From Nature to a Managed System

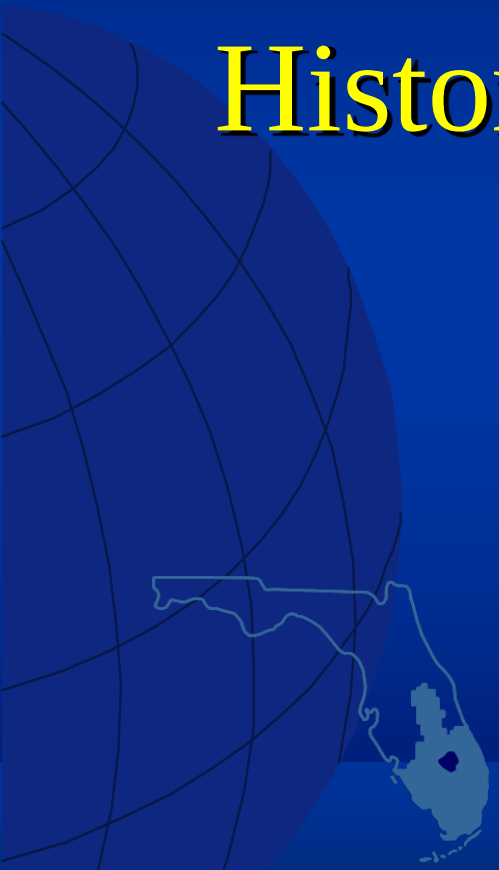
History of Water Management In South Florida

Garth W. Redfield, Ph.D.

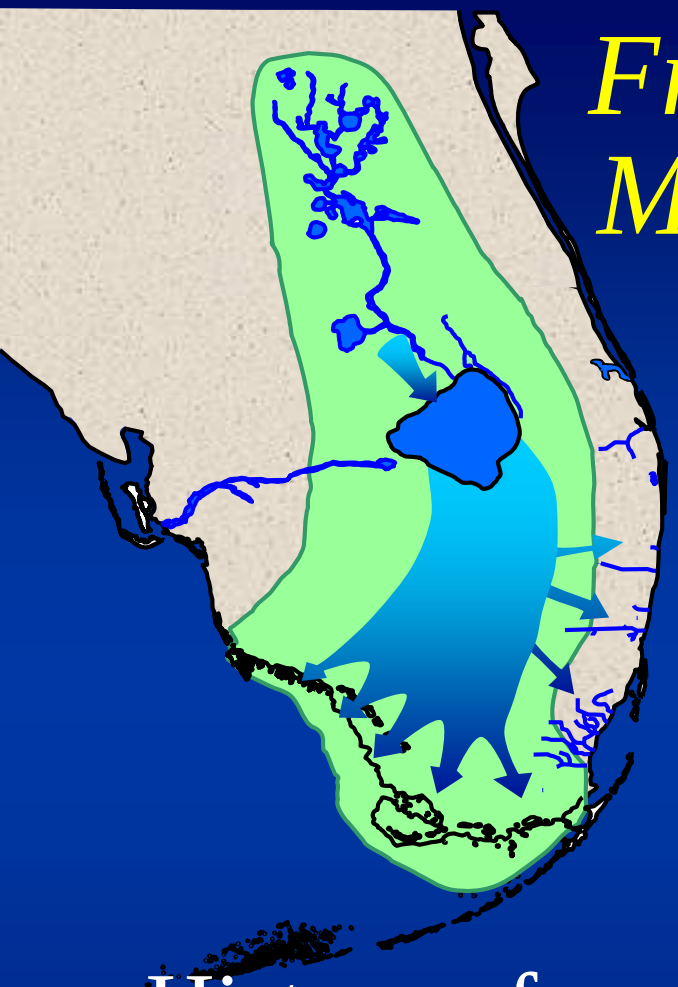
Chief Scientist, Water Quality Bureau

South Florida Water Management District,

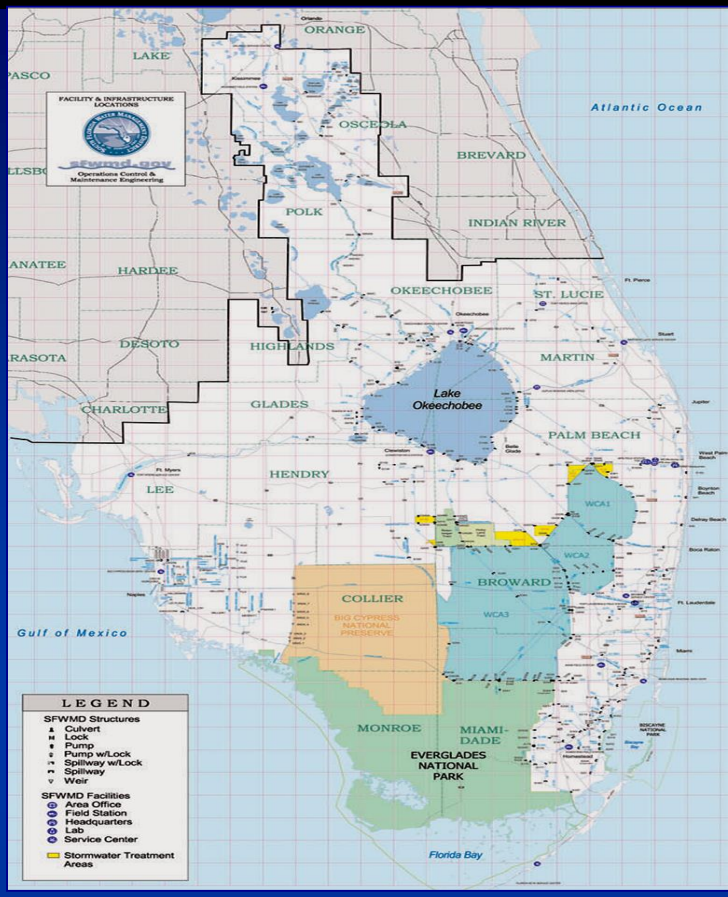
West Palm Beach, FL USA



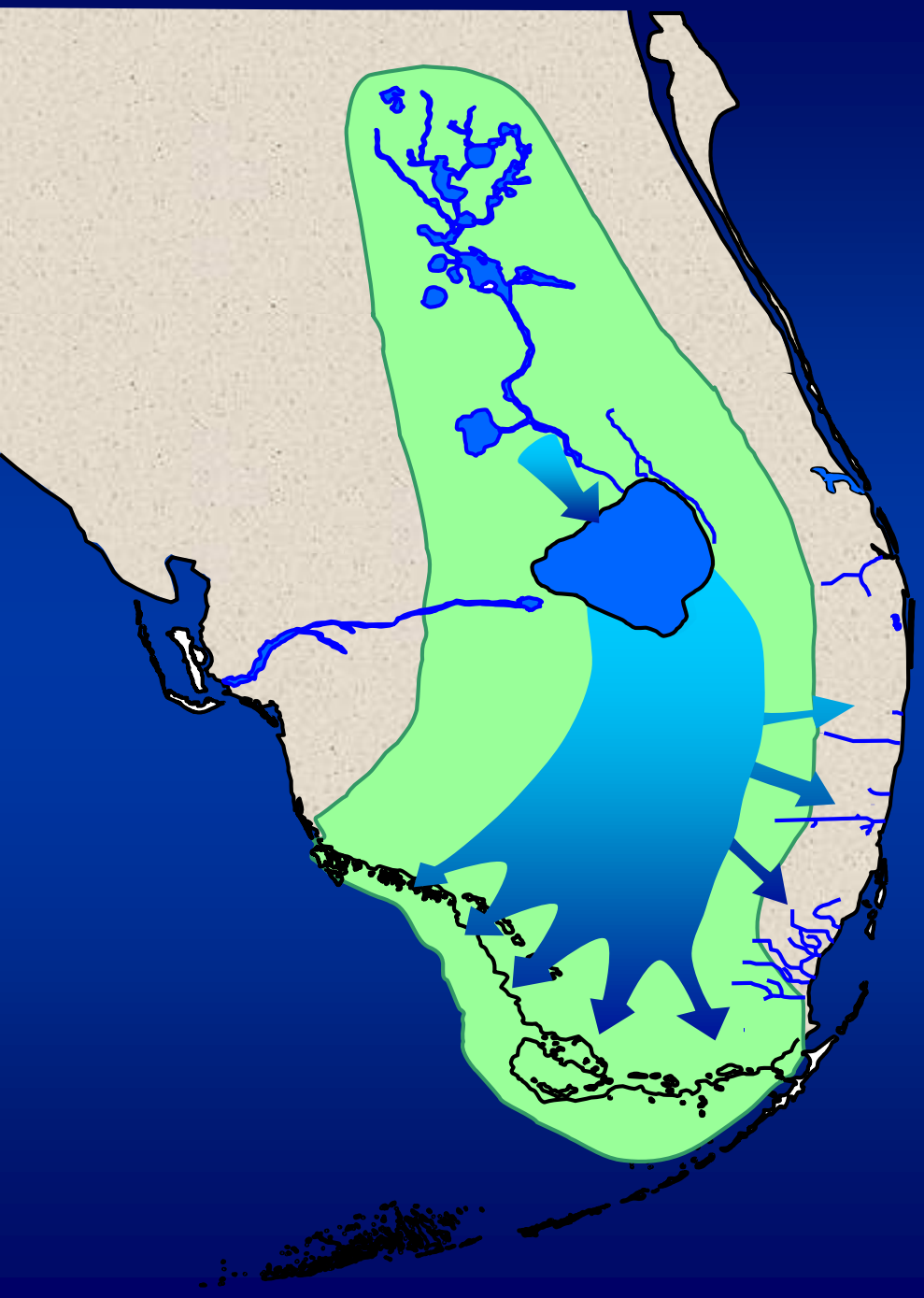
sfwmd.gov



From Nature to a Managed System



History of water management in South Florida integrates politics, economics, law, engineering, science and metrology..let’s look across the years.



