

Flood Control Operations and Wet Season Readiness

Tommy B. Strowd, P.E., Director
Operations, Maintenance & Construction Division

Governing Board Workshop
June 14, 2012

Today's Presentation

- Introduction - Tommy Strowd
- Hurricane Andrew - Scott Thorp, Homestead F.S. Superintendent
- Hurricanes in the Kissimmee Basin – Larry Russell, St. Cloud F.S. Superintendent
- Lake Okeechobee Hurricanes – Richard Champlin, Clewiston F.S. Superintendent
- Miami-Dade Floods – Tommy Strowd
- What We Do - Richard Champlin
- Summary – Tommy Strowd

Flooding in South Florida

- The issue of 'Flooding' was one of the primary forces in the development of South Florida
 - Drainage of the Greater Everglades to support development was a major issue since long before Florida became a State.
- But as early development increased into floodplains, damages from floods became more and more a focus of public policy
 - 1926 & 1928 Failures of the Lake Okeechobee Dike
 - 1947 Hurricanes
- Resulted in the development and implementation of the Central & Southern Florida Project for Flood Control and Other Purposes in 1949

1926 AND 1928

**DEVASTATING
HURRICANES**

... LOSS OF 2,500 LIVES



**HOOVER DAM
AUTHORIZED
1930**

... COMPLETED 1937



**Flood Waters Caused by 1947 Hurricane
Okeechobee Lake Front Near Buckhead Ridge**





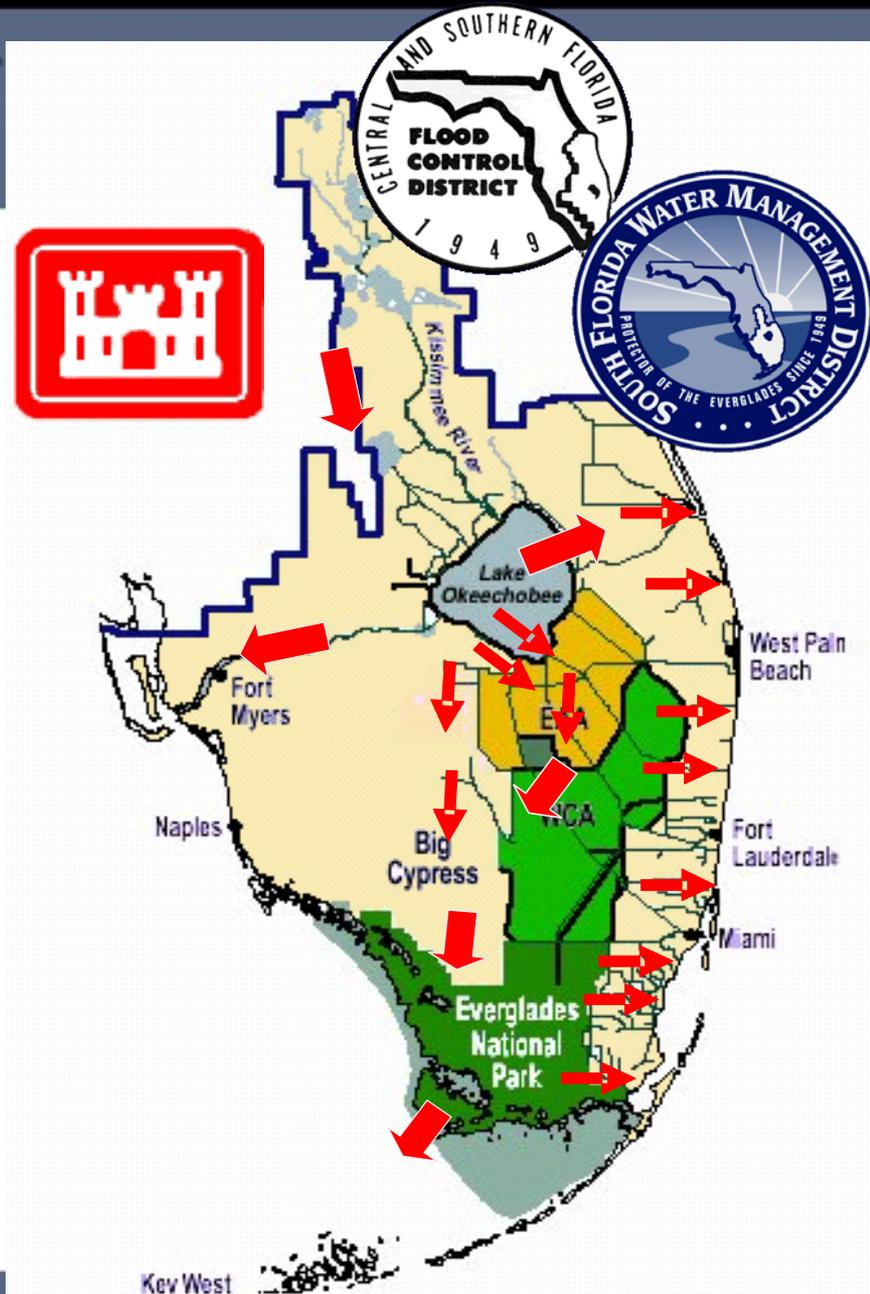
TENTATIVE
REPORT
OF
FLOOD
DAMAGE

FLORIDA
EVERGLADES
DRAINAGE
DISTRICT

1947

Central and Southern Project for Flood Control & Other Purposes

- Designed for multiple purposes
- Initially authorized in 1949 and constructed between 1950 & 1970
- The C&SFFCD was created by the legislature to serve as local sponsor
- Operated and maintained by SFWMD in accordance with USACE criteria



THE ORIGINAL MEETING OF THREE HUNDRED CITIZENS OF CENTRAL AND SOUTHERN FLORIDA WHO AUTHORIZED THE FORMATION OF THE "FLOOD CONTROL COMMITTEE OF FLORIDA" WAS HELD ON THIS SPOT OCTOBER 6, 1947.

THIS COMMITTEE REPRESENTED THE AREA BEFORE ALL STATE AND NATIONAL AGENCIES AND THE PUBLIC UNTIL THE PROJECT WAS APPROVED IN WASHINGTON AND STATE LEGISLATION WAS ENACTED FORMING THE CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT IN 1949.



Awards Being Presented
Flood Control Celebration
Okeechobee, FL 1950



**Flood Control Celebration Parade
Okeechobee, FL 1950**



Parade Queen
Dian Williamson

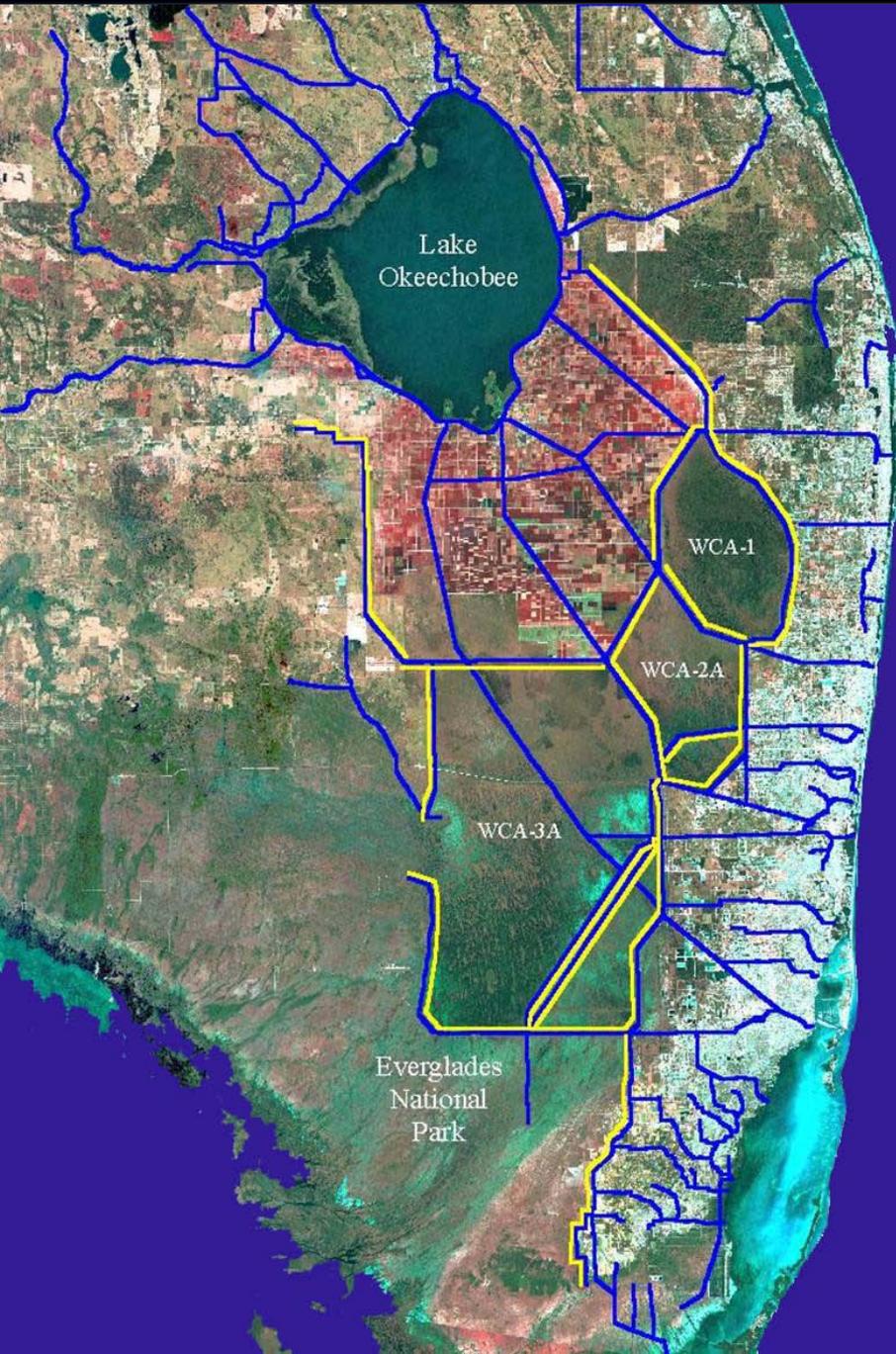
Flood Control Celebration Parade
Okeechobee, Fl 1950



Flood Control
Celebration
Okeechobee, Fl
C. 1950

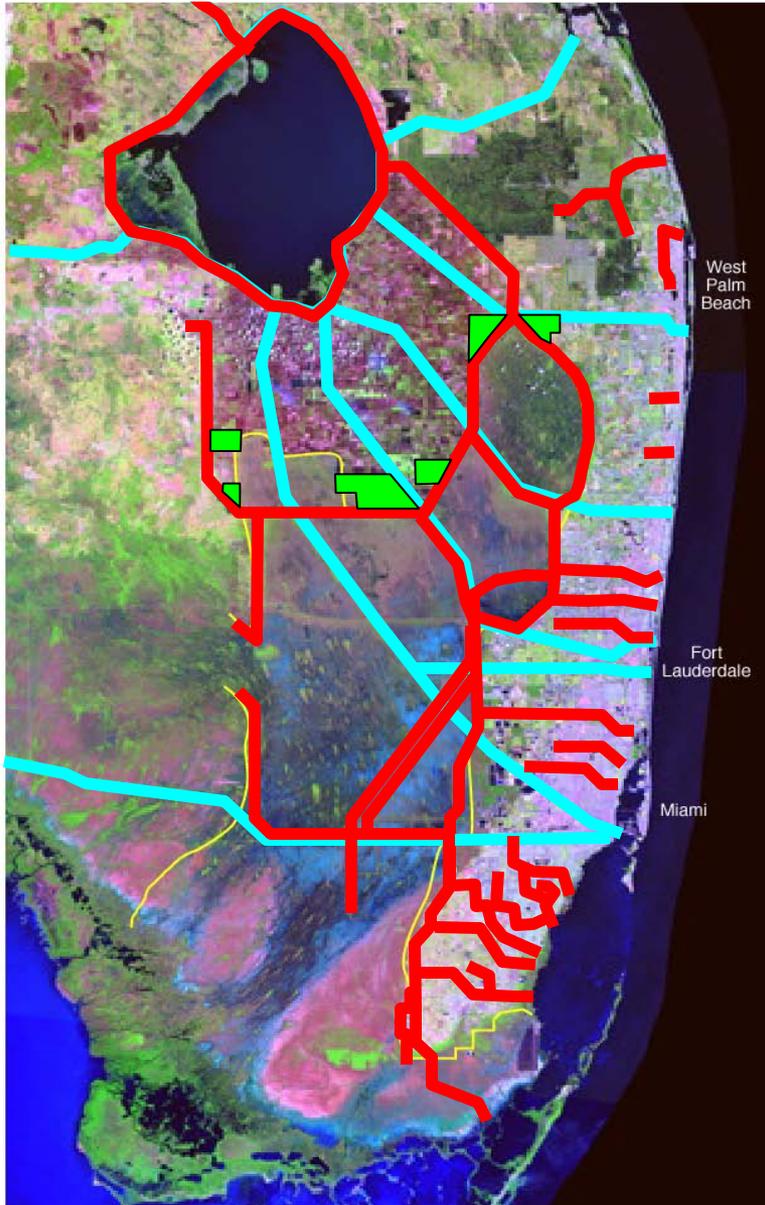


Plan to Reduce Flooding



- Wall off the Everglades
 - East Coast Protective Levee
 - EAA Levees
- Drain to the Ocean
 - Cheap
 - Effective
 - Minimal footprint on high priced lands
 - Water lost, but we had too much

Chronology of Water Management Changes



Managed System (2003)

Pre-Central & South Florida Projects

- Caloosahatchee/Kissimmee Rivers 1881-93
- East Coast Canals/St. Lucie Canal 1905-24
- Tamiami Trail – 1915-28
- Lake Okeechobee HH Dike – 1932-38

Central & Southern Florida Project

- Eastern Protective Levee System – 1952-54
- Everglades Agricultural Area – 1954-59
- Water Conservation Area Levees – 1960-63
- Lower East Coast Canals – 1954-65
- Lake Okeechobee Levees – 1960-64
- Kissimmee River Channelization – 1962-71
- South Dade System – 1965-83

