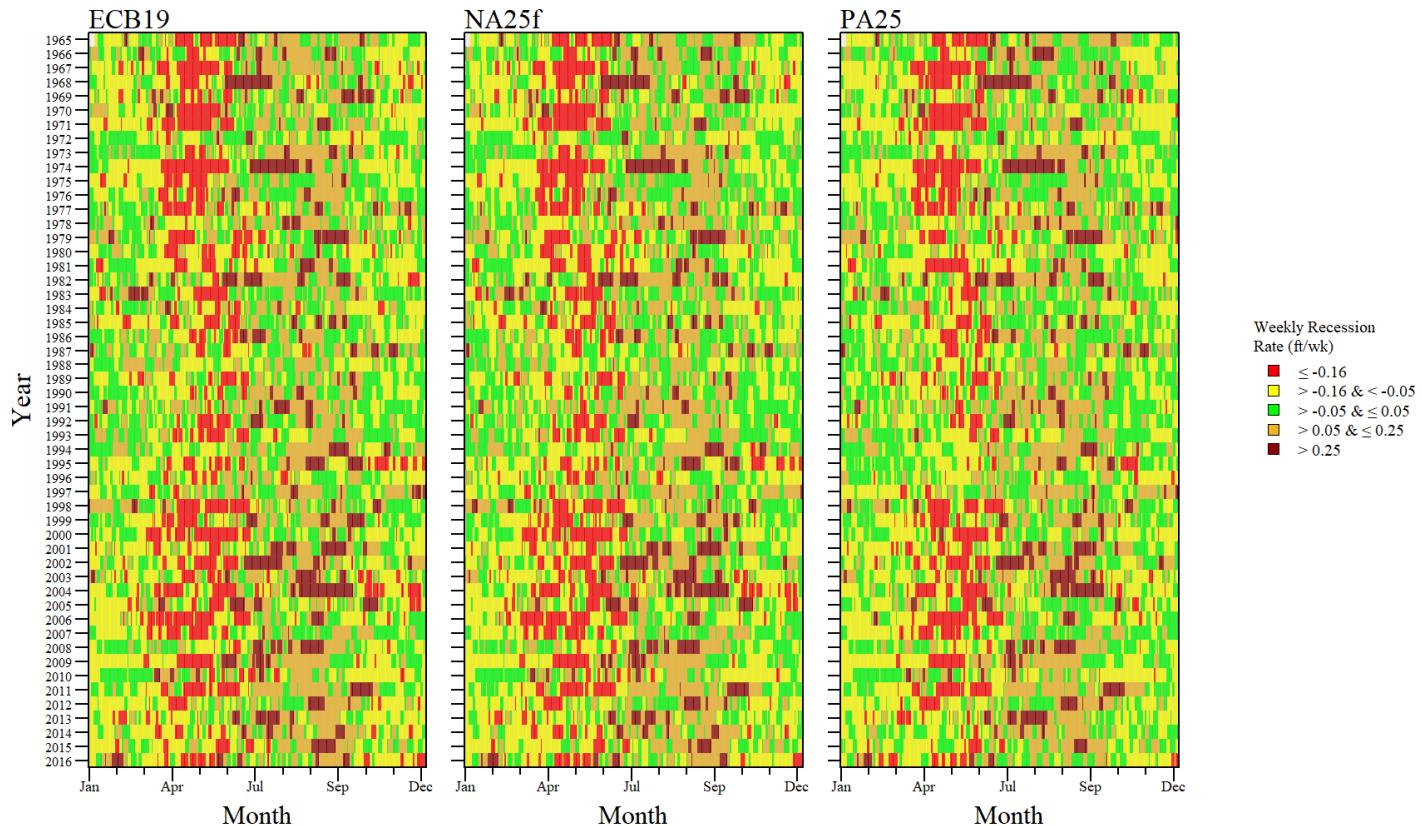
LOK ecological stage envelope total scores (all years).