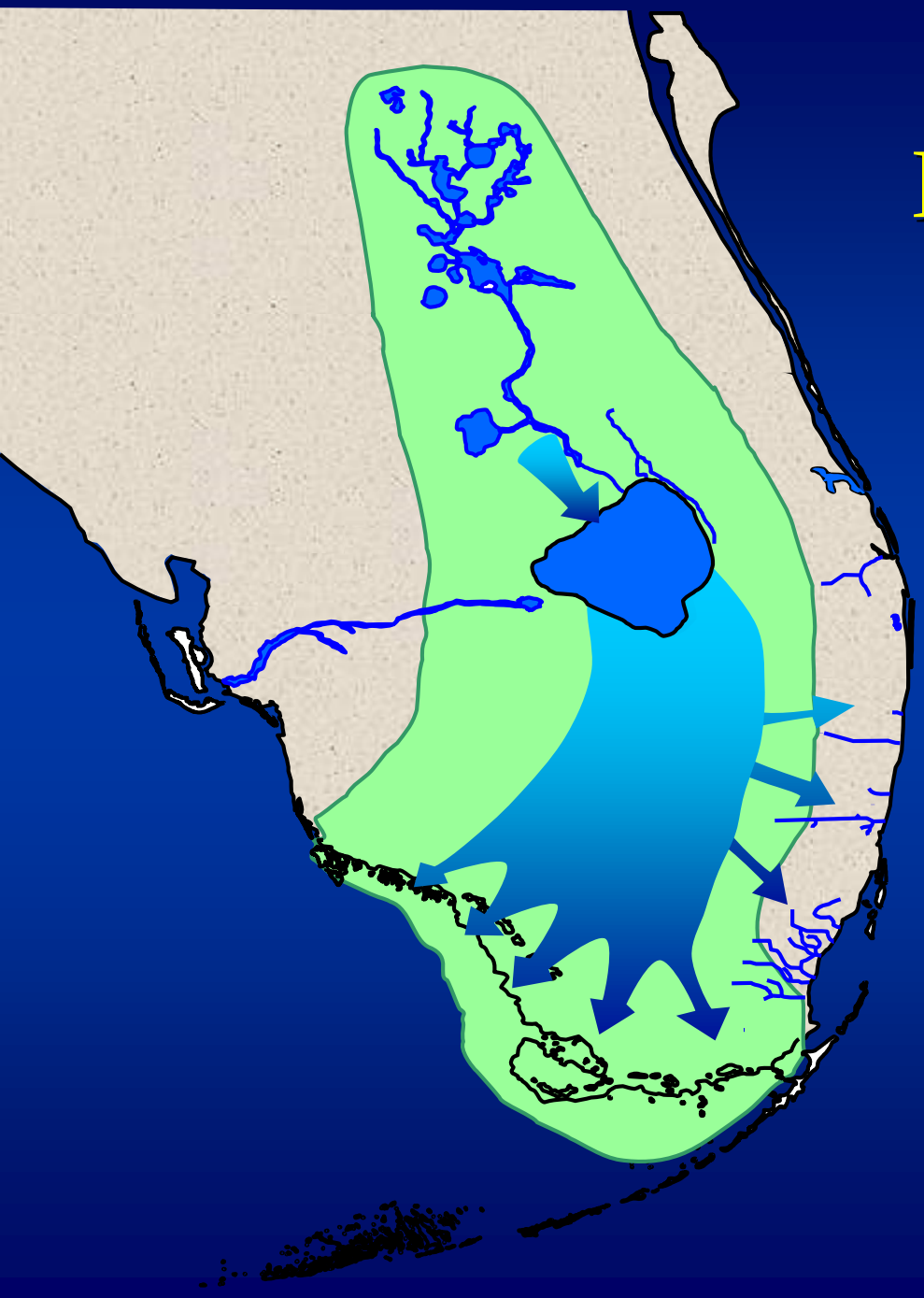
Original Everglades Floodplain and Ecosystem

Great for nature

Vast areas (~1,000,000 ha) of open marshes in a flat landscape

Huge volumes of water, slowing moving from north to south

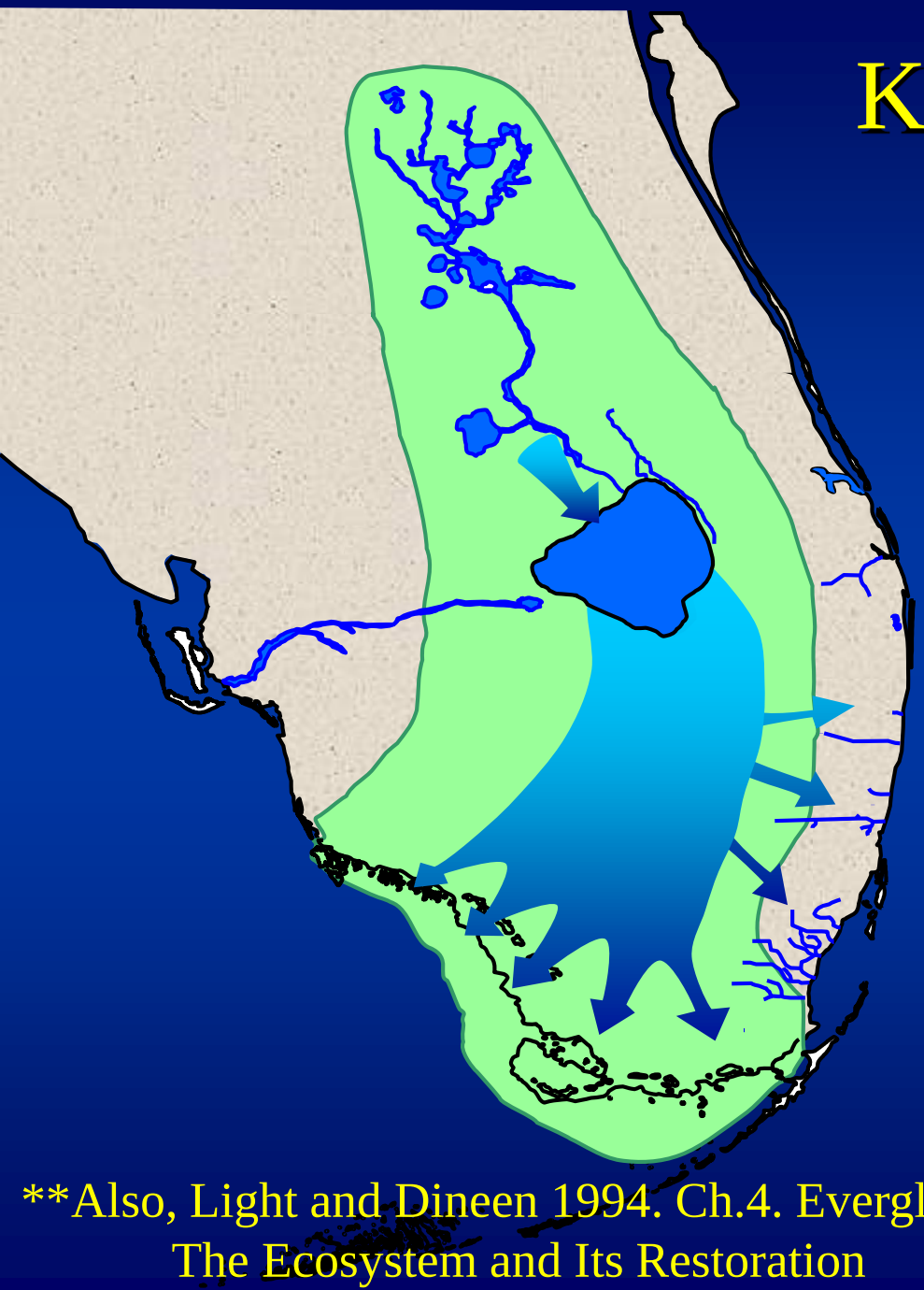
Not so great for man



Key Historic Concepts*

- Water deeper (~1 m) than today with more continuous inundation
- Vast areas of organic soils, peats
- Slow, nearly continuous water movement and outflow
- Water movement interacted with landscape pattern

**'Landscapes and Hydrology of the Predrainage Everglades'*
McVoy et al. 2011
University Press of Florida



Key Drainage Concepts*

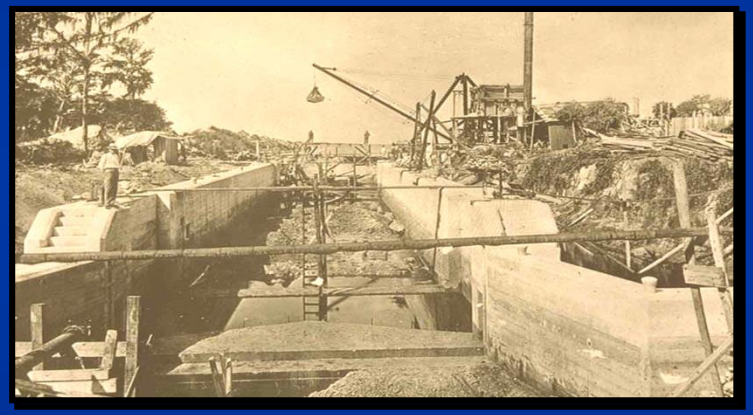
Eras of drainage**:

