

# LAKE OKEECHOBEE SYSTEM OPERATING MANUAL

## BLUE-GREEN ALGAE TASK FORCE MEETING 19 NOVEMBER 2020

U.S. Army Corps of Engineers (USACE)  
Jacksonville District



US Army Corps  
of Engineers®



# MEETING PURPOSE



- Introduce Lake Okeechobee System Operations Manual Algae Bloom Risk Metric
- Request Blue Green Algae Task Force Review





# OUTLINE OF PRESENTATION



- Opening Remarks and Public Engagement
- Overview of Lake Okeechobee System Operating Manual
- USACE Request to Blue Green Algae Task Force
- Introduction of Draft Algal Bloom Risk Metric
- Discussion



# OPENING REMARKS AND PUBLIC ENGAGEMENT

Colonel Andrew Kelly, Commander, USACE, Jacksonville District



# OPENING REMARKS: WHAT ARE WE DOING AND WHY?



## What are we doing?

- Conducting a study to evaluate Lake Okeechobee operations
- Study will result in a new operational manual
- No new infrastructure will result from the study

## Why are we doing it now?

- Herbert Hoover Dike Rehabilitation will be complete in 2022
- Section 1106 of Water Resources Development Act (WRDA) of 2018:

***“The Secretary shall expedite completion of the Lake Okeechobee regulation schedule to coincide with completion of the Herbert Hoover Dike project and may include all relevant aspects of the Comprehensive Everglades Restoration Plan described in section 601 of the Water Resources Development Act of 2000 (114 Stat. 2680)”.***



# OPENING REMARKS- GOALS AND OBJECTIVES



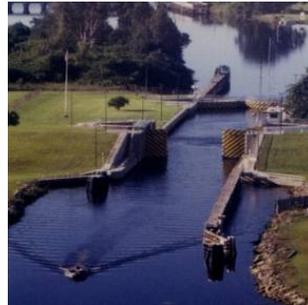
**Goal:** Incorporate flexibility in Lake Okeechobee operations while balancing congressionally authorized project purposes.



Flood Control



Water Supply



Navigation



Recreation



Preservation of Fish & Wildlife

- **Objective 1.** Manage risk to public health and safety, life and property
- **Objective 2.** Continue to meet authorized purposes for navigation, recreation and flood control
- **Objective 3.** Improve water supply performance
- **Objective 4.** Enhance ecology in Lake Okeechobee, northern estuaries and across the south Florida ecosystem.



# OPENING REMARKS- GOALS AND OBJECTIVES: WHAT ABOUT WATER QUALITY?



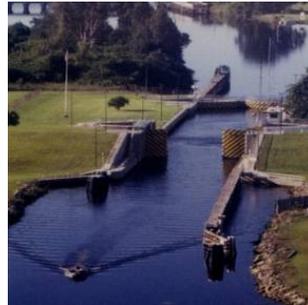
**Goal:** Incorporate flexibility in Lake Okeechobee operations while balancing congressionally authorized project purposes.



Flood  
Control



Water  
Supply



Navigation



Recreation



Preservation  
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Public Comment Period  
(Fall 2022)

**COMPLETION**  
Decision/Approval

**START**  
Scoping Period

10 Public Meetings  
(Feb - Mar 2019)  
> 8,000 comments received

Educational  
Webinars

Final NEPA\*  
Document

# LOSOM Public Engagement Opportunities

Public Comment Period  
(Spring 2022)

Draft NEPA\*  
Document

**PDT+ Meetings & Public Workshops**

- Develop Purpose & Need, Study Objectives, Constraints and Considerations
- Develop Performance Metrics & High-Level Scenarios

[lakeocomments@usace.army.mil](mailto:lakeocomments@usace.army.mil)  
[www.saj.usace.army.mil/LOSOM](http://www.saj.usace.army.mil/LOSOM)

**PDT+ Meetings & Public Workshops (2020 – 2021)**

- Select Operational Alternatives
- Evaluate and Compare Alternatives
- Develop Operational Alternatives

