

**CENTRAL AND SOUTHERN FLORIDA (C&SF) FLOOD  
RESILIENCY STUDY BROWARD BASINS (SECTION 203)  
PROJECT PLANNING MEETING  
AGENDA**

October 24, 2024  
10:00 AM

Broward County Building Code Services Division  
Riverbend Corporate Park  
2307 West Broward Boulevard, Suite 300  
Fort Lauderdale, FL 33312

Zoom Link: <https://broward-org.zoomgov.com/j/1606970360>

1. Opening Remarks - Drew Bartlett, Executive Director, SFWMD; Wes Brooks, Ph.D., Chief Resiliency Officer, State of Florida; and Jennifer Jurado, Ph.D., Chief Resiliency Officer, Broward County
2. Southeast Florida Flood Resiliency Studies - Carolina Maran, Ph.D., P.E., Chief of District Resiliency, SFWMD
3. Overview of Section 203 Water Resources Water Development Act of 1986 - Matthew Morrison, Chief Policy Advisor, SFWMD
4. Introduction to the C&SF Flood Resiliency Study - Broward Basins (Section 203) - Matthew Morrison, Chief Policy Advisor, SFWMD
5. Break
6. Evaluation and Modelling Tools - Walter Wilcox, P.E., Water Resources Systems Modelling Bureau Chief, SFWMD
7. Next Steps - Matthew Morrison, Chief Policy Advisor, SFWMD
8. Q&A
9. Public Comment
10. Closing Remarks - Carolina Maran Ph.D., P.E., Chief of District Resiliency, SFWMD
11. Adjourn

Presentation Deck: (Staff contact, Yvette Bonilla)

**Agenda Item Background:**  
[C&SF Broward Basins Section 203](#)



## Opening Remarks

Drew Bartlett, Executive Director, SFWMD

Wes Brooks, Ph.D., Chief Resiliency Officer, State of Florida

Jennifer Jurado, Ph.D., Chief Resilience Officer, Broward County



# Central & Southern Florida System Broward Basins Flood Resiliency Study

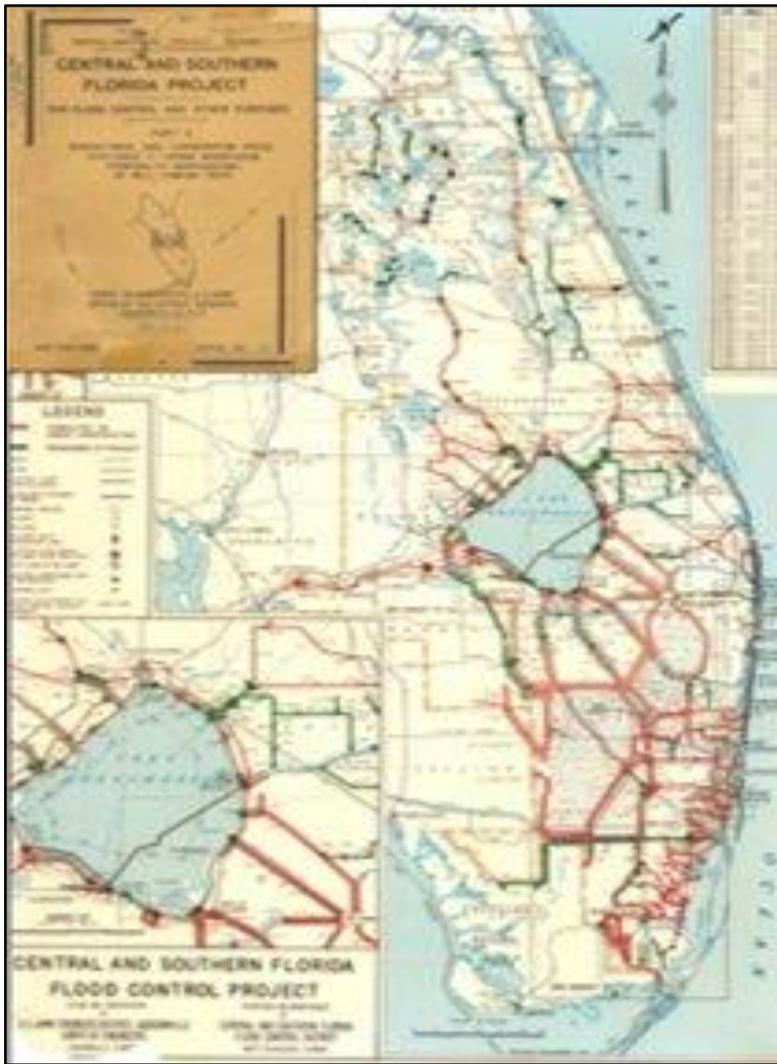
# Southeast Florida Flood Resiliency Studies



## Central and Southern Florida System Planning and Implementation Progress, October 2024

Carolina Maran, P.E. Ph.D.  
Chief of District Resiliency, SFWMD

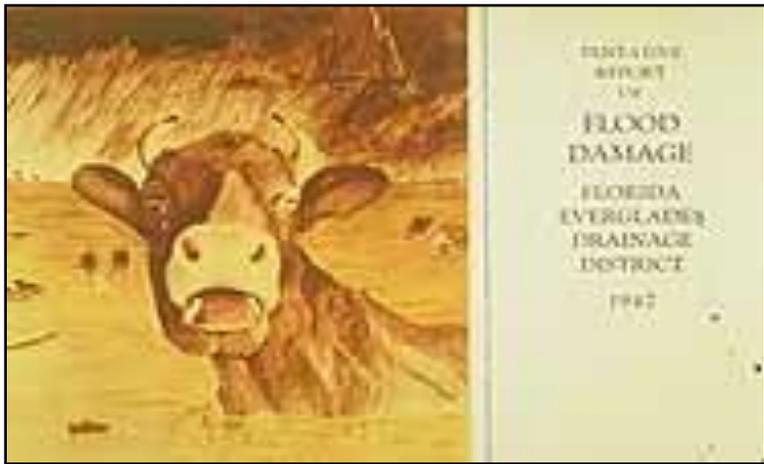
# Central and Southern Florida Project



**1926 AND 1928**  
**DEVASTATING HURRICANES**  
... LOSS OF 2,500 LIVES

**HOOVER DIKE AUTHORIZED 1930**

... COMPLETED 1937



# South Florida Water Management District Today

## TYPES OF STRUCTURES OPERATED AND MANAGED BY THE DISTRICT



### Stormwater Treatment Areas (STAs):

Large, constructed wetlands designed to remove nutrient pollution from water using natural aquatic plants.



**Weirs:** Structures across a canal or stream that block the flow of water until the water flows over the structure.



**Spillways:** Structures that allow movement of water between water bodies by use of gates.



**Culverts:** Structures that allow the flow of water between two areas. They are typically placed under roads or levees.

**Canals:** A system of human-made trenches used for the movement of water.



### Reservoirs and Impoundments:

Human-made water bodies used for water storage. A Flow Equalization Basin (FEB) is a type of impoundment designed to temporarily capture and hold water.



**Pumps:** Mechanical control structures that force movement of water.



**Dikes & Levees:** A barrier that diverts or restrains the flow of water. Large earthworks that surround Lake Okeechobee are generally referred to as dikes. Smaller earthworks surrounding canals and Water Conservation Areas are generally called levees.

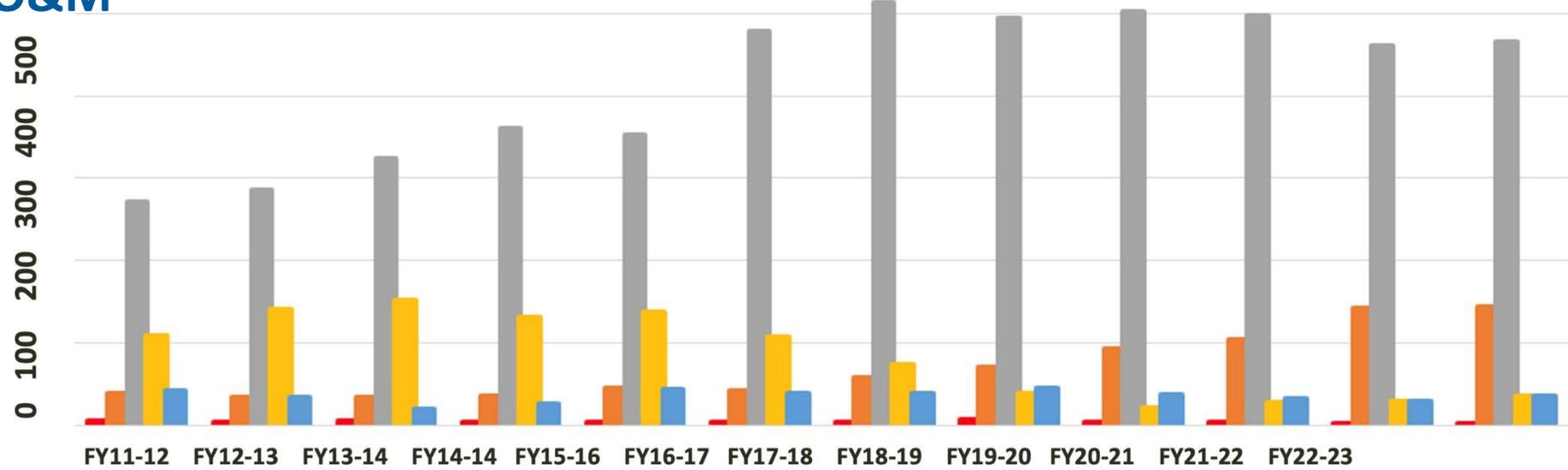


- On average the flood control system moves more than **20-million-acre feet of water each year.**
- More than **2,175 miles** of canals
- More than **2,130 miles** of levees/berms
- More than **915** water control structures
- More than **620** project culverts
- **90** pump stations
- Approx. **3,537** hydrological monitoring stations at more than **687** flow sites, including **201** rain gauges and **22** weather stations.
- Every year new capital projects add more infrastructure:
  - Comprehensive Everglades Restoration Plan
  - Northern Everglades and Estuaries Protection Plan
  - Dispersed Water Storage
  - Restoration Strategies
  - Resiliency

# Structure Inspection Program

## Aging Infrastructure & O&M

<b>C-5</b>	Repair within one year
<b>C-4</b>	Repair within 18 months
<b>C-3</b>	Repair within two years
<b>C-2</b>	Monitor
<b>C-1</b>	No Action

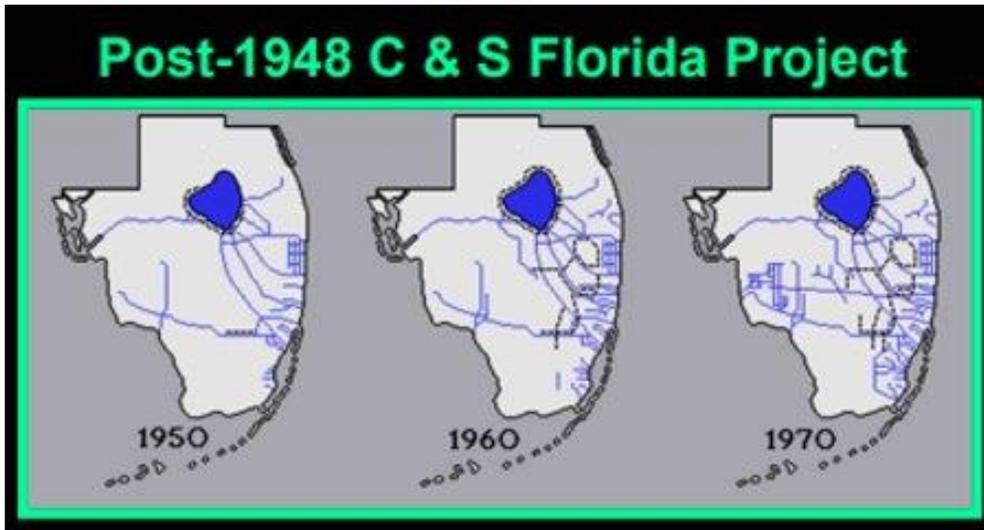
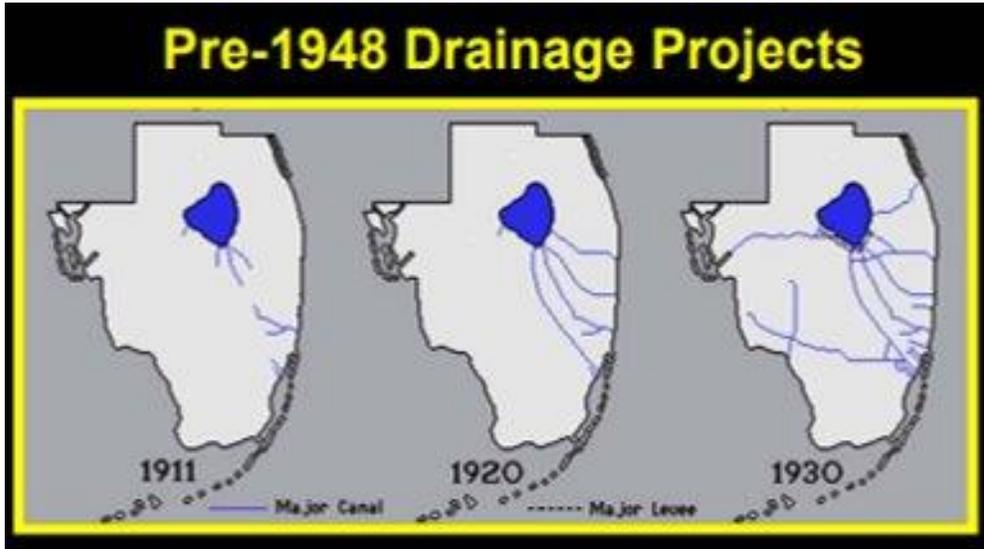