- Lake Okeechobee
- Muck canal
- Impoundment

- Alteration began in 1880s
- Fundamental, pervasive changes from drainage
- Loss of water depth and peat soils
- Levees and canals divided region

**Also, Light and Dineen 1994. Ch.4. Everglades The Ecosystem and Its Restoration

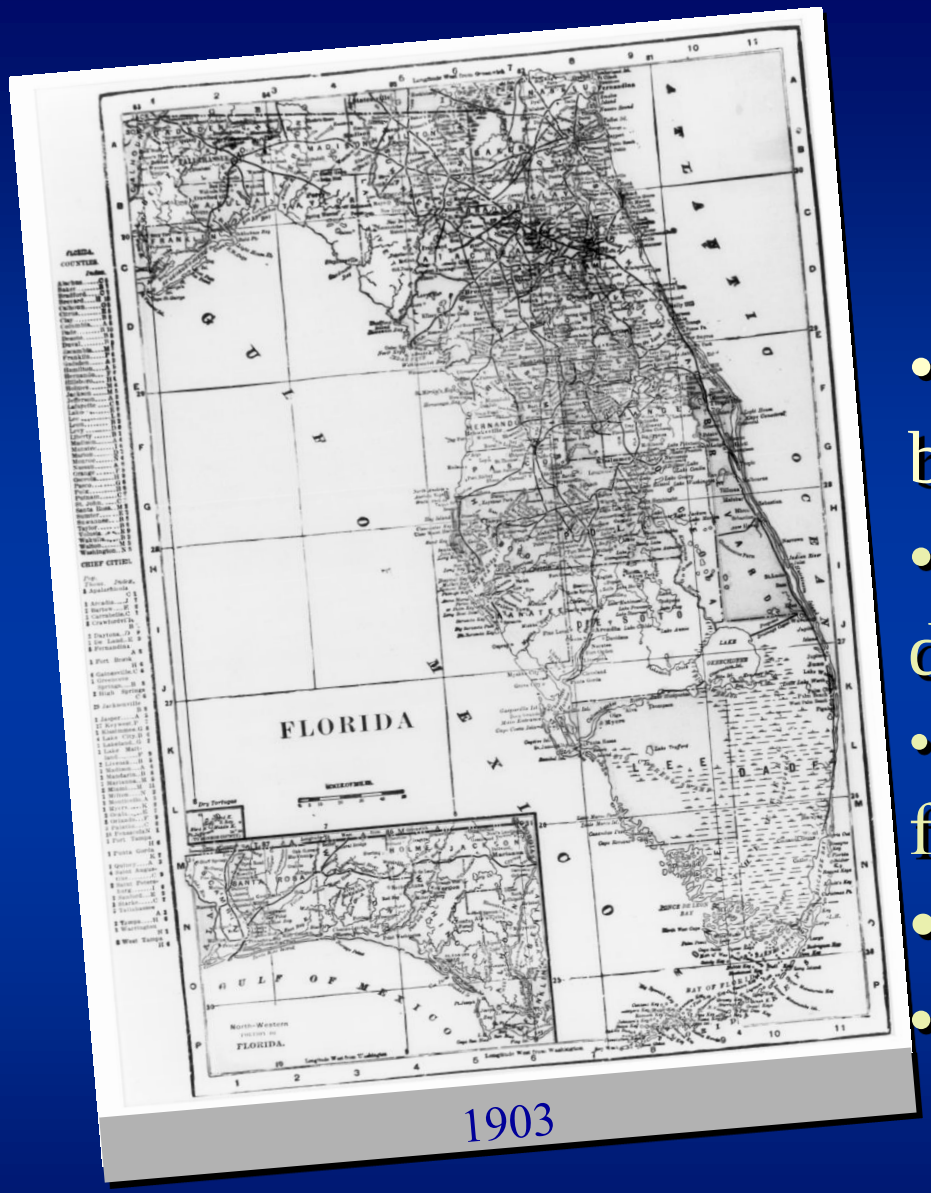
*'*Landscapes and Hydrology of the Predrainage Everglades'* McVoy et al. 2011 University Press of Florida



Lake Okeechobee Era

- The Swamplands Act 1850 transferred 8 million ha of land for drainage and reclamation

- Hamilton Disston lead initial drainage efforts on the Caloosahatchee and Kissimmee Rivers
  - Lowered lake, opened Caloosahatchee River

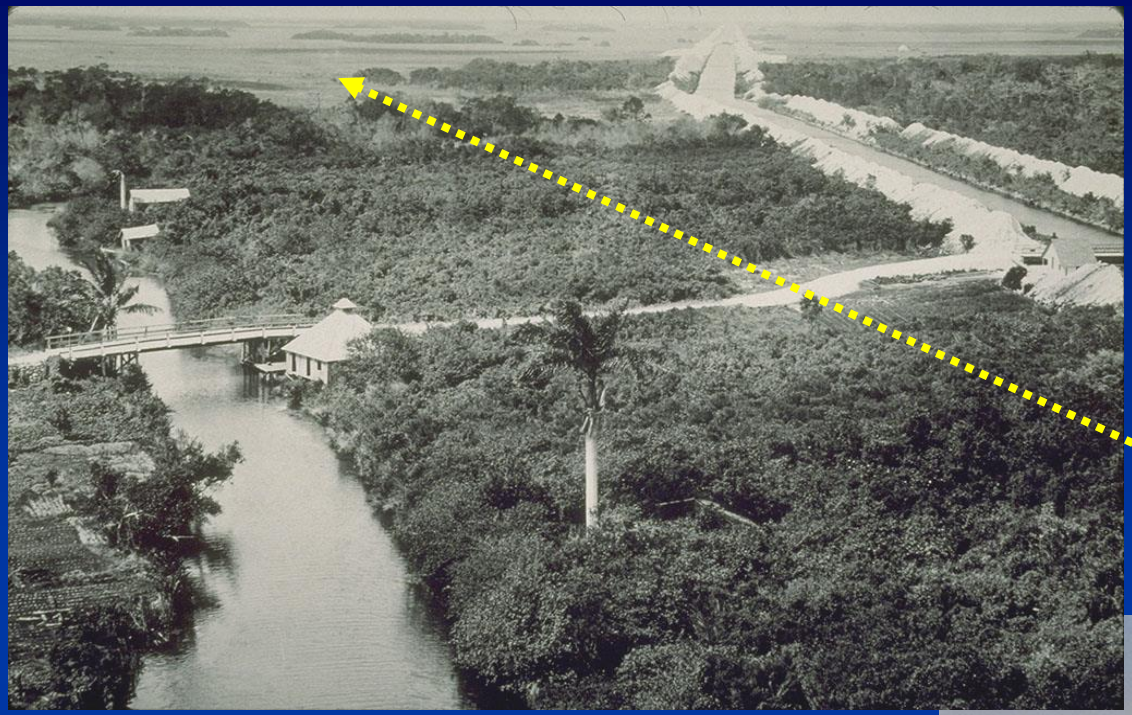


Muck Canal Era

- Everglades Drainage District formed by Florida legislature in 1907
- Initial drainage works enhanced development opportunities
- Settlement in South Florida increased from the late 1800's
- Navigation Improvements
- Severe floods & droughts persisted

By 1917, four primary canals dug from the Lake to the Atlantic Ocean

- *West Palm Beach Canal*
- *Hillsboro Canal*
- *North New River Canal*
- *Miami Canal*