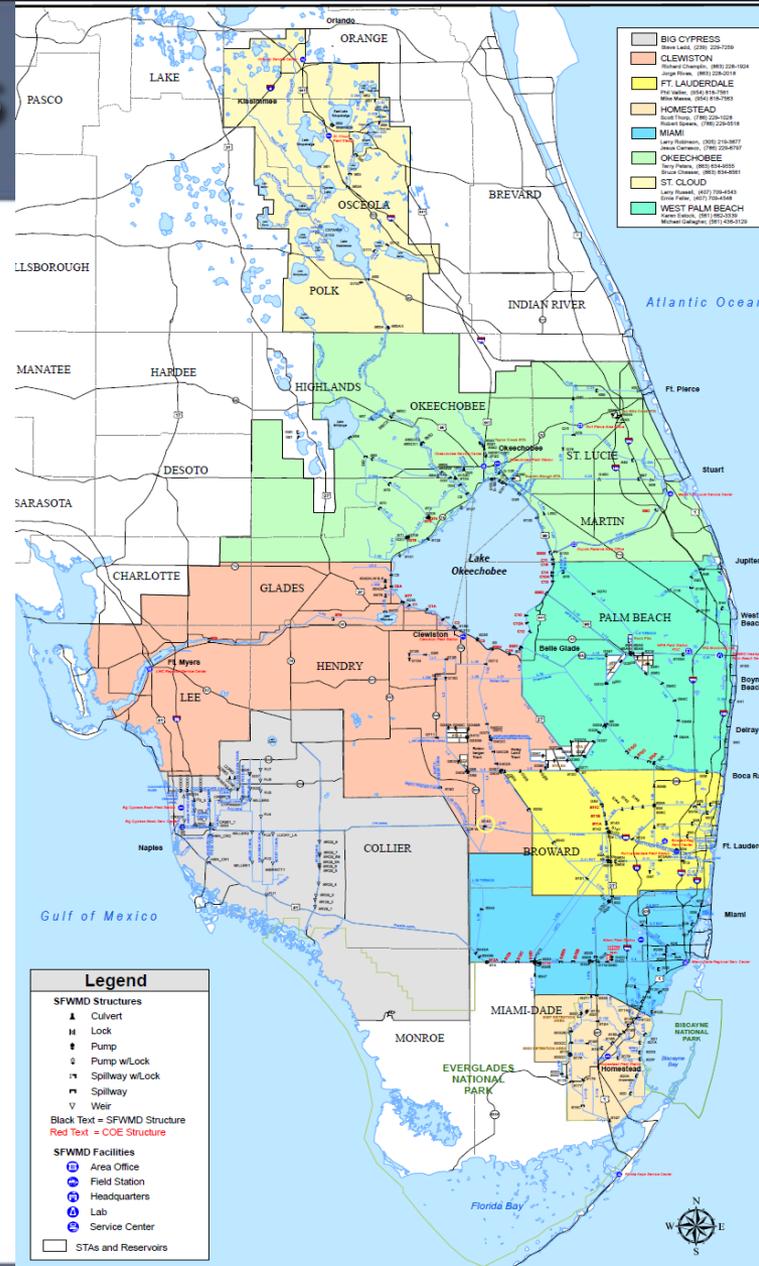
Everglades Construction Project

- Stormwater Treatment Areas – 1994-Present

Source: Light and Dineen, 1994; SFWMD & USACE, 2008

Sub-Regional Field Stations

- 8 Field Stations
 - 2 hour response time
- Maintenance
 - Structures, Pump Stations, Canals & Levees
 - Overhauls & Preventive maintenance
 - Vegetation control (mowing, spraying, tow boats)
 - Shoal removal / erosion repair
- Operations
 - Pump station staffing
 - often 24/7
 - Manual structure operations as required



Surface Water Regulation

- Enhanced benefit of the C&SF system by limiting inflows to avoid overwhelming the system
- Requires water storage systems for new development to limit storm flows into the primary canal system
- This insures that no increase in the peak rate of flow is discharged to the canals after development occurs
 - Has been a key in avoiding having to increase canal capacity over time (unlike the highway system)



District-wide Hydrologic Monitoring System



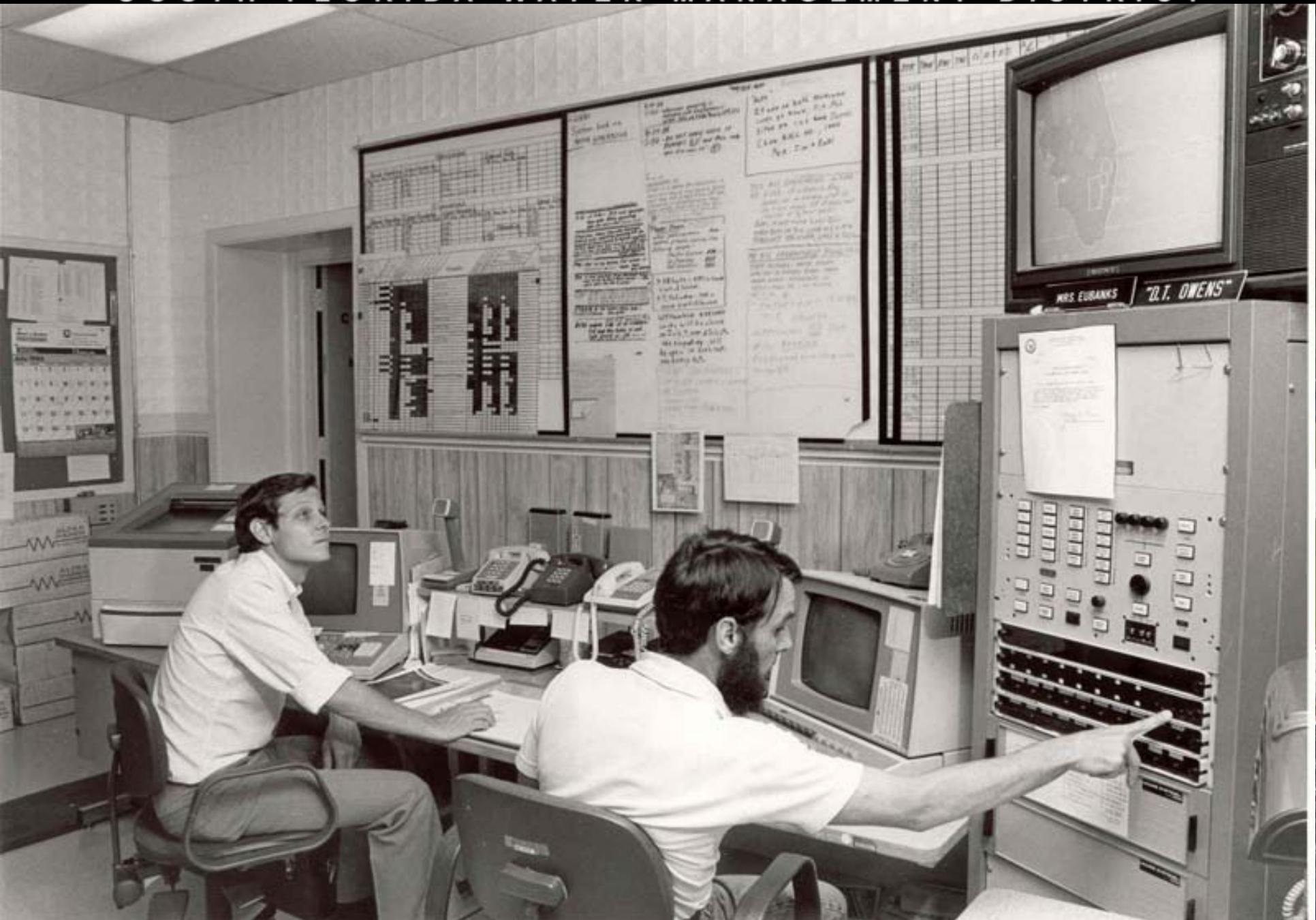
- The 1949 authorization recognized the critical importance of remote monitoring of water levels and meteorological conditions
- SFWMD developed a monitoring network to support operational decisions
 - Initially, a manual system (daily & weekly readings)
 - Now, primarily a remote/automated system (real time)
- 1500 stations currently monitored in real-time as part of the flood control system

Centralized Real-Time Operations

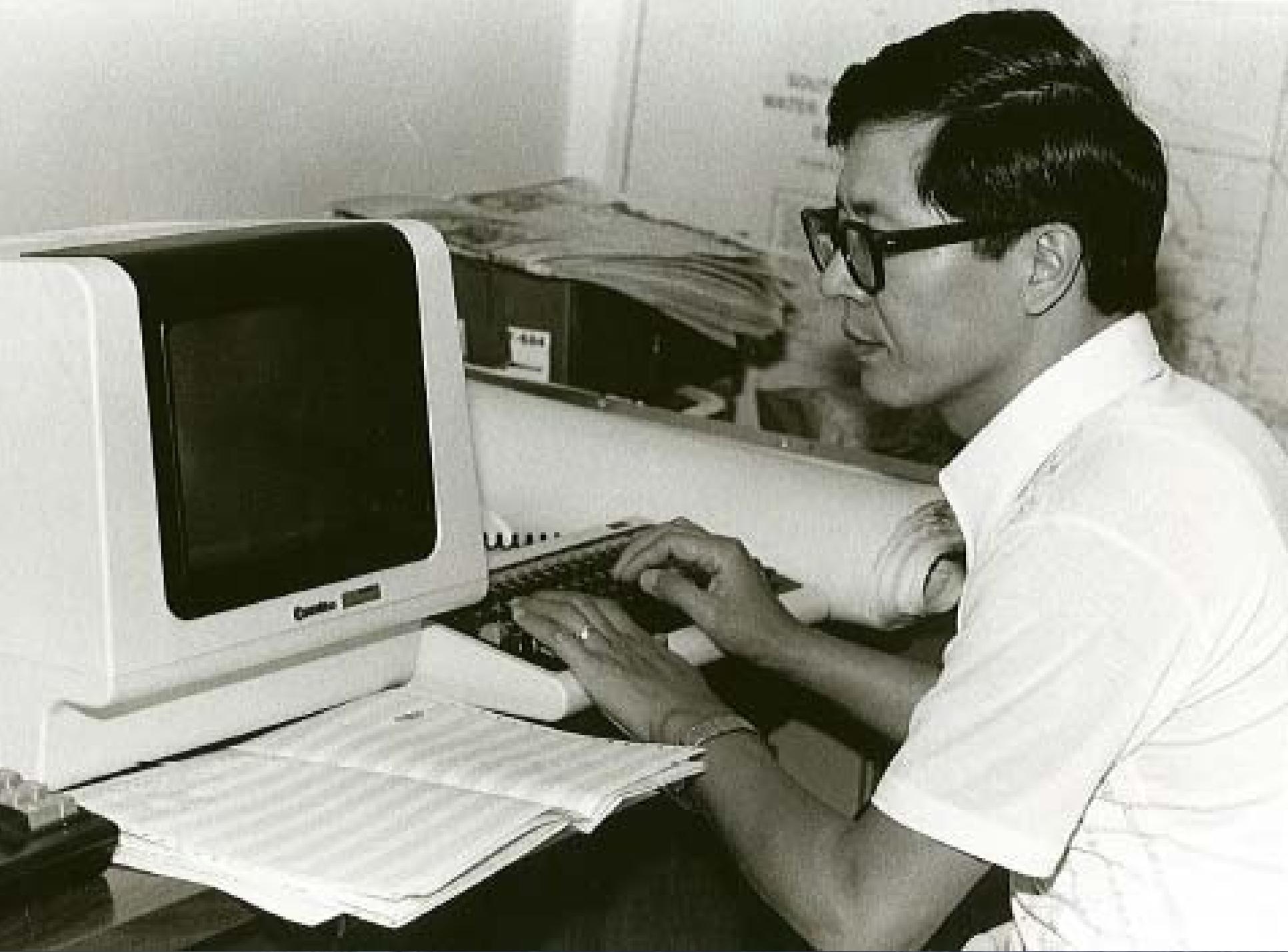


- William Storch, District Chief Engineer, led the effort to create a District-wide 'wireless' microwave telemetry system to facilitate both...
 - Real-time data acquisition, and
 - Remotely automated structure control
- In the mid-1980's, District centralized operational decision at its headquarters
 - Was first know as the 'Radio Room'
 - Received manually collected data
 - Dispatched orders to operate pumps and structures
- Created the Operations Control Center (or the Control Room)
 - Most flood control structures are remotely operated, including some of the newer pumping stations

SOUTH FLORIDA WATER MANAGEMENT DISTRICT











Hurricane Andrew 1992





S-123 Structure today







Standard Operating Procedures prior to Hurricane Andrew

- NO Emergency Operations Organization
- Pre-storm inspection of Water Control Structures and Canals draw-down
- Stationed two employees at Water Control Structures
- Employees were to bring food and bedding
- Rapid Response Team (RRT)
- **Technology**
 - 100 watt two way radios in the vehicles and field stations
 - Beepers and Two cell phones (bricks)

Standard Operating Procedures Implemented after Hurricane Andrew

- District established the Emergency Ops Center in 1994
 - Incident Command System (ICS) for Operations
 - Rapid Impact Assessment Team (RIAT)
 - Damage Assessment Team (DAT)
 - Rapid Response Team (RRT)
 - Public Assistance Coordinator (PAC)
 - Engineering Response Team (ERT)
 - Flood Assessment Team (FAT)
 - Debris Operations Unit (DOU)
- Howard Nicholas Emergency Fund (for employees in impacted area)
- Recovery Support & Hazmat Unit

Standard Operating Procedures Implemented after Hurricane Andrew

- **Field Station**

- Pre-storm inspection of Water Control Structures and Canals draw-down
- Pre-storm Water Control Structures gate adjustments (manual structures)
- Prior to storm event some employees are released to go home and requested if possible to return to work after the all clear is given

- **Technology**

- Water Control Structures can be operated remotely through MOSCAD and Telvent Systems through the Control Room
- Satellite phones/Cell phones
- Two way radios in vehicles/Two way radio at the field stations
- Emergency ops management tools (Web-EOC/Remedy)