**WE ARE HERE** ←

\* :NEPA, National Environmental Policy Act

+ : PDT, Project Delivery Team

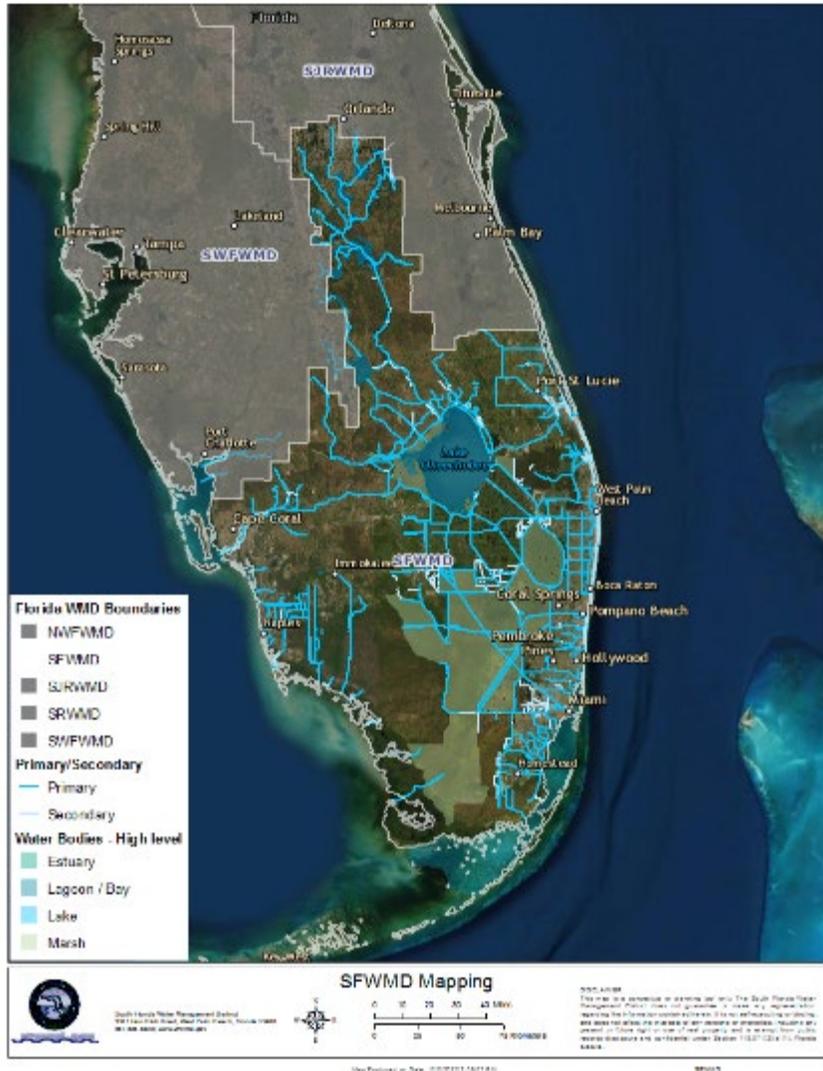


# OVERVIEW OF LAKE OKEECHOBEE SYSTEM OPERATING MANUAL

Tim Gysan, Project Manager, USACE, Jacksonville District



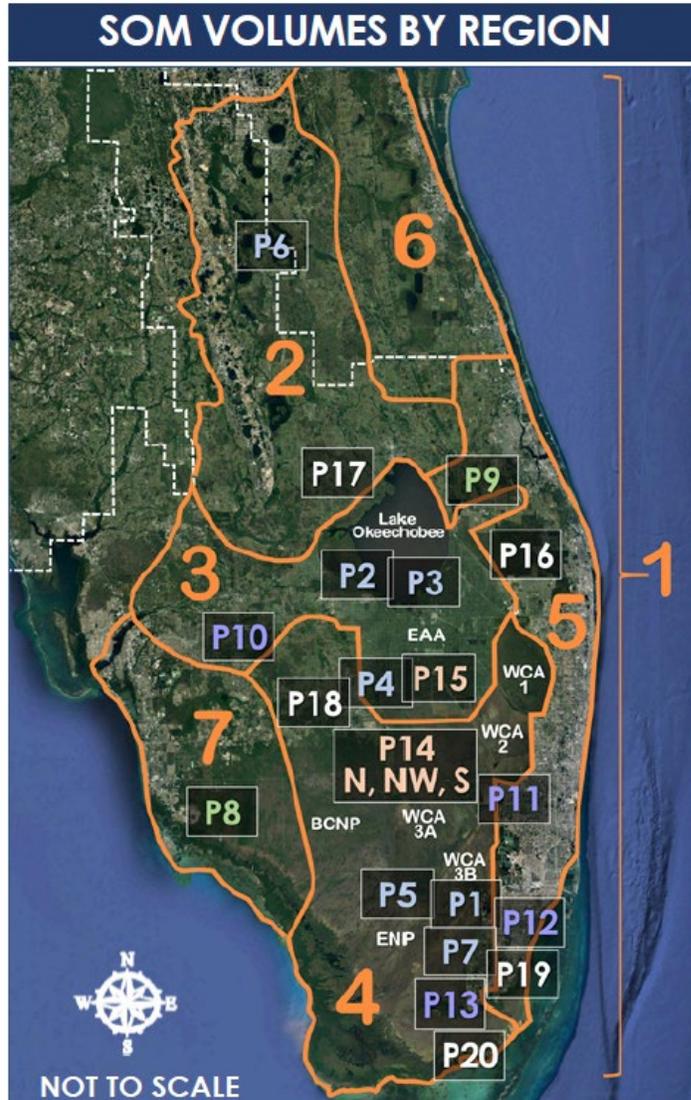
# OVERVIEW OF LOSOM: LAKE OKEECHOBEE IS A PART OF THE SYSTEM



- The Central and Southern Florida (C&SF) Project (*Authorized 1948 – House Document No. 643*)
- Includes an interconnected system of 1,000 miles of canals, 720 miles of levees, and several hundred water control structures
- U.S. Army Corps of Engineers operates and maintains Lake Okeechobee as well as other parts of the C&SF Project
- Lake Okeechobee operations are governed by a manual developed through a public process