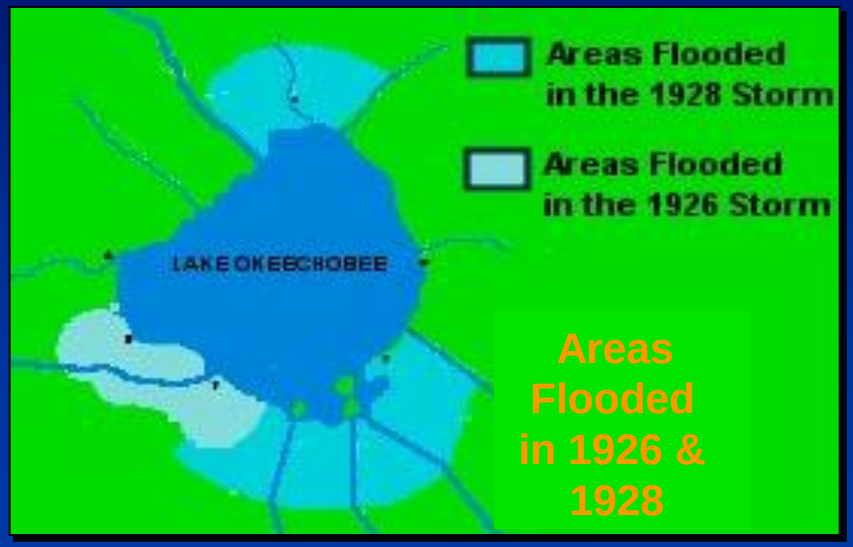
Muck Canal Era

Miami River and Miami Canal in 1912

Miami International Airport

Contemporary photo of the same area

Historic Problems for Water Management



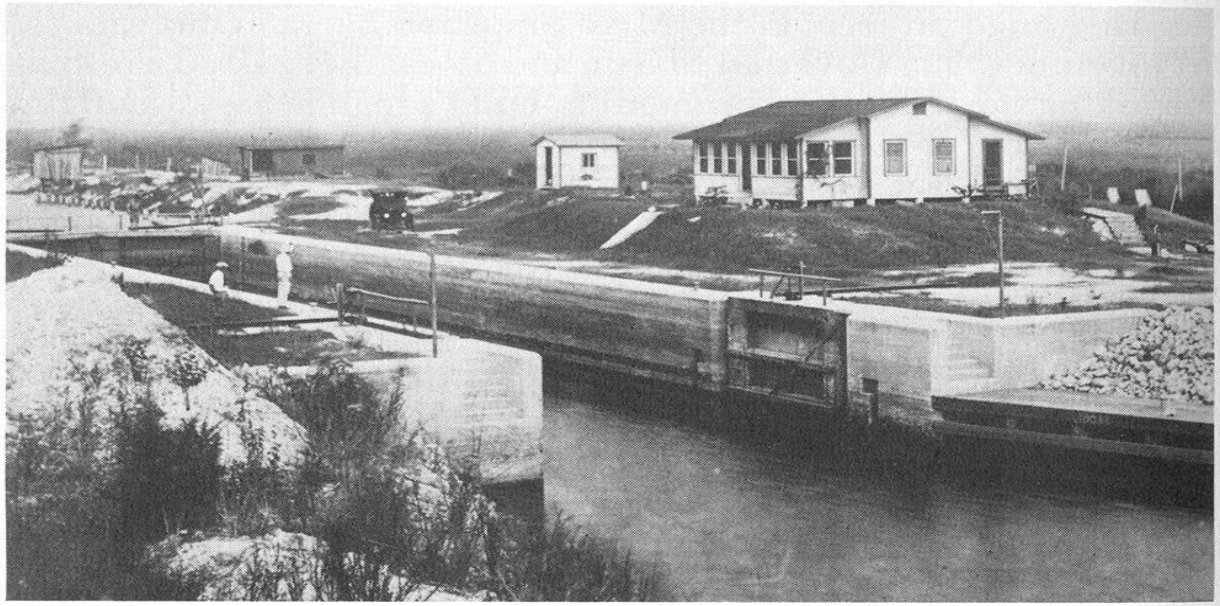
- Flood Control
  - 1926/1928: Lake Okeechobee levee failed
  - 1947: Hurricane & regional flooding
- Water Supply
  - 1931 – 1945: Lower East Coast saltwater intrusion threat identified
  - Marshes over-drained in dry years
- State of Florida requested federal assistance to encircle Lake Okeechobee with a high levee in the 1930's
- Then, a regional system to allow better water management

Muck Canals Had Real Limitations

One of Moore Haven's Few Standing Homes.

Governor John W. Martin (in white shirt) Entering Moore Haven on Inspection Trip After Disaster.

After the 1926 hurricane in Moore Haven near Lake Okeechobee



Caloosahatchee Lock No. 3, near Fort Thompson on the Caloosahatchee Canal. SPA.

Even the best engineered projects can't control *Mother Nature*

Newly constructed

After the flood of 1922

Caloosahatchee Lock No. 3 during flood of 1922. A series of floods during the 1920s revealed the inadequacy of the old canals to prevent flooding. SPA.

Severe Droughts in the mid 1930's

Produced major regional impacts from marsh dry outs, muck fires, peat subsidence, and salt water intrusion

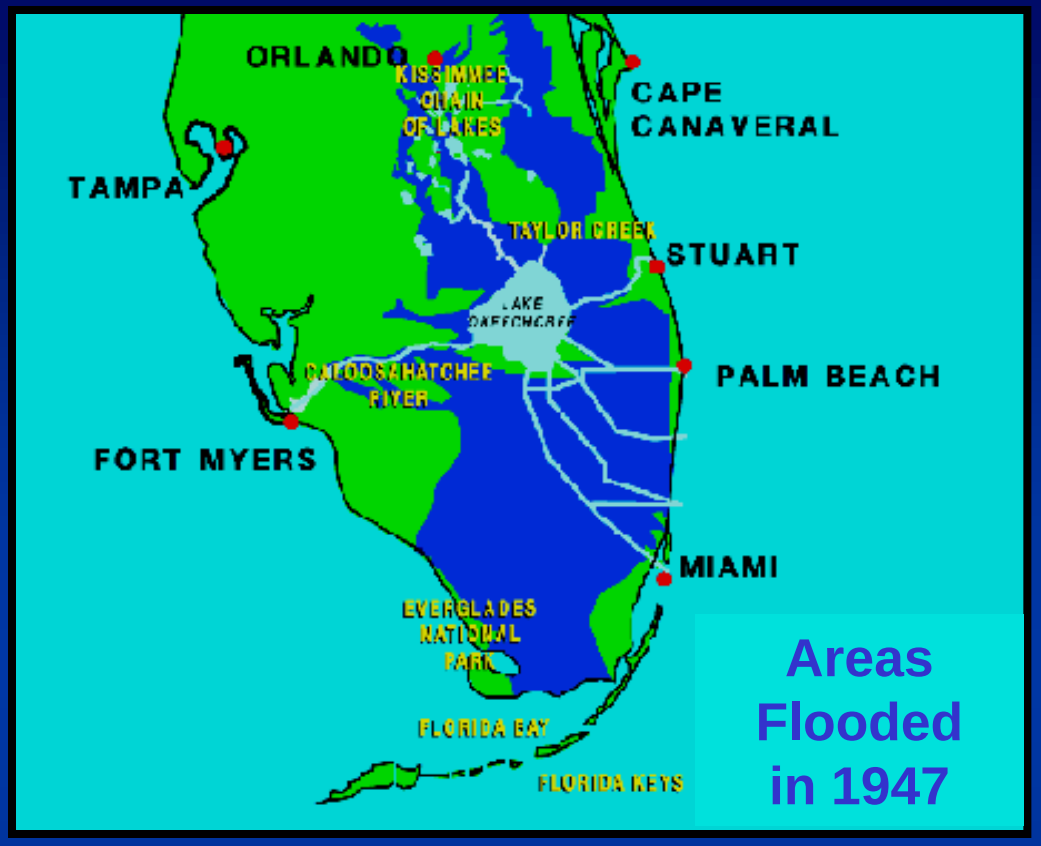
The hurricane of 1928 was a killer storm

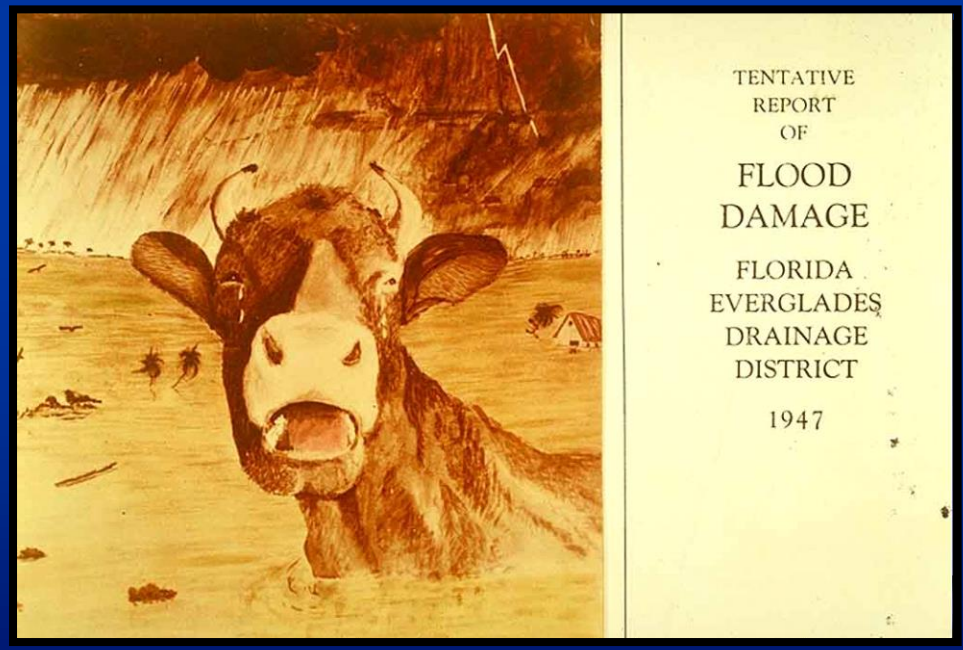
The lake's storm surge over-topped the levee sending a wall of water across the agricultural landscape

1947 Hurricane Season

- Two hurricanes
- 12 inches of rain fell in a 30 minute period
- In some areas, over 100 inches of rainfall that year