# Lake Okeechobee - Extreme Stage Events



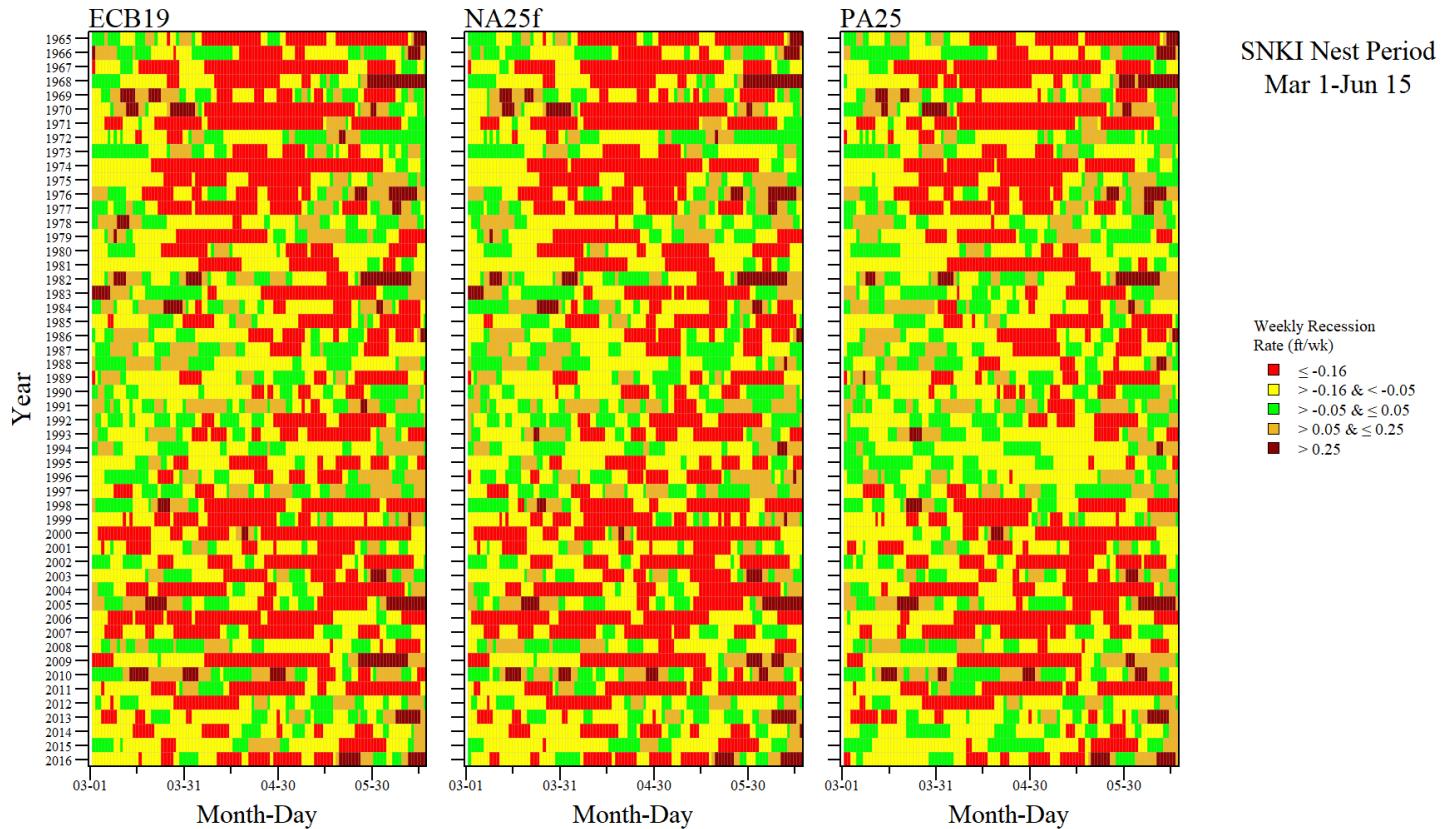
Lake Okeechobee high stage events and duration.

# Lake Okeechobee - weekly recession



Calendar plot of LOK weekly recession rates (all years and days).

# Lake Okeechobee - weekly recession



Calendar plot of LOK weekly recession rates specific to SNKI nesting period.

