

# Lake Okeechobee Watershed Project

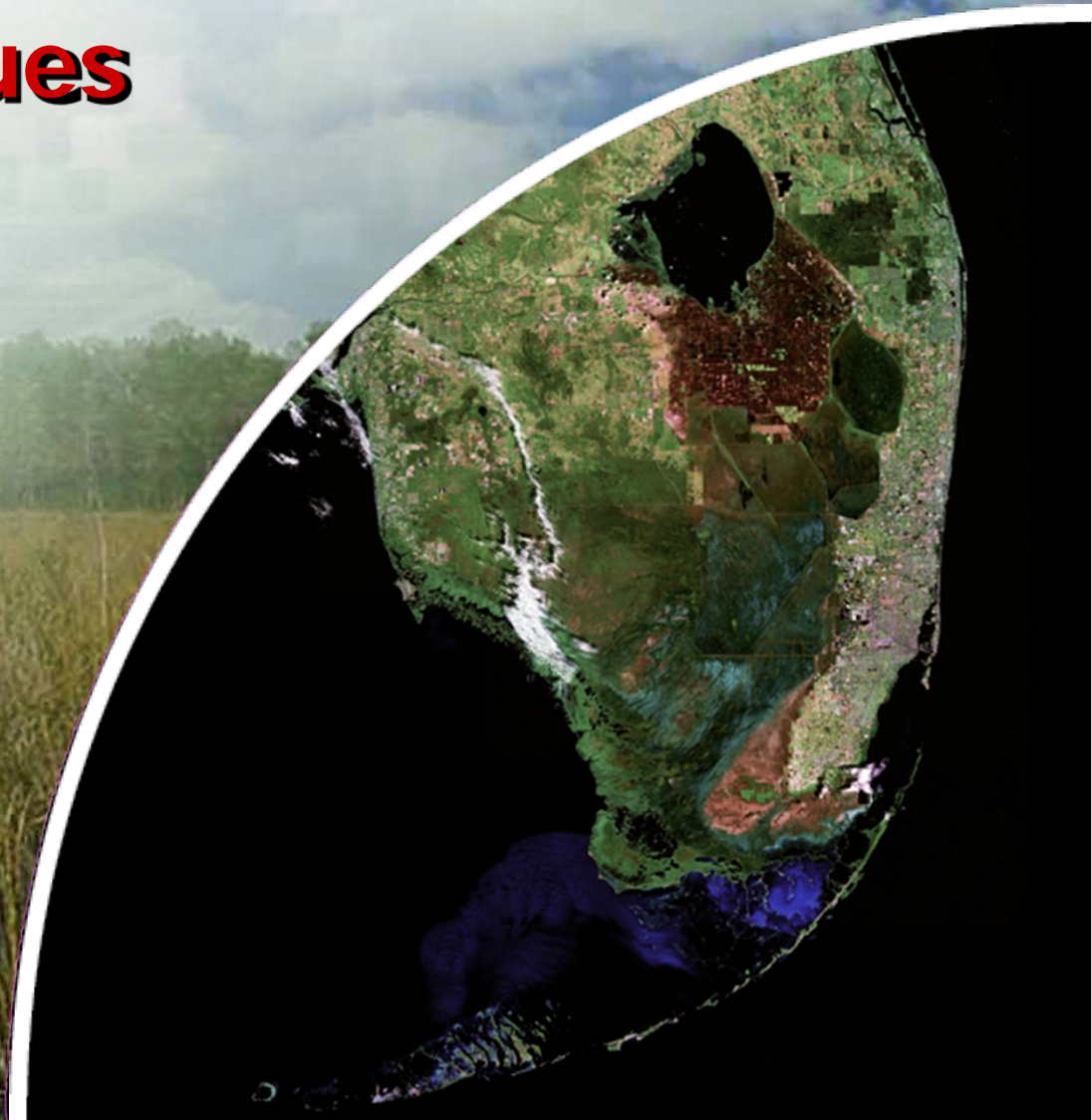
## Tools & Techniques

Presented by:  
LOW Modeling Team

August 10, 2016

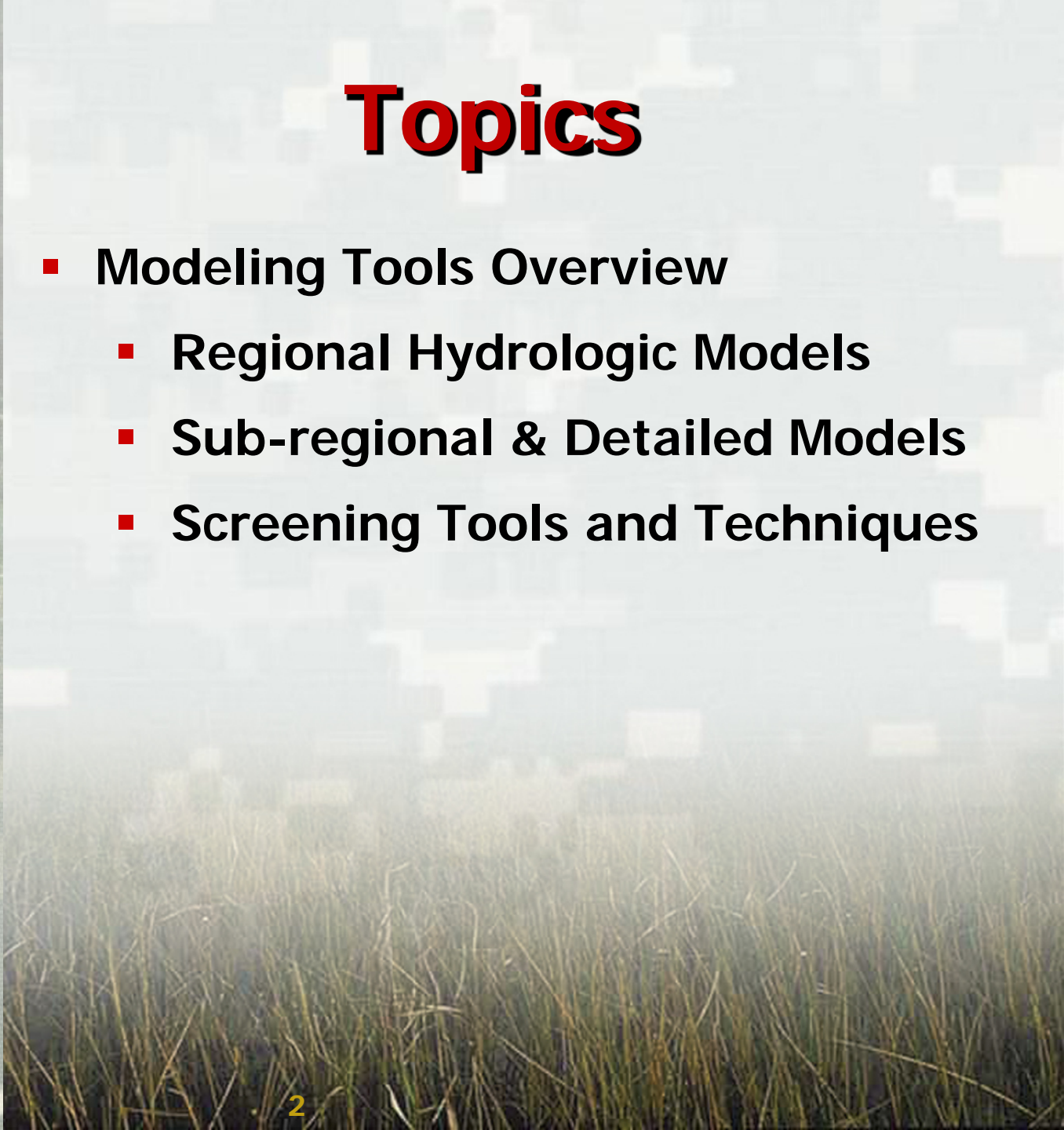


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# Topics

- **Modeling Tools Overview**
  - **Regional Hydrologic Models**
  - **Sub-regional & Detailed Models**
  - **Screening Tools and Techniques**



# Modeling Tools Overview

## Regional Hydrologic Models

- Primary modeling tools for Central Everglades assessment. The models provide daily, detailed estimates of hydrology across the planning domain.