Effects of the 1947 Hurricane and Rainfall





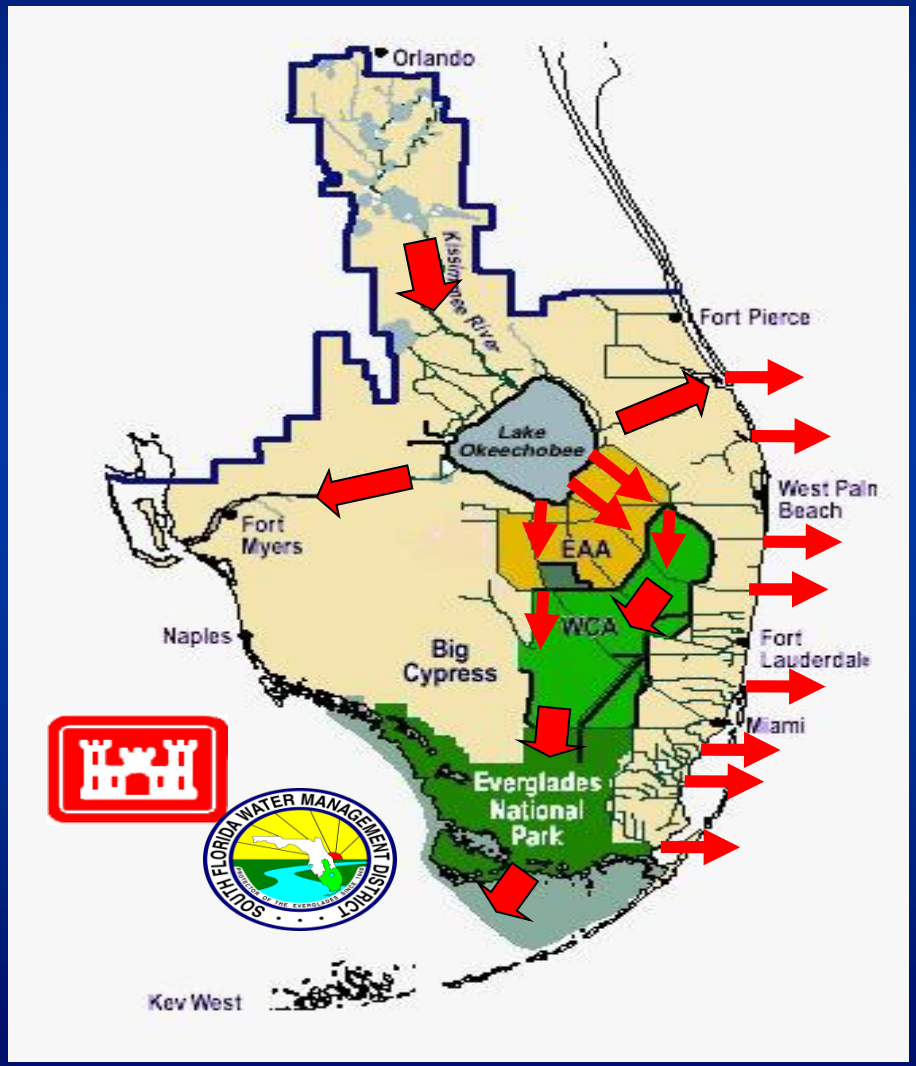
The original muck-scalped canals could not provide flood protection

A better regional system was needed

Impoundment Era after World War II

The Central and Southern Florida Project

- Central and Southern Florida Project for Flood Control and Other Purposes (Project)
  - *Authorized in 1948*
  - *Constructed between 1950's and 1970's*
- Operated in accordance with US Army Corps of Engineers (USACE) criteria
- Now the *South Florida Water Management District*



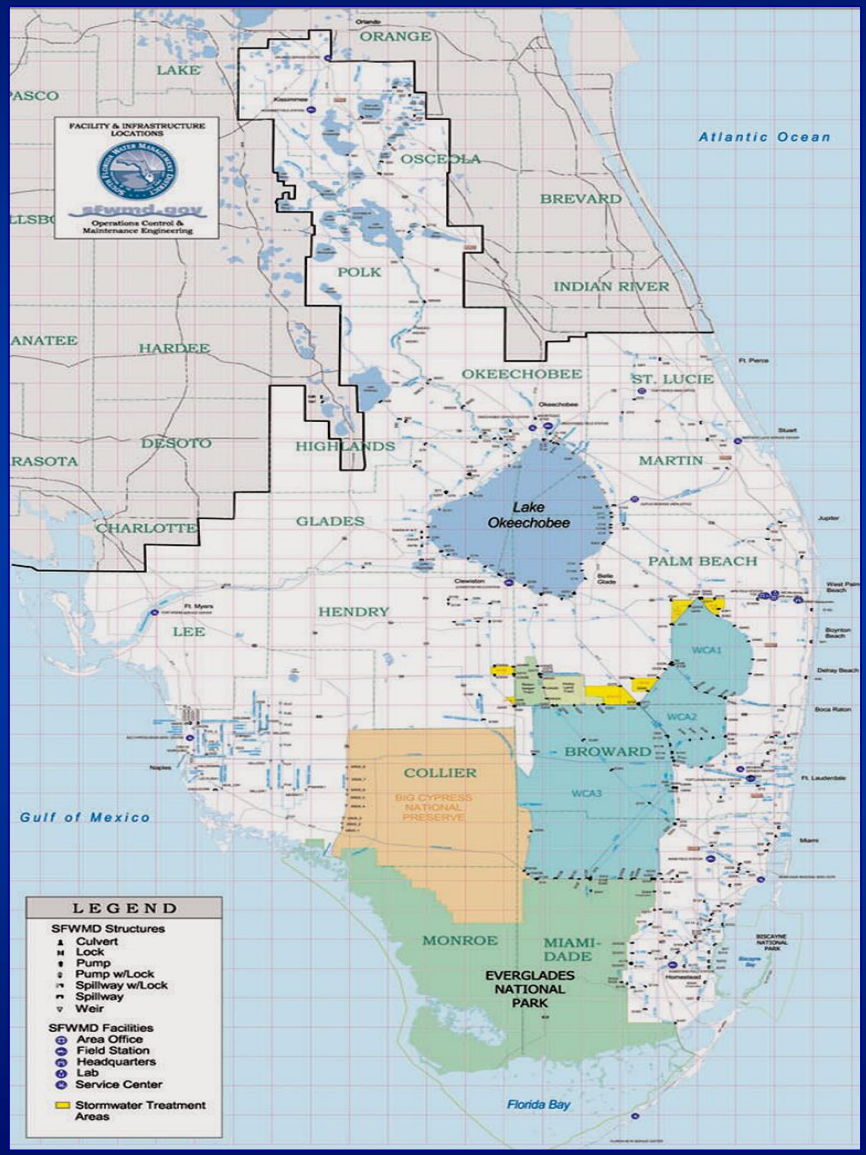
Water Management System Components

- 3,200 kilometers of canals and levees
- 160 drainage basins
- 501 structures
  - *206 remotely operated*
  - *295 manually operated or fixed structures*
- 50 pump stations
  - *50% with remote operation capabilities*

South Florida Water Management District

Infrastructure

One of the world's largest and most complex water resource management systems



Regional System Supplements Water Supply

Urban Water Supply

- Primarily Groundwater Wells
- Natural areas provide water during dry periods
  - *Water Conservation Areas*
  - *Lake Okeechobee*
  - *Backup waster supply for Lower East Coast using primary canals*

Agricultural Water Supply

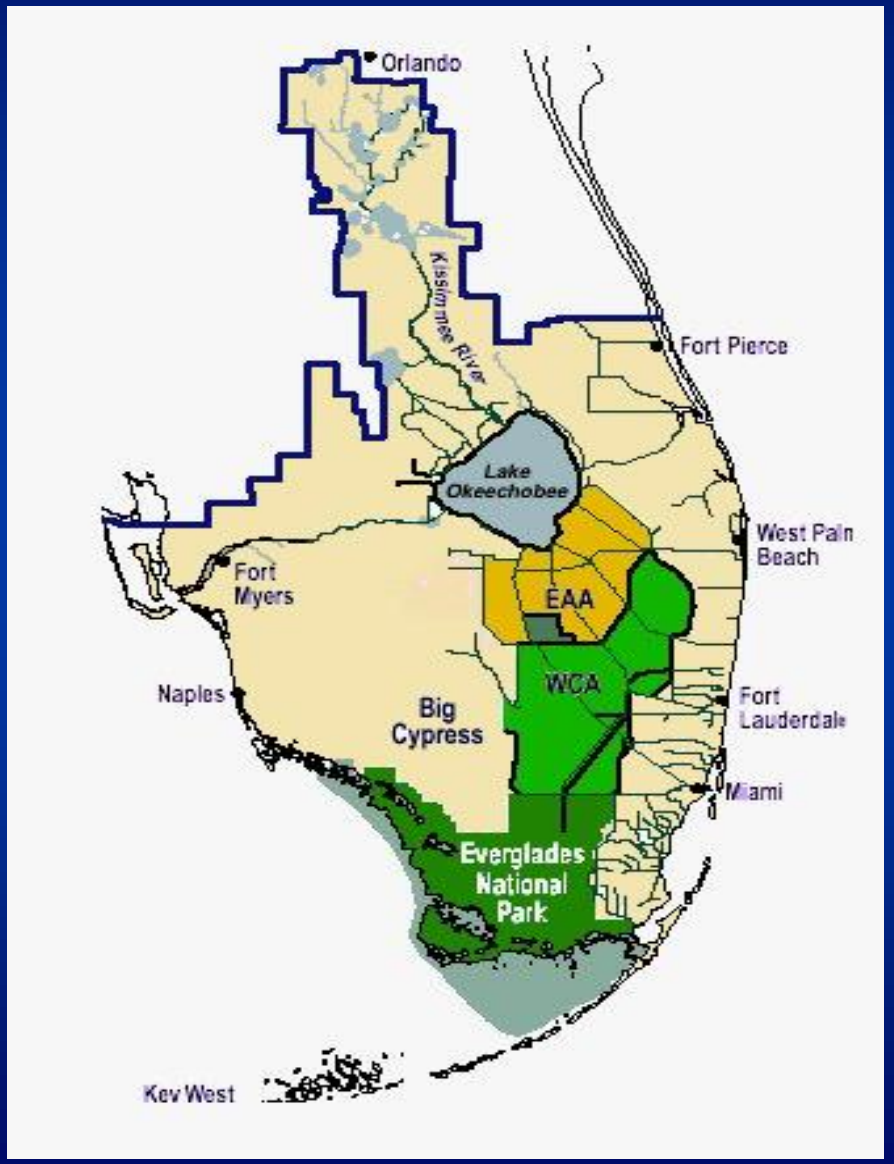
- Primarily Surface Water
- Major sources of water during dry periods
  - *Lake Okeechobee*
  - *Water Conservation Areas*
  - *Surficial & deep aquifers*
  - *Canal network*