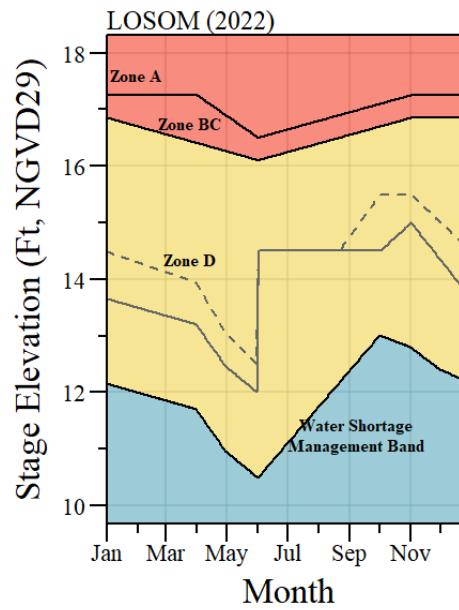
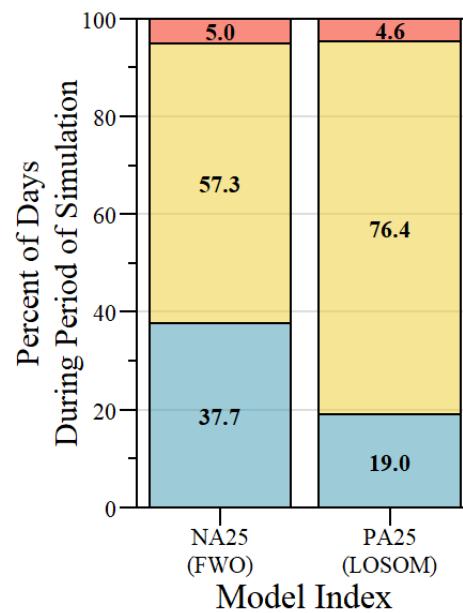
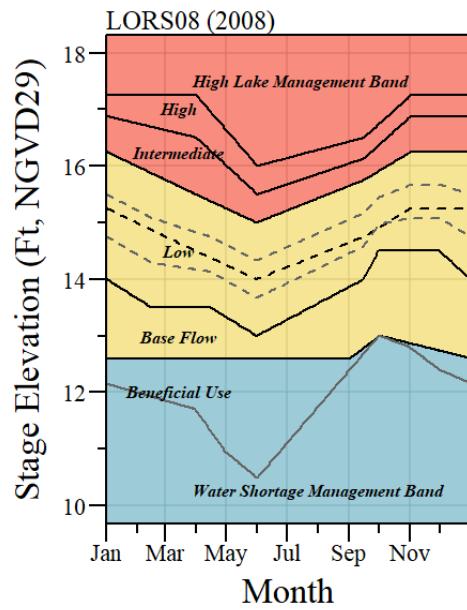
# Performance Measure Summary

Performance Measure <sup>1</sup>	ECB19	NA25f	PA25	% Diff. FWO <sup>2</sup>
CRE - Low Q Sal. Env.	663	556	455	-18.2
CRE - Optimum Q Sal. Env.	469	588	765	30.1
CRE - Stress Q Sal. Env.	184	183	66	-63.9
CRE - Damaging Q Sal. Env.	198	187	81	-56.7
CRE - Extreme Q Sal. Env.	66	57	72	26.3
SLE - Low Q Sal. Env.	109	107	183	71.0
SLE - Optimum Q Sal. Env.	831	865	912	5.4
SLE - Stress Q Sal. Env.	164	145	30	-79.3
SLE - Damaging Q Sal. Env.	159	140	38	-72.9
SLE - Extreme Q Sal. Env.	179	162	164	1.2
CRE - Extreme Q > 30 days	5	5	9	80.0
SLE - Extreme Q > 30 days	1	1	2	100.0
S77 Reg. Discharge	510.0	523.1	501.1	-4.2
S271 Reg. Discharge	56.8	58.7	11.2	-80.9
S308 Reg. Discharge	229.1	186.1	112.4	-39.6
S351+S354 Reg. Discharge	60.4	60.1	205.7	242.1
LOK - Stage Env.	31946	31774	43299	36.3
LOK $\geq$ 17Ft	54	41	246	500.0
LOK $\leq$ 10Ft	1220	1188	829	-30.2

<sup>1</sup> Units: Sal Env. = 14 Day periods; Extreme Q > 30 days = Events; Reg. Discharge = kAcFt Yr<sup>-1</sup>; Stage Env. = Total Penalty Score; LOK  $\geq$  17Ft &  $\leq$  10Ft = Days during simulation