## Sub-regional & Detailed Models

- Smaller scale, more detailed models to help analyze specific areas of interest (e.g. water quality, conveyance of water, etc...)

## 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.

# Regional Hydrologic Modeling

## Purpose:

- Simulate detailed daily rainfall-runoff processes and flow routing within the Lake Okeechobee Watershed (LOW) project area as a function of existing infrastructure and proposed configurations.

## Strategy:

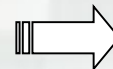
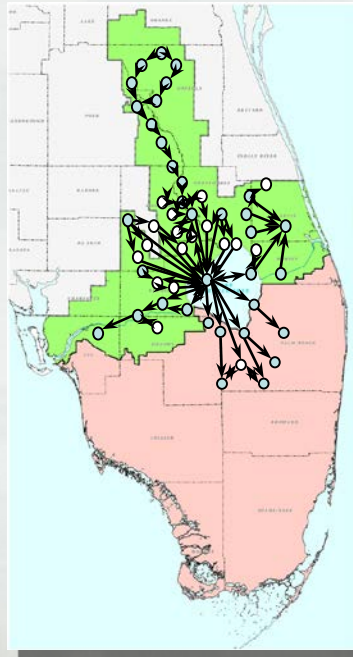
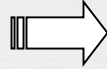
- Use a link-node model for the LOW project area and EAA.

# Regional Modeling Approach

## Scenario

- **Climatic Input**
  - Rainfall
  - ET
- **Boundary Conditions**

Period of record:  
1965-2005



- **Model Output**
  - Daily time series of water levels, flows
  - Demands not met



- Project Features
- Land Use/Land Cover
- Water Demands
- Operating Criteria

**Evaluation**  
(Environmental,  
Water Supply, etc...)

# Regional Hydrologic Modeling

## RSMBN (Basins)

- A link-node application of the Regional Simulation Model (RSM) specific to Lake Okeechobee and basins in its vicinity, i.e., north of the “Red Line”
- Previously utilized for the SFWMD Northern Everglades planning initiatives (Lake Okeechobee Phase 2 Technical Plan and River Watershed Protection Plans)
- Will provide hydrologic representation of Lake Okeechobee, the Kissimmee Basin, the EAA and other northern watersheds including the Caloosahatchee and St Lucie Estuaries.

# RSMBN (Basins)

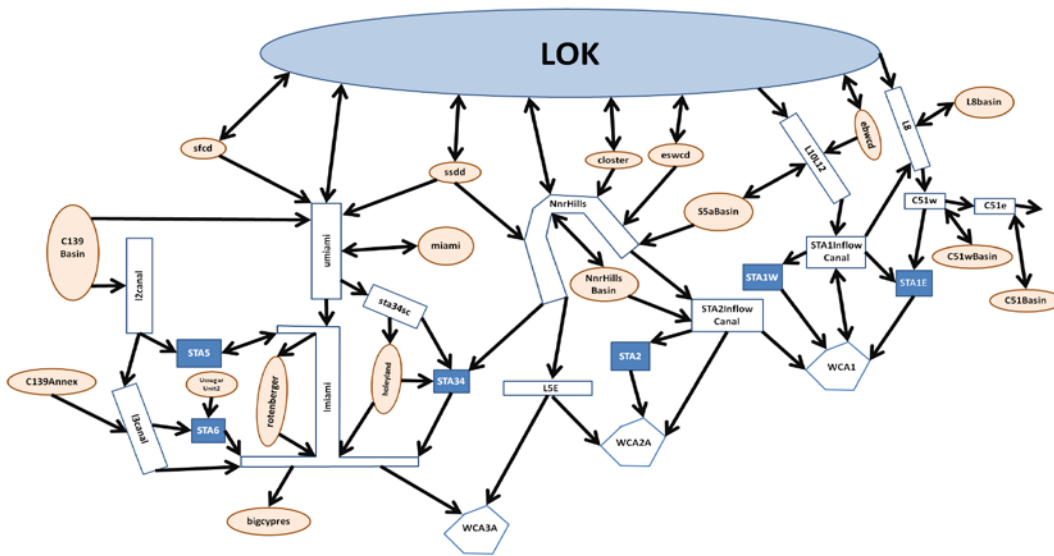
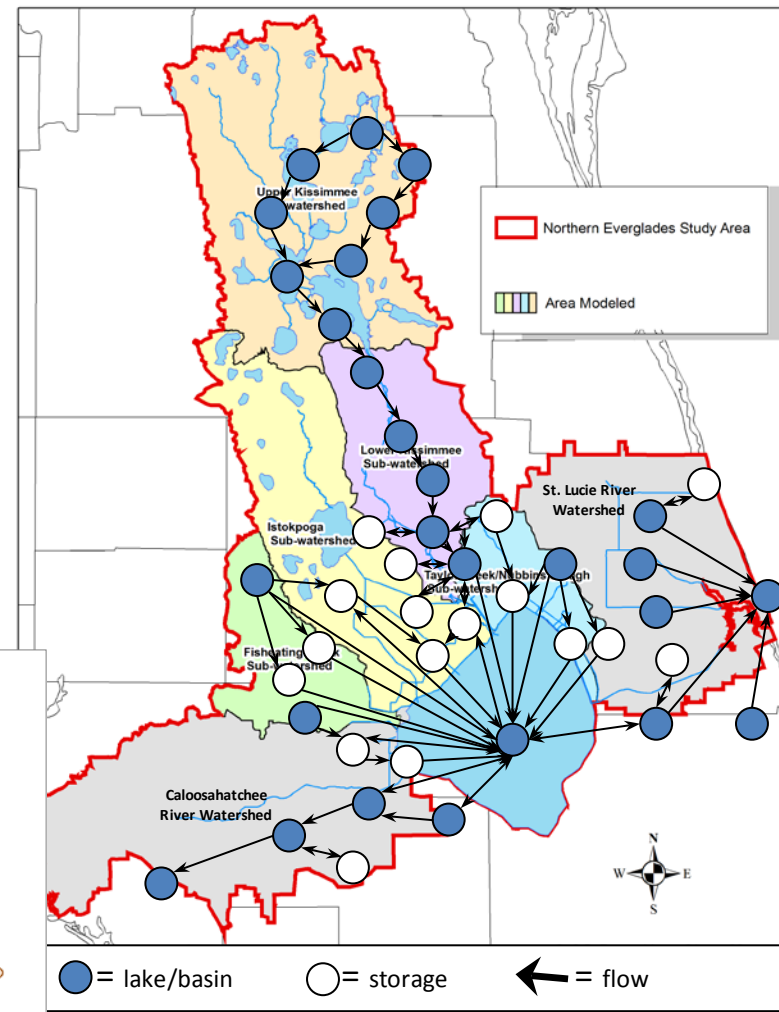
## Node Information:

total number of basins/lakes/canals represented: ~ 110

## Link Information:

total number of connections represented: ~ 155

Run Time:  
~ 10 minutes



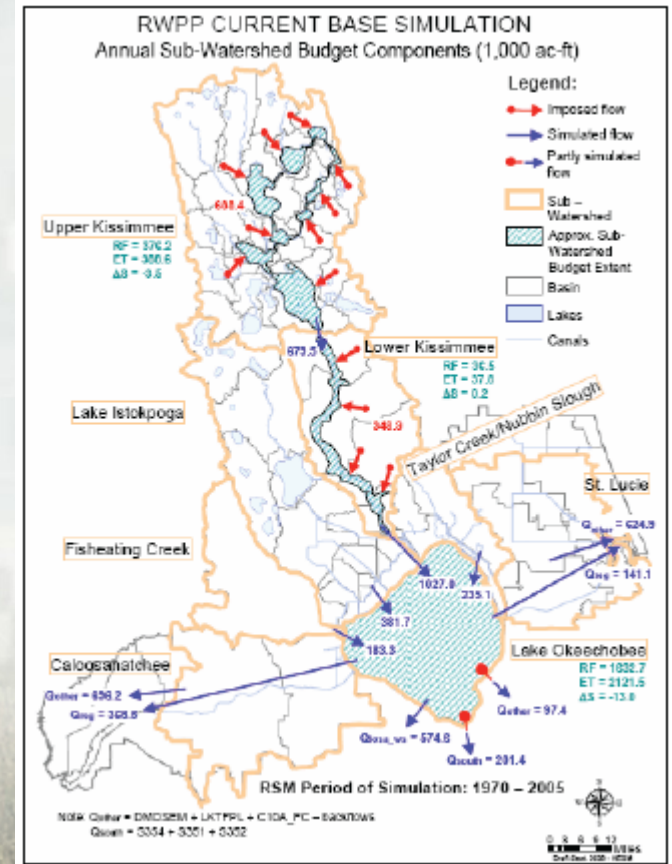
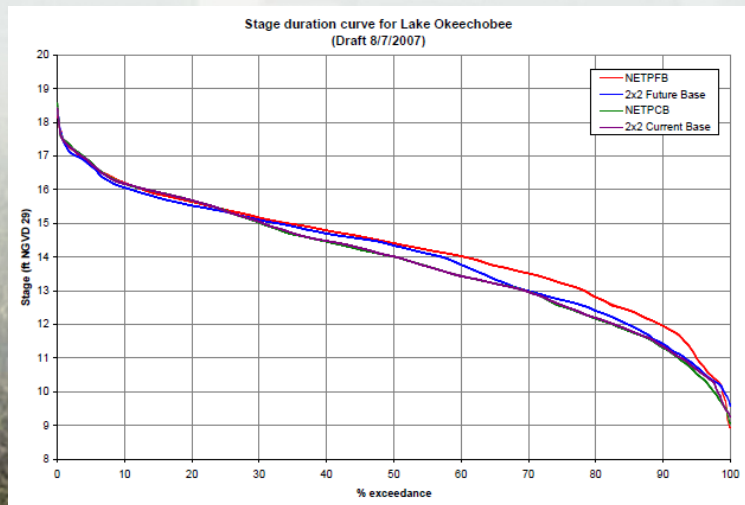
RSMBasin Schematic of the EAA  
(Draft Nov. 2011)

## Domain Information:

EAA area represented:  
~ 690 sq. miles

# RSMBN Performance Measures

- Stages/Head
- Stage Duration Frequency Curves
- Hydrographs
- Flow Distributions
- Basin Water Budgets
- Water shortage indicators





# Sub-regional & Detailed Models

- On an as-needed basis, additional models may be applied to complement or assist the regional hydrologic models in analyzing system features.
- Examples of this type of model application will be shown for assessing water quality considerations and conveyance of water.
- Detailed flood assessment modeling is not envisioned within the Lake Okeechobee Watershed Project.

# Example: Dynamic Model for Stormwater Treatment Areas (DMSTA)

- Developed for the U.S. Department of the Interior and the U.S. Army Corps of Engineers (Walker and Kadlec 2005)
- Extensively used in south Florida to analyze Stormwater Treatment Area design, operation & management

**Dynamic Model for Stormwater Treatment Areas - Version 2**  
W. Walker & R. Kadlec for U.S. Dept. of the Interior & U.S. Army Corps of Engineers      Version Date: 6/1/2005

**Select Project:**

- project\_examples
- project\_template
- project\_reservoirs
- project\_eaasr\_network

Retrieve Project

Run All Cases in Project

Simulate Case Network

**Select Case:**

- STA\_0
- STA\_1
- STA\_2
- STA\_3
- STA\_4
- STA\_5
- STA\_6
- STA\_7
- STA\_8
- MARSH\_1
- MARSH\_2
- RES\_1
- RES\_2
- RES\_3
- RSTA\_1
- RSTA\_2

Retrieve Case

Edit Input Values

Run Model

Save Case

**Select Output Sheet:**

- Model Input Parameters
- Summary of Project Cases
- Simulate Network of Cases
- Overall Mass Balance
- Mass Balances for Each Cell
- Frequency Distributions
- Reservoir Performance
- Mass-Balance Schematic
- Graphs - Cell Averages
- Graphs - Selected Cell
- Graphs - Combined Inflows & Outflows
- Graphs - Selected Variable
- Graphs - Project Summary
- Inflow Daily Time Series
- Output Time Series - Overall
- Output Series - Current Cell
- Calibration Range Check

Go to Sheet

*press Ctrl-m to return to menu*

Delete Case

DMSTA Website      Check for Updates      Disclaimer

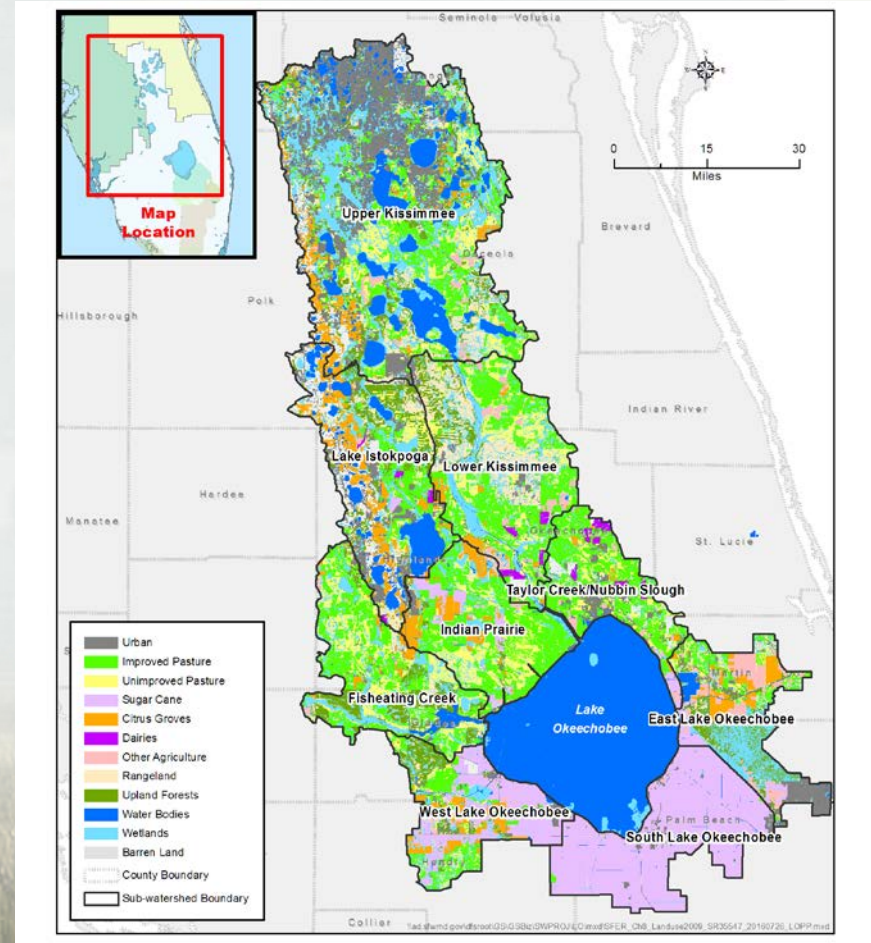
Project Name: PROJECT\_EXAMPLES      Project Cases: 16      Project Networks: 0  
Time Series: TS\_RES      Series Dates: 01/01/65 thru 01/01/65  
Current Case: RSTA\_1      Output Dates: 01/01/66 thru 12/31/74  
Description: Reservoir discharging to STA with 3 cells

# Example: Watershed Assessment Model (WAM)

- Developed by Soil and Water Engineering Technology, Inc.
- Peer reviewed in 2009.
- GIS based model that simulates hydrology and water quality responses within a watershed.
- Capable of simulating water quality response
- Can be used to perform hydrological and water quality analysis that:
  - Simulate flows and nutrient loads for existing landuses, soils, and land management practices.
  - Analyze hydrological and water quality impacts on streams and lakes.
  - View and analyze the simulated flow and concentrations for source cells and stream reaches.

# Example: Watershed Assessment Model (WAM)

- Land use distribution detailing Florida FLUCCS level III for agriculture and level I for other land use types in the LOW project.

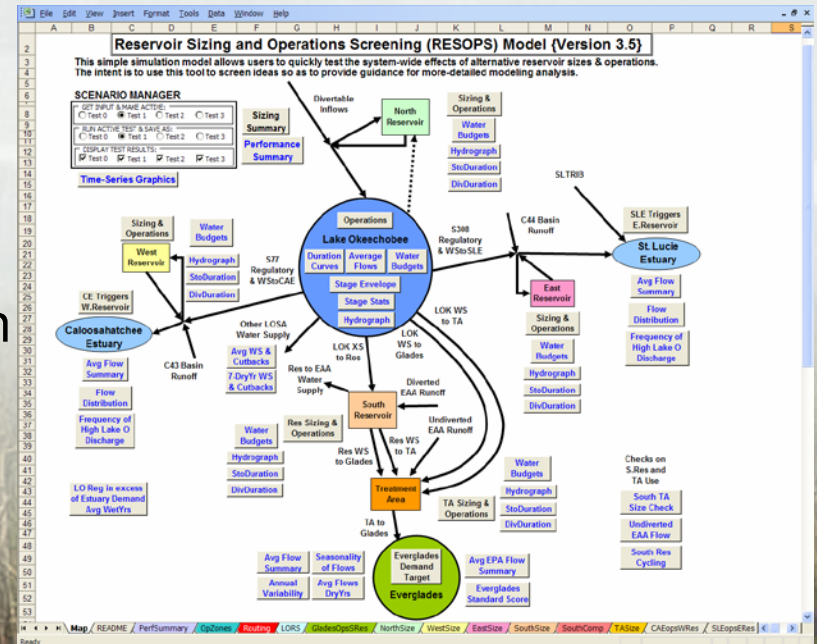


# Screening Tools and Techniques

- The benefit of screening is to quickly test the performance of alternative configurations and scenarios to identify feasible ideas for further in-depth analysis.
  - Not a replacement for the detailed regional models
  - Can reduce the burden on the more complicated regional models (RSM) and inform project decision making efforts.
- Optimization techniques can be used to automatically evaluate thousands of operating rules and select the best performers.

# REservoir Sizing and OPerations Screening (RESOPS) Model

- Coarse-scale Water Management Simulation Model
- Provides rapid screening-level testing of the integrated effects of alternative reservoir sizes and proposed operating rules for...
  - Lake Okeechobee Watershed Storage,
  - Lake Okeechobee,
  - EAA Storage
  - Flows to the Everglades
- Performs 41-year continuous simulation (monthly time-step) of the hydrology and operations of the water management system
- Runtime = ~ 1 second

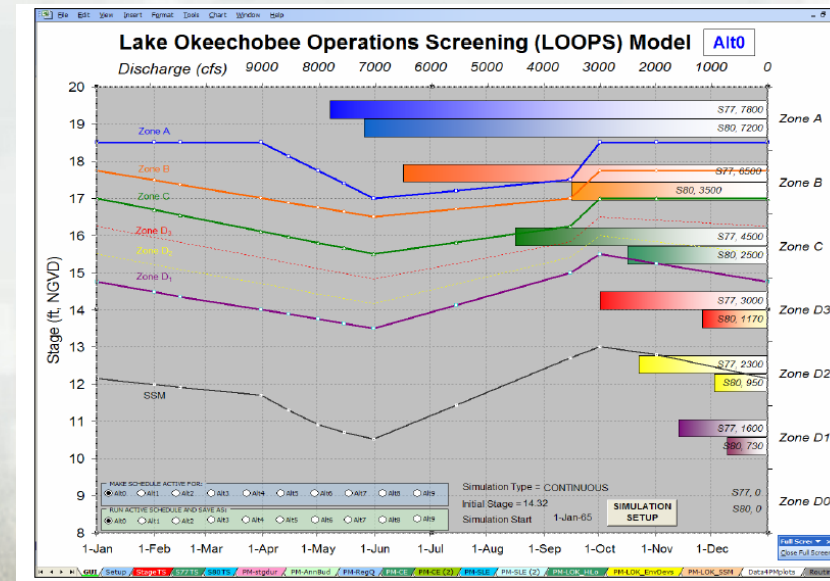


# RESOPS Performance Measures

- Flow to the Everglades imposed as a boundary condition flow south from Lake Okeechobee.
- Currently selected PM's:
  - Reduction in Lake Okeechobee high discharge events to the northern estuaries
  - Lake stage envelope

# Lake Okeechobee Operations Screening (LOOPS) Model

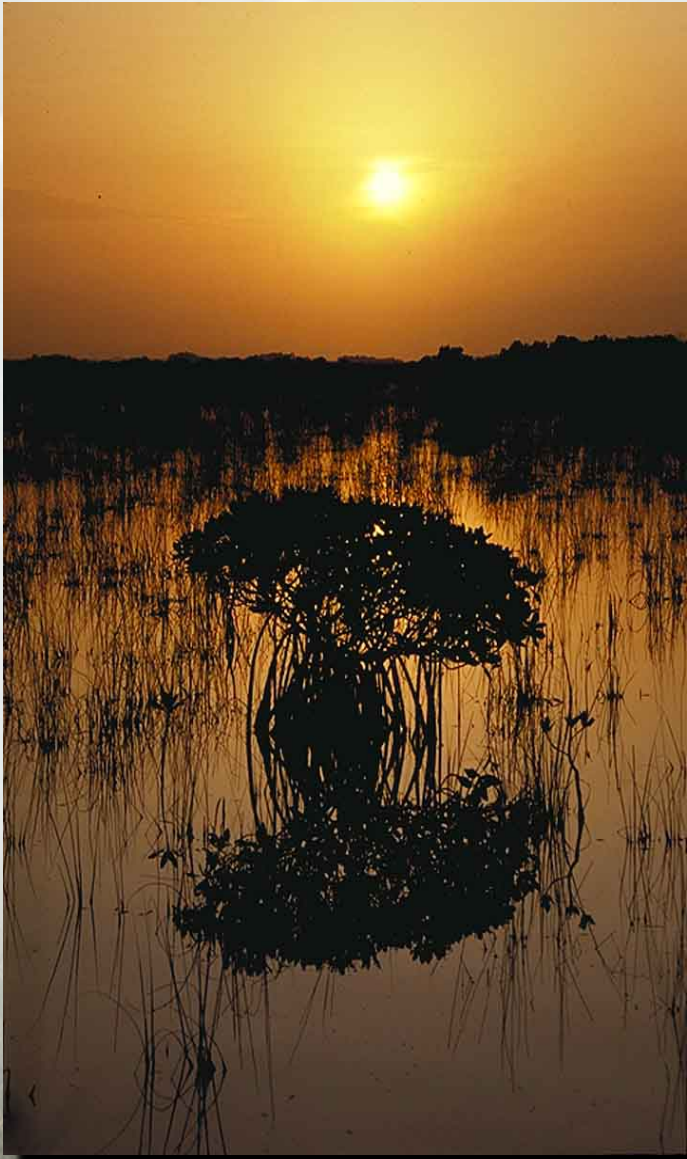
- LOOPS is a hydrologic routing screening model that simulates Lake Okeechobee stages and discharges through the primary outlets as prescribed by a user-defined regulation schedule.
- Contains batch-processing algorithms to allow for rapid testing of multiple Lake Okeechobee schedules.
- LOOPS does not simulate project storage features in the south Florida system.
- Performs 41-year continuous simulation (daily time-step) of the hydrology and operations of the water management system.





# LOOPS Performance Measures

- Flow to the Everglades imposed as a boundary condition flow south from Lake Okeechobee.
- Six key performance measures used to help identify feasible operating protocols for the Lake.
  - Reduction in Lake high discharge events to the Northern Estuaries
  - Average of 8 worst years of LOSA cutbacks
  - 4 Lake O. PMs (RECOVER standard scores, % time >17 ft, % time < 11 ft)
- Three Baselines used for reference: WSE, LORS08 and Adaptive Protocols (ADP)



# **DISCUSSION**