Water Supply for the Environment

- Authorized environmental deliveries
  - *Everglades National Park*
  - *Occasional releases to Caloosahatchee estuary*
- Major sources of water for natural areas during dry periods
  - *Lake Okeechobee*
  - *Water Conservation Areas*
  - *Storage in surface waters limited*
- Hydrologic variation in natural areas
  - *Impacted by water management system*
    - Drainage, compartmentalization
    - Urban/Agricultural Water Supply

South Florida Water Management District Major Features

- *The Upper Chain of Lakes*
- *The Kissimmee River*
- *Lake Okeechobee*
- *The Caloosahatchee and St. Lucie Rivers*
- *The Everglades Agricultural Area*
- *The Water Conservation Areas*
- *Everglades National Park*
- *Florida Bay*



C&SF Project: A Qualified Success

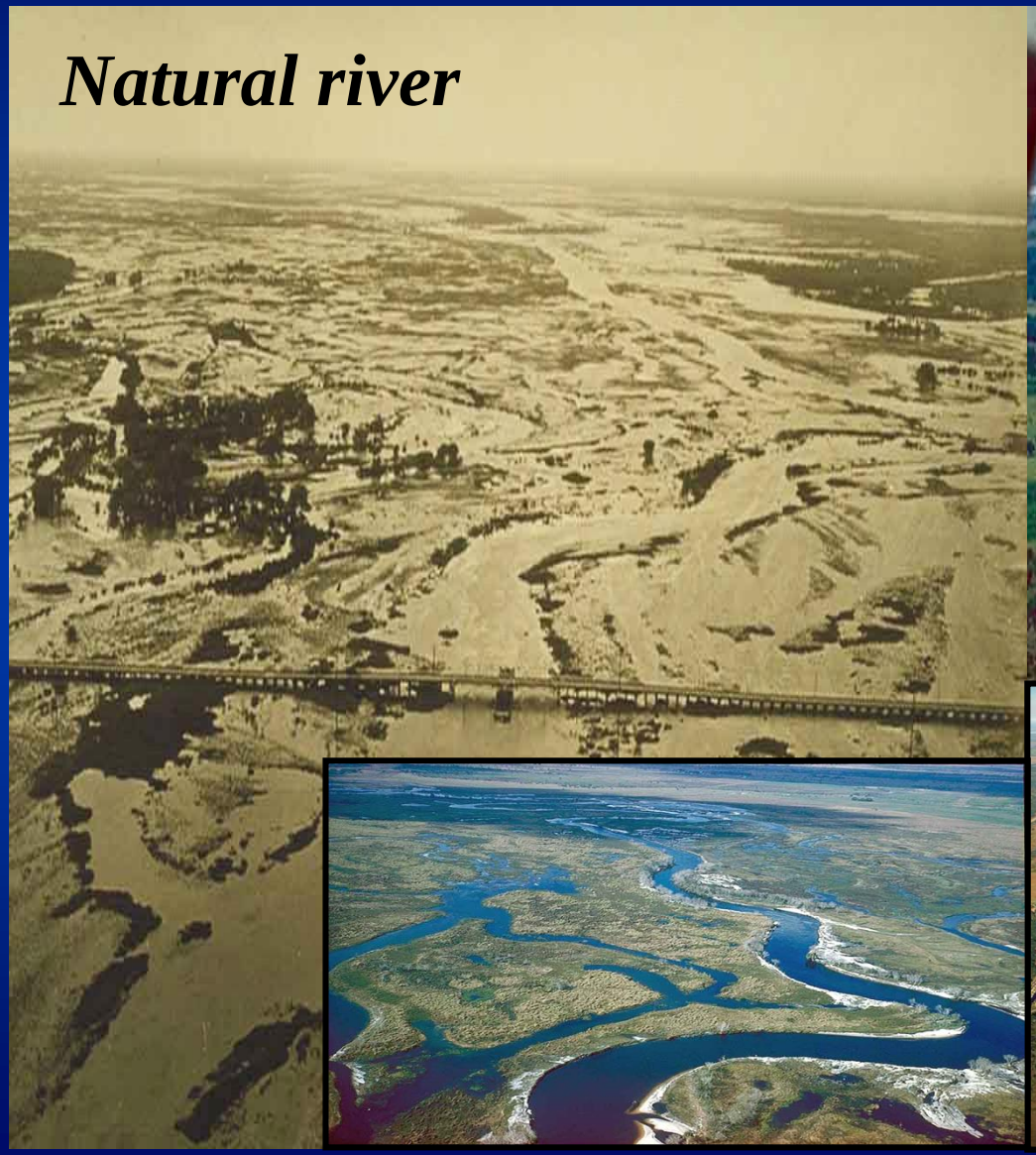
- Provides significant benefits to developed areas
  - *Flood Control*
  - *Water Supply*
- Unintended Ecological impacts associated with C&SF construction and operation
- Allows some limited operation for the environment

South Florida Water Resource Management: Objectives & Challenges

- Mission Elements: Environmental Management; Drainage & Flood Control; Water Supply; Water Quality

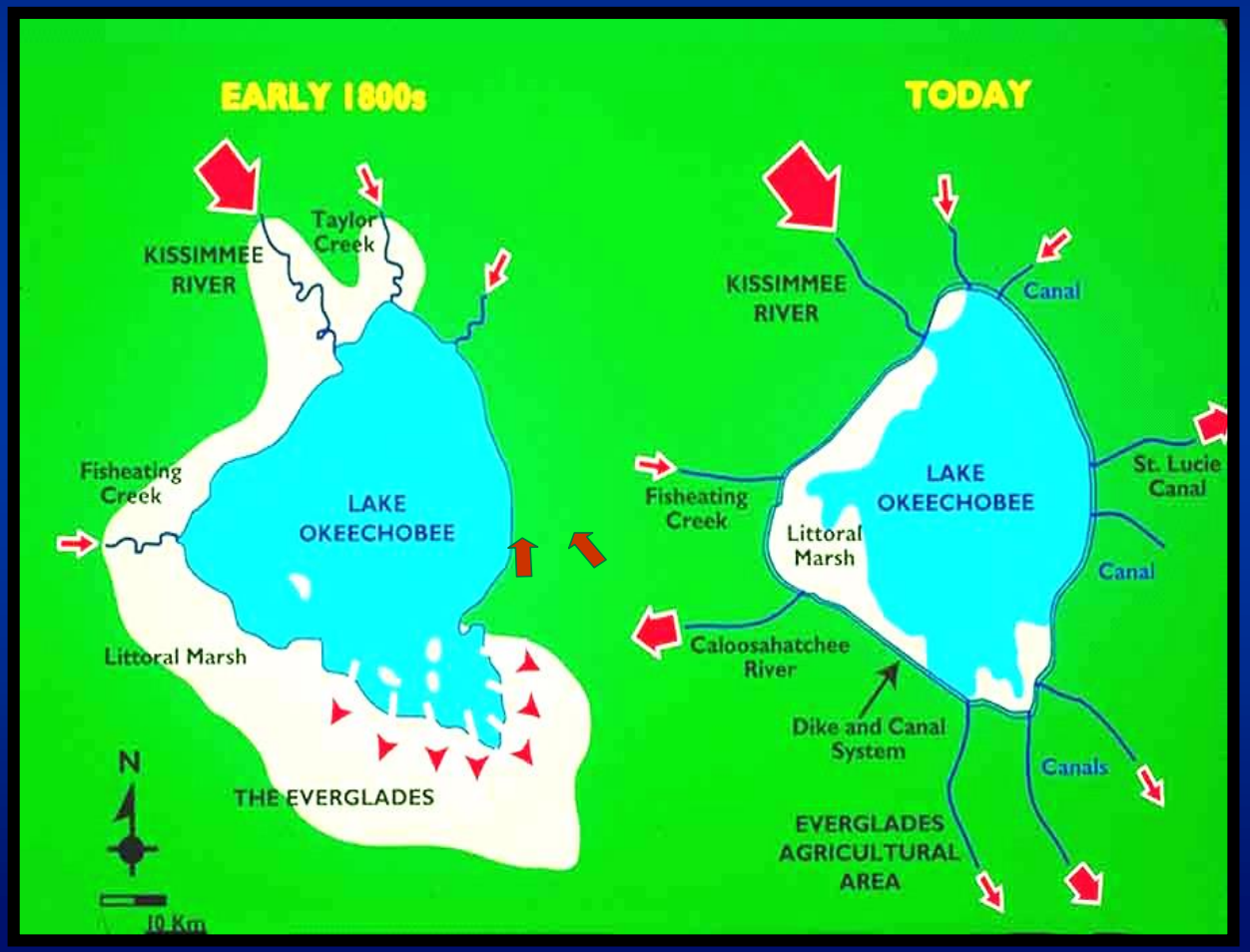
- Challenges: Climatic "extremes"; Global Climate Change; population; District objectives often conflict; and environmental restoration