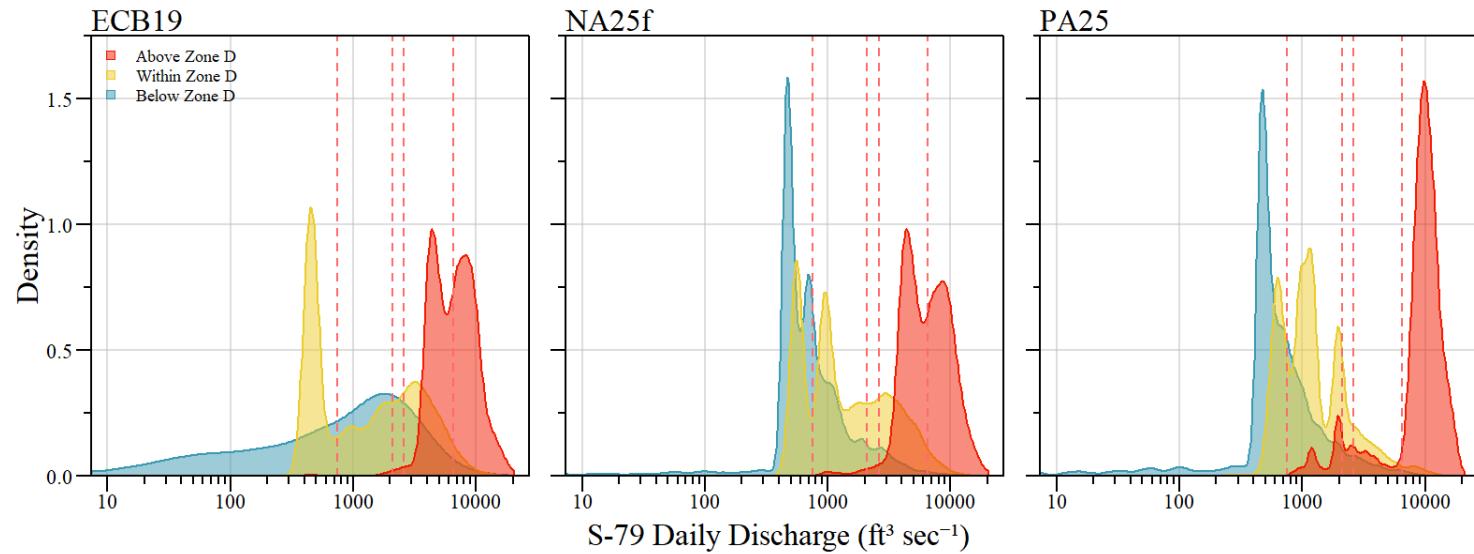
<sup>2</sup> Percent difference relative to FWO (NA25f)

# Lake Okeechobee Regulation Schedule



Percent of time above, within, and below Zone D of the regulation schedule.

# Lake Okeechobee Regulation Schedule



Distribution of daily discharge relative to Lake stages above, within and below Zone D.

# Lake Okeechobee Regulation Schedule

Under LOSOM "we" should see:

- Reduced low flow discharges to CRE
- Reduced stressful, and damaging discharges (from Lake) to CRE
- Increased optimal discharges to CRE
- Increased extreme discharges to CRE
- Higher Lakes stages more frequently
- Increased flows south
- Reduced regulatory volumes to CRE, SLE, and LWL.

# Application of Hydrologic Restoration Goals for a Large Subtropical Lake (*In Prep.*)

Based on methodology of Havens (2002).

Lake stage is a major driver in Lake ecology (see Conceptual Ecological Model).

- Extreme high lake stage (>5.2 m/17 Ft NGVD29)
- Moderate high lake stage (>4.9 m/16 Ft NGVD29) > 90 days
- Moderate low lake stage (<3.3 m/11 Ft NGVD29) > 90 days
- Extreme low lake stage (<3.0 m/10 Ft NGVD29)
- Spring/SNKI nest period recession
  - March 1 - June 15
  - weekly recession rate between -0.05 and 0.05 Ft/wk (0.02 m/wk) for more than 1/4th of nesting period.
- Events per decade