# OVERVIEW OF LOSOM: LOSOM REPRESENTS VOLUME 3 OF THE C&SF SYSTEM OPERATING MANUAL



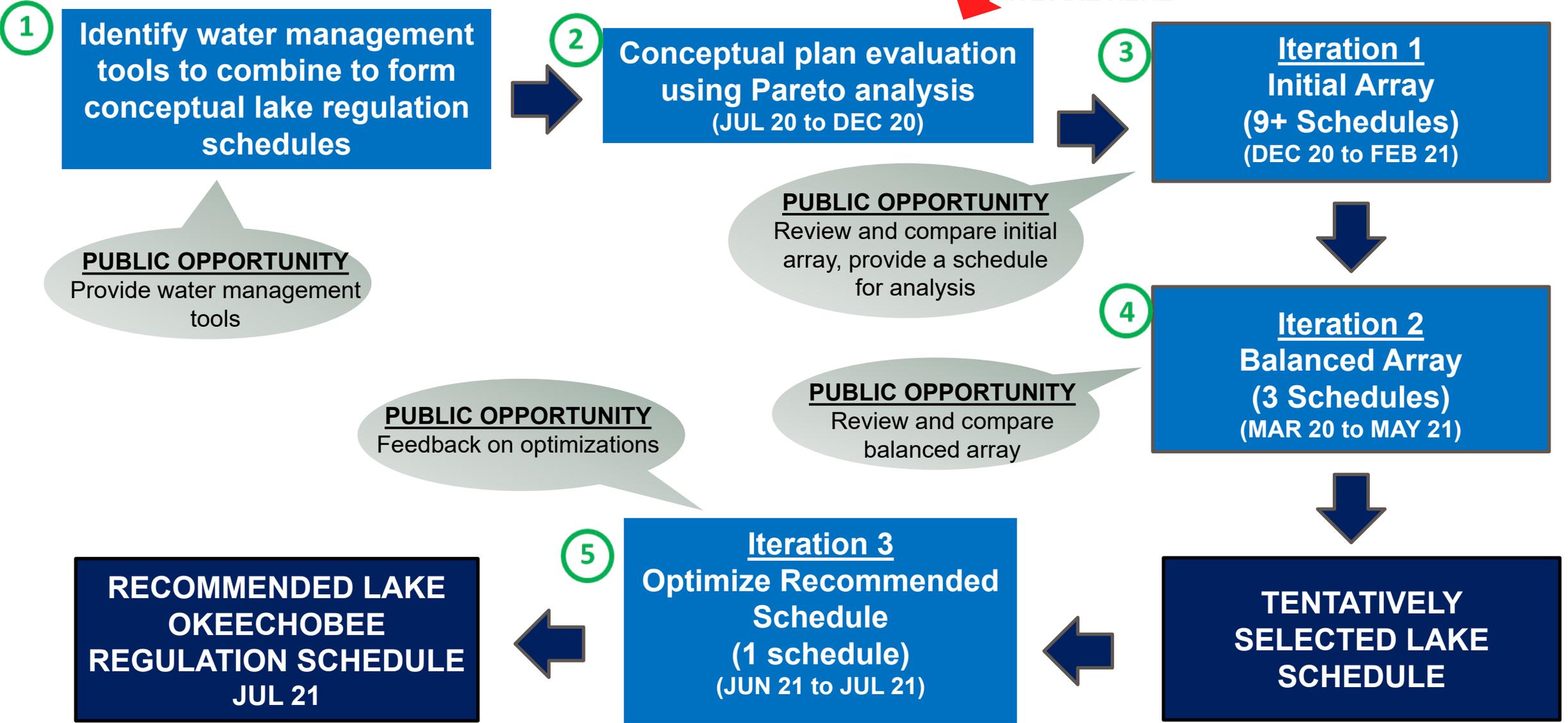
- Operating manuals describe how to operate project components to ensure that the goals and purposes of the projects are achieved.
- The C&SF System Operating Manual (SOM) consists of 7 volumes organized according to geographical regions, that collectively ensure that projects function in a coordinated, systematic way.
- **Volume 3 – Lake Okeechobee and the Everglades Agricultural Area, is the volume being updated in parallel with LOSOM development of Lake Okeechobee regulation schedule**



# OVERVIEW OF LOSOM: PLAN FORMULATION STRATEGY



**WE ARE HERE**





# OVERVIEW OF LOSOM: MODELING



## Regional Hydrologic Models (RSM)

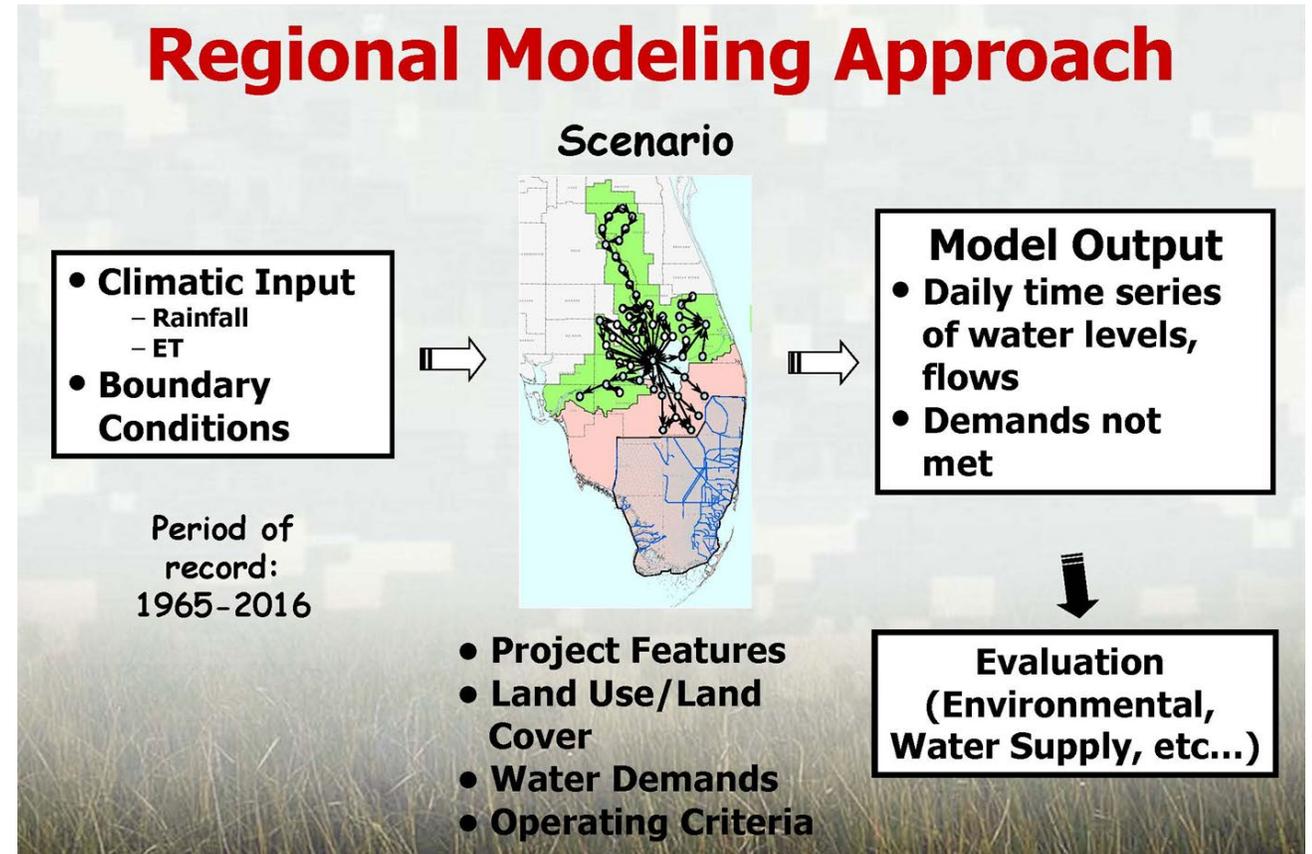
- Primary modeling tools for LOSOM assessment. The models provide daily, detailed estimates of hydrology across the planning domain.
- RSMBN & RSMGL