Kissimmee River and Restoration



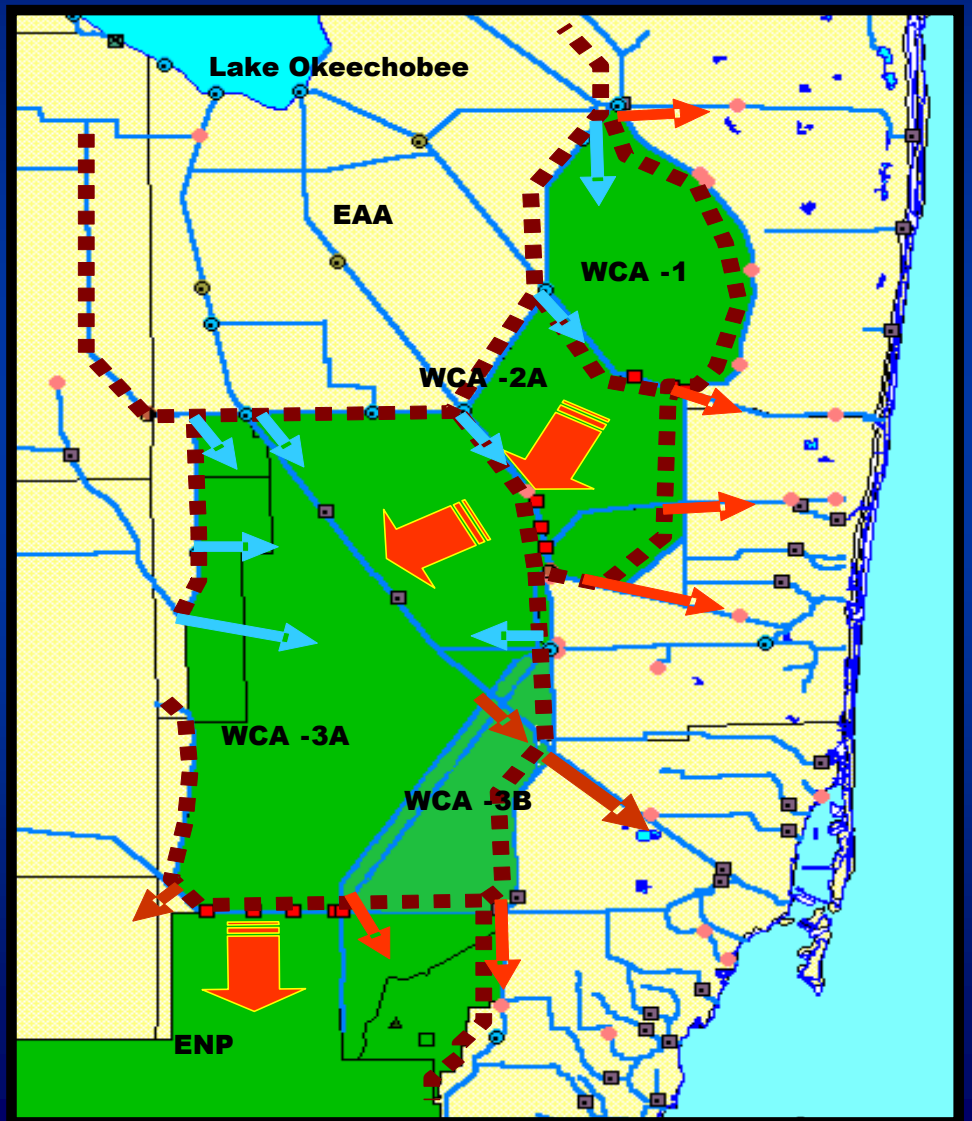
Lake Okeechobee Natural vs. Altered Conditions

- Littoral marsh areas significantly reduced
- Discharge to the Everglades significantly reduced
- Discharge to coastal estuaries significantly increased
- Modified range of typical stages



Everglades Protection Area Flow Patterns

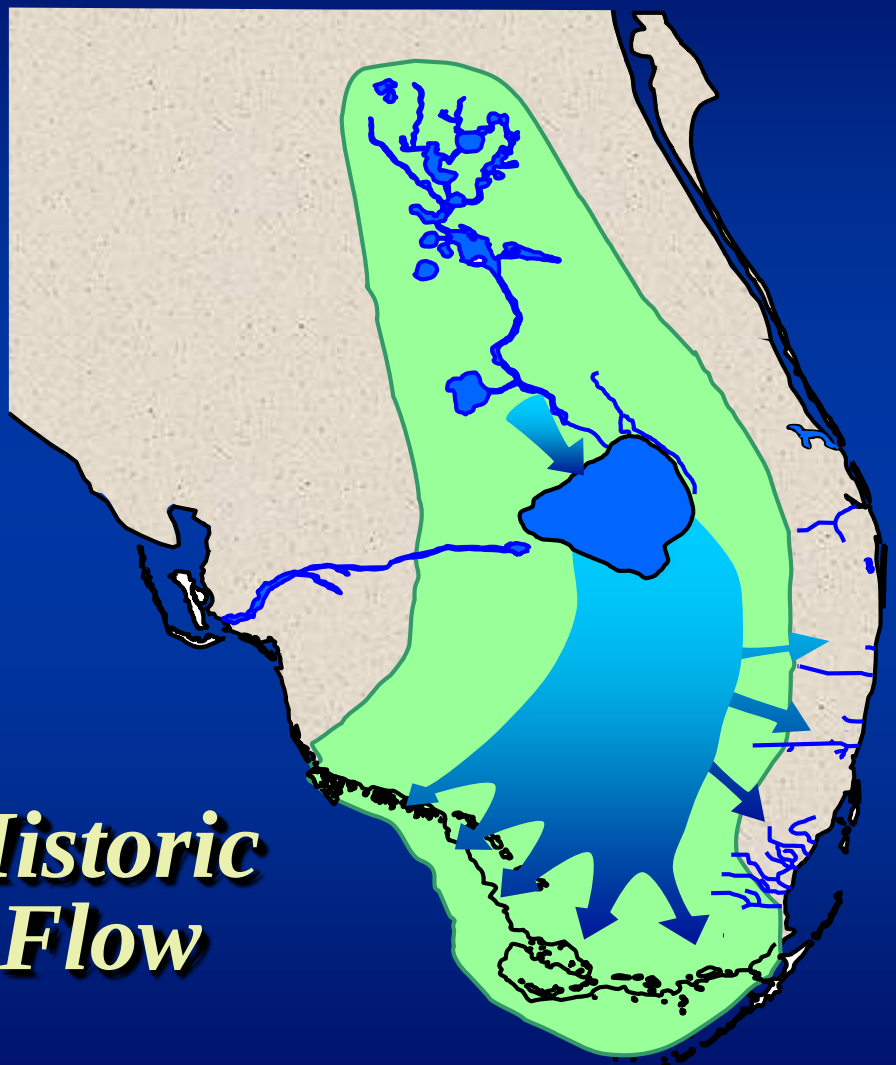
- Levees impounded the Water Conservation Areas
  - *Primary inflows for*
    - Flood Control (pumped)
    - Water supply from Lake Okeechobee
      - *Water supply to EAA*
      - *Water supply to Lower East Coast*
- Major structures move excess water south
- Smaller structures discharge water to the ocean
- Environmental restoration?



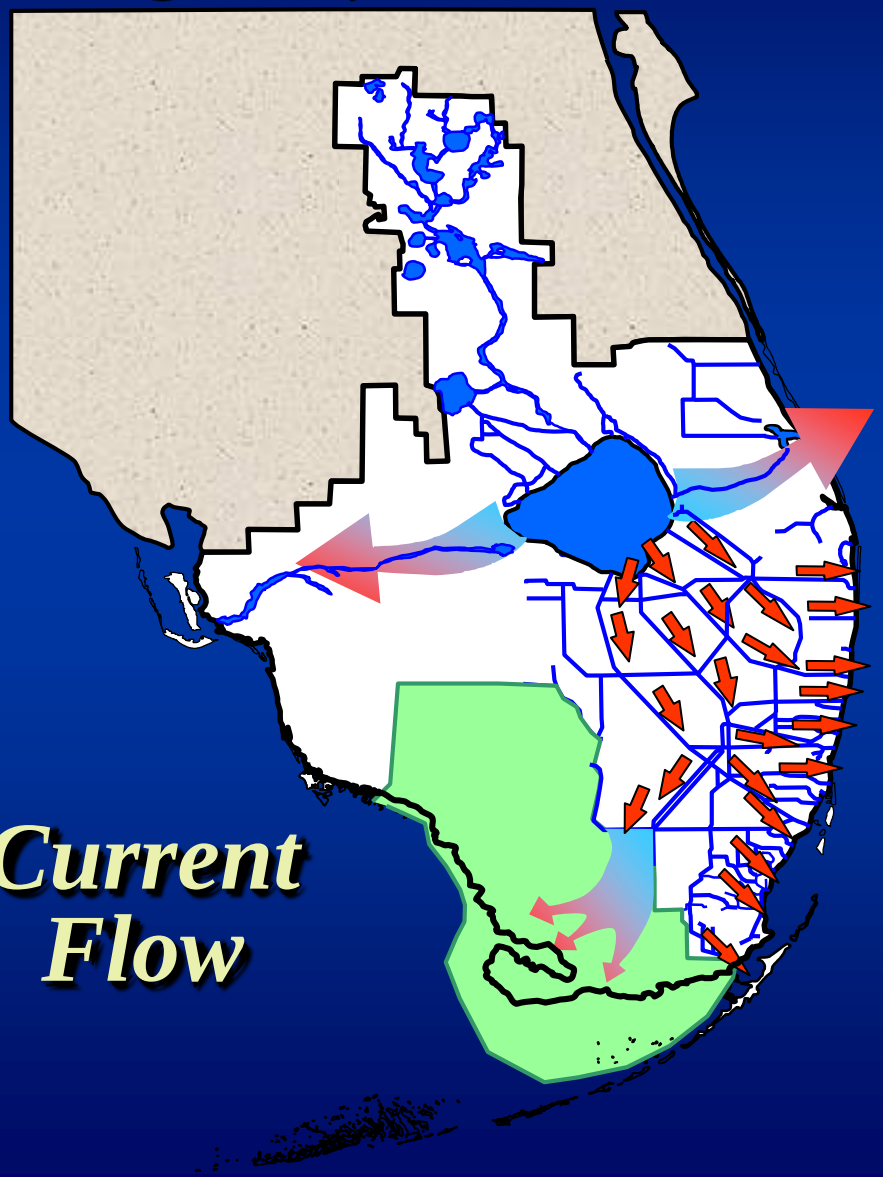
SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Water Resource Modifications