Rating	FY2011-12	FY2012-13	FY2013-14	FY2014-15	FY2015-16	FY2016-17	FY2017-18	FY2018-19	FY2019-20	FY2020-21	FY2021-22	FY2022-23	Quantity Change from FY2011-12 to FY2022-23
<b>C-5</b>	5	4	5	3	3	3	3	6	4	4	2	2	-3
<b>C-4</b>	38	34	33	35	45	41	58	70	93	103	142	143	105
<b>C-3</b>	271	285	324	360	353	478	514	494	503	497	461	466	195
<b>C-2</b>	108	140	152	131	137	107	74	39	21	28	29	36	-72
<b>C-1</b>	42	34	19	26	43	39	39	44	37	32	29	35	-7
<b>Total</b>	<b>464</b>	<b>497</b>	<b>533</b>	<b>555</b>	<b>581</b>	<b>668</b>	<b>688</b>	<b>653</b>	<b>658</b>	<b>664</b>	<b>663</b>	<b>682</b>	<b>218</b>

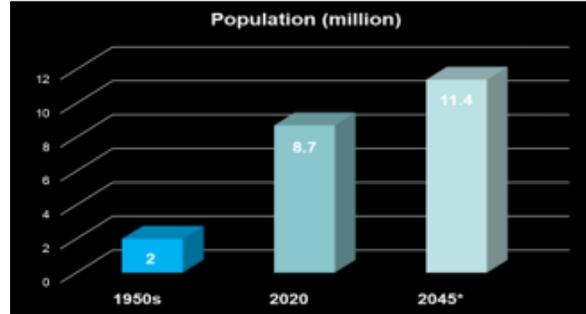
- Structures inspected every 5 to 7 year
- Overall inspection rating provides infrastructure condition



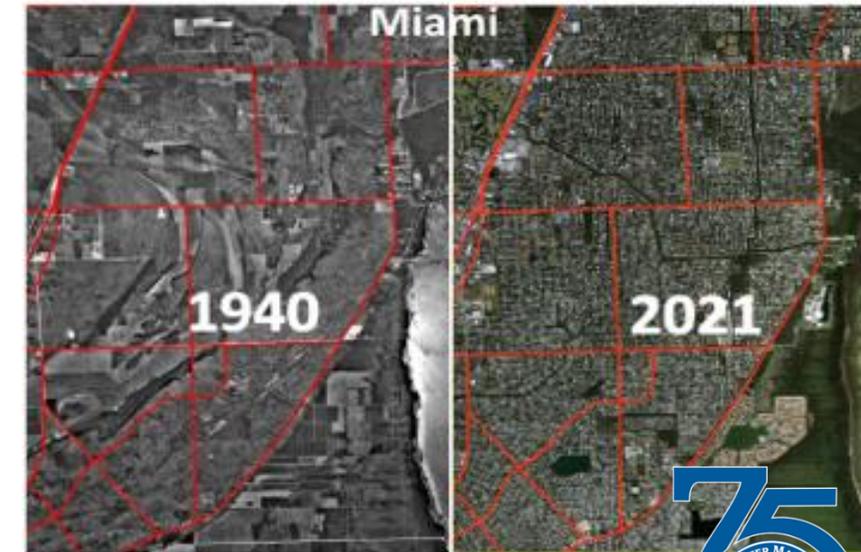
# Recognizing Changed Conditions



## POPULATION GROWTH



\*Estimate taken from BEBER 2017 publication (Median SFWMD boundaries)

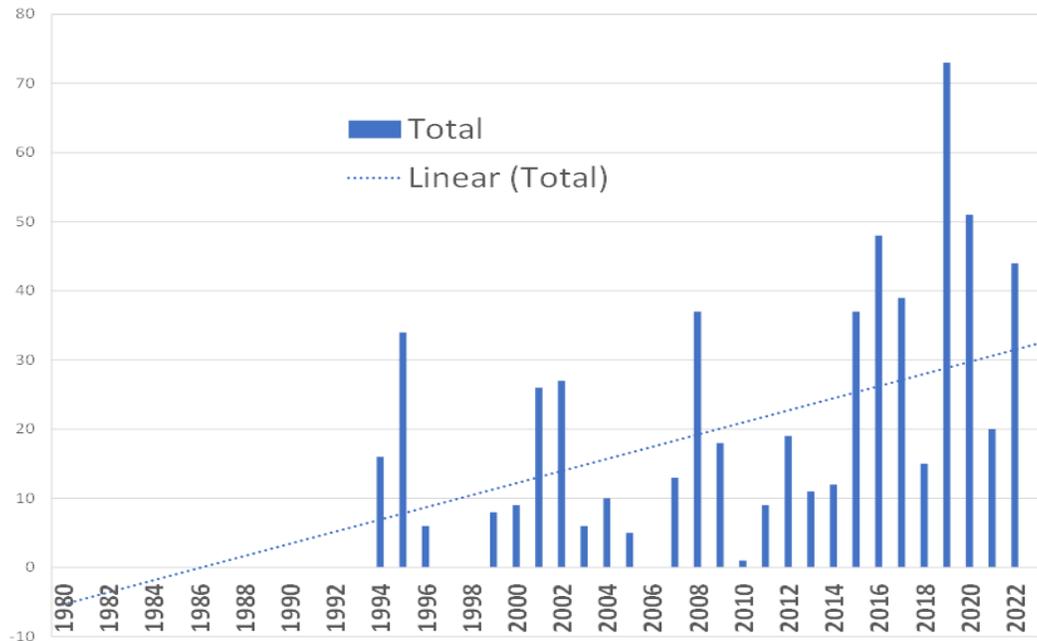


# Changed Conditions: Sea Level Rise

## Coastal Structure Gate Overtop



S28 - Number of Days in a Year where TW > HW



Saltwater moving inland, bypassing the top of the gate of the salinity coastal structure during a High Tide event in 2019.

# Monitoring Changing Conditions – Water and Climate Resilience Metrics



## Resilience Metrics Hub

**Regional Rainfall**

Changes in rainfall patterns will impact people and ecosystems by altering the amount of water in our region throughout the year.

**Evapotranspiration Trends in South Florida**

Evapotranspiration (ET) determines water exchanges between the land, plant communities, and the atmosphere.

**Tidal Elevations at Coastal Structures and Sea Level**

Flood control and the prevention of saltwater intrusion in South Florida relies heavily on the operation of coastal gravity structures.

**Saltwater Intrusion in Coastal Aquifers**

The inland migration of saltwater poses a threat to water supply and critical freshwater habitats.

**Salinity in the Everglades**

The salinization of previously freshwater systems poses threats to several factors.

**Estuarine and Mangrove Inland Migration**

Trends in Estuarine Inland Migration provide insights to the impacts of sea level rise in...

**Soil Subsidence in South Florida**

Maintaining soil elevations within coastal and intertidal habitats, as sea level changes, is a...

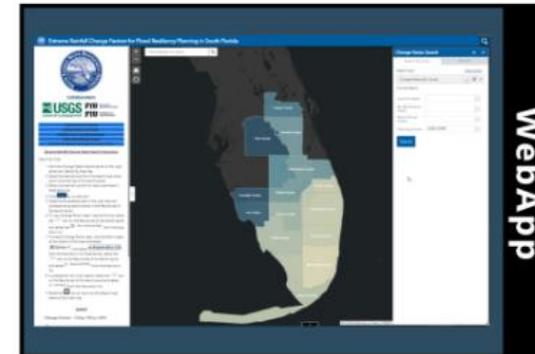
## Early Insights in Regional Resiliency

Efforts for data collection and preliminary data analysis.



## Future Outlook in Regional Resiliency

Projections based on current data and models to inform long-term planning and decision-making.



**Future Extreme Rainfall Change Factors for Flood Resiliency Planning in South Florida Web Application**

This tool provides access to future extreme rainfall change factors for resiliency planning for the 16 counties and 14 rainfall areas within...

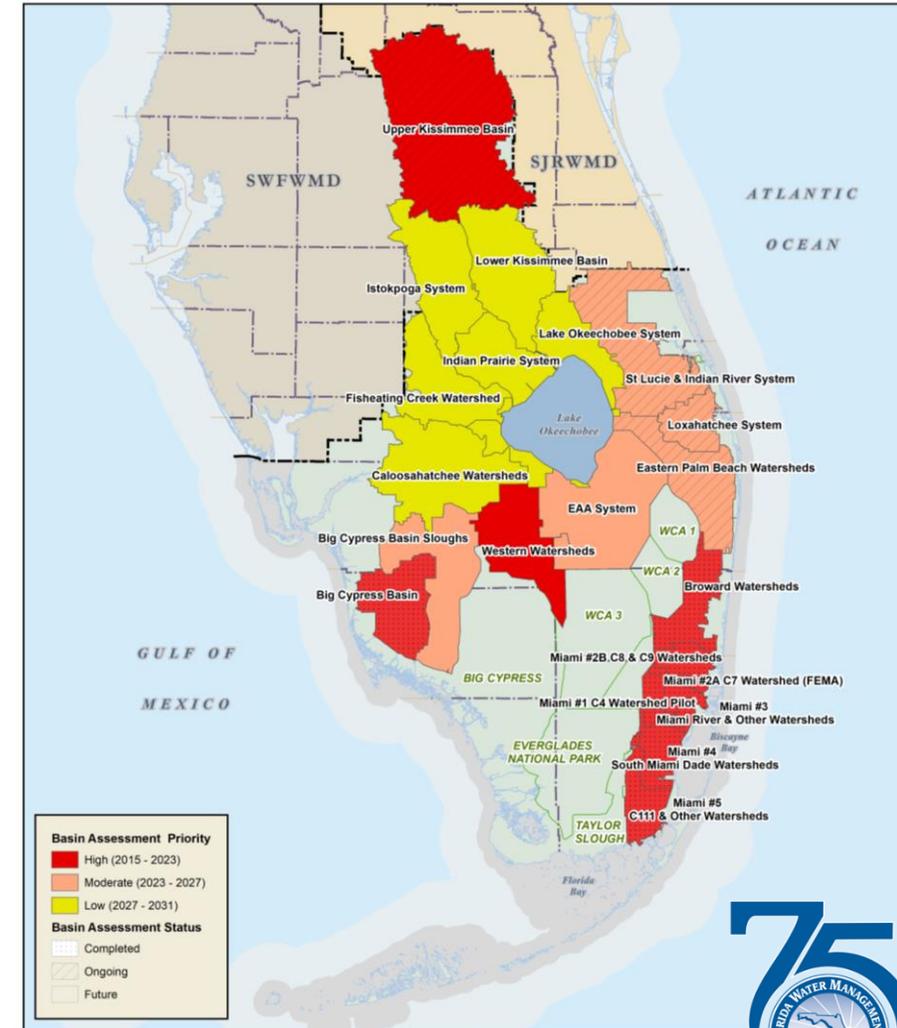


**Enhanced Tide Predictions**

Locally Relevant Tide Forecasts to Support Effective Planning and Response

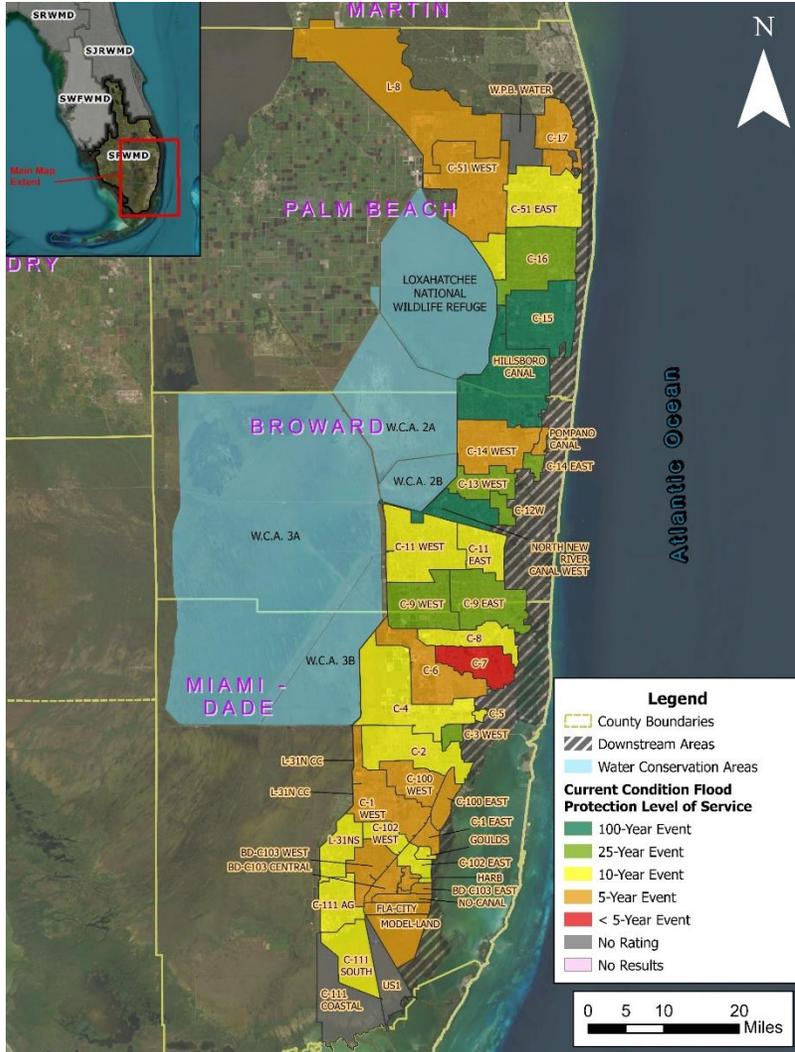
# Flood Protection Level of Service Program