## Sub-regional & Detailed Models

- Smaller scale, more detailed models to help analyze specific areas of interest
- DMSTA (water-quality)

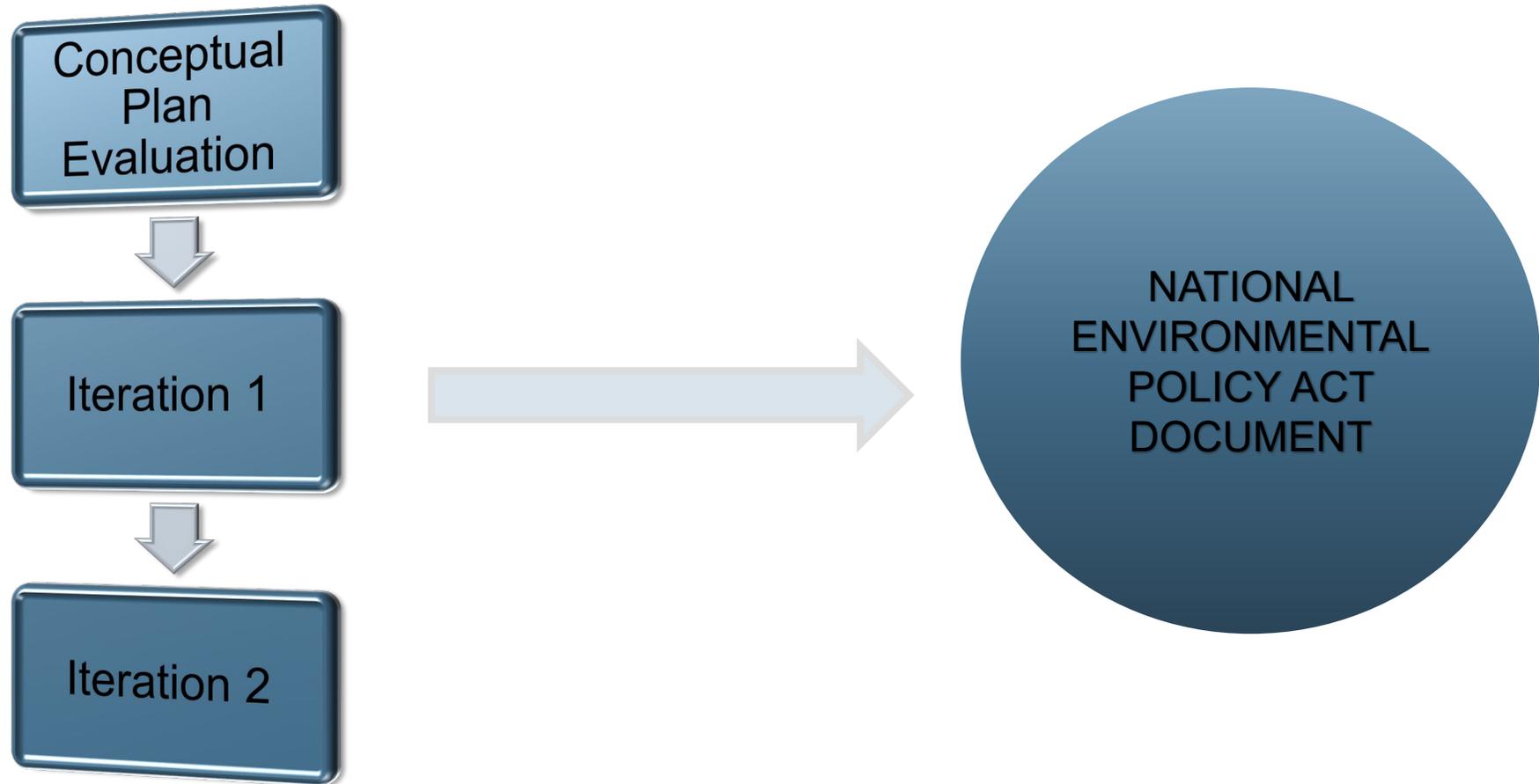
## Screening Tools and Techniques

- Simplified models and data processing techniques to analyze a broad range of options and to screen ideas for further in-depth analysis