The new Command & Control at S-331



Field Station Personnel that rode out Andrew at S-331 Pump Station



Questions



Hurricane Charley

2004



Hurricane Season 2004

Hurricane Charley – 2004

Quick Facts

- Strongest hurricane to hit US since Andrew in 1992
- Peak intensity: Est. 145 mph sustained winds
- Maintained sustained winds of 85 mph as it reached Orlando
- Damage in state over \$13 Billion
- At that time, second costliest in US history

Fickle Beast

- **Sudden Change of Course:**
 - Thousands of evacuees from Tampa fled to Orlando area, directly into path of the storm
 - Rapid course change caught some Port Charlotte area residents off guard
- **Rapid Intensification**
 - Within a five hour period before landfall, winds intensified from 115 mph to 145
- **Forward Acceleration**
 - Rapid forward acceleration just prior to landfall



National Weather Service National Hurricane Center

Home

News

Organization

CHARLEY Graphics Archive

**Rapid
Forward
Acceleration**



Select
3-d
5-d
Strik
W
W
V

Loop Images

Adjust Speed

Advance One

Zoom



Wind





Debris









Water





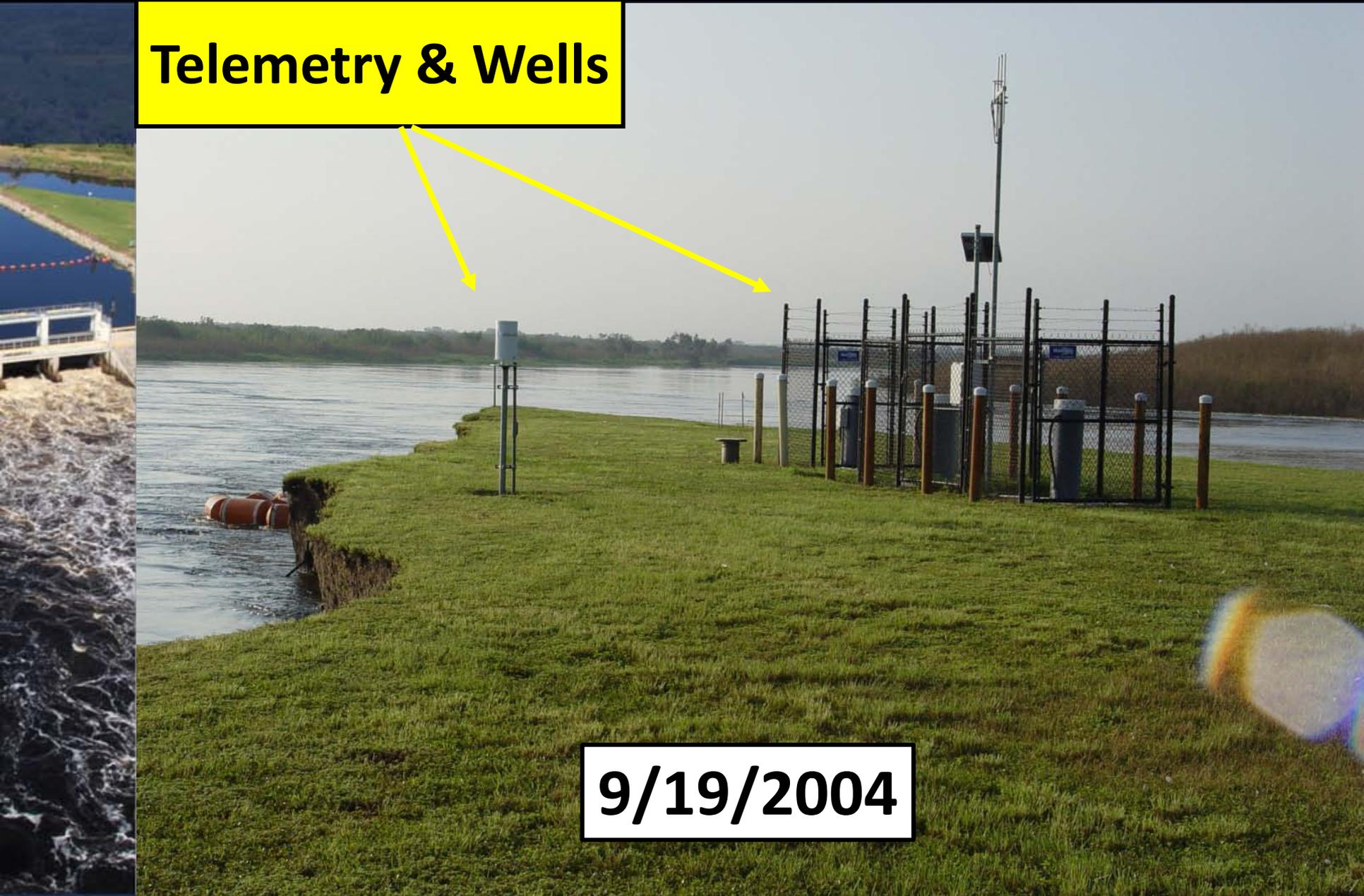


Erosion





Telemetry & Wells



9/19/2004

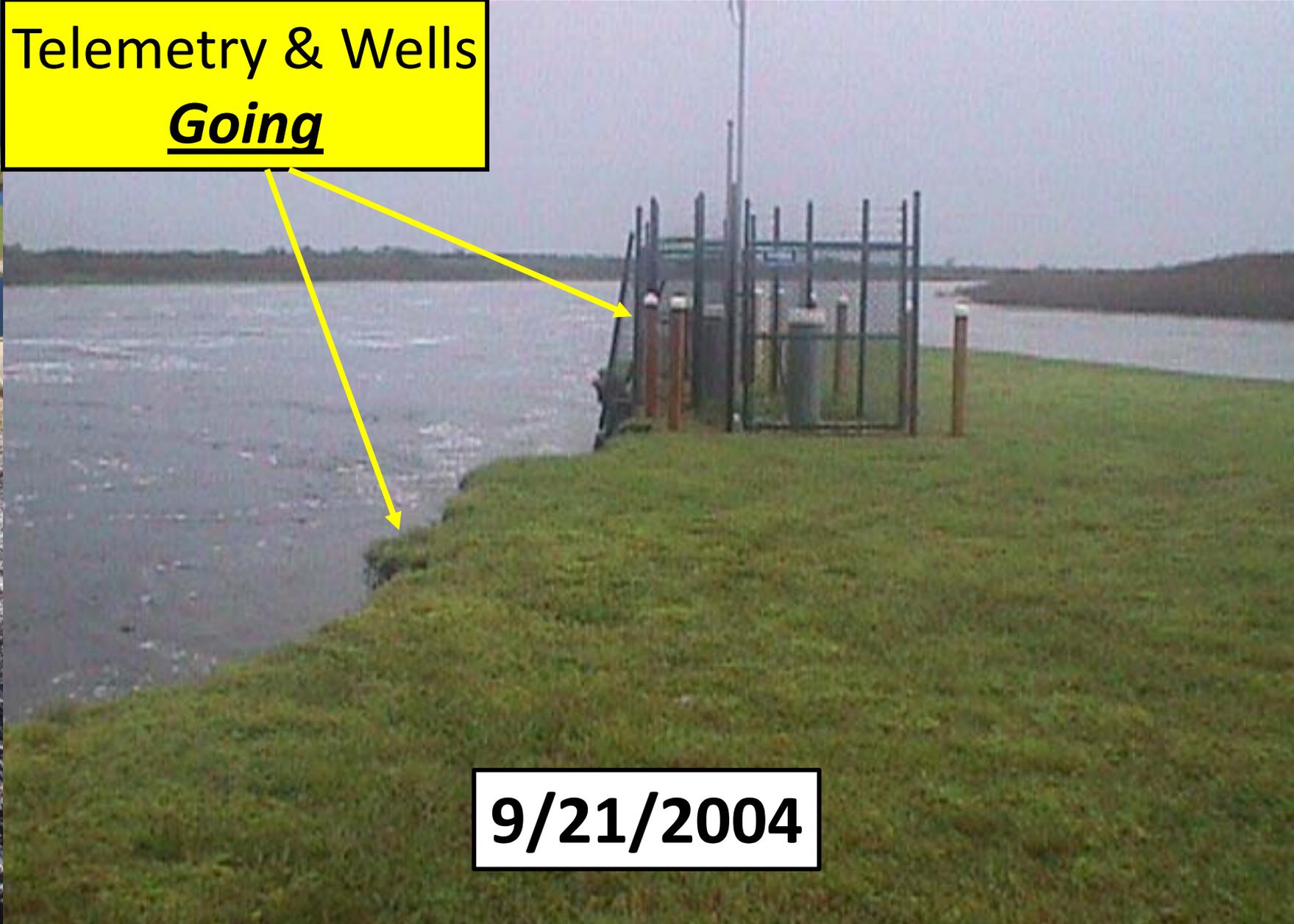
Telemetry & Wells
Going



9/20/2004

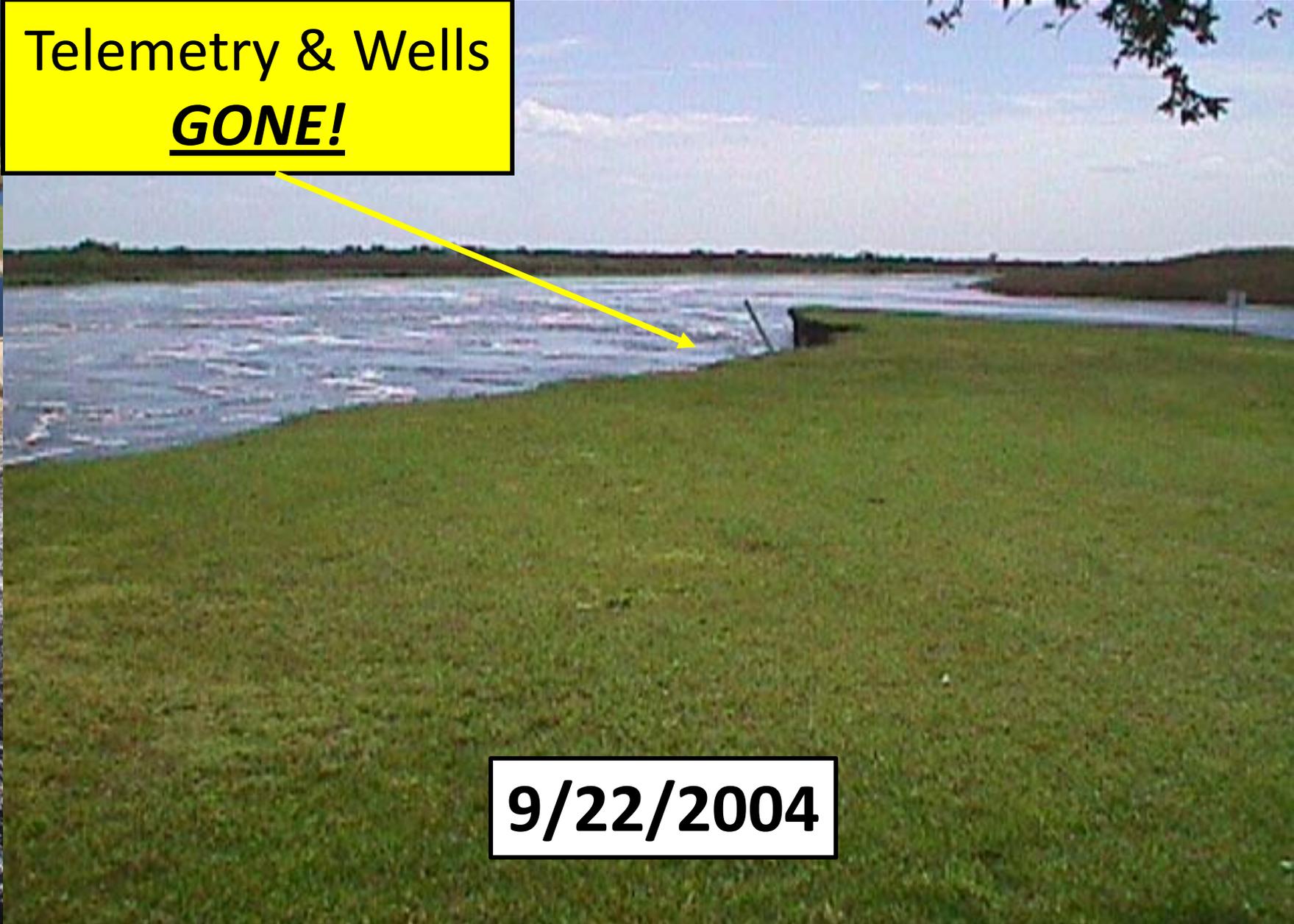


Telemetry & Wells
Going



9/21/2004

Telemetry & Wells
GONE!