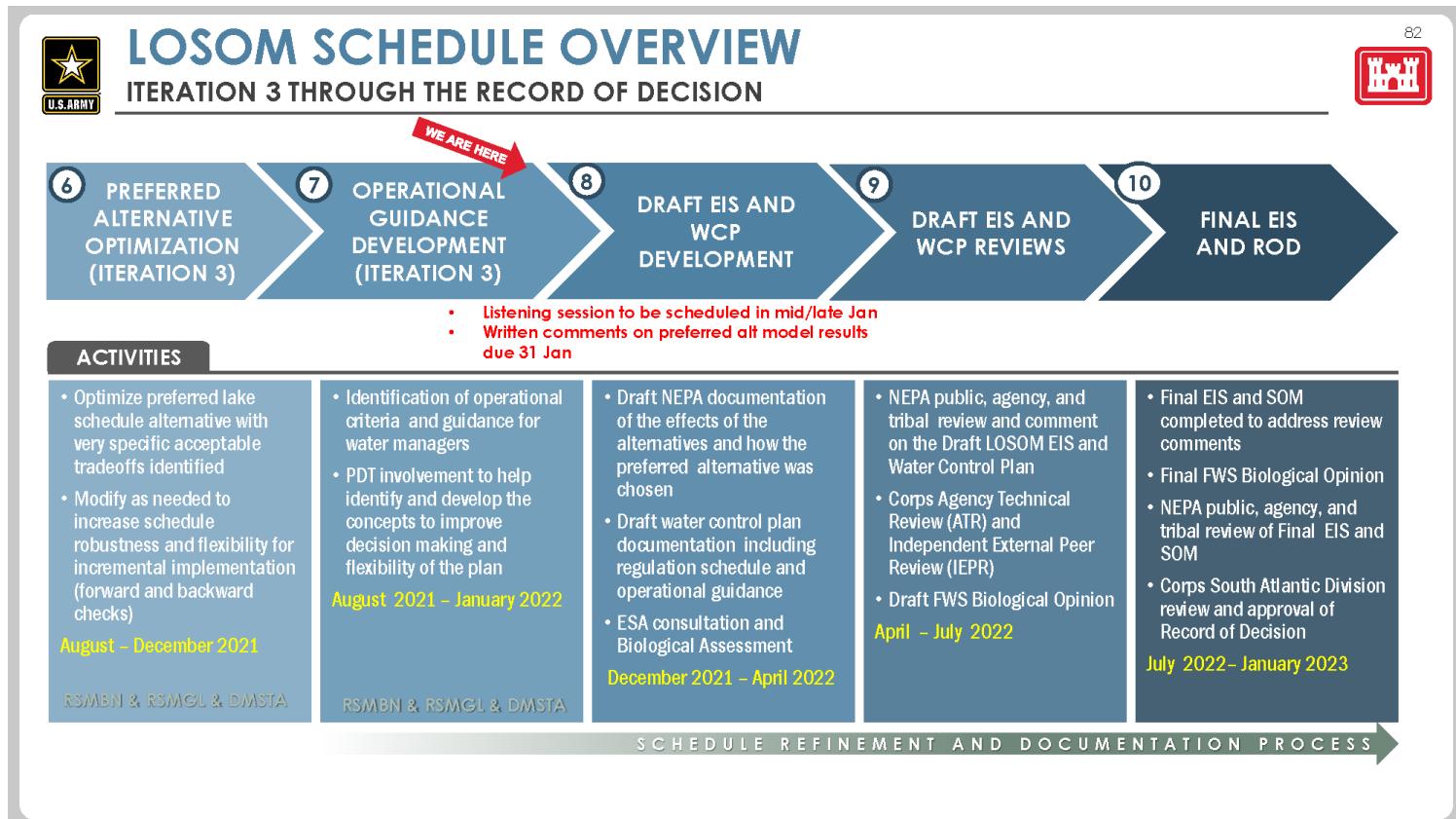
## Preliminary results:

Alternative	Score
ECB19	0.75
NA25f	0.78
<u>PA25</u>	0.53

- PA25 has higher Extreme & Moderate high stage events (see Extreme Event Analysis slide) lowering the score.
- LOSOM is not a restoration plan but should take into account ecology of the system.
- Benefits to other parts of the system is balanced on the back of the Lake

Havens (2002) Development and Application of Hydrologic Restoration Goals for a Large Subtropical Lake. Lake and Reservoir Management 18:285–292. doi: [10.1080/07438140209353934](https://doi.org/10.1080/07438140209353934)

# Where we are today...



From USACE PDT 12 Jan 2022 meeting presentation