- SFWMD's strategy for assessing the impacts of land development and changing climate on flood control infrastructure
- Evaluate current and future flood risks to communities in South Florida
  - Performance metrics: canal stages, discharge capacity, overland flood inundation and duration
  - Considers rainfall, groundwater levels, tides, storm surge and sea level: compound flooding analysis
  - Regional Basin-wide integrated H&H modeling
- Support decision making on prioritizing infrastructure investments

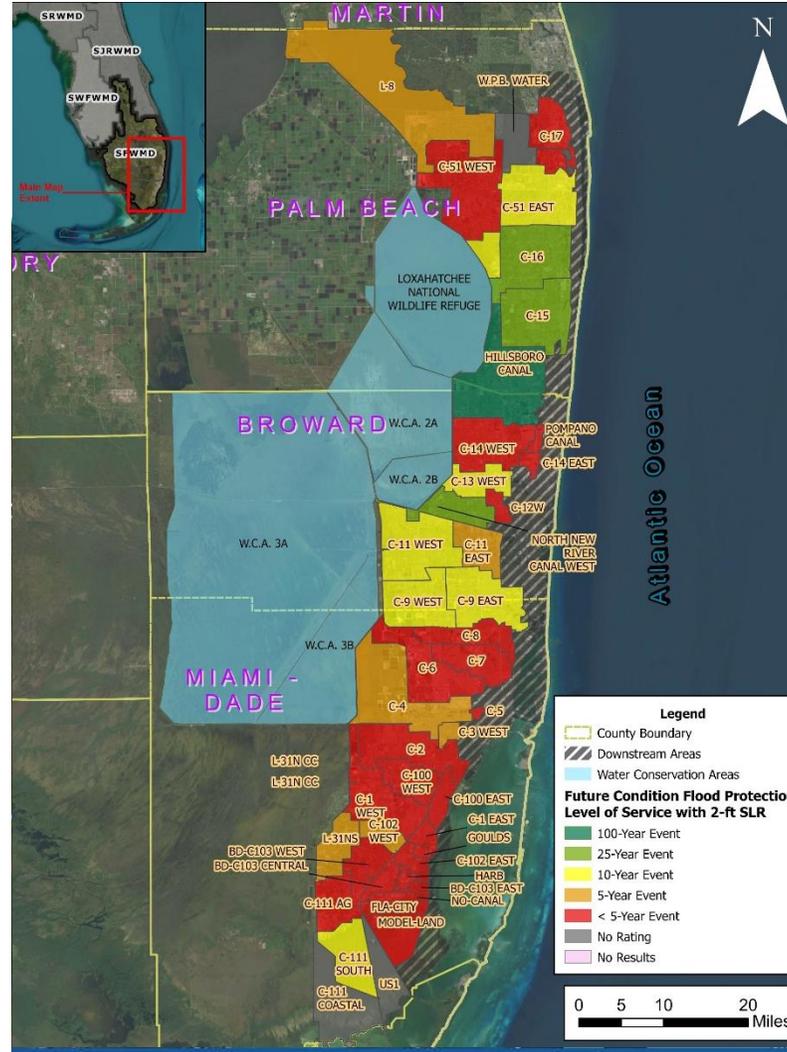


# Flood Protection Level of Service

## Current and Future Conditions (2ft SLR)



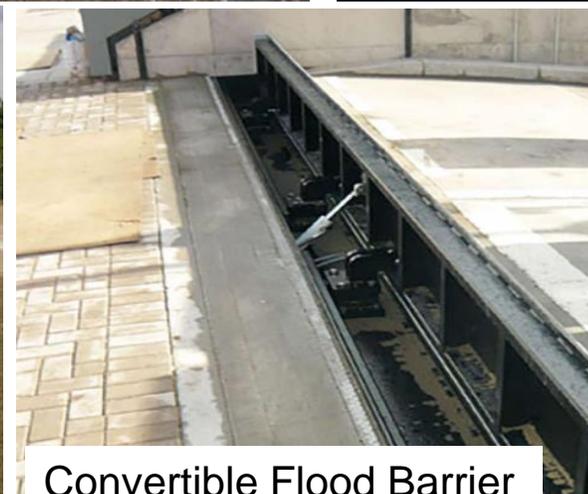
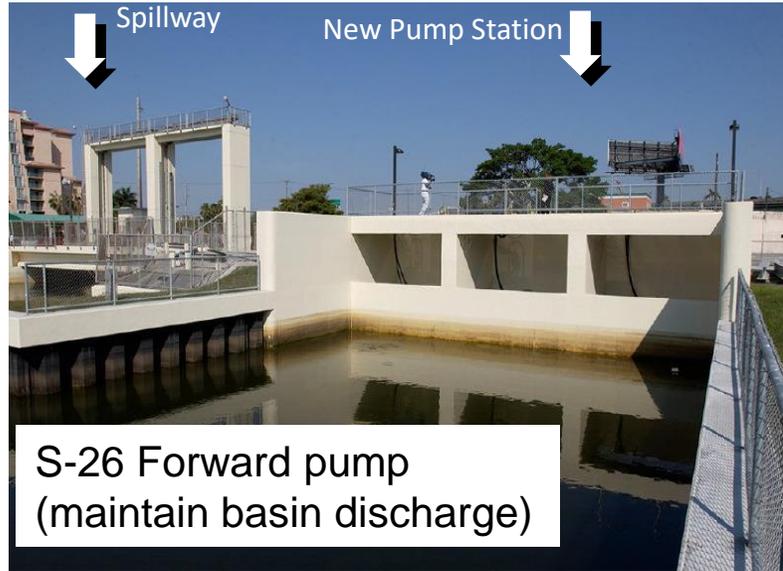
THE C&S SYSTEM TODAY



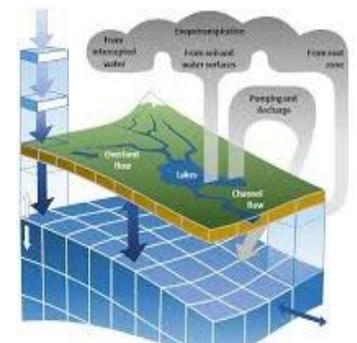
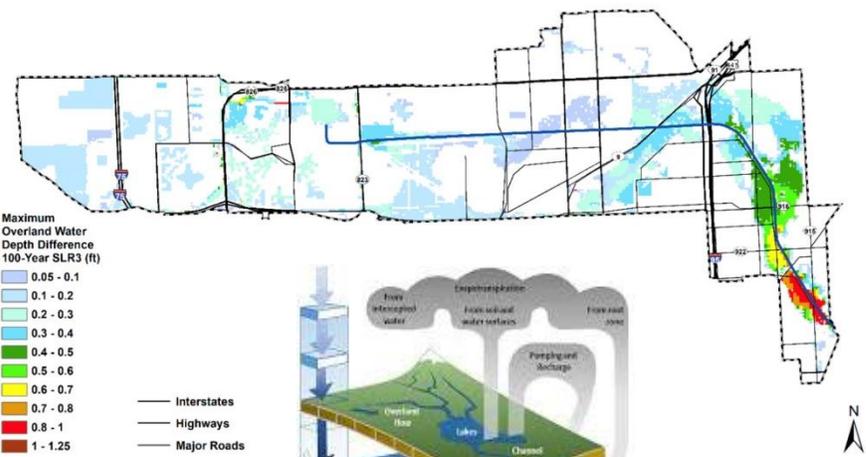
THE C&S SYSTEM IN THE FUTURE



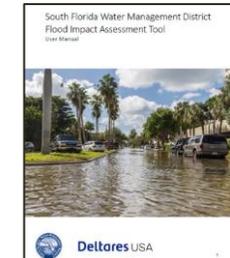
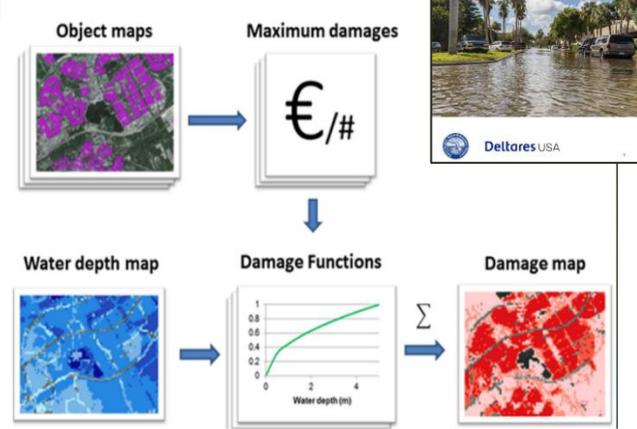
# Examples of Flood Mitigation Solutions



# District Resiliency Planning



Reducing the risks of flooding, sea level rise and other climate impacts on water resources and increasing community and ecosystem resiliency in South Florida



2024 SEA LEVEL RISE AND FLOOD RESILIENCY PLAN

Building Resilience and Mitigating Risks to South Florida's Water Resources

FINAL SEPTEMBER 1, 2024



# FDEP Resilient Florida



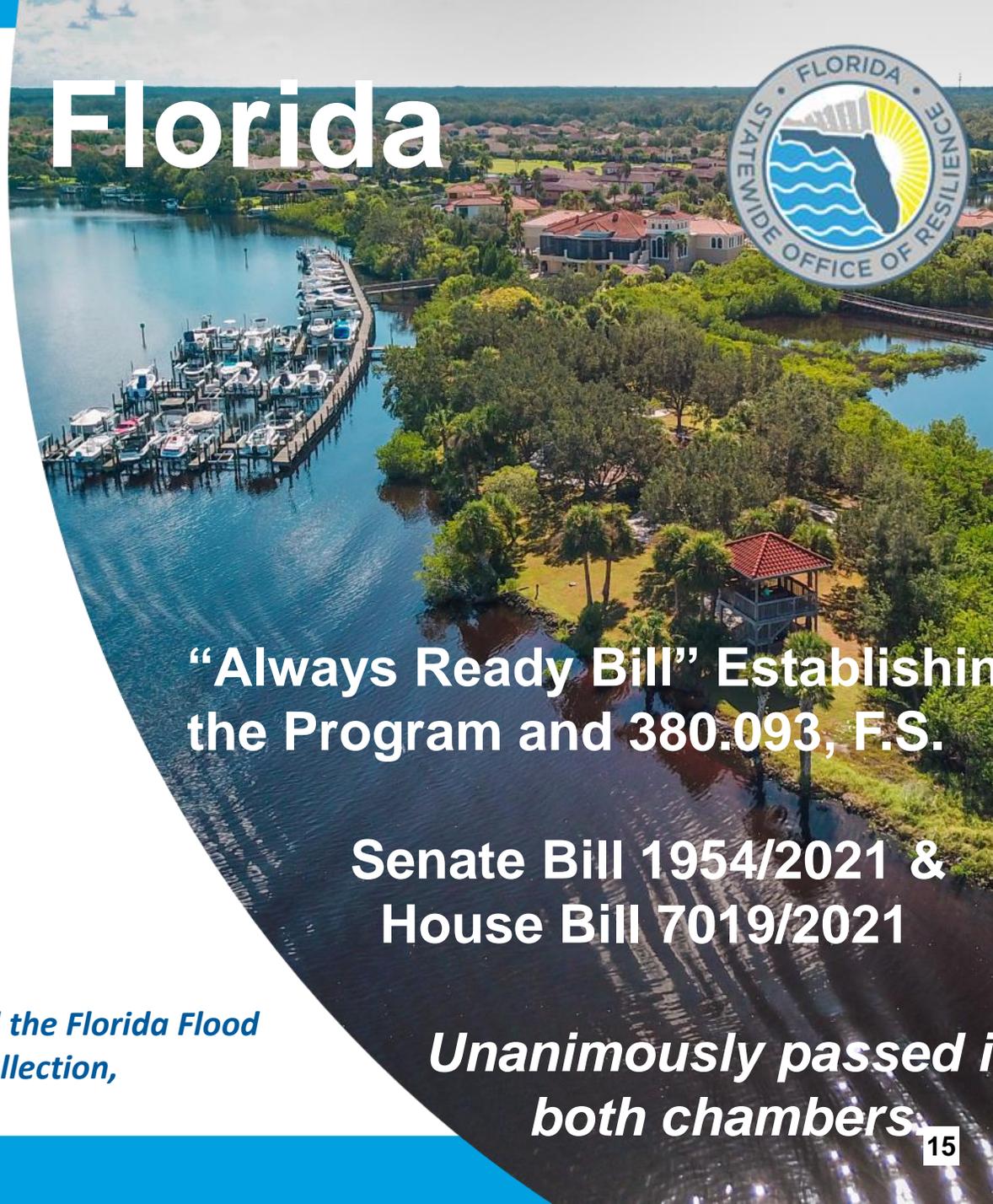
RF Grant Program (Planning Grants)

Statewide Flooding and Sea Level Rise Resilience Plan

Regional Resilience Entities (RRE)

Comprehensive Statewide Data Set and Assessment

Florida Flood Hub for Applied Science



“Always Ready Bill” Establishing the Program and 380.093, F.S.

Senate Bill 1954/2021 & House Bill 7019/2021

Unanimously passed in both chambers

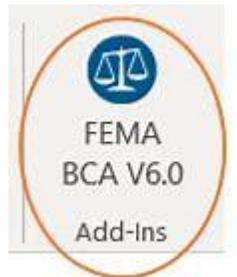
*New in 2023: WMDs support to local government adaptation planning and the Florida Flood Hub for Applied Research and Innovation and FDEP in data creation and collection, modeling, and the implementation of statewide standards.*

# FEMA/FDEM BRIC, HMA, HMGP Programs

- Incentivize public infrastructure projects (flood risk reduction)
- Incentivize projects that mitigate risk to one or more lifelines (critical infrastructure)
- Innovative Solutions & Future Conditions
- Incentivize projects that incorporate nature-based solutions
- Shared responsibilities, community capability and partnership

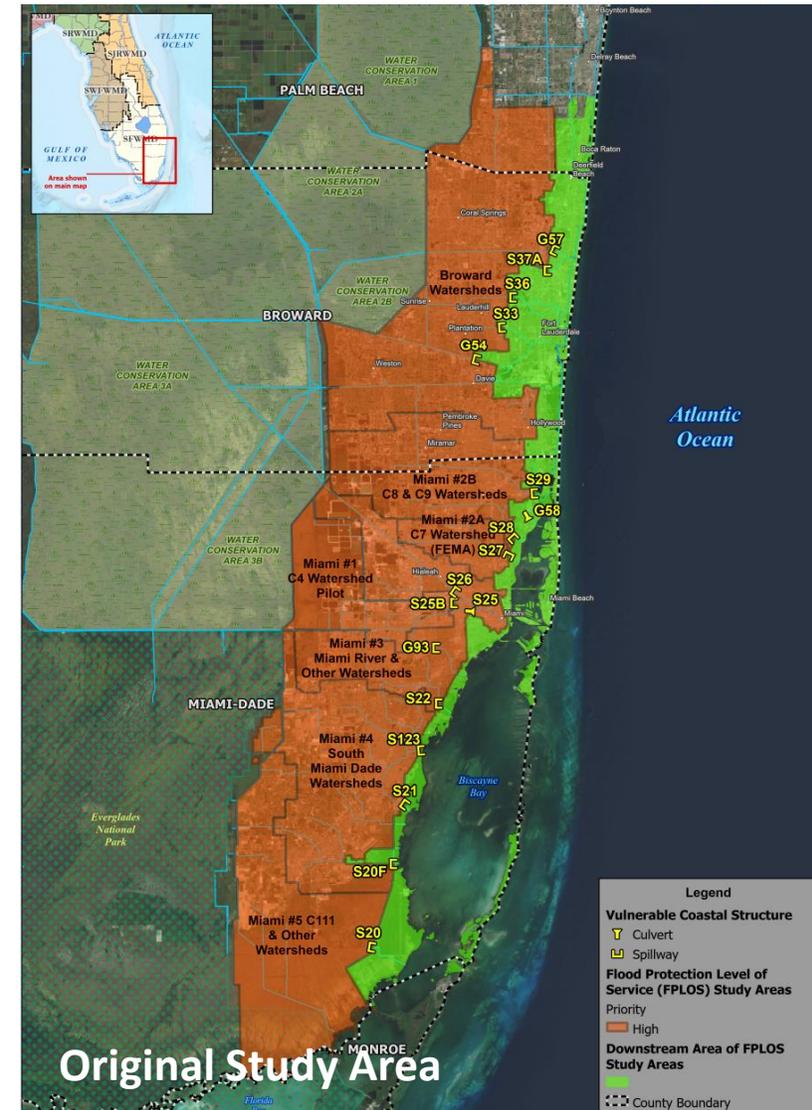


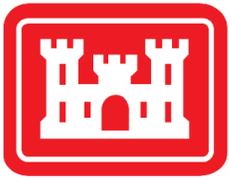
FEMA



# USACE/SFWMD C&SF Flood Resiliency Study

- Ongoing study to evaluate existing flood risk management infrastructure and recommend adaptation strategies to build flood resiliency now and into the future, in the communities served by the C&SF system
- To be conducted under Section 216 of the Flood Control Act of 1970
- Cost Share Agreement between USACE and SFWMD (local sponsor)
- Focus on the highly vulnerable infrastructure that can reduce the most immediate flood risks due to to changing conditions, and the resilience aspects of such infrastructure
- Currently under schedule, scope, budget revision





# C&SF Flood Resilience: Integrated Path Forward



## Planning Reach A - Broward County Basins

- Section 203 Feasibility Study – Target WRDA 26
- Funding support from FDEP and Broward County

## Planning Reach B - C-7, C-8, C-9 Basins

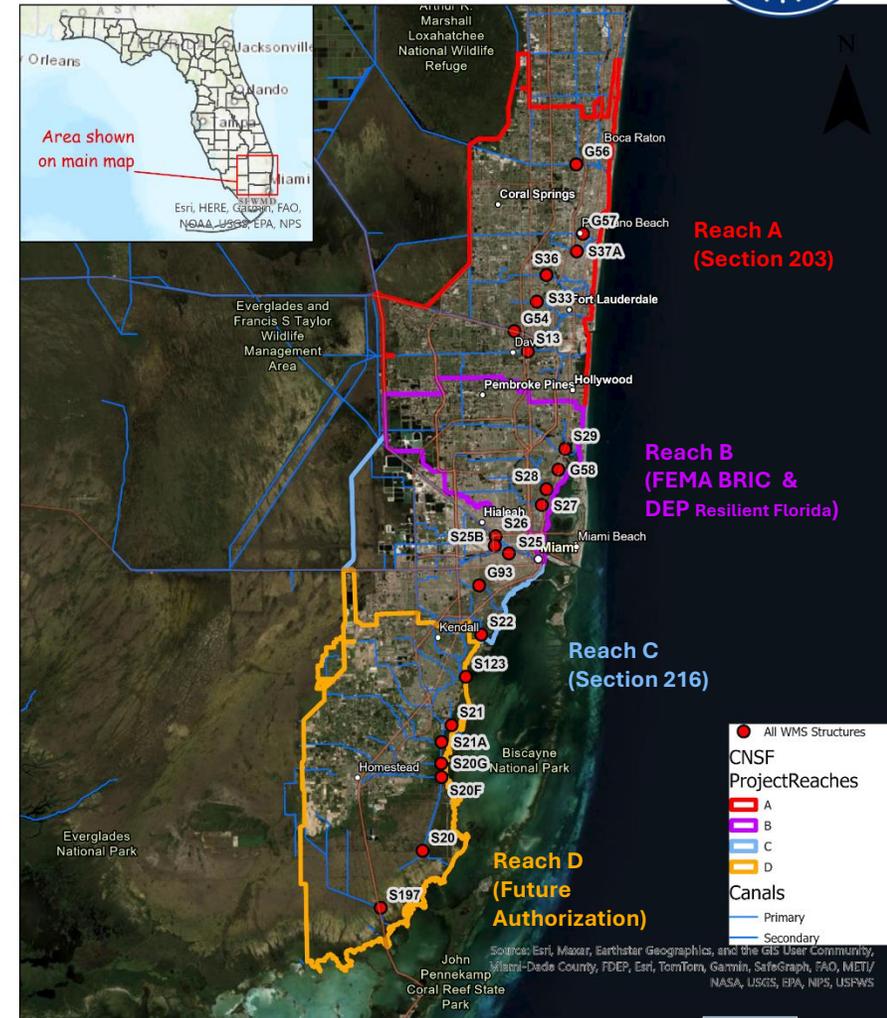
- FEMA Building Resilient Infrastructure and Communities (BRIC)
- Resilient Florida Grant Funding Available
- Funding support from Miami Dade County

## Planning Reach C – Miami River Basins

- C&SF Flood Resiliency Study – Section 216 Authorization – Seeking Budget
- Feasibility Study - Target WRDA 28

## Planning Reach D - South Dade Basins

- CS&F Comprehensive Study or future planning studies



**C&SF Project Reaches and Associated Coastal Structures**

South Florida Water Management District  
3301 Gun Club Rd, West Palm Beach, FL 33406  
561-686-8900 • FL WATS 1-800-432-2046

0 3.25 6.5 13 Miles

IMPORTANT DISCLAIMER:  
The user is responsible for ensuring that the information provided in this report is used for the intended purpose and is not relied upon for any other purpose. The user is also responsible for ensuring that the information is used in accordance with the applicable laws and regulations.

Date Exported: 7/18/2025



# Joint Flood Protection Responsibility

- **Primary**

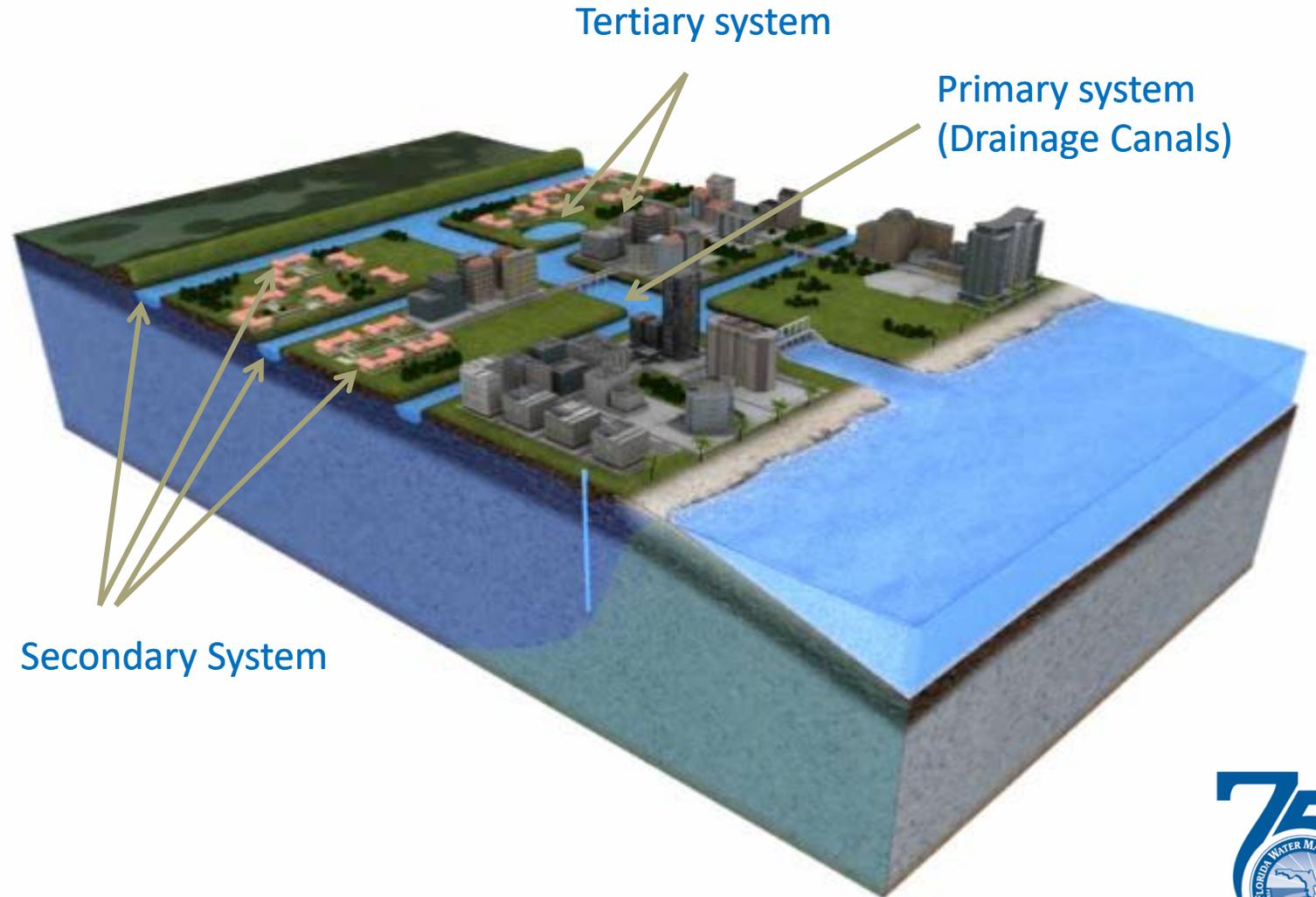
- USACE
- SFWMD

- **Secondary**

- Local/County Governments
- Special Districts

- **Tertiary**

- Homeowners Associations
- Private Landowners



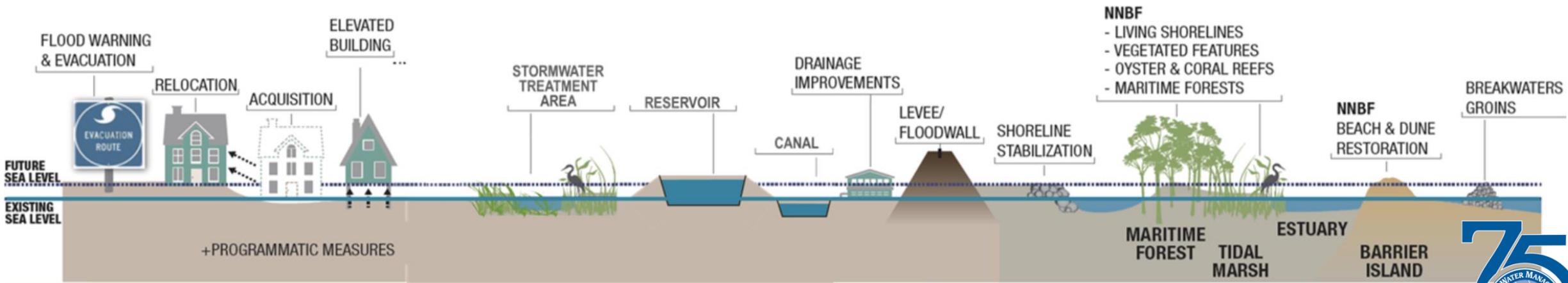
# Resiliency Initiatives Coordination

## Integrating Inland and Coastal Flood Mitigation Strategies



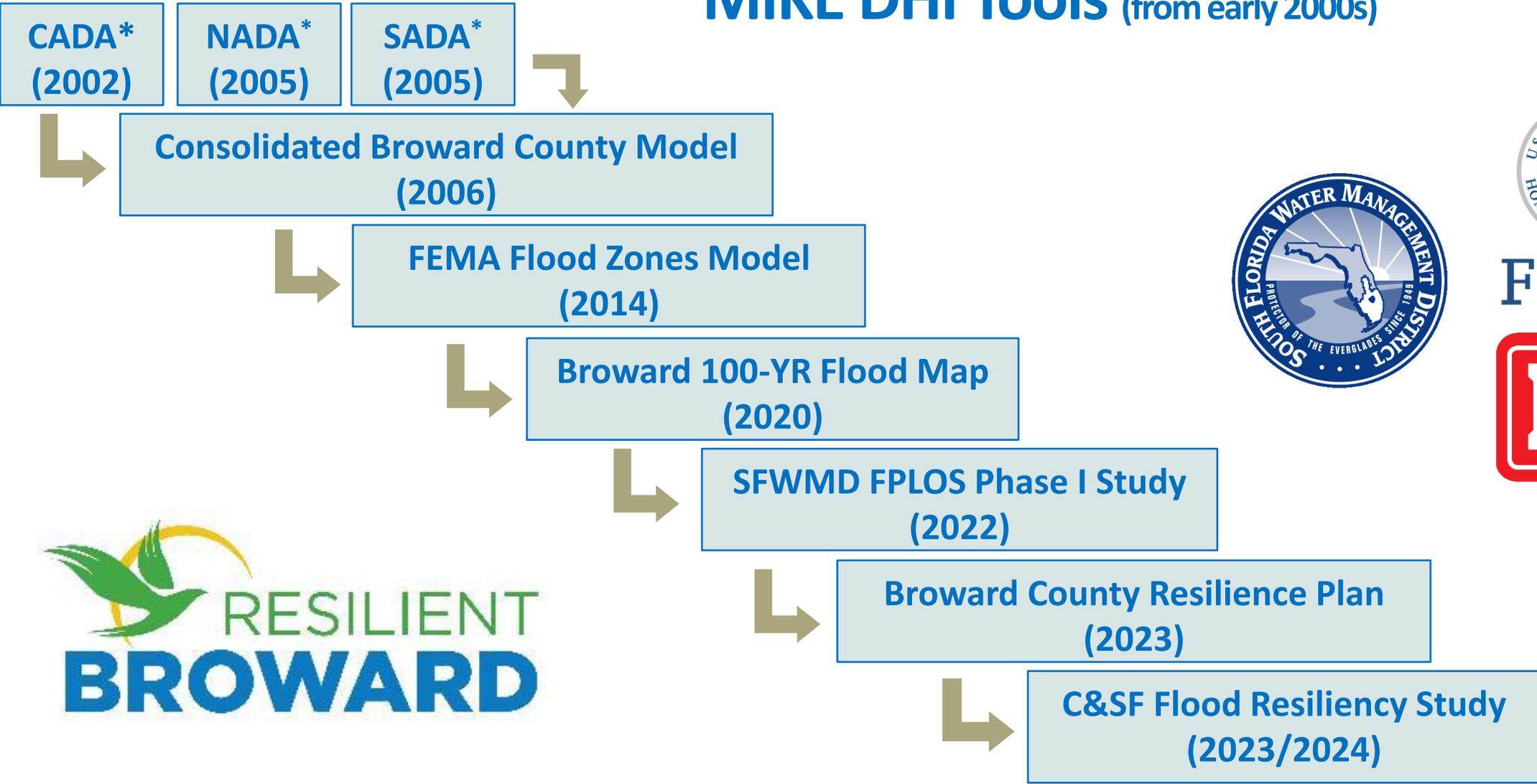
### POTENTIAL MEASURES TO IMPROVE RESILIENCE AND SUSTAINABILITY

Graphic modified from [https://ewn.el.erdc.dren.mil/nnbf/other/5\\_ERDC-NNBF\\_Brochure.pdf](https://ewn.el.erdc.dren.mil/nnbf/other/5_ERDC-NNBF_Brochure.pdf)

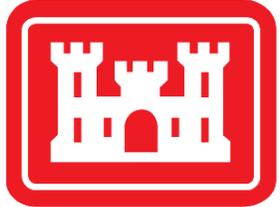


# Broward County Basins: Progressive Flood Risk Assessments

## MIKE DHI Tools (from early 2000s)

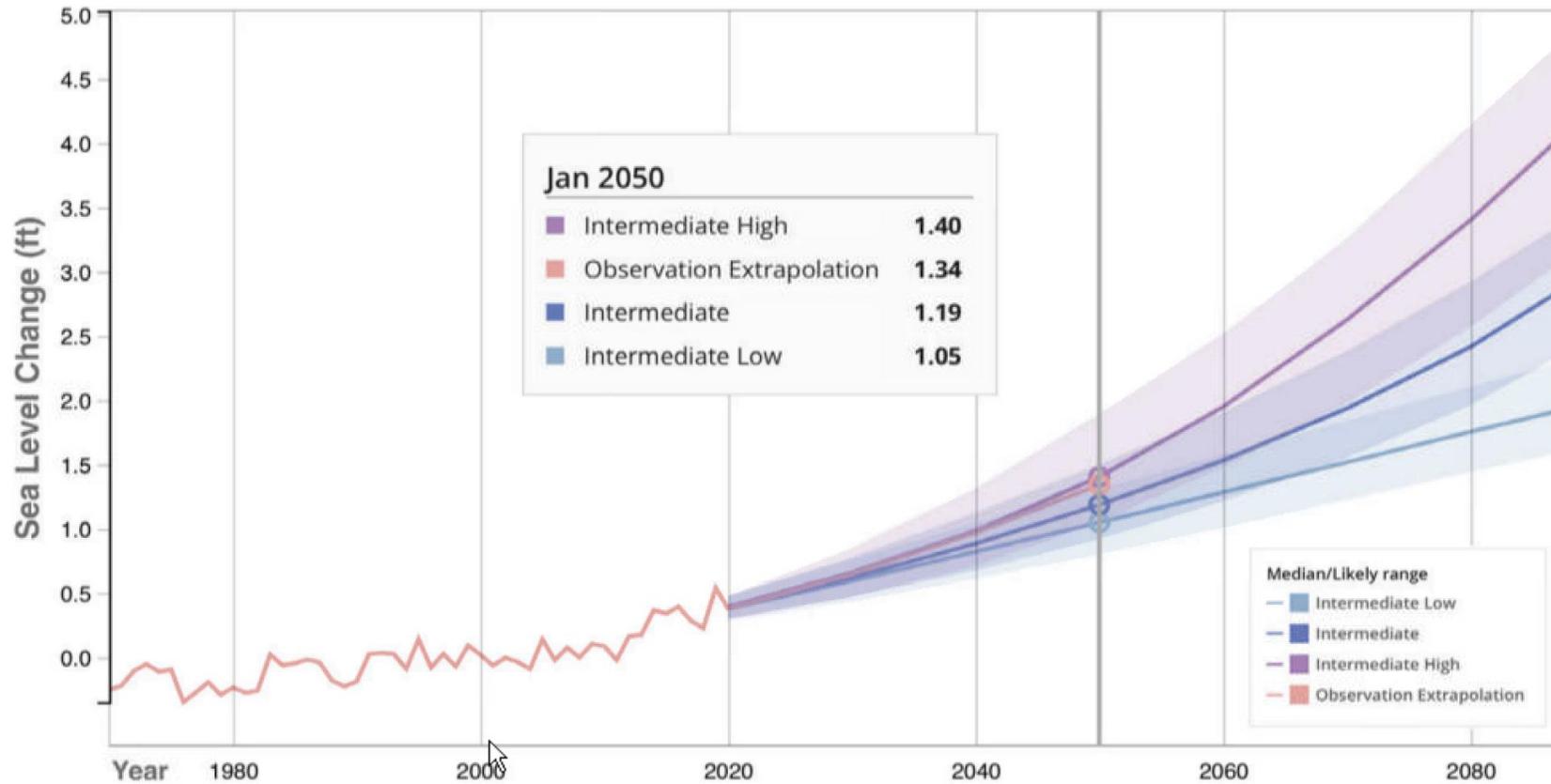


FEMA



\*North, Central, South Area Drainage Assessments

# Sea Level Rise – Time is Critical



Source: Interagency Sea Level Rise Scenario Tool/NASA Sea Level Change Portal/Southeast Region.  
<https://sealevel.nasa.gov/task-force-scenario-tool/?type=regional&region=SE>



Florida Statewide Office of Resilience  
 Resilient Florida C&SF Regional Tour  
 USACE, SFWMD, USDOJ OERI, Miami Dade,  
 Broward County, City of Fort Lauderdale, City  
 of Dania Beach, City of Miami (April 2024)





**THANKS FOR YOUR ATTENTION**

**Carolina Maran, Ph.D., P.E.,**

**[cmaran@sfwmd.gov](mailto:cmaran@sfwmd.gov)**

**Chief of District Resiliency**

**South Florida Water Management District**

**[www.sfwmd.gov/resiliency](http://www.sfwmd.gov/resiliency)**





Central & Southern Florida  
Broward Basins Flood Resiliency Study

### **3. Section 203 Water Resources Water Development Act**

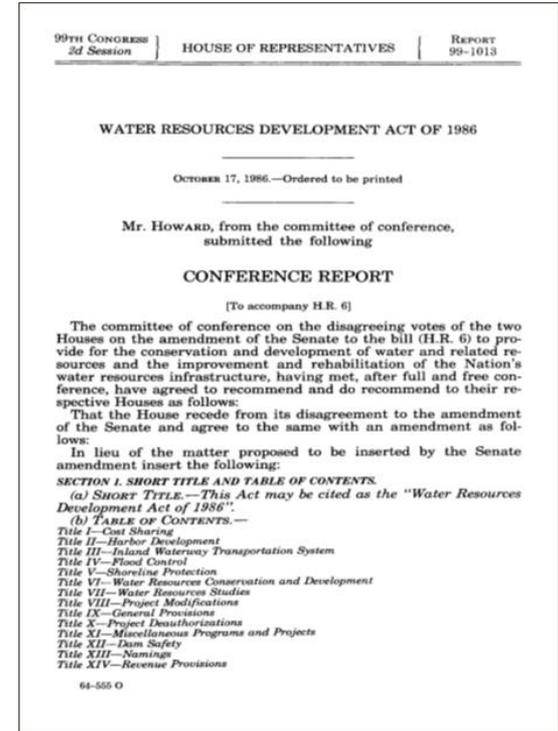
**Matthew Morrison  
Chief Policy Advisor**





# Section 203 Water Resources Water Development Act (WRDA) of 1986

- Authorizes non-Federal interests to undertake feasibility studies of proposed water resource development projects for submission directly to the Secretary of the Army for Federal participation and cost share
- Requires non-Federal interest conduct feasibility study on their own, except limited technical and federal assistance may be provided by the Corps, with the concurrence of ASA(CW), if the non-Federal interests pays for those services
- Assistant Secretary of the Army for Civil Works [ASA(CW)] evaluates and reports whether the project is feasible, providing any recommendations concerning project planning, design or conditions for construction to congressional committees for inclusion and authorization in a Water Resources Development Act (WRDA)
- Section 203 Flood Resiliency Study for Broward Basins is being conducted by the SFWMD as the non-federal sponsor of the Central and Southern Florida (C&SF) project





# USACE Jacksonville District Delegated Authority Flood Resiliency Study Broward Basins

- USACE, Jacksonville District, was delegated the authority to undertake Technical Assistance and Federal Activities on the Flood Resiliency Study for Broward Basins by letter from the Assistant Secretary of the Army (Civil Works) dated August 22, 2024
- Authorizes Jacksonville District to develop and negotiate Memorandum of Agreements (MOAs) and scopes of work with the SFWMD to provide Technical Assistance and undertake Federal Activities, to be approved by the South Atlantic Division Commander
- Allows Jacksonville District to accept funds from the SFWMD for Technical Support and Federal Activities provided
- Does not allow for project credit or repayment of funds provided





# USACE Jacksonville Technical Assistance and Federal Activities Flood Resiliency Study Broward Basins

## Technical Assistance Examples

- Corps Engineering Regulations and Policy Guidance Documents
  - Modeling, project benefits analysis, design and cost estimating requirements
- Approved tools for use
  - Cost effectiveness and incremental cost analysis
  - HEC FDA economic flood damage model
- Consultation and Coordination Activities
  - Fish and Wildlife Coordination Act (FWCA)
  - Section 7 Endangered Species Act (ESA)
  - National Oceanic and Atmospheric Administration (NOAA)
  - Tribal Coordination

## Federal Activities Examples

- Preparation of the Environmental Impact Statement (EIS)
- Certification of Project Cost Estimate
- Distribute Tribal, Stakeholder, and Agency Scoping Letters
- Federal Register Notifications and Publications
  - Notice of Intent
  - Public Scoping Letter and Public Scoping Meeting
  - Publish Notice of Availability (NOA) and Publication of Draft and Final Integrated Feasibility Study and Environmental Impact Statement
- Public Meeting Participation
  - Scoping Meeting
  - Other Public Meeting



# USACE Jacksonville Technical Assistance and Federal Activities Flood Resiliency Study Broward Basin

## Current Status

- The Corps, Jacksonville District, was delegated the authority to undertake Technical and Federal Assistance on the Flood Resiliency Study for Broward Basins by letter from the Assistant Secretary of the Army (Civil Works) dated August 22, 2024
- Memorandum of Agreements (MOAs) for Technical Assistance and Federal Activities are under expedited policy compliance review at the USACE South Atlantic Division
- Once MOAs are approved SFWMD will transfer funds to the Jacksonville District to negotiate, finalize, execute and implement scopes of work to provide Technical Assistance and undertake Federal Activities



Central & Southern Florida  
Broward Basins Flood Resiliency Study

# Questions and Discussion





Central & Southern Florida  
Broward Basins Flood Resiliency Study

## **4. Introduction to the C&SF Flood Resiliency Study – Broward Basins**

**Matthew Morrison  
Chief Policy Advisor, SFWMD**





## Section 203 C&SF Flood Resiliency Study for Broward Basins

**Project Purpose:** Identify the most effective and feasible plan to reduce flood risk

- Utilize WRDA 1986 Section 203 process to complete an integrated Flood Resiliency Study and Environmental Impact Statement for Broward Basins
- Study focus on the primary canals and coastal water control structures in Broward County that are part of the C&SF project
- SFWMD Non-Federal Sponsor
  - Funding support/partnership with FDEP and Broward County
- Leverage C&SF Flood Resiliency Study (216 Study) Milestones - Reach A
- Project management, modeling and evaluations will be completed by SFWMD
- Consulting Services will provide technical, policy, modeling and engineering support services
- Technical and Federal Assistant from the Jacksonville District
- Targeting authorization WRDA 2026



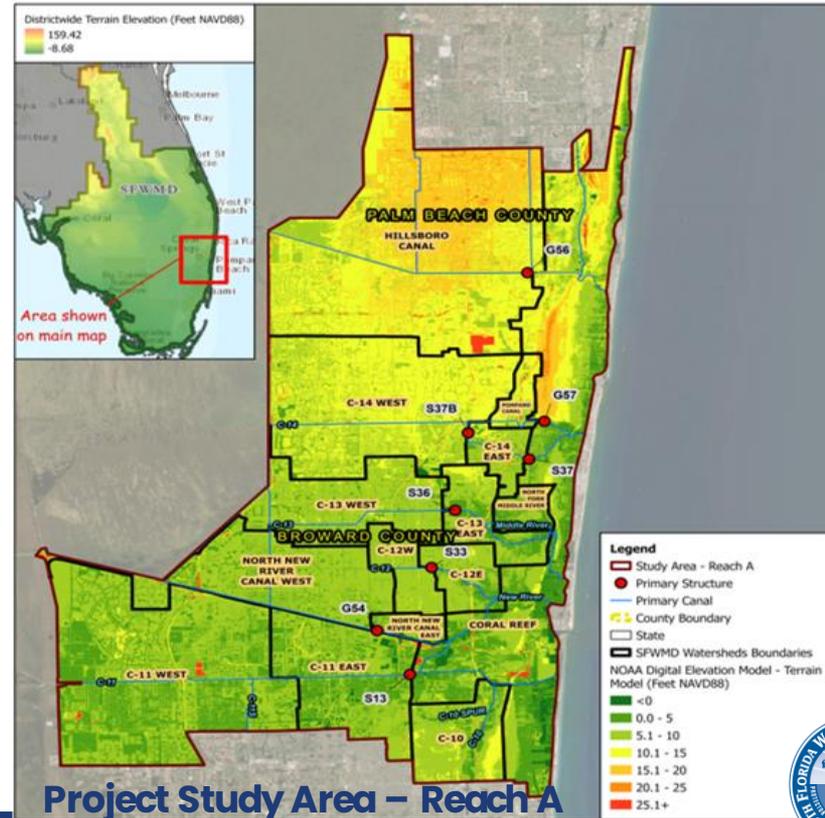


# Section 203

## C&SF Flood Resiliency Study for Broward Basins

### Project Study Area

- Reach A in the C&SF Flood Resiliency Study (Section 216) is the Section 203 Project Study Area
- Approximately 420 square miles
- Relatively flat landscape, slightly above sea level



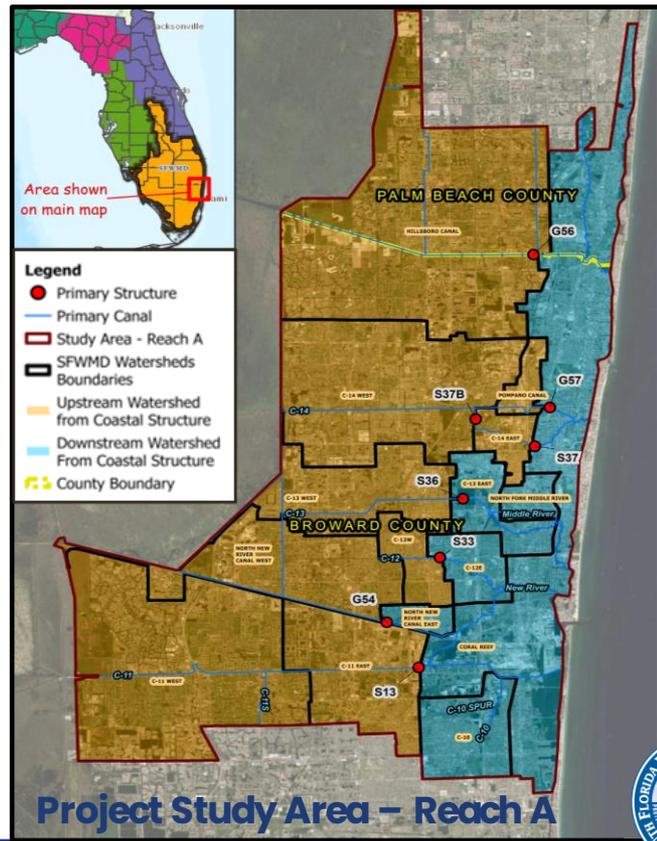


# Section 203

## C&SF Flood Resiliency Study for Broward Basins

### Project Study Area

- Several managed watershed basins
- Primary canals/ rivers
- Primary coastal water control structures
- Other non-managed watersheds downstream of coastal water control structures



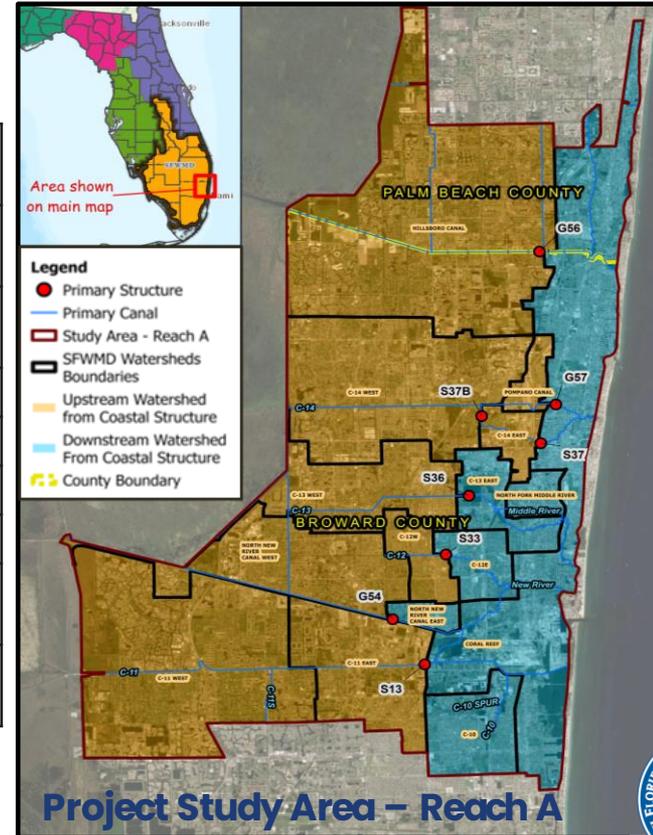


# Section 203

## C&SF Flood Resiliency Study for Broward Basins

### Project Study Area - Managed Basins

MANAGED BASIN	PRIMARY CANAL	COASTAL WATER CONTROL STRUCTURE
Hillsboro Canal Basin	Hillsboro (G-08) Canal	G56 Gated Spillway
Pompano Canal Basin	Pompano (G-16) Canal	G57 Gated Spillway
C-14 West Basin	C-14 Canal	S37B Gated Spillway
C-14 East Basin	C-14 Canal	S37A Gated Spillway
C-13 West Basin	C-13 Canal	S36 Gated Spillway
C-12 West Basin	C-12 Canal	S33 Gated Spillway
North New River Canal West Basin	North New River (G-15) Canal	G54 Gated Spillway
C-11 West & East Basins	C-11 Canal	S13 Pump Sta. & Gated Spillway





## Section 203

# C&SF Flood Resiliency Study for Broward Basins

### Draft Problems (leveraging 216 work):

- Changing climatic conditions have demonstrated the immediate need for a holistic and integrated approach to addressing flood and coastal storm risk management
- The more than 70-year-old gravity driven C&SF water management infrastructure system was not designed to manage the current conditions of combined runoff, storm surge, and high tides, resulting in a reduction of the system efficiency
- System inefficiencies are further exacerbated by sea level rise and extreme rainfall events that further stress the system and reduce its ability to provide flood protection in the future
- The highly dense urban areas in Broward County Florida, served by the C&SF system, are experiencing significant flooding now, which is expected to worsen in the future
- Flooding events result in property damage (residences, businesses and critical infrastructure), health and life safety risks, saltwater intrusion and threatens economic activities that are of significance





# Section 203

## C&SF Flood Resiliency Study for Broward Basins

### Draft Opportunities (leveraging 216 work):

- Provide continued flood risk management to reduce the most immediate flooding risks of vulnerable areas within the C&SF Project
- Expediently modifying C&SF coastal infrastructure in highly vulnerable areas to reduce the risk of harmful and damaging flooding and impacts to communities and economies
- Manage life, health and safety caused by inland inundation

### Draft Goals and Objectives (leveraging 216 work):

- Develop, evaluate and recommend flood risk management measures and adaptation strategies to build flood resiliency in Broward County communities served by the C&SF system, now and in the future, and contribute to national economic development
- Enhance existing C&SF infrastructure functionality and capacity to improve flood risk management and resiliency, which has been degraded by changed conditions within Broward County
- Quantify flood risk reduction benefits and assess the economic feasibility of alternatives
- Complete a feasibility study with economic analysis that justifies expenses for modifications and improvements

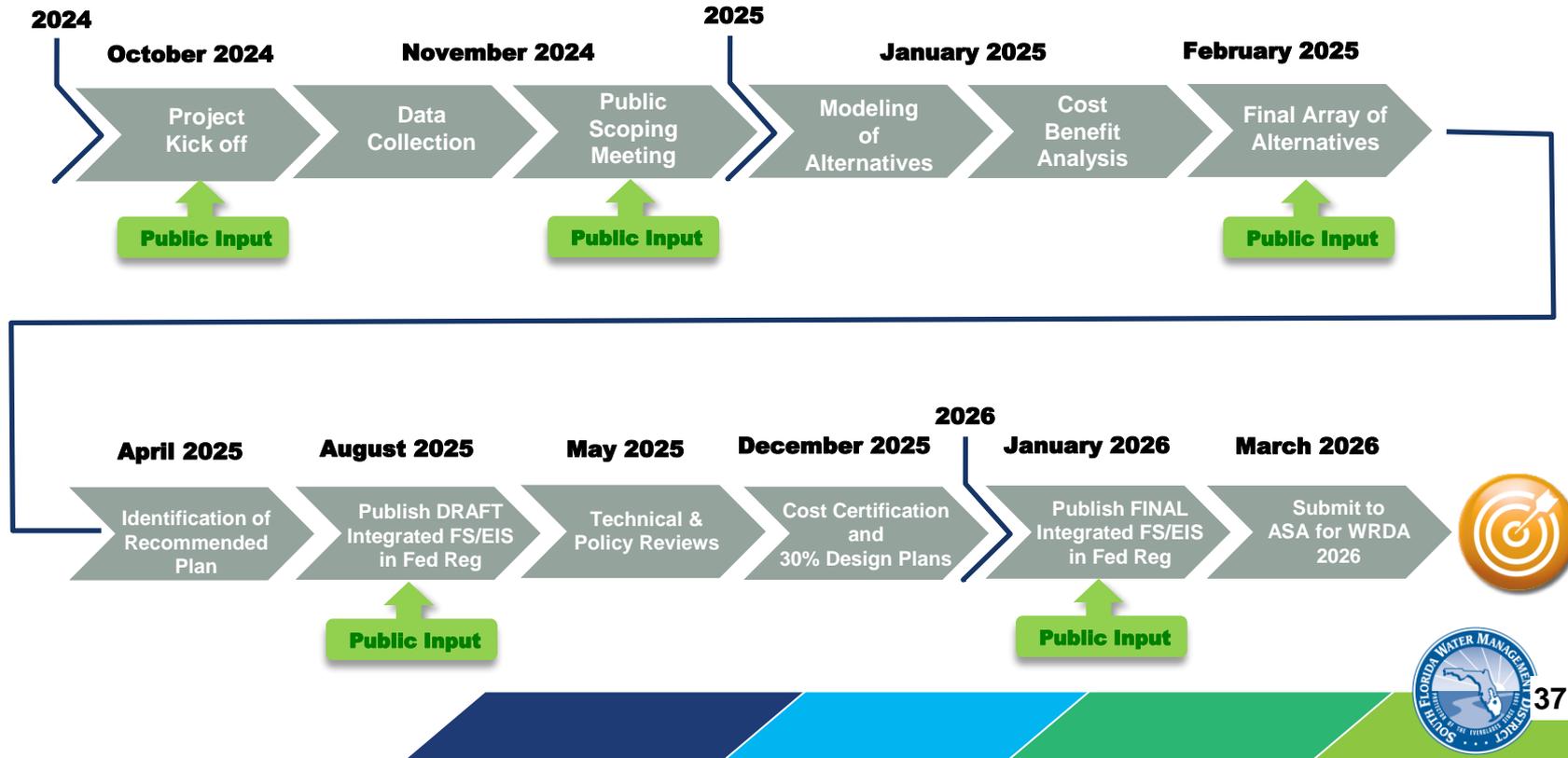
### Draft Constraints (Section 203):

- Study limited to modifications to the primary canals and coastal water structures in Broward County



# Project Schedule

Targeting March 2026 – Deliver Final Feasibility Report and Environmental Impact Statement to ASA Civil Works





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# Questions and Discussion





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## 5. Break





## 6. Evaluation and Modeling Tools

Walter Wilcox, P.E., Bureau Chief

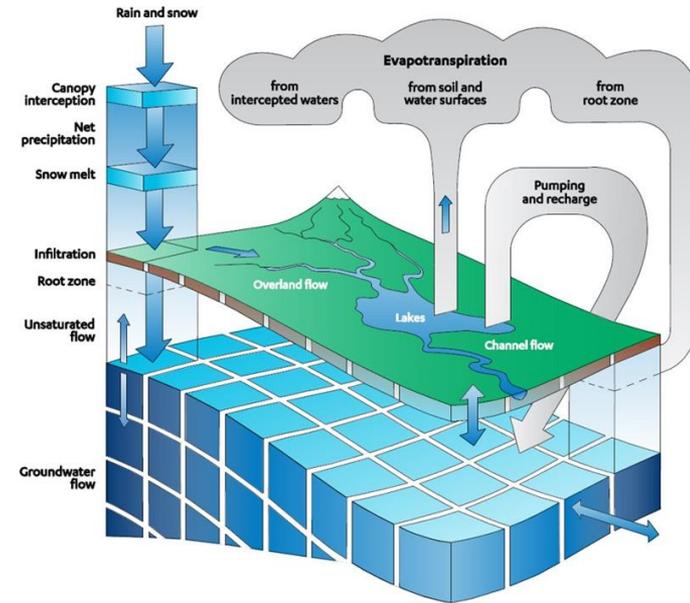
Water Resources Systems Modelling Bureau, SFWMD



# HYDROLOGIC AND HYDRAULIC MODELING TOOL

The integrated/coupled surface-groundwater model MIKE SHE/MIKE Hydro (2022) will be used to simulate the hydraulics and hydrology for the project area.

- Conducts sub-regional scale simulations
- Simulates surface water and groundwater systems & their interactions and allows for the accounting of rising water tables and reduced soil storage
- Able to simulate the effects of different boundary conditions such as tidal and storm surge-influenced tailwater conditions with current and future sea-level rise scenarios
- Comprehensive operational flexibility, can simulate structure gate operating rules and can use calibrated flow parameters for canal structures





# H&H MODELING APPROACH & IMPLEMENTATION

- Utilize available MIKE SHE/HYDRO models with successful application history in the SFWMD Flood Protection Level of Service and Broward County Resiliency planning efforts
  - These models are also “approved for use” by the United States Army Corps of Engineers (USACE)
- Available models have been extended to include the downstream coastal areas and updated with the latest available data:
  - Assumed land use is a combination of SFWMD 2014-2016 Land Use dataset and the 2019 Broward County Current Conditions model, which was developed from the SFWMD Land Use Land Cover data with minor changes based on satellite imagery from 2015 with 2018.
  - The future conditions land use map was developed by modifying the current conditions land use map to reflect projected future conditions land use maps for 2040 from the Broward County Planning Council, Palm Beach County Planning, Zoning and Building Department.
- The focus of this study is on the primary system; however, the models include a high level of detail within the secondary/tertiary canal systems

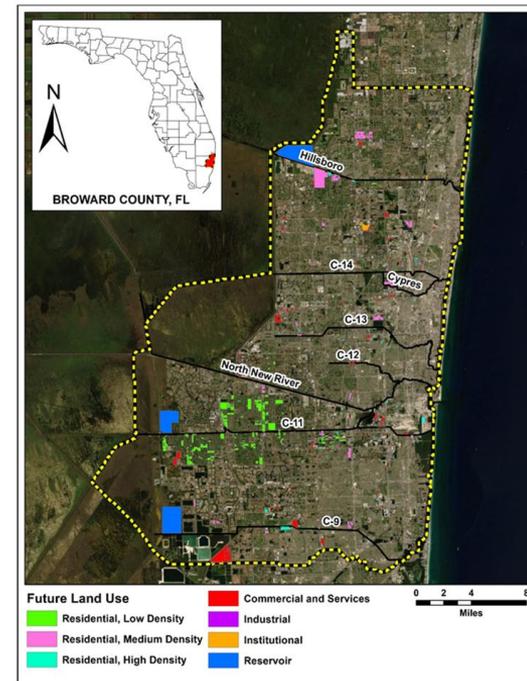


Figure 2.2-1: Areas of Future Land Use Change





# CANAL CONFIGURATION AND OPERATIONS

- The focus of this study is on the primary system with a high level of detail placed on the secondary/tertiary canal systems
- SFWMD structure flow parameters from SFWMD flow rating analysis reports and the 2015 SFWMD Atlas of Flow Computations
- C&SF system and operating rules for SFWMD structures from Eastern Broward County Water Control Operations Atlas updated Dec. 9, 2022
- Assumes high rainfall and pre-storm drawdown operations by operating tidal structures in low range to meet control elevations in the primary canals
- Tidal structures assume salinity operations (spillway gates close when tailwater at the structure is higher than headwater for the prevention of saltwater intrusion)
- Broward County and South Broward Drainage District structures operations from the 2019 Broward County Current Conditions model which has operating criteria inherited from the 2014 FEMA model and verified/updated based on stakeholder data and the SBDD Facilities Report, 2013, GIS database and Water Control Plan



**Water Control Operations Atlas: Eastern Broward County**

**Part 2: Structure Descriptions**

**South Florida Water Management District  
Hydrology and Hydraulics Bureau**

**August 12, 2021  
Updated on December 9, 2022**

*This report supersedes DRE-231, Eastern Broward County Basin Atlas, November 1987.*



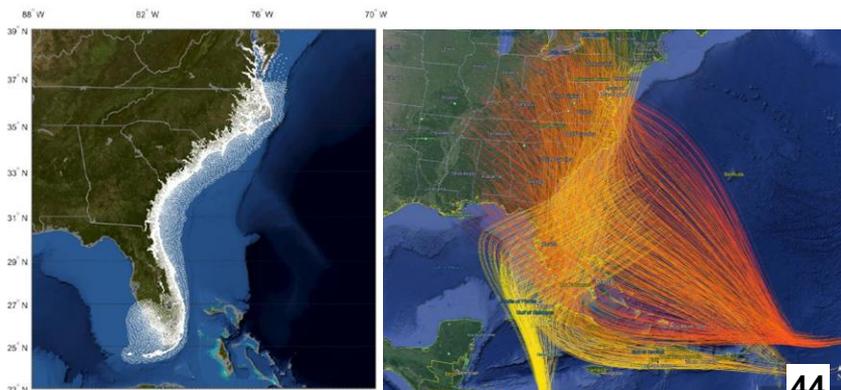
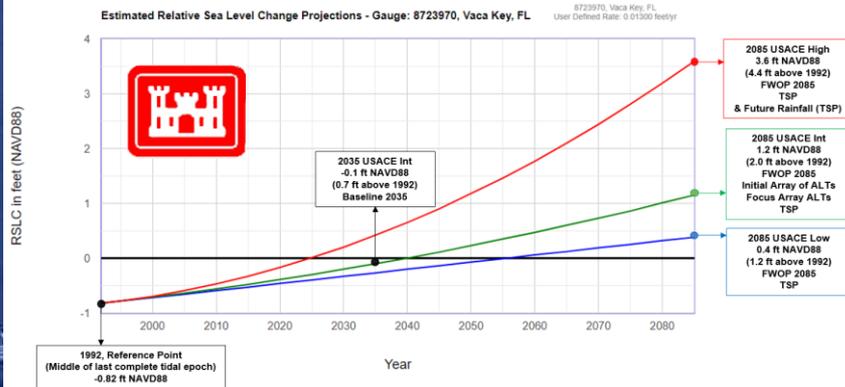
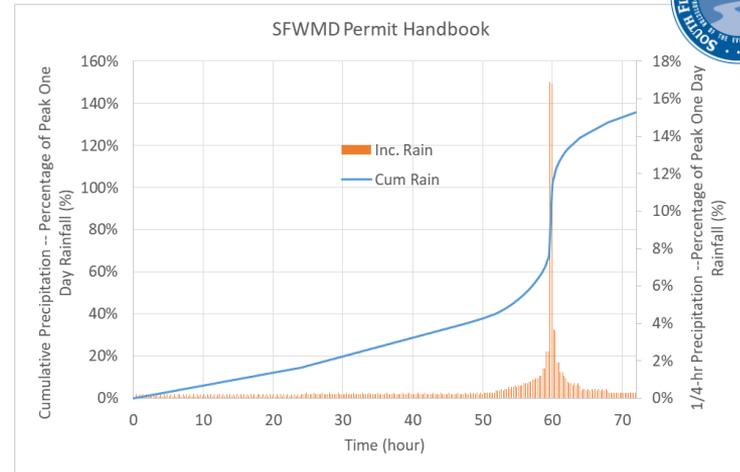
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# MODEL INPUT ASSUMPTIONS: RAINFALL & TIDE

- **Rainfall**
  - Spatially distributed gridded input derived from National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rainfall depths
  - Temporally distributed based on SFWMD 72-hour distribution
- **Coastal Boundary**
  - The South Atlantic Coastal Study (SACS) Coastal Hazard System (CHS) provides numerical and probabilistic modeling results for coastal forcings, including storm surge.
  - The CHS stage-hydrographs will be applied as a downstream boundary condition





## EVALUATION OF COMPOUND FLOODING

- The total water level (i.e., compound flooding) due to multiple flood sources, including rainfall runoff, groundwater and coastal forcings will be simulated.
- Hydrologic & Hydraulic model simulations include an array of rainfall and coastal return frequency events. Sea level change is included in the coastal water level data & run in parallel for low, intermediate & high sea level scenarios.

Coastal water level Return Period (CHS data )	Rainfall return period (NOAA Atlas14)
2-year	5-year
2-year	10-year
10-year	10-year
2-year	25-year
20-year	25-year
2-year	100-year
100-year	100-year
2-year	500-year





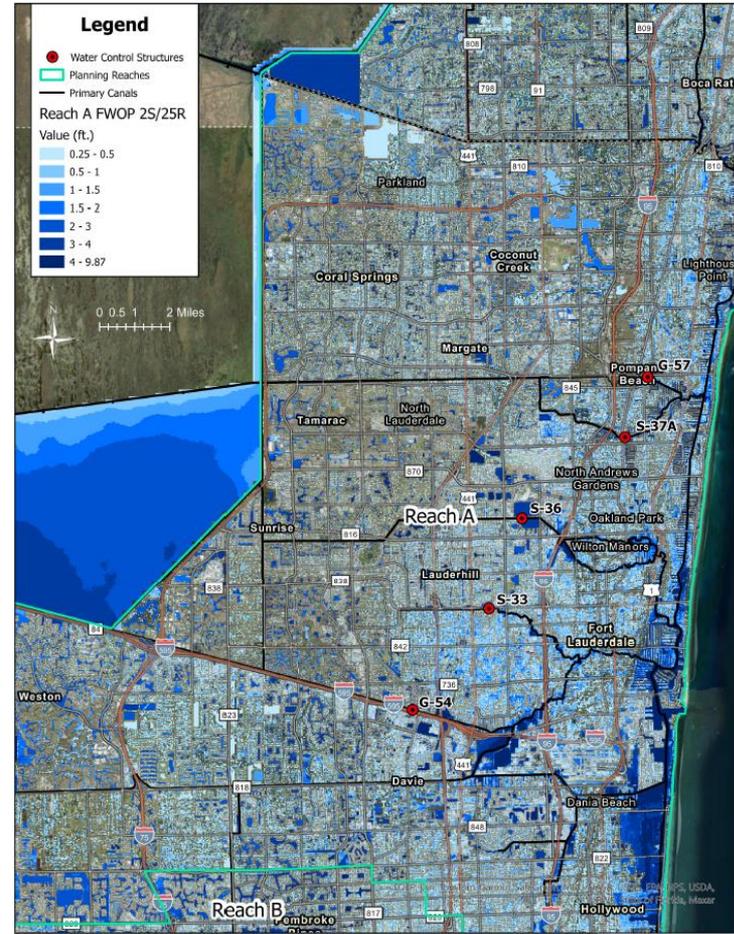
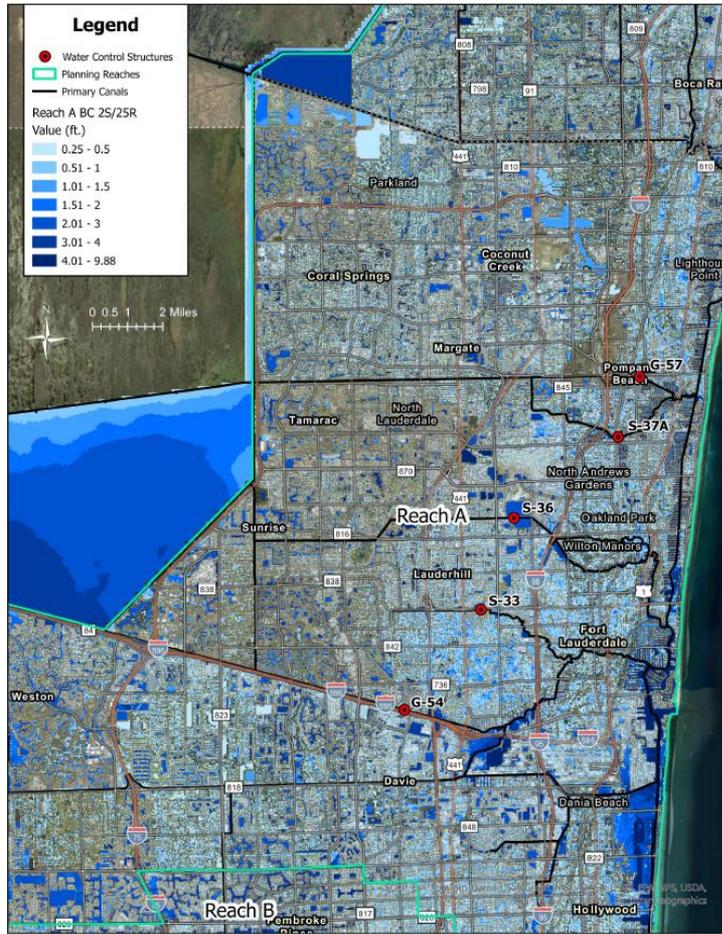
## MODEL RESULTS DISCLAIMER

The results of this modeling effort should not be used to make personal decisions about flood risk now or in the future. Nor should the content replace flood risk maps from governmental agencies such as the Federal Emergency Management Agency.

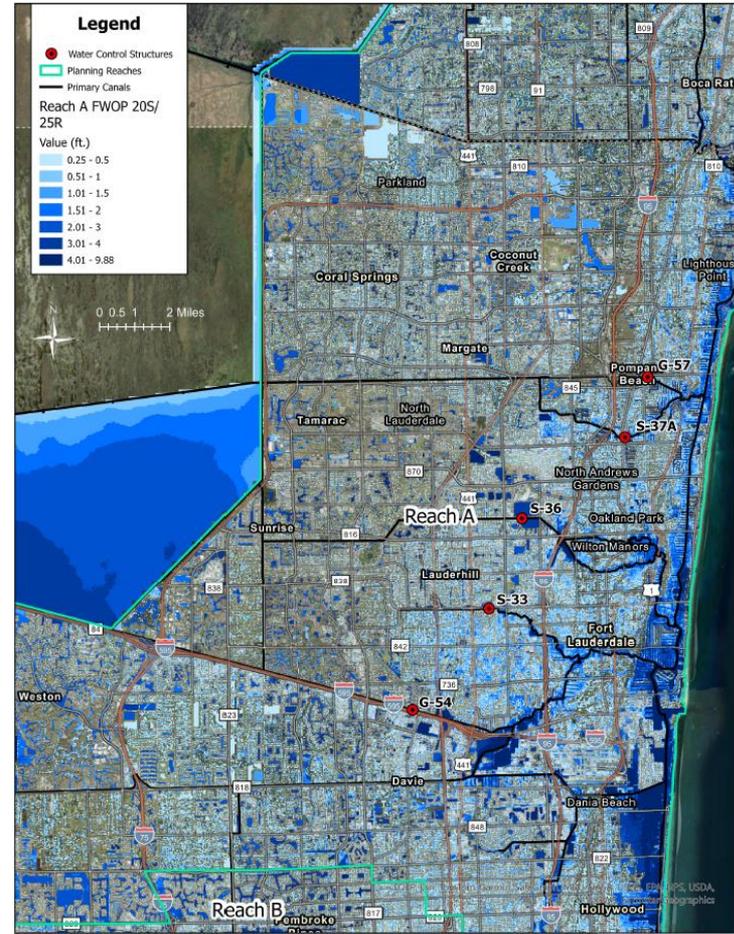
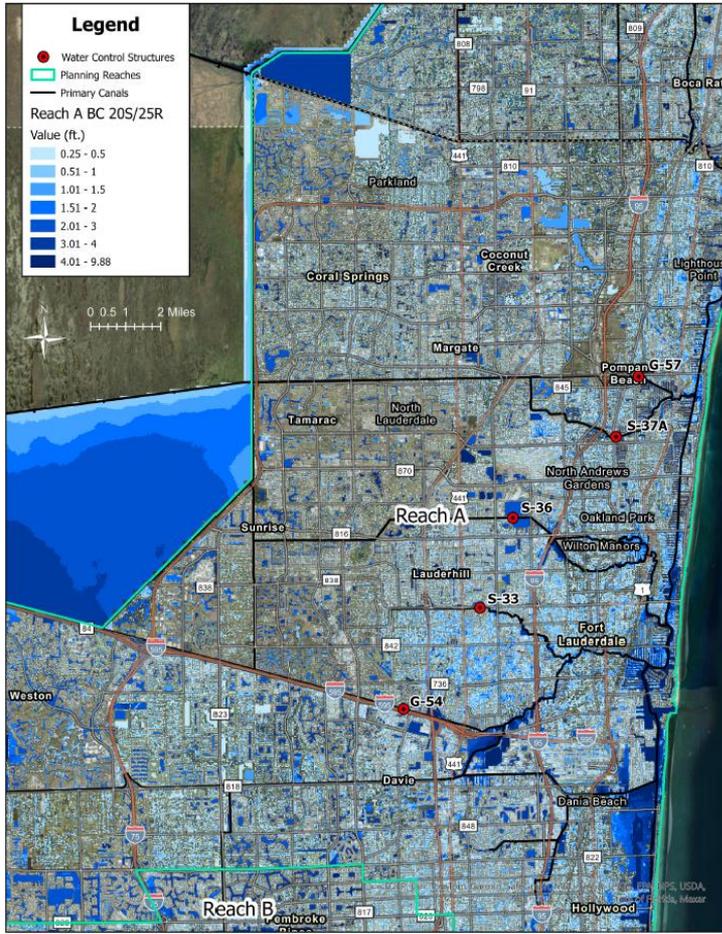
The maps, projections, data and examples on these slides were compiled for use by the Project Team that is studying a complex system. They represent the results of data collection and modeling assumptions about future conditions designed to assist in evaluating flood risk over a large project footprint. The South Florida Water Management District make no representations as to the suitability or accuracy of the data for any other purpose.



# EXAMPLE: MAXIMUM DEPTHS 25-YEAR RAINFALL, 2-YEAR SURGE

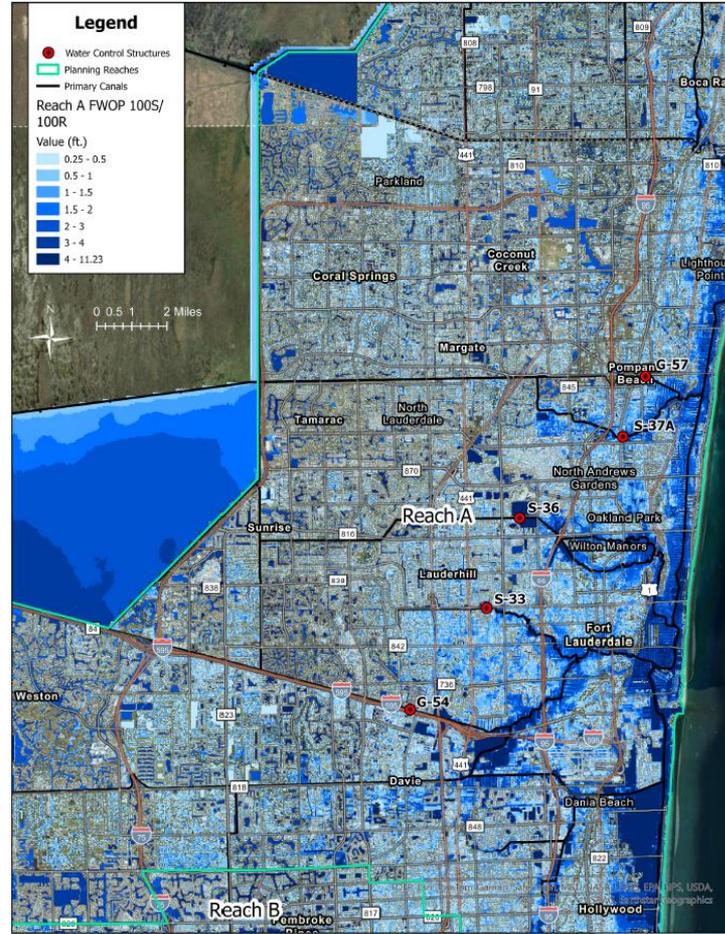
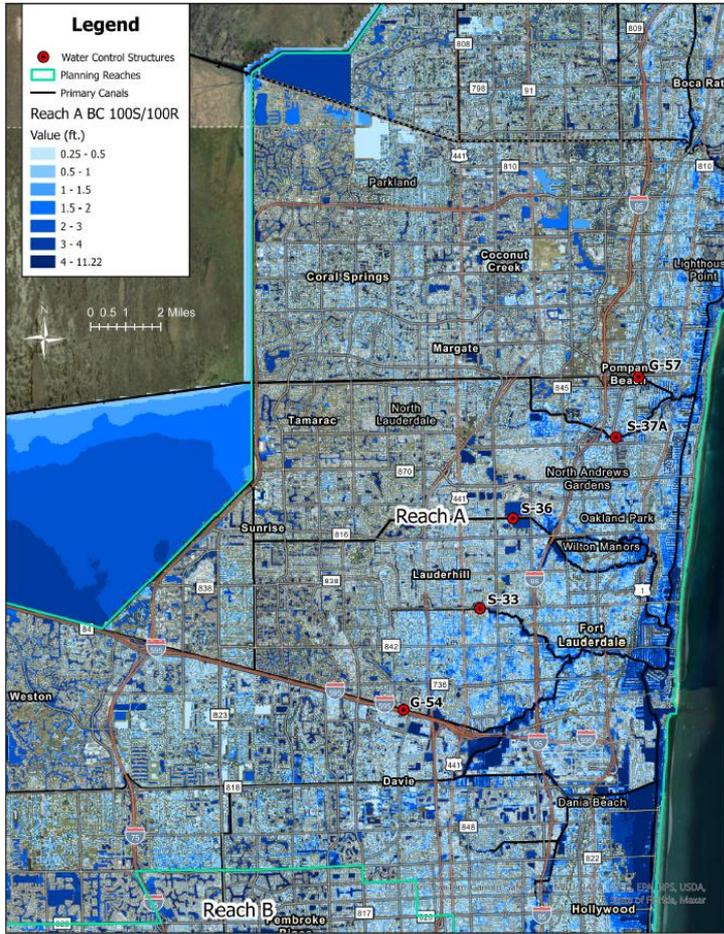


# EXAMPLE: MAXIMUM DEPTHS 25-YEAR RAINFALL, 20-YEAR SURGE