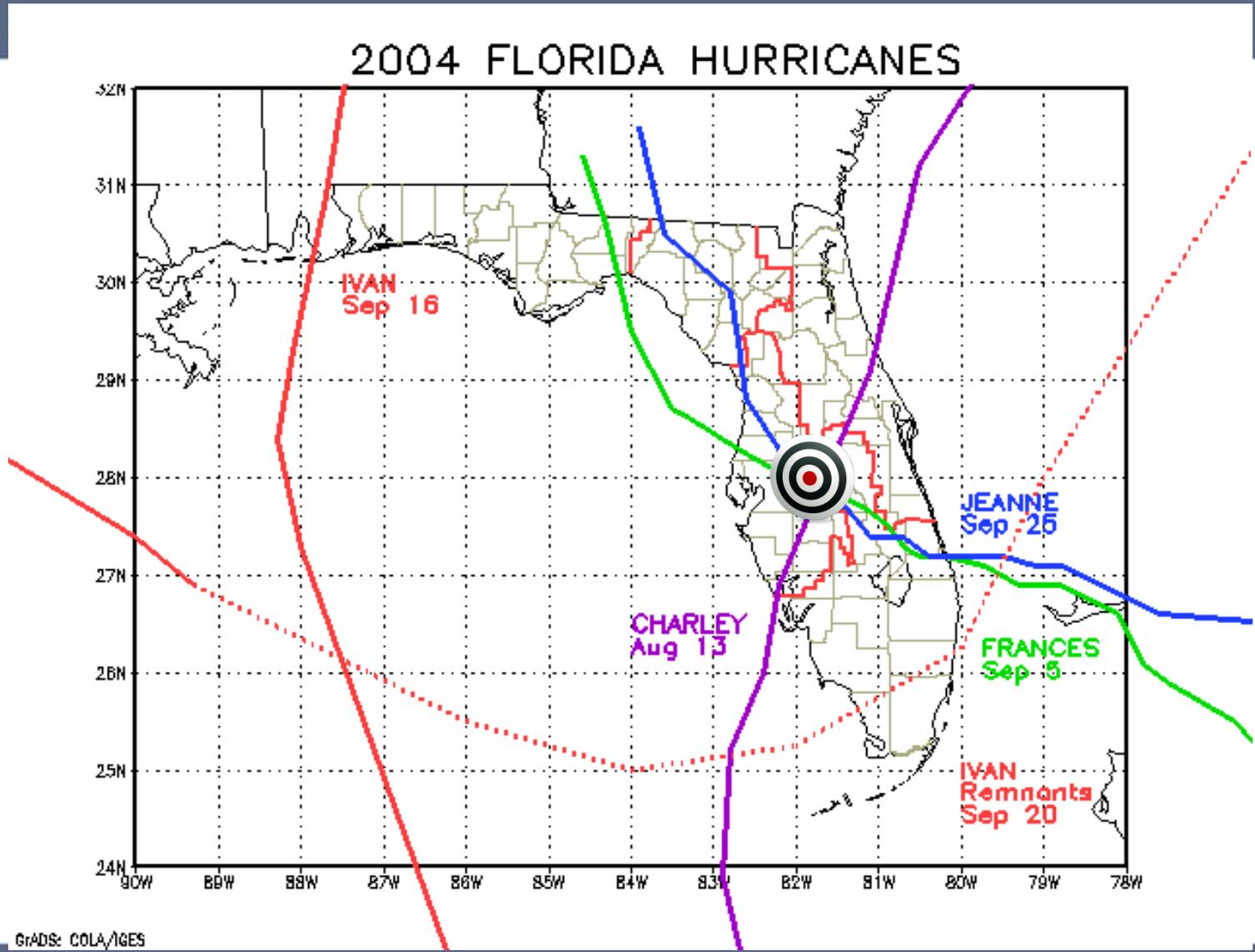


9/22/2004



S-65A After Hurricane Repairs

2004 Hurricane Season Bull's Eye - Central Florida

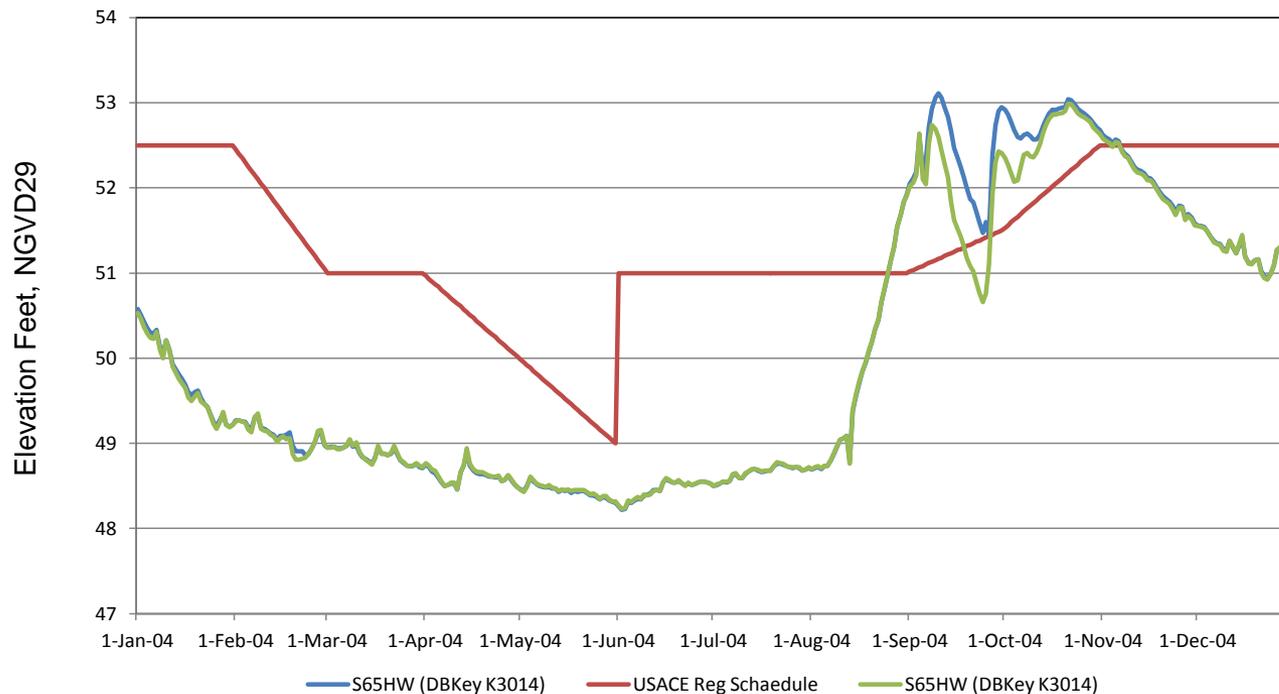


GrADS: COLA/IGES

30" of rain in the Upper Kissimmee basin during August and September.

Wettest 2-month period for the Upper Kissimmee basin on record going back to 1915 .

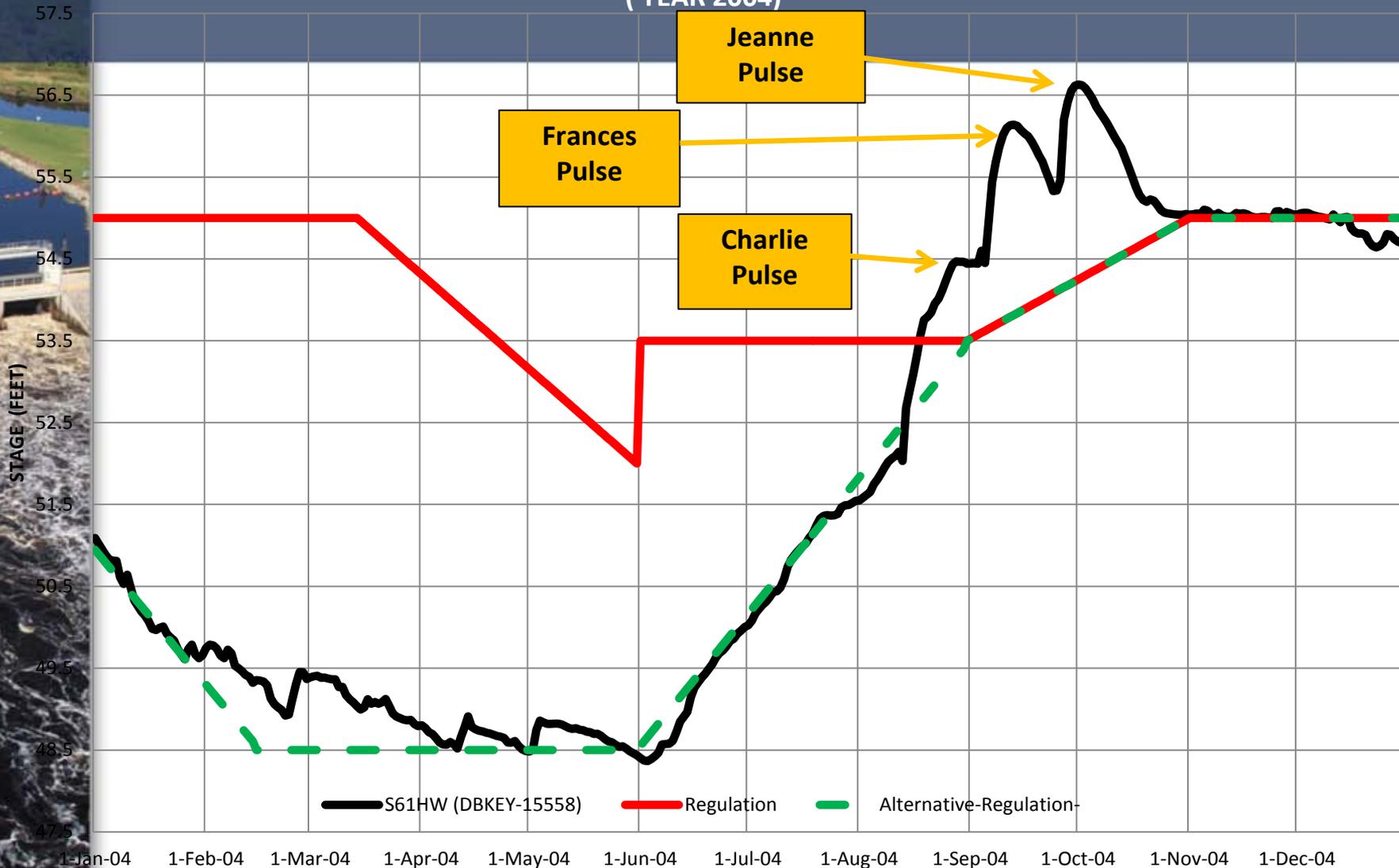
Lake Kissimmee Jan 2004 – Dec 2004



Hurricane Charley (August 12 -16, 2004)
Hurricane Frances (September 4 - 8, 2004)
Hurricane Ivan (September 19-23, 2004)
Hurricane Jeanne (September 24 - 28, 2004)

LAKE TOHOPEKALIGA (SITE S61)

(YEAR 2004)



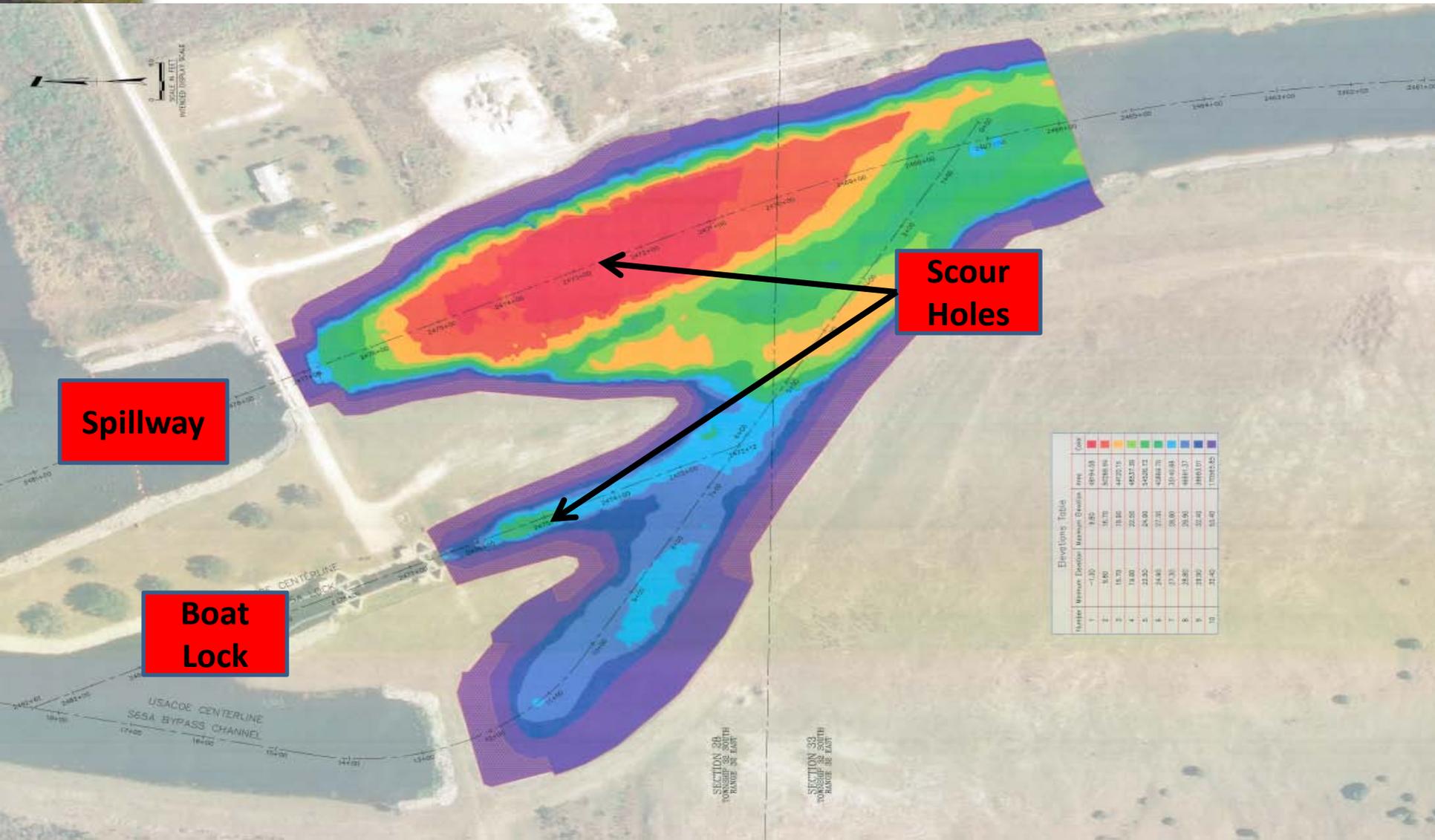
**S-65A Boat Lock Pressed Into Service For
Water Conveyance
(first time ever)**





S-65A Boat Lock Pressed Into Service For Water Conveyance (first time ever)

S-65A Structure, Lock & S-65AX Structure Bathymetry



Post-Storm Effects on Staff

- Many had own property and family impacted by storms
- Stress dealing with personal property damage/insurance claims
- Repeated long term power outages over six week period and beyond
- No respite from heat (it's hot in the field at work and power out at home)
- Fuel, food and ice sometimes in short supply

Lessons

Lessons From the Past:

- Paired up field stations for mutual aid based on geography (HOM/KIS). They are far enough apart that it's less likely that both would be seriously impacted by same storm.
- Employee Services help (Howard Nicholas Fund)

Lessons Carried to the Future:

- Used three boat locks for water conveyance in 2011 during October no-name storm event.
- Ramped up efforts to fortify structures and canal banks to minimize erosion damage (rip rap)
- Enhanced Debris Management Teams/Planning

Questions?