From Nature to a Managed System



Historic Flow



Current Flow

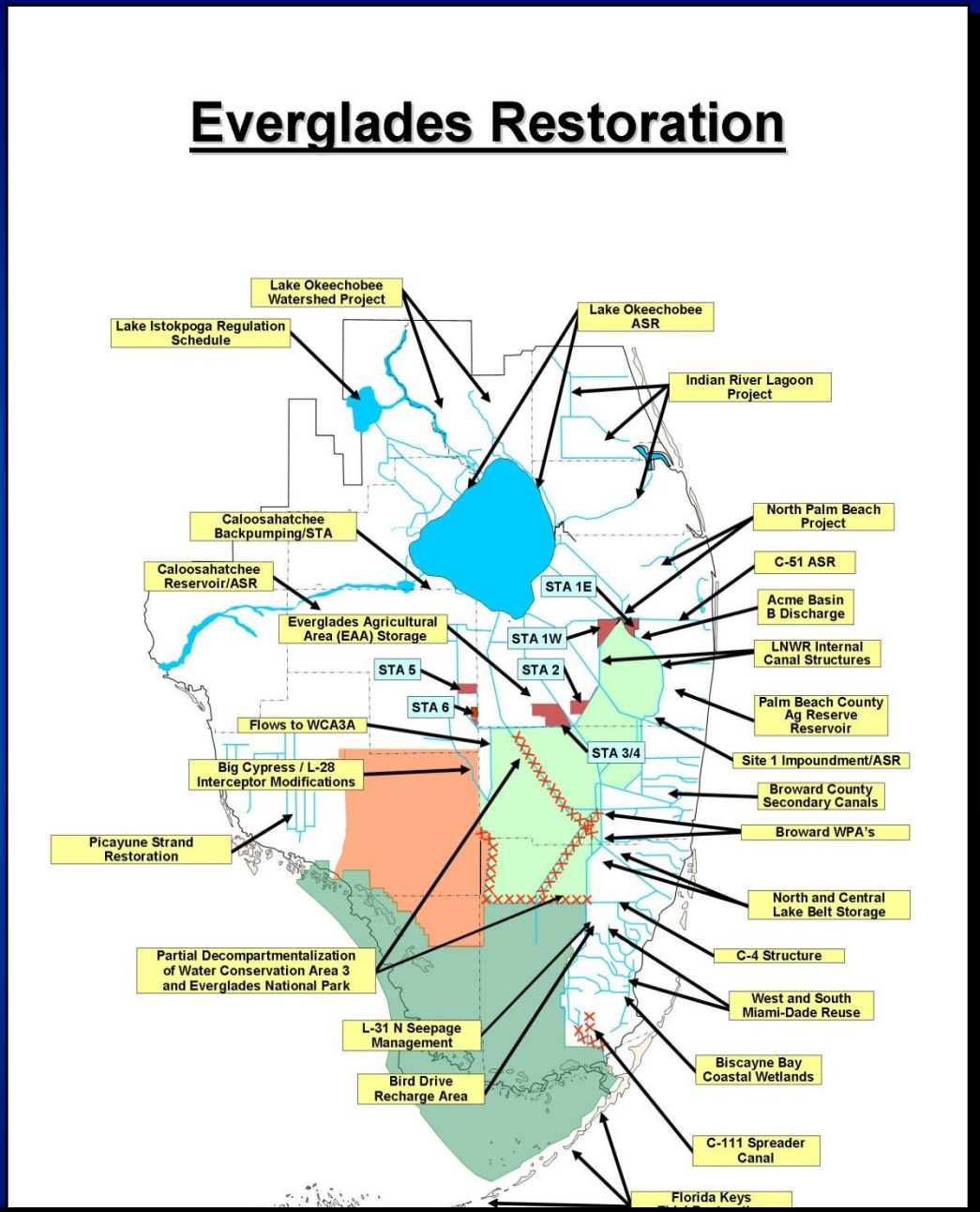
Everglades
Natural vs Altered Conditions

Unintended Consequences of the C&SF Project

- *Too much or too little water for the South Florida Ecosystem*
- *Degradation of water quality*
- *Repetitive water shortages and salt water intrusion*
- *6.5 million cubic meters of water a day discharged to tide*
- *Significant loss of Everglades habitat*

Comprehensive Everglades Restoration Plan (CERP) & Central Everglades Planning Project (CEPP)

- *Plan includes 68 components to be implemented over 35 years.*
- *Some progress, but most components remain in planning phase*
- *Central Everglades Planning Project attempts to invigorate process*



Getting the Water Right. . .

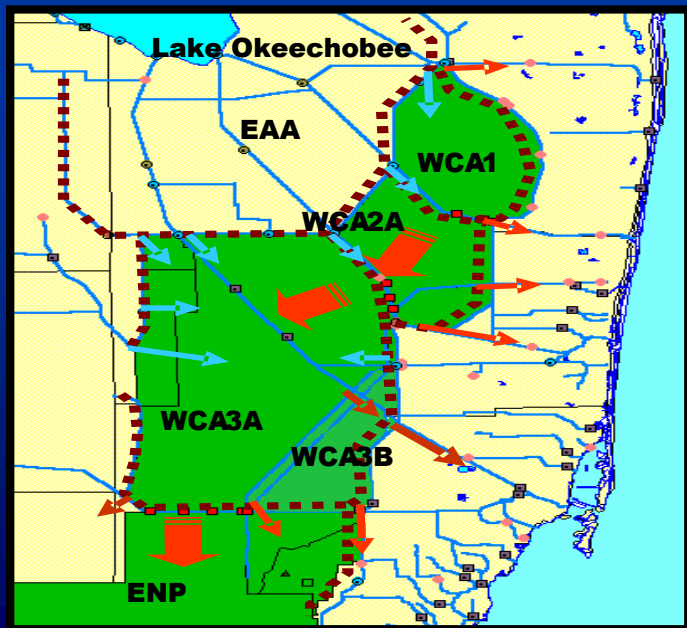
A Rational Premise
or
Risky Assumption?

What is the goal for each element?

Historic? Current? Other?

South Florida Water Management - Central Themes -

- **Past 100 years through World War II.**
  - *Drain the land for agriculture and other development; unsatisfactory and unsustainable with unintended consequences.*
- **Last 50 years to the present.**
  - *Provide water supply, flood control, water quality and environmental management; successful for water supply and flood control; unsatisfactory for environmental management and water quality with more unintended consequences.*
- **Future with CERP or CEPP and other projects**
  - *Develop a more intricate system with complex operational criteria; overcome challenges for sustainability.*

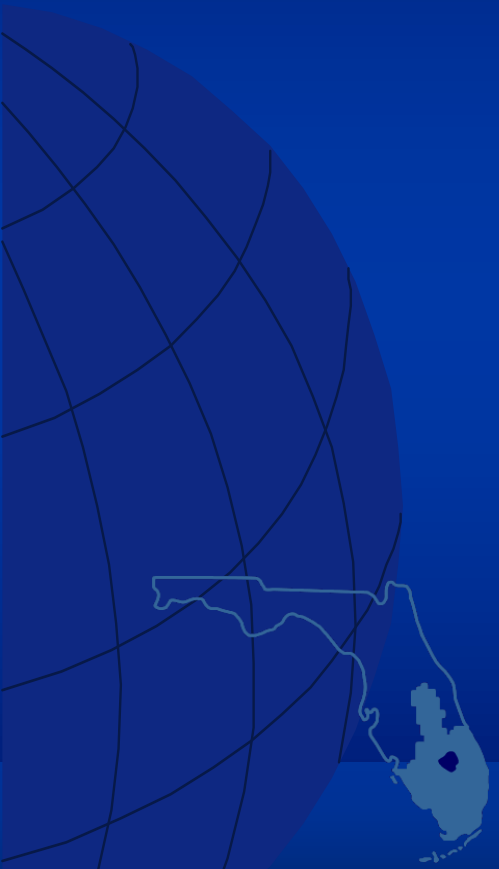


SOUTH FLORIDA WATER MANAGEMENT DISTRICT

From Nature to a Managed System

History of Water Management In South Florida

Questions?



sfwmd.gov

Garth W. Redfield, Ph.D.
Chief Scientist
South Florida Water Management District,
West Palm Beach, FL