# OVERVIEW OF LOSOM: HOW WILL THE METRIC BE USED?



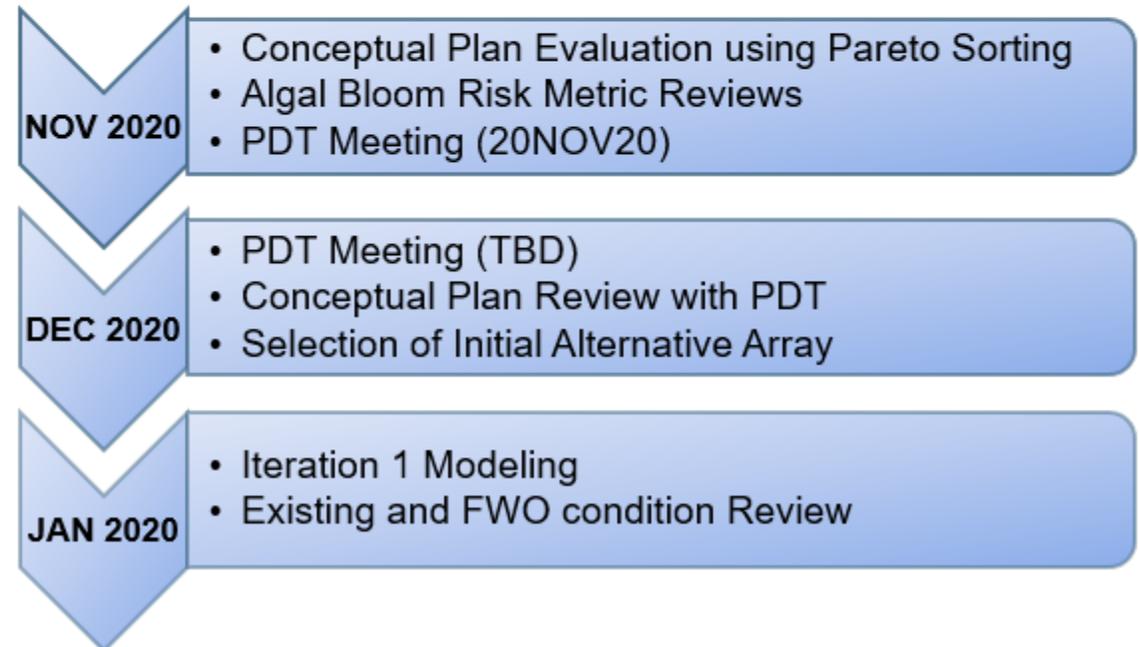


# LOSOM OVERALL SCHEDULE



## 90 DAY LOOK AHEAD

MILESTONE	DATE
Scoping Meetings (complete)	February - March 2019
Plan Formulation & Performance Evaluation Finalized	June 2020
Evaluation of Alternative Lake Schedules	July 2020 – July 2021
Draft Report Release	January 2022
Final Report Release	July 2022
Record of Decision (ROD)	October 2022





# USACE REQUEST TO BLUE GREEN ALGAE TASK FORCE

Colonel Andrew Kelly, Commander, USACE, Jacksonville District



# USACE REQUEST TO BLUE GREEN ALGAE TASK FORCE

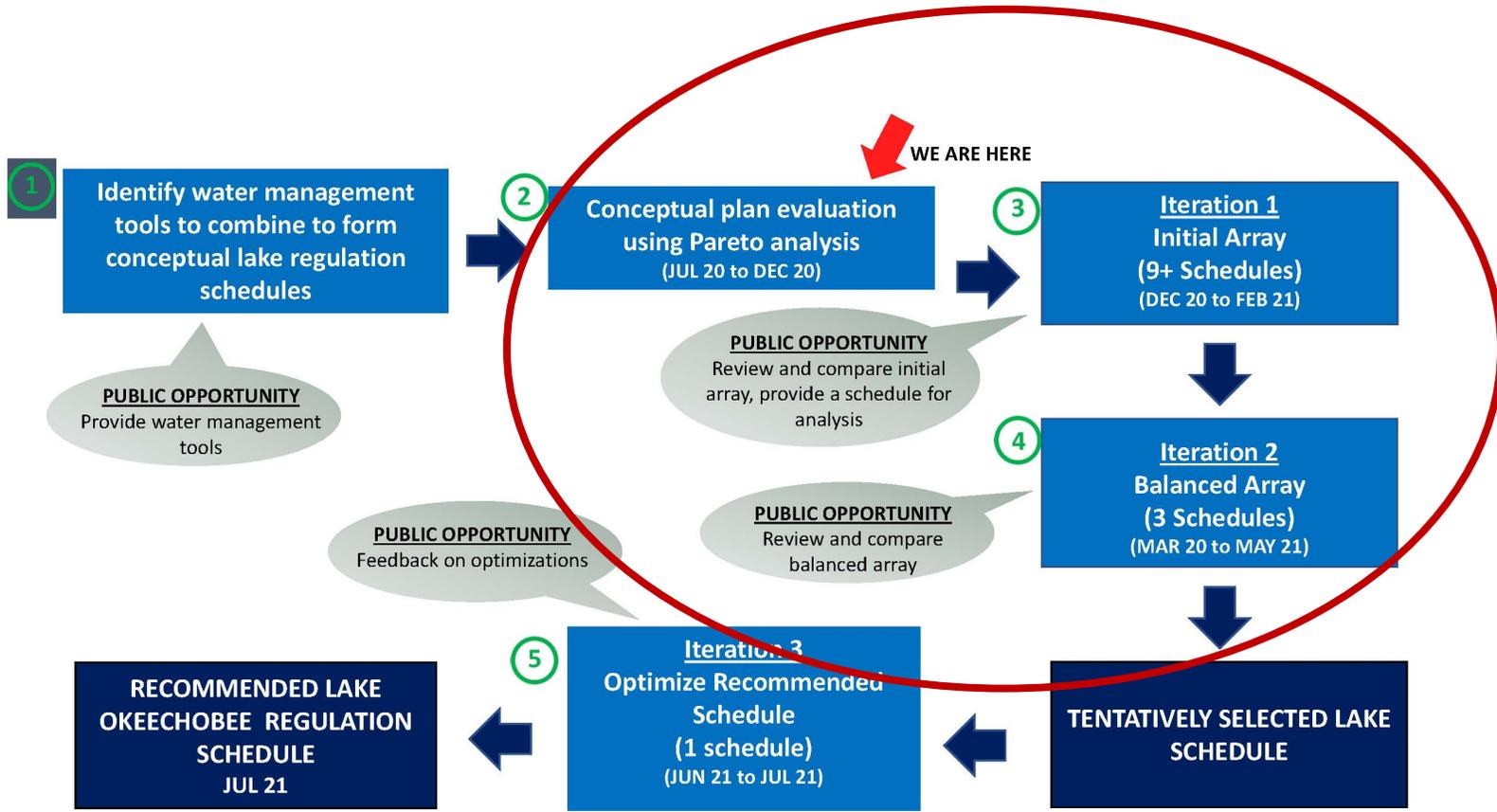


## Does Our Approach Makes Sense?

- Is the metric technically sound relative to its design objectives?
- Any comments on the underlying theory, concept, or computational aspects of the model?
- Do you see any potential issues that may affect the model's usability, reliability, or use in comparing potential alternatives?
- Can you suggest additional tools that we could use to predict the potential for algal bloom risk **given limitation of output from RSMBN (e.g. flow, stage)?**



# USACE REQUEST TO BLUE GREEN ALGAE TASK FORCE



USACE REQUESTS THE BLUE GREEN ALGAE TASK FORCE TO PROVIDE COMMENTS TO USACE BY:

**10 DECEMBER 2020**

USING THE COMMENT RESPONSE MATRIX PROVIDED



# USACE REQUEST TO BLUE GREEN ALGAE TASK FORCE: LOSOM ALGAL BLOOM RISK PERFORMANCE METRIC DOCUMENTATION



## USACE Documents Provided:

- PowerPoint Presentation Overview
- Initial Draft Algal Bloom Risk Performance Metric Documentation Sheet
- Initial Draft Regression Analyses Spreadsheet
- Model Support Literature and Conceptual Ecological Model
- Comment Response Matrix

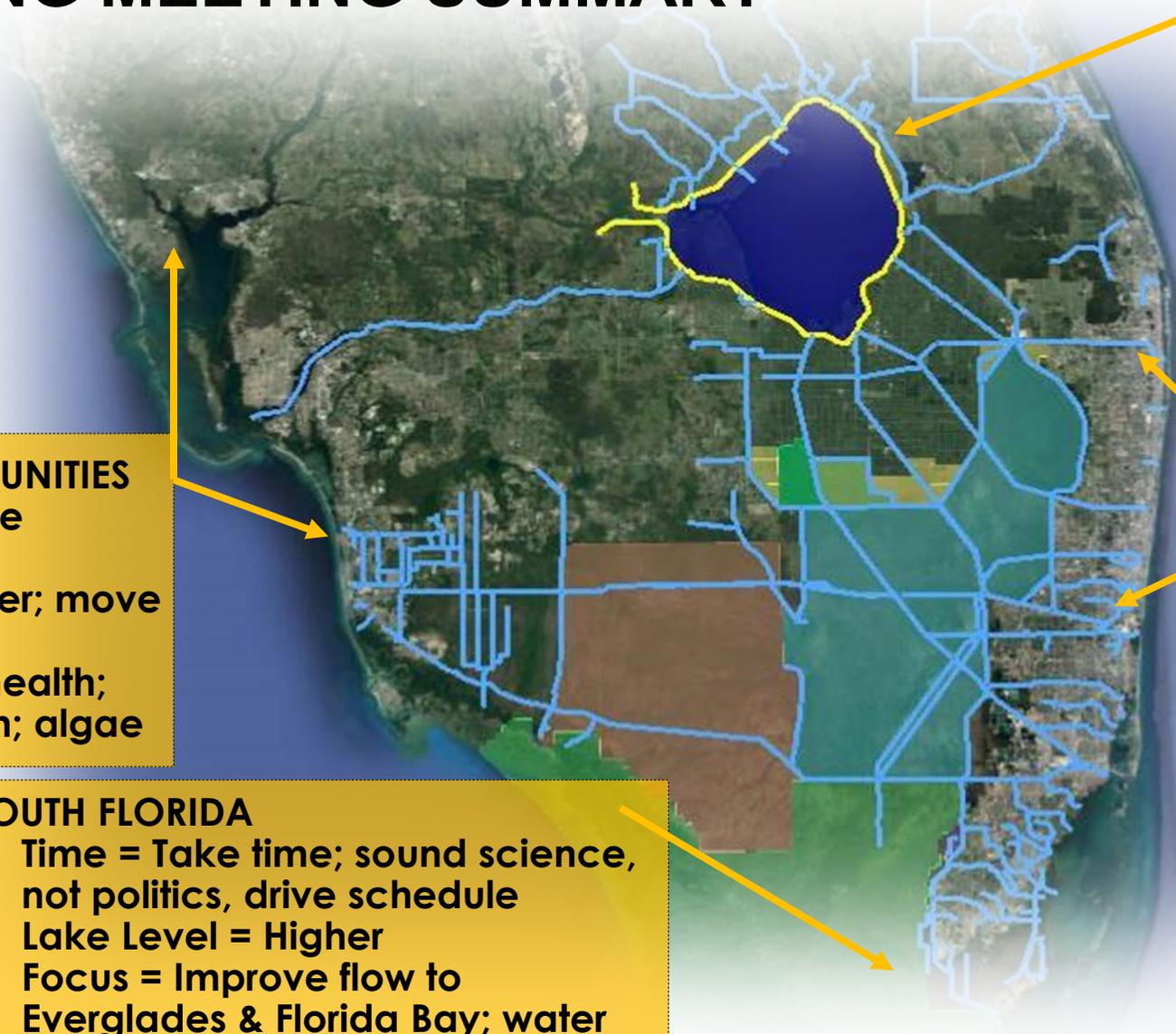


# INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC

Jim Riley, Water Quality Lead



# INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC: SCOPING MEETING SUMMARY



**COMMUNITIES AROUND LAKE O**

- Time = Take time; sound science; not politics, drive schedule
- Lake Level = Higher
- Focus = Water quality; agriculture; water supply; recreation; Lake health

**WEST COAST COMMUNITIES**

- Time = Accelerate LOSOM
- Lake Level = Lower; move water south
- Focus = Human health; ecosystem health; algae

**EAST COAST COMMUNITIES**

- Time = Accelerate LOSOM
- Lake Level = Higher & lower
- Focus = Human health; water supply; water quality; algae; economy

**SOUTH FLORIDA**

- Time = Take time; sound science, not politics, drive schedule
- Lake Level = Higher
- Focus = Improve flow to Everglades & Florida Bay; water supply; water quality



# INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC



2020 REPORT TO CONGRESS:

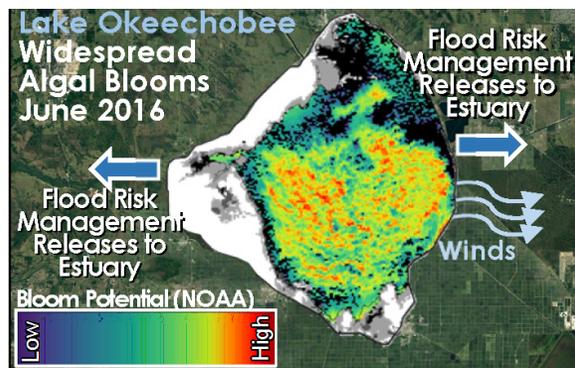
## LAKE OKEECHOBEE | NORTHERN ESTUARIES HARMFUL ALGAL BLOOMS



Algal Blooms in Caloosahatchee Estuary\*

### PRECEDING CONDITIONS

High Rainfall
Nutrient Run-off from Watersheds Surrounding Lake and Estuary
Warm Temperatures
Long Hours of Daylight
Stagnant Conditions
Lake Releases to Estuaries for Flood Risk Management



- Although algal blooms occurred during each year of this reporting period, the summer of 2016 provides an example of the conditions that can spawn these events. June 2016 data indicated high levels of chlorophyll and detection of cyanobacteria in the Lake (June 14, 2016 NOAA cyanobacteria imagery overlaid on the map above).
- Prevailing winds and releases from Lake Okeechobee for Flood Risk Management sent algal blooms and nutrients into the estuaries. Coupled with nutrients from their watersheds, extensive algal blooms formed in the estuaries.

Lake Okeechobee and the Northern Estuaries experienced algal blooms in 2015-2020

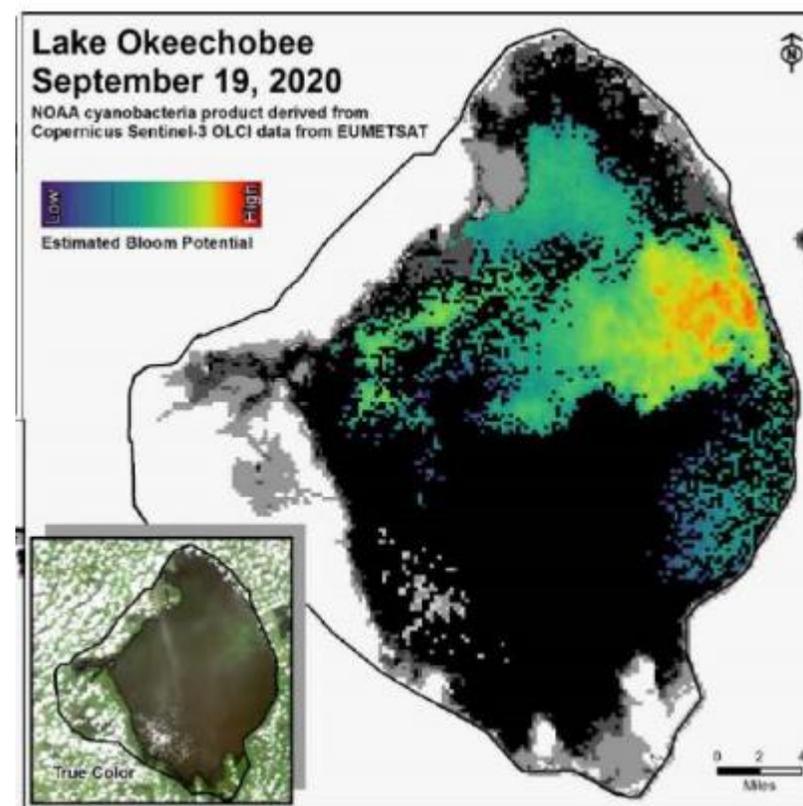


Image courtesy of NOAA 2020

\*Image courtesy of Cavin Brothers



# INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC



## Performance Metric Development

- LOSOM Water Quality Sub-Team: Multi-agency, multi-disciplinary team (Scientists and Engineers, State, Federal, Local Governmental Agencies and Tribes)
- The LOSOM Water Quality Sub-Team reviewed available tools that could use RSMBN model output (**stage and flows are the only output**) to evaluate algal bloom risk
- Two concepts considered to evaluate algal bloom risk: 1) Dr Walker's chl *a* predictive equations; and 2) Dr. Welch's concept to use the Lake Okeechobee environmental stage envelope.
- LOSOM Water Quality Sub-Team determined to use the chl *a* predictive equations. Metric documentation was only developed for that approach.
- Primary Authors of metric documentation for the chl *a* predictive equations :
  - Dr. Donatto Surratt, Department of the Interior, Everglades National Park
  - James Riley, USACE, Jacksonville District
  - Dr. Bill Walker, Department of the Interior Consultant (Regression Analyses)



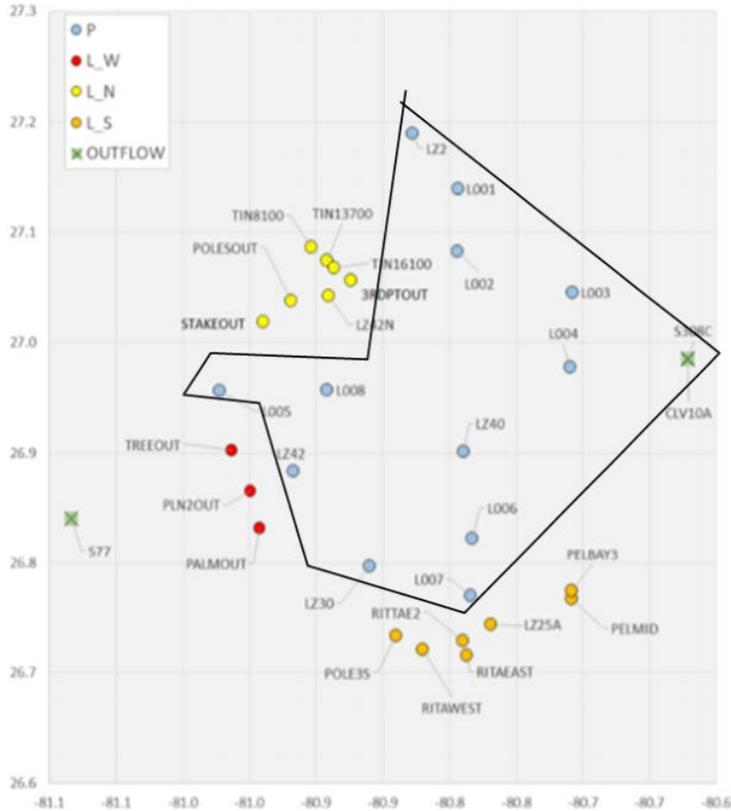
# INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC



- Recognizing that the science and predictive modeling tools for algal blooms/algal bloom risk are under development, this metric is our path forward to evaluate algal bloom risk for the development of LOSOM alternatives until better tools are available. ***This tool is not intended to guide daily or weekly operational decisions.***
- The proposed metric uses chlorophyll *a* (chl *a*) concentration as a proxy/surrogate for estimating phytoplankton abundance and biomass in the water. There is a very large database of chl *a* values and Lake Okeechobee stage data. Preliminary analysis indicates that chl *a* conditions are correlated to lake stages.
- Chl *a* concentrations in Lake Okeechobee were simulated by separate regression equations developed for the lake's littoral and pelagic regions based on the correlation of chl *a* with Lake Okeechobee stage
- Two chl *a* thresholds are used to assess algal bloom risk:
  - ❑ 20 ppb( $\mu\text{g/l}$ ) chl *a* -The concentration standard for colored lakes in Florida
  - ❑ 40 ppb ( $\mu\text{g/l}$ ) chl *a* - Development of TMDL target for Lake O used 40 ppb ( $\mu\text{g/l}$ ) chl *a* as representative of a moderate bloom condition (normally visible to the unaided human eye). Concentrations of chl *a* above 40 ppb( $\mu\text{g/l}$ ) is considered indication of excessive nutrient concentrations.



# INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC



Pelagic	Littoral West	Littoral South
L001	PALMOUT	PELMID
L002	PLN2OUT	POLE3S
L003	TREEOUT	RITAEAST
L004	S77	RITAWEST
L005		PELBAY3
L006		RITAE2
L007		RITAW3
L008		LZ25A
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# INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC



Summer months (May through August) chlorophyll-*a* projections will be based on simple regression models of the form,

$$\log(chla_z) = stage_i * m + b,$$

where  $chla_z$  is the predicted mean summer chlorophyll-*a* concentration by *z* (zone) for each year,  $stage_i$  is the summer average stage per year (*i*), *m* represents the slope, and *b* the intercept. Specific formulations for the three zones are presented in **Table 1**.

**Table 1. Predictive equations for annual summer mean chlorophyll-*a* concentrations and performance statistics.**

<b>Zone</b>	<b>Equation</b>	<b>R2</b>	<b>Standard Error</b>	<b>Years</b>
<b>Pelagic</b>	$\log(chla_{pelagic}) = stage_i * 0.122 + 2.956$	0.31	0.23	16
<b>Littoral West</b>	$\log(chla_{westLit}) = stage_i * 0.716 + 1.761$	0.73	0.56	16
<b>Littoral South</b>	$\log(chla_{southLit}) = stage_i * 0.570 + 1.708$	0.73	0.44	15



# INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC



## Algal Bloom Risk Metric Model Output

- Frequency of exceeding the thresholds,
- Mean chlorophyll-*a* concentrations, and
- Percent of releases from Lake Okeechobee towards each individual estuary during high-risk windows.

## Performance Evaluation

- Percent of time of each zone above the chl *a* thresholds of 20 and 40 ppb relative to baseline conditions
- Frequency and magnitude of exceeding either threshold within the lake will be used to assess each scenario through conceptual planning and alternatives evaluations in the LOSOM process.
- The volumes delivered west (S-77) and east (S-308) from the lake with chlorophyll-*a* concentration above the thresholds will be used to evaluate risk of algal blooms for the Caloosahatchee and St. Lucie estuaries.



# INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC



## Limitations:

- The Algal Bloom Risk Metric is not a predictive tool intended to guide daily or weekly water management operational decisions.
- The Algal Bloom Risk Metric cannot predict the presence of toxins
- USACE recognizes the need for a holistic predictive model that relies upon nutrient concentrations, temperature, wind/weather conditions and predictions, circulation model information, etc.
- Jacksonville District in collaboration with NOAA, FDEP, and UF are seeking funding opportunities to develop these sort of tools. No immediate funding plan has been identified.



# INTRODUCTION OF DRAFT ALGAL BLOOM RISK METRIC



Parallel Corps ECO-PCX Review

Step 1: Conceptual Level Review

- Determine the degree to which the subject metric can be described as technically sound relative to its design objectives.
- Comment on the underlying theory, conceptualization, and computational aspects of the model.
- Comment on aspects of the model that potentially affect its usability and reliability as a potential producer of information to be used to influence planning decisions.
- Suggestion for additional tools that Jacksonville District could employ to ascertain the potential for algal bloom risk.

Step 2: Model Approval (February 2021)



# QUESTIONS?