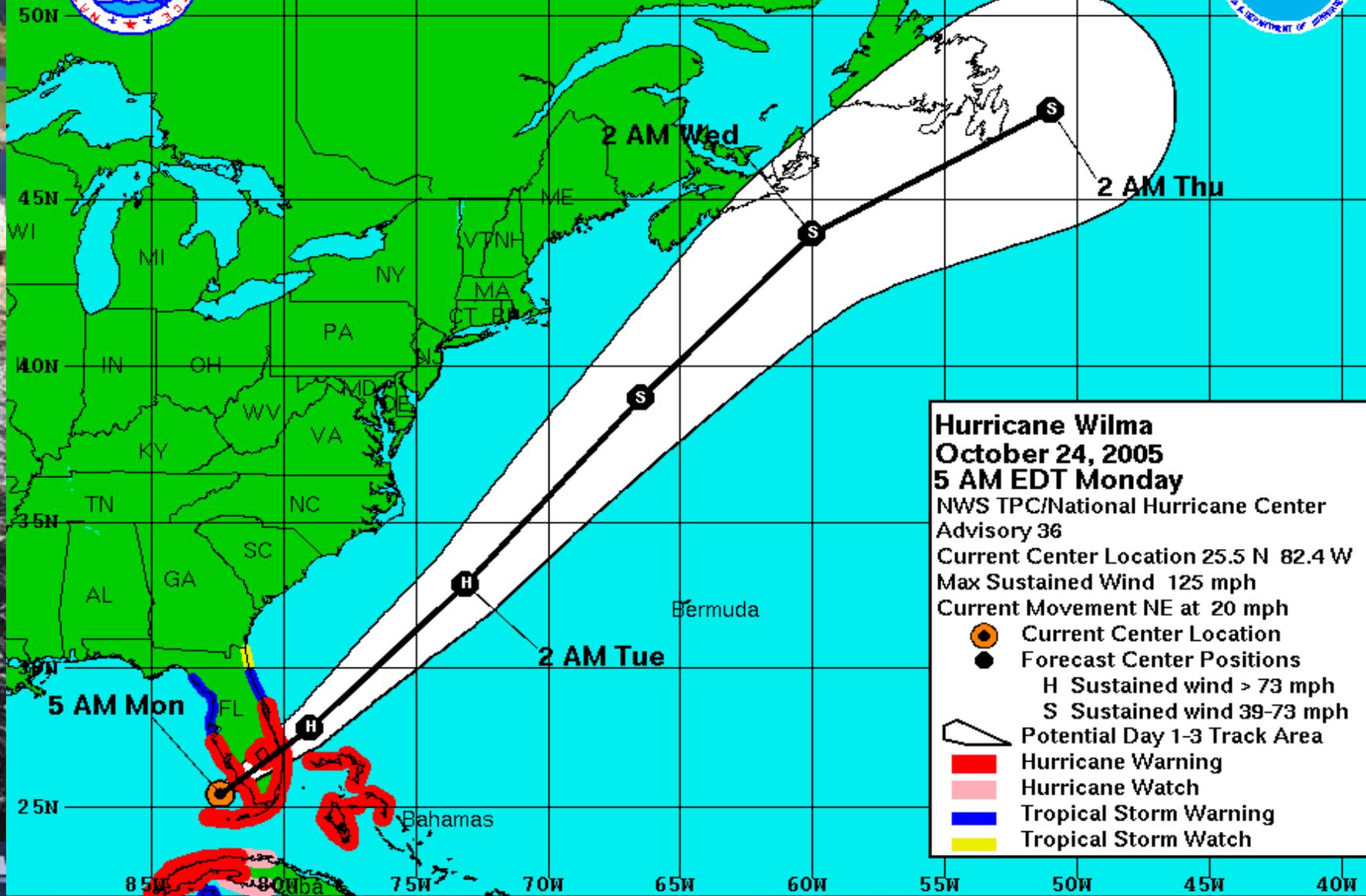
Hurricane Wilma

2005

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Approx. Distance Scale (Statute Miles)

SM 125 250 375 500
True at 30.00N



Hurricane Wilma
October 24, 2005
5 AM EDT Monday
NWS TPC/National Hurricane Center
Advisory 36
Current Center Location 25.5 N 82.4 W
Max Sustained Wind 125 mph
Current Movement NE at 20 mph

- Current Center Location
- Forecast Center Positions
 - H Sustained wind > 73 mph
 - S Sustained wind 39-73 mph
- ▭ Potential Day 1-3 Track Area
- ▭ Hurricane Warning
- ▭ Hurricane Watch
- ▭ Tropical Storm Warning
- ▭ Tropical Storm Watch

Facts

- Formed: October 15, 2005
- Dissipated: October 26, 2005
- Highest Winds: 185 MPH (Category 5)
- Damage: \$21 Billion (USD – 2005)
- Wilma made landfall in Cape Romano, Florida with winds of 120 mph. Wilma briefly weakened back to a Category 2 hurricane, but again re-intensified as it reached the Atlantic Ocean.

Homestead Field Station Area of Responsibility



Large tree partially in C-1N Canal
North R/W

Homestead Field Station Area of Responsibility



Homestead Field Station Area of Responsibility



Large trees fallen in C-102
South R/W



Irrigation System in Canal



Large tree blown over onto adjacent property
C-1W North R/W

Miami Field Station Area of Responsibility



Miami Field Station Area of Responsibility

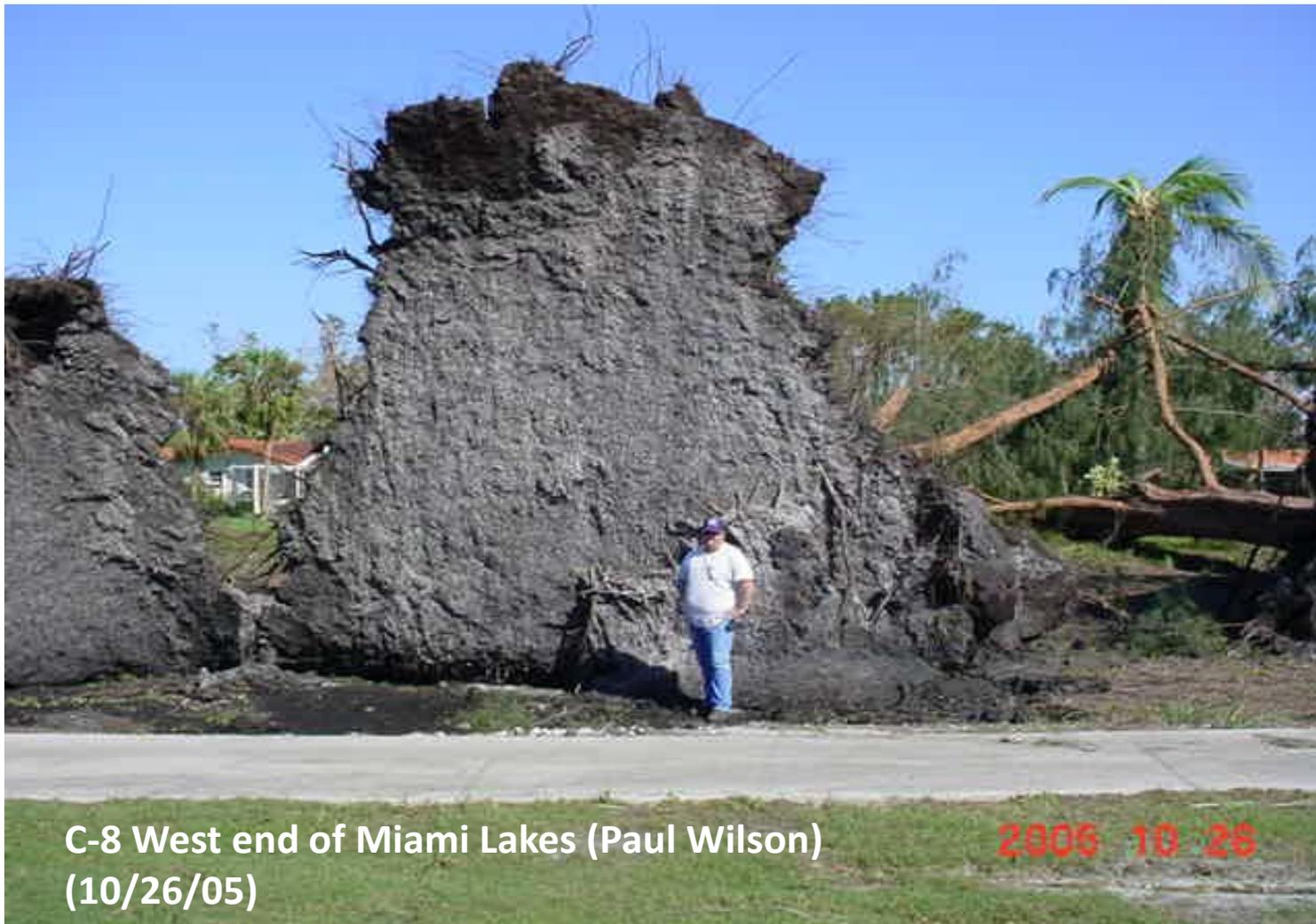


C-6 – 105th Way, west of boat ramp. South Side (10/25/05)

Miami Field Station Area of Responsibility



Miami Field Station Area of Responsibility



C-8 West end of Miami Lakes (Paul Wilson)
(10/26/05)

2006 10 26

Miami Field Station Area of Responsibility



Fort Lauderdale Field Station Area of Responsibility



Fort Lauderdale Field Station Area of Responsibility



C-100 Between C-100 INTEF
(10/28/05)



OCT 25 2006

Fort Lauderdale Field Station Area of Responsibility

Dania Cut Off (Finger Canal) - SW 47th St. west of 30th Ave



Big Cypress Basin Field Station Area of Responsibility



Okeechobee Field Station Area of Responsibility

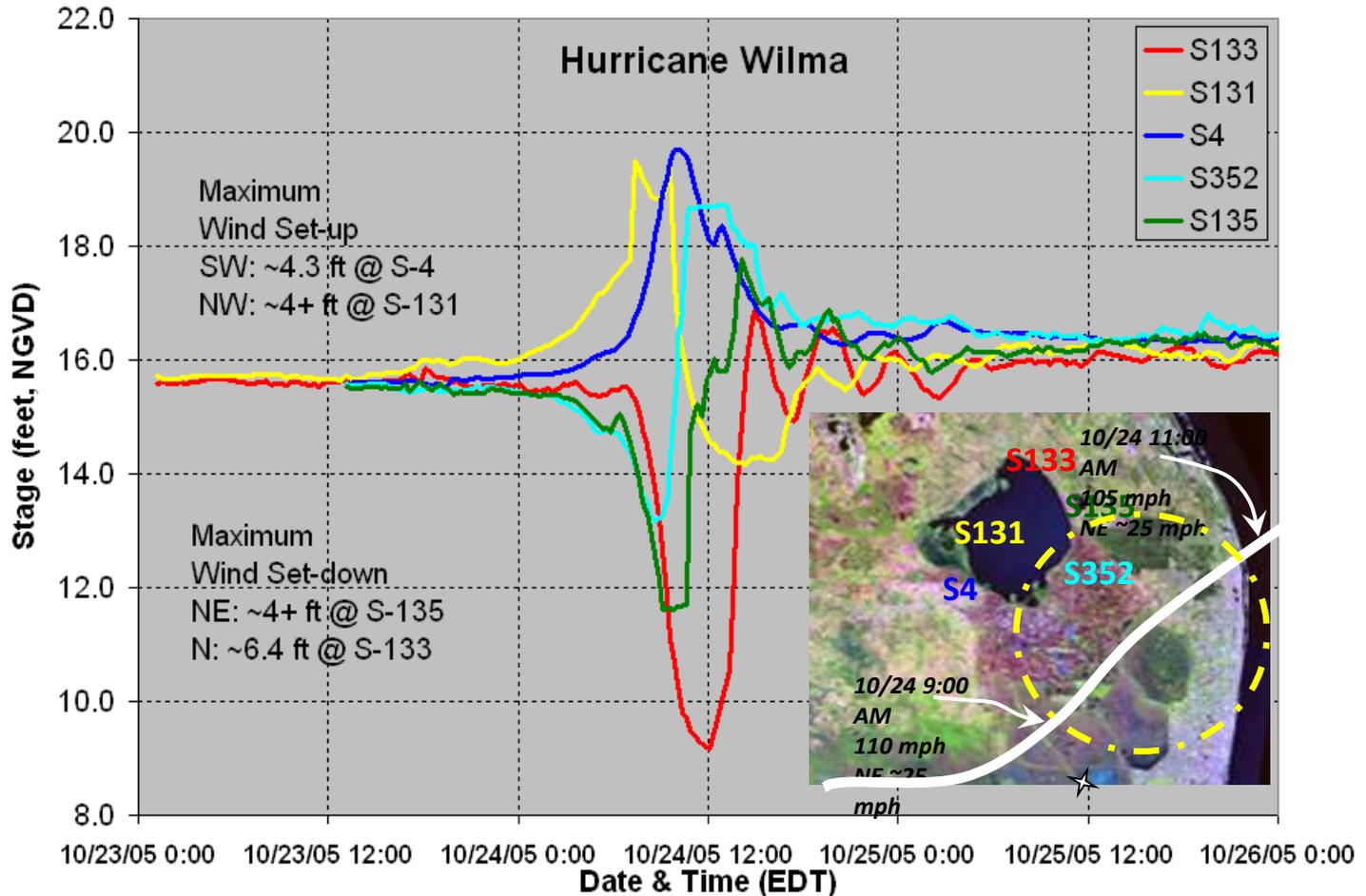


Monterey Waterway

Clewiston Field Station Area of Responsibility



Lake Okeechobee Stages



Clewiston Field Station Area of Responsibility



Clewiston Field Station Area of Responsibility



Clewiston Field Station Area of Responsibility



Clewiston Field Station Area of Responsibility



Debris in Rim Canal



S-2 Discharge Bay with
Debris and Dock



Clewiston Field Station Area of Responsibility



S-351 trailer blocking structure

Clewiston Field Station Area of Responsibility



S-3 Pump Station Debris in Discharge

Clewiston Field Station Area of Responsibility







Clewiston Field Station Area of Responsibility

City of South Bay Water Intake





Questions?

Belle Glade Camp Ground Debris Field



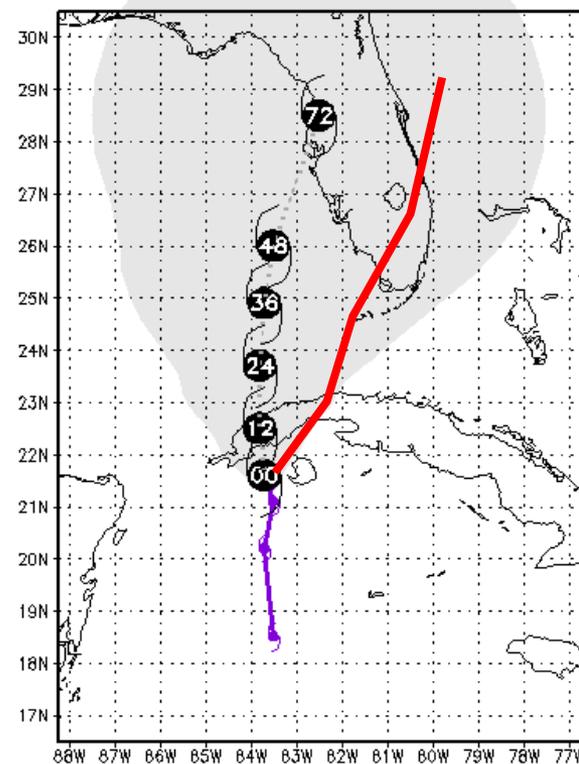
Hurricane Irene & The 'No-Name' Storm

1999 - 2000

Hurricane Irene

- Hurricane Irene formed south of Cuba on October 14th
- Category 1 – Low wind threat
- Forecast to move north, and was expected to bring excessive rains to most of south Florida through the weekend

National Hurricane Center Forecast Track
And Storm Motion During Previous 72 Hours
Plot Generated: Thu – Oct 14, 1999 – 0900 UTC (-4 for EDT)



85W

80W

75W

NESDIS/OSE1 NOAA-15 AVHRR HRPT RGB=CH1,CH2,CH4 10/15/99 12:57 UTC



30N

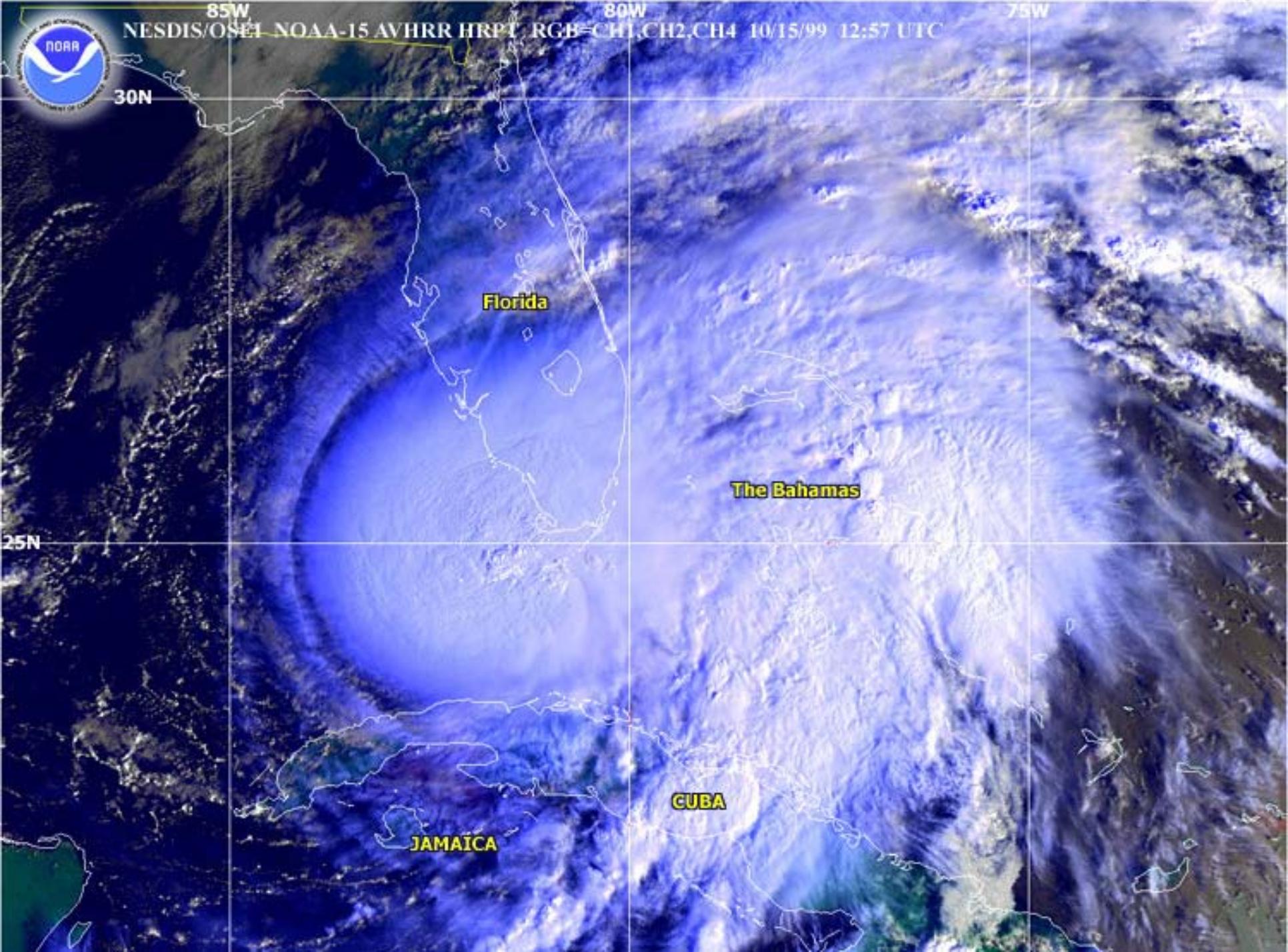
25N

Florida

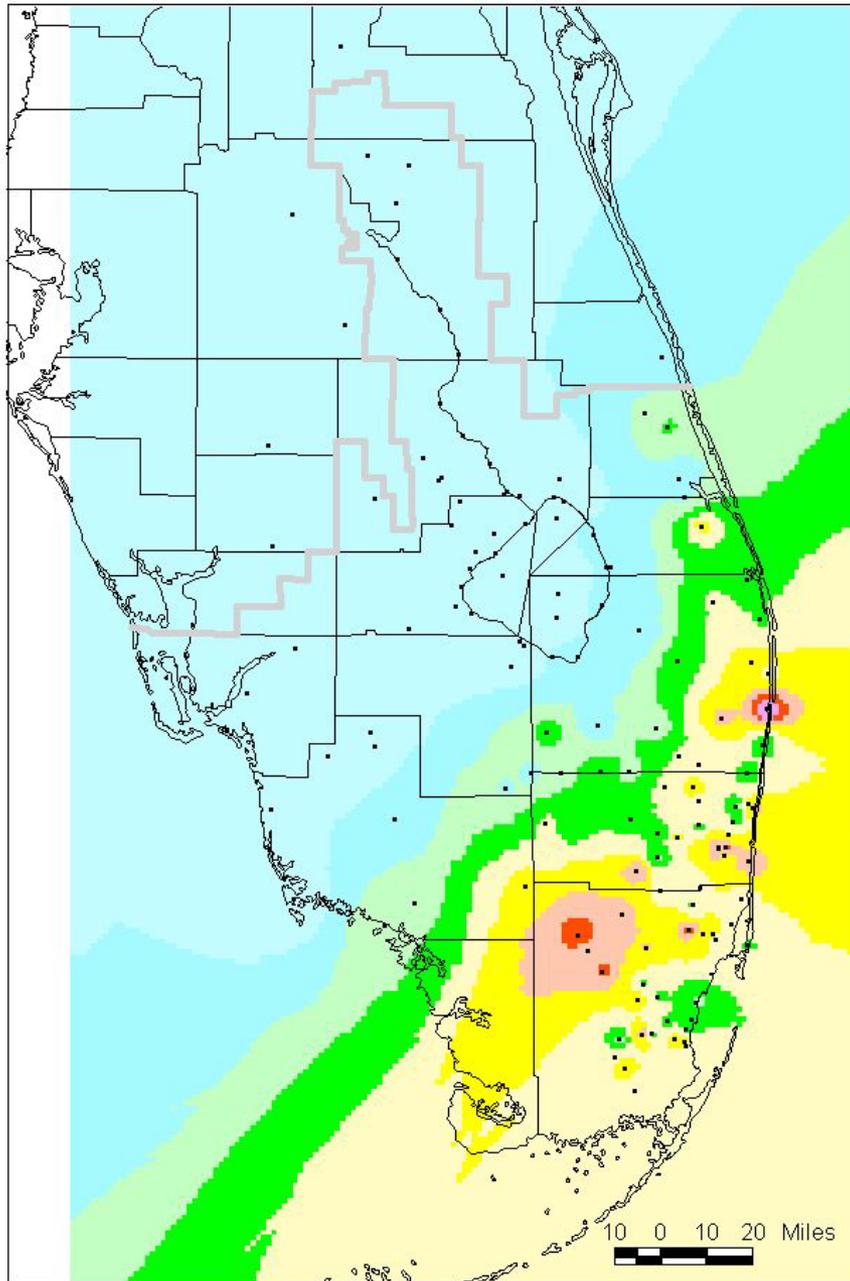
The Bahamas

CUBA

JAMAICA



RAINFALL DISTRIBUTION - HURRICANE IRENE October 14 - 16, 1999



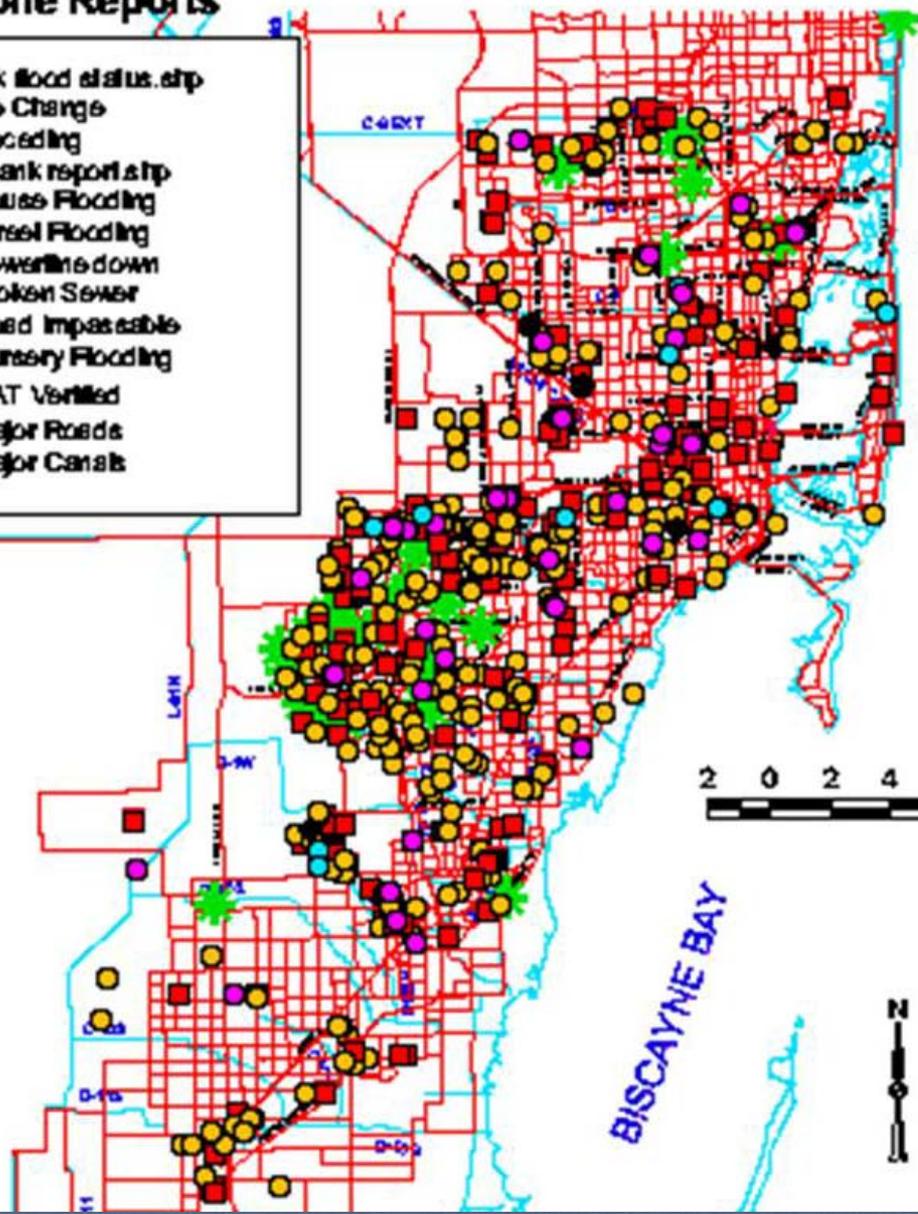
- SFWMD Boundary
- County Lines
- Rain Gauges
- Lake Okeechobee
- Surface from Rain Gauges
- < 2
- 2-4
- 4-6
- 6-8
- 8-10
- 10-12
- 12-14
- 14-16
- 16 +



**WATER
RESOURCE
OPERATIONS**

Miami-Dade County Phone Reports

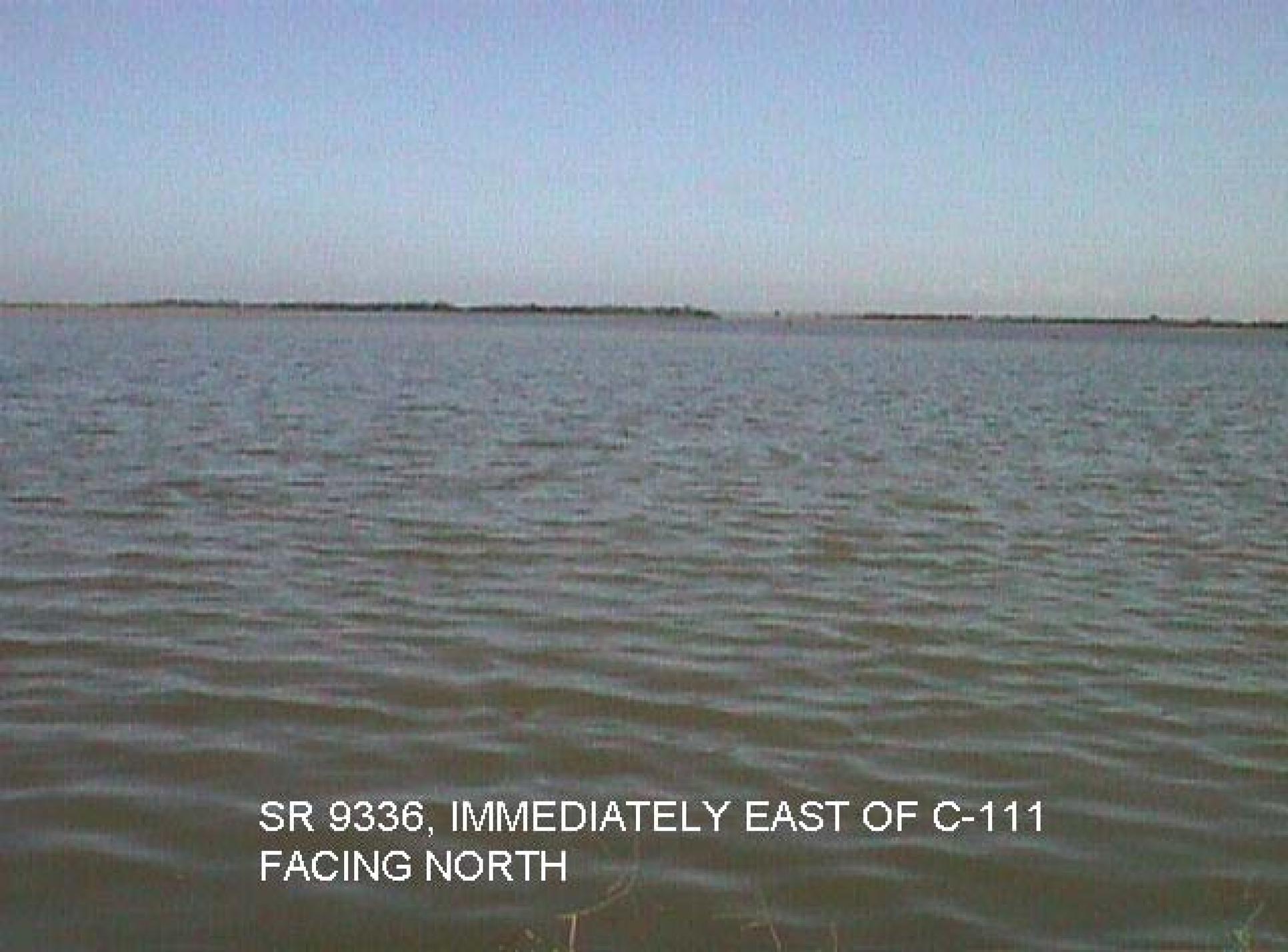
- call back flood status.stp
 - No Change
 - Receding
- phone bank report.stp
 - Houses Flooding
 - Street Flooding
 - ⚡ Powerline down
 - ◆ Broken Sewer
 - ⊕ Road Impassable
 - ▲ Nursery Flooding
 - ★ CAT Verified
- Major Roads
- Major Canals







DANGER
HIGH
WATER

A wide-angle photograph of a large body of water, likely a bay or estuary, extending to a distant, low-lying shoreline. The water is a deep blue-grey color with gentle ripples. The sky is a clear, pale blue. In the foreground, the water's surface is slightly darker and shows some texture. The overall scene is calm and expansive.

SR 9336, IMMEDIATELY EAST OF C-111
FACING NORTH





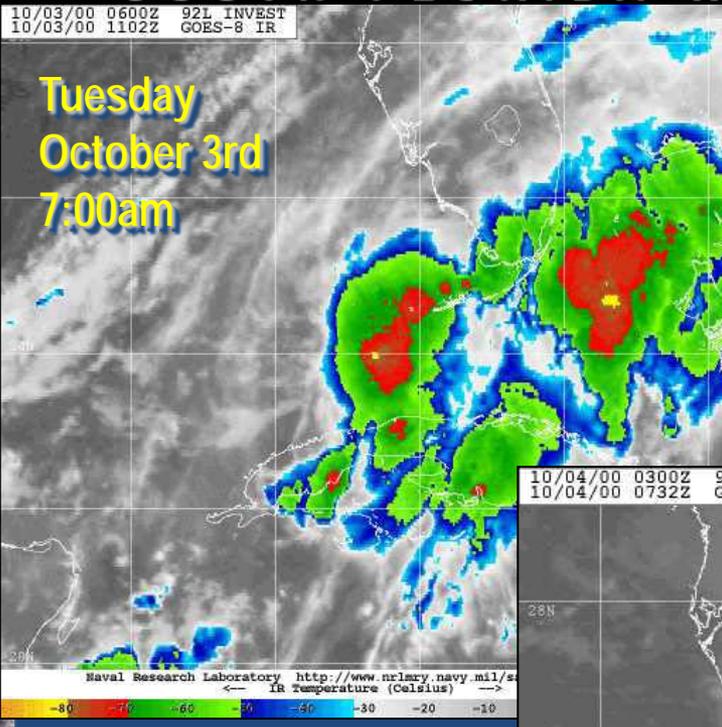




SOUTH FLORIDA WATER MANAGEMENT DISTRICT

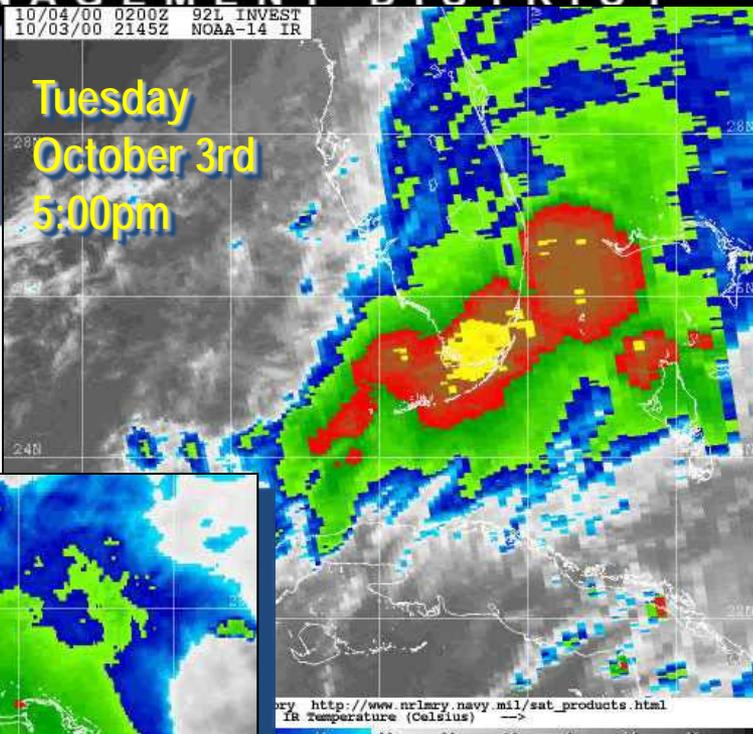
10/03/00 0600Z 92L INVEST
10/03/00 1102Z GOES-8 IR

Tuesday
October 3rd
7:00am



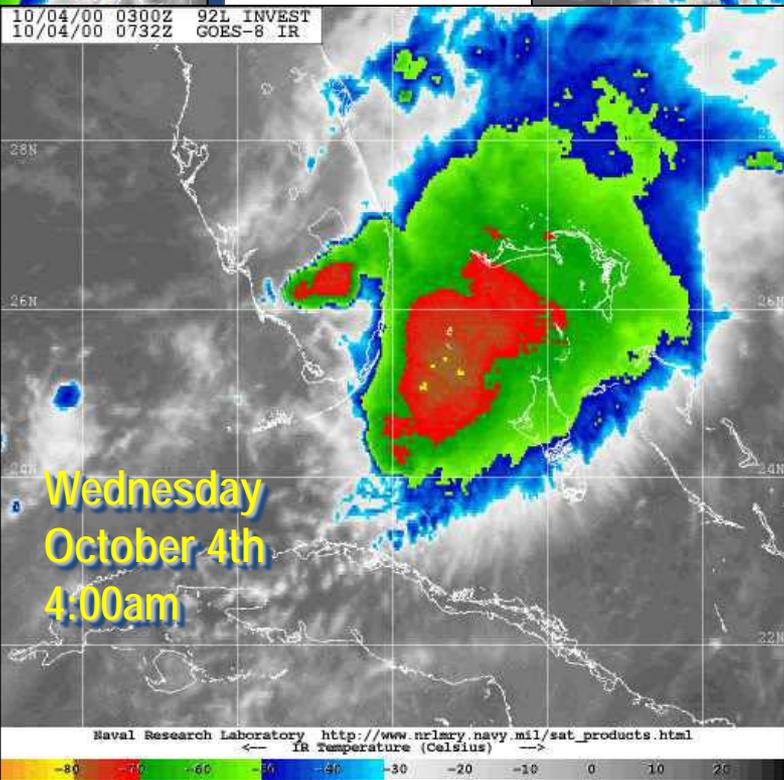
10/04/00 0200Z 92L INVEST
10/03/00 2145Z NOAA-14 IR

Tuesday
October 3rd
5:00pm



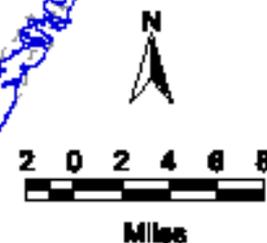
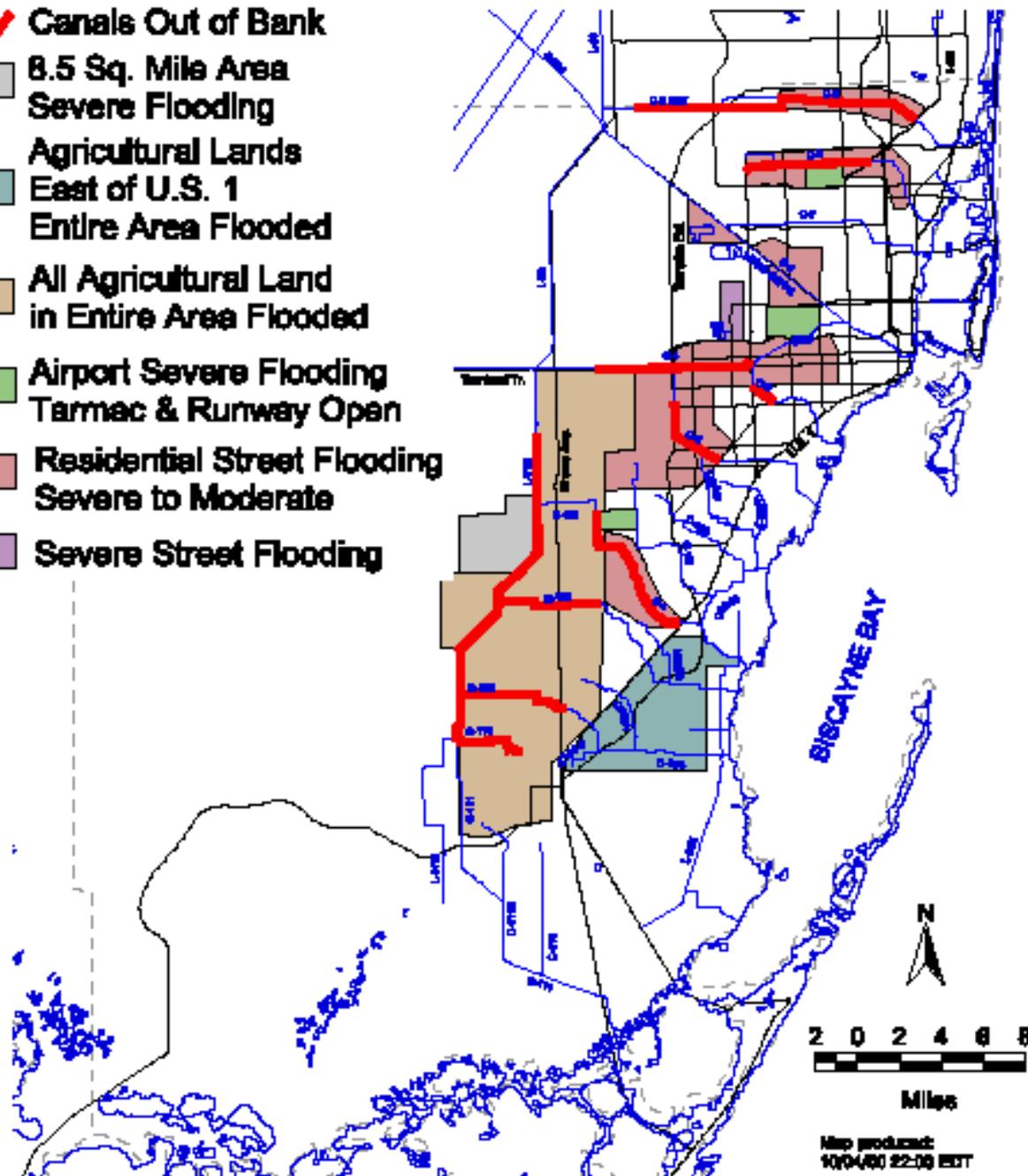
10/04/00 0300Z 92L INVEST
10/04/00 0732Z GOES-8 IR

Wednesday
October 4th
4:00am



Miami-Dade County Flood Areas

-  Canals Out of Bank
-  8.5 Sq. Mile Area Severe Flooding
-  Agricultural Lands East of U.S. 1 Entire Area Flooded
-  All Agricultural Land in Entire Area Flooded
-  Airport Severe Flooding Tarmac & Runway Open
-  Residential Street Flooding Severe to Moderate
-  Severe Street Flooding



Map produced:
10/04/00 02:00 EST











Flood Awareness Month

Operations, Maintenance &
Construction
What we do

Canal/Levee Maintenance



08/22/2011

Martin County: Installation of project culvert (PC35) on C-23.

Canal/Levee Maintenance



08.30.2011

Palm Beach County: L-23 levee repairs.

Canal/Levee Maintenance



Osceola County: Bank stabilization on C-33 right of way.

Canal/Levee Maintenance



Palm Beach County: C-17 removal of submerged boat.

Canal/Levee Maintenance



Highlands County: S-65Dx1 shoal removal.

Canal/Levee Maintenance



12/08/2011

Martin County: PC-50, excavation of site.

Canal/Levee Maintenance



Martin County: PC-50, Installing new pipe

12/11/2011

Canal/Levee Maintenance



12/01/2011

Martin County: PC-50, Installing sheet piling

Water Control Structures



Hendry County: Navigational Locks S-310 fire pump replacement

Water Control Structures



Glades County: Structure S-235 gate replacement.

Water Control Structures



Highlands County: S-70's major gate overhaul. (setting stop logs)

Water Control Structures



Miami-Dade County: Final inspection of new stainless steel gate S-1

Water Control Structures



Collier County: Cocohatchee 1 – Gate Overhaul.

Water Control Structures



Collier County: 175-1 – Gate Overhaul

Water Control Structures



Collier County: I75-1 – Gate Overhaul

Water Control Structures



S-9 Major Gate Overhaul

Water Control Structures



S-9 Major Gate Overhaul

Water Control Structures



S-9 Major Gate Overhaul

Water Control Structures



S-9 Major Gate Overhaul

Water Control Structures



S-9 Major Gate Overhaul

Vegetation Maintenance



Palm Beach County: Spray weeds in STA 3/4

Vegetation Maintenance



Broward County: Spraying the East Coast Protective Levee bench area

Vegetation Maintenance



09.16.2011

Palm Beach County: Side slope mowing on L-14

Vegetation Maintenance



Osceola County: Lake Kissimmee Tusscock removal

Vegetation Maintenance



Glades County: Vegetation removal from pump station S-4

Vegetation Maintenance



Melaleuca Spraying in the Buffer Strip along US 27

Vegetation Maintenance



Hydrilla treatment: Liquid application in the Kissimmee Chain of Lakes

Vegetation Maintenance



Hydrilla treatment: Granular application in the Kissimmee Chain of Lakes

Vegetation Maintenance



Torpedo grass treatment in Lake Okeechobee

Vegetation Maintenance



Dade County: C-102 Grass Carp delivery

Vegetation Maintenance



Dade County: C-102 Grass Carp delivery

Vegetation Maintenance



Miami-Dade County: C-7 tree removal.

Vegetation Maintenance



11/01/2011

C-100 Tree Removal

Vegetation Maintenance



C-100 Tree Removal

Vegetation Maintenance



11/01/2011

C-100 Tree Removal

Fleet Maintenance



Collier County: Changing tire

Fleet Maintenance



Hendry County: Vehicle preventative maintenance

Fleet Maintenance



Hendry County: Vehicle maintenance (filter replacement)

Pump Stations



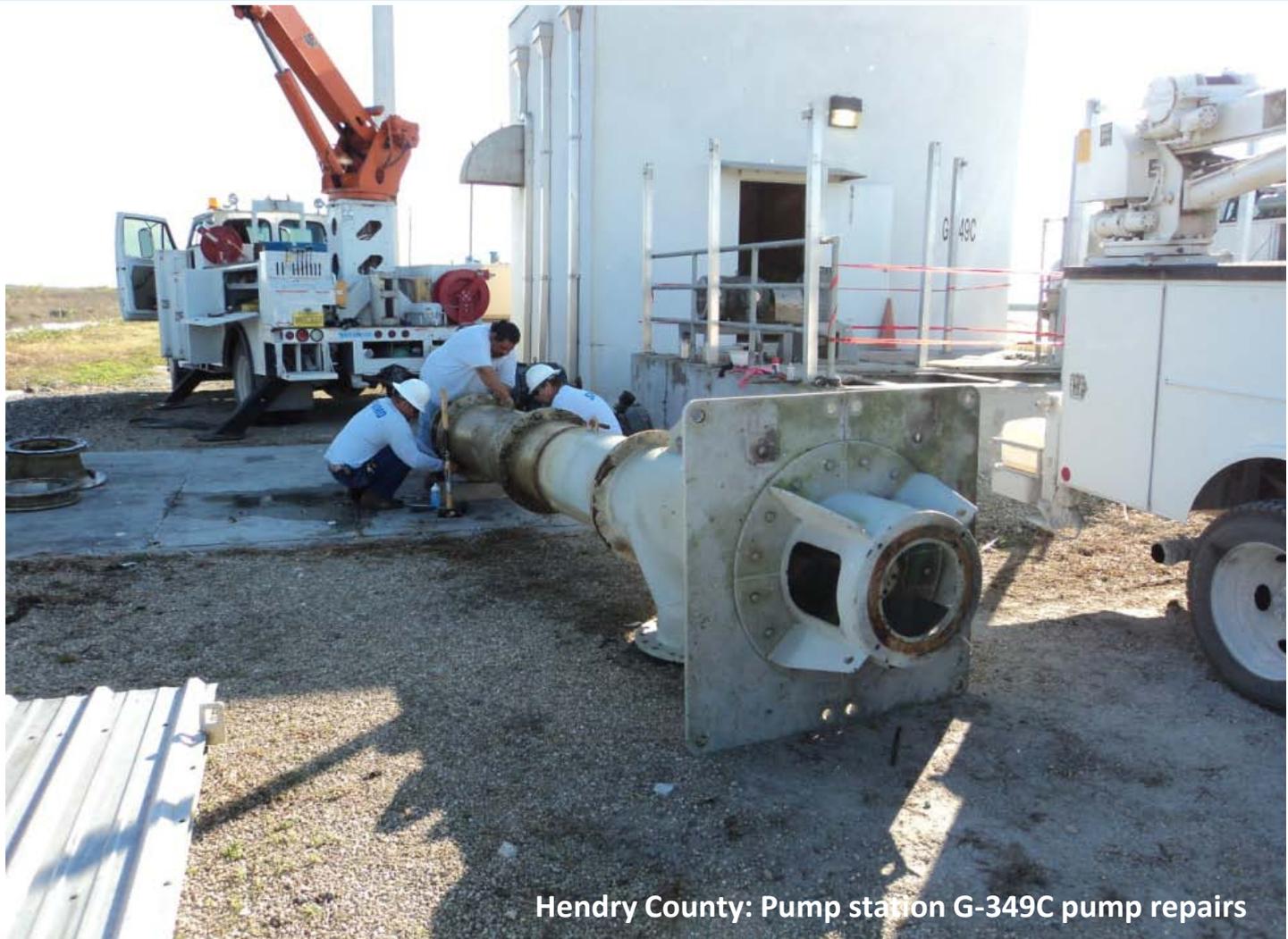
Hendry County: Pump station G-409 pump refurbishment

Pump Stations



Broward County: Removing main engine at pump station S-13

Pump Stations



Hendry County: Pump station G-349C pump repairs

Pump Stations



Palm Beach County: Gear box installation at pump station S-2



Pump Stations



Martin County: Pump Station S-135 pump and engine refurbishment

Pump Stations



Pump station S- 332B Cummins engine overhaul

Pump Stations



Broward County: Pump station S-140, pulling half of pump intake bell

Pump Stations



Installation of overhauled gate at pump station S-9

Pump Stations



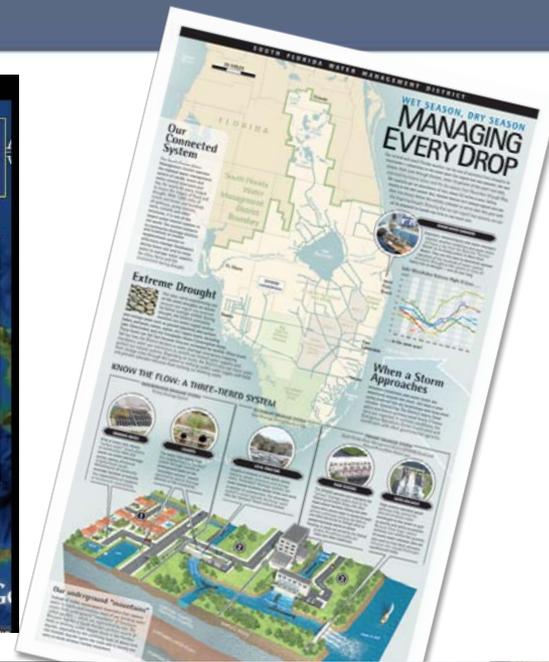
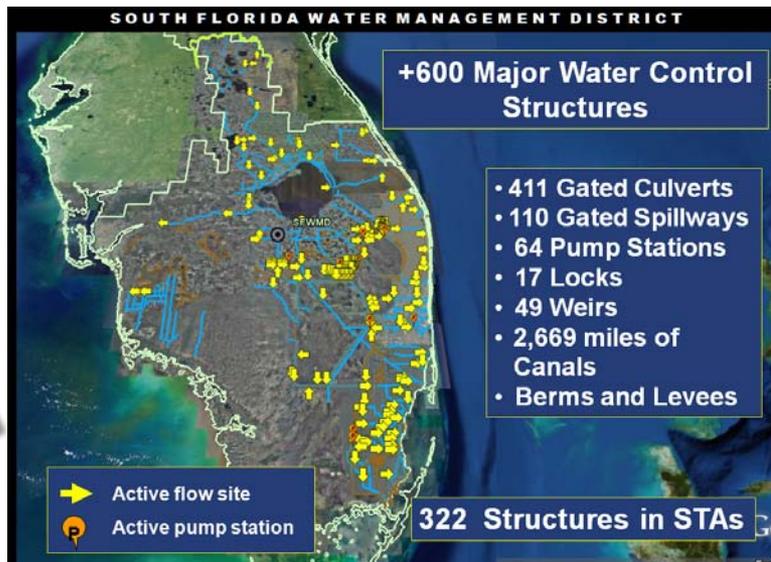
Palm Beach County: Rebuilding main pump at pump station S-5A

Pump Stations

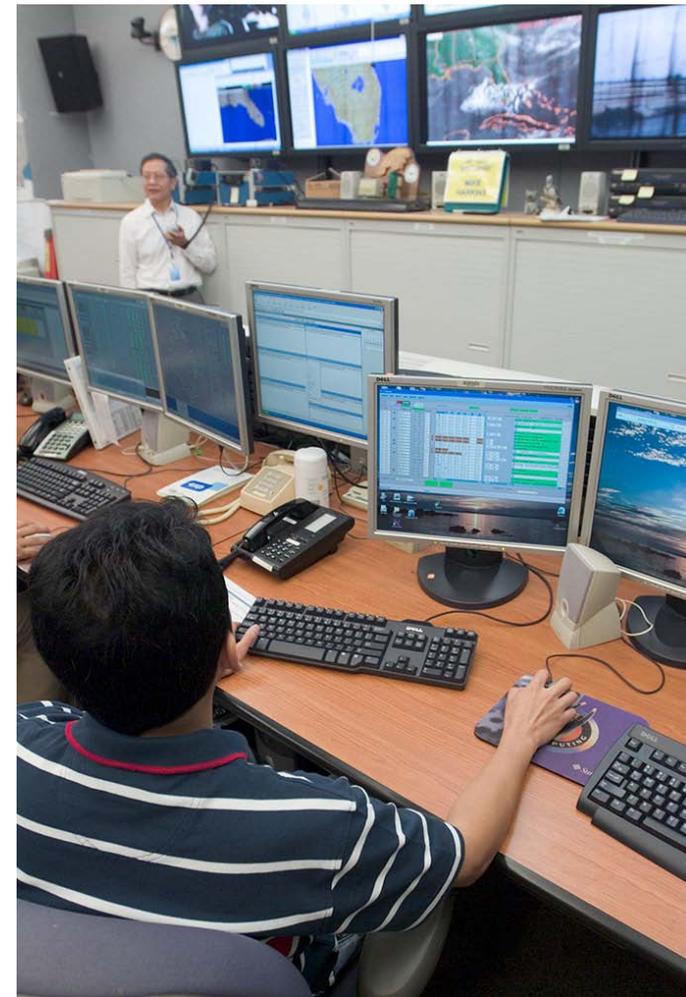


Palm Beach County: Installing new pump bearings at pump station S-5A

Water Control Operations



Water Control Operations



SCADA



FP9: Quarterly Preventative maintenance

SCADA



L001: Performance of monthly preventative maintenance

SCADA



MARKH: Performance of Water Quality sonde well cleaning

SCADA



08.25.2011

S135: Baseline inspection as part of our Site Turn-over process

SCADA



WCA2F1: Malfunction repair of stage sensor

SCADA



LKIS5B: Removal of the old LKIS5B as part of the PATON project

SCADA



S7: Digging for junction box for antenna replacement as part of the CIFER project

SUMMARY



Ready for the Wet Season...

- Completed most refurbishment on water control structures
- Performed Preventive Maintenance on critical structures
- Finished cross-training for Pump Stations Operators
- Completed Pre-Hurricane season joint USCOE – District inspection flights
- Vegetation management continues to maintain canals unobstructed
- Heavy equipment is operational
- Mobile pumps are serviced and ready to go
- Emergency response training performed with staff
- Annual Hurricane Freddy Exercise successful

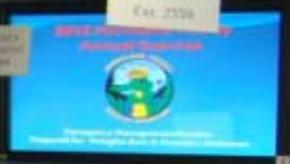
AREA
COMMANDER
(North, South)
EXT. 2358

DEPUTY EOC
MANAGER
(North, South)
EXT. 4099

DEPUTY EOC
MANAGER
(North, South)
EXT. 2367

OPERATIONS
SUPPORT
EXT. 2356

OPERATIONS
SUPPORT
EXT. 2365









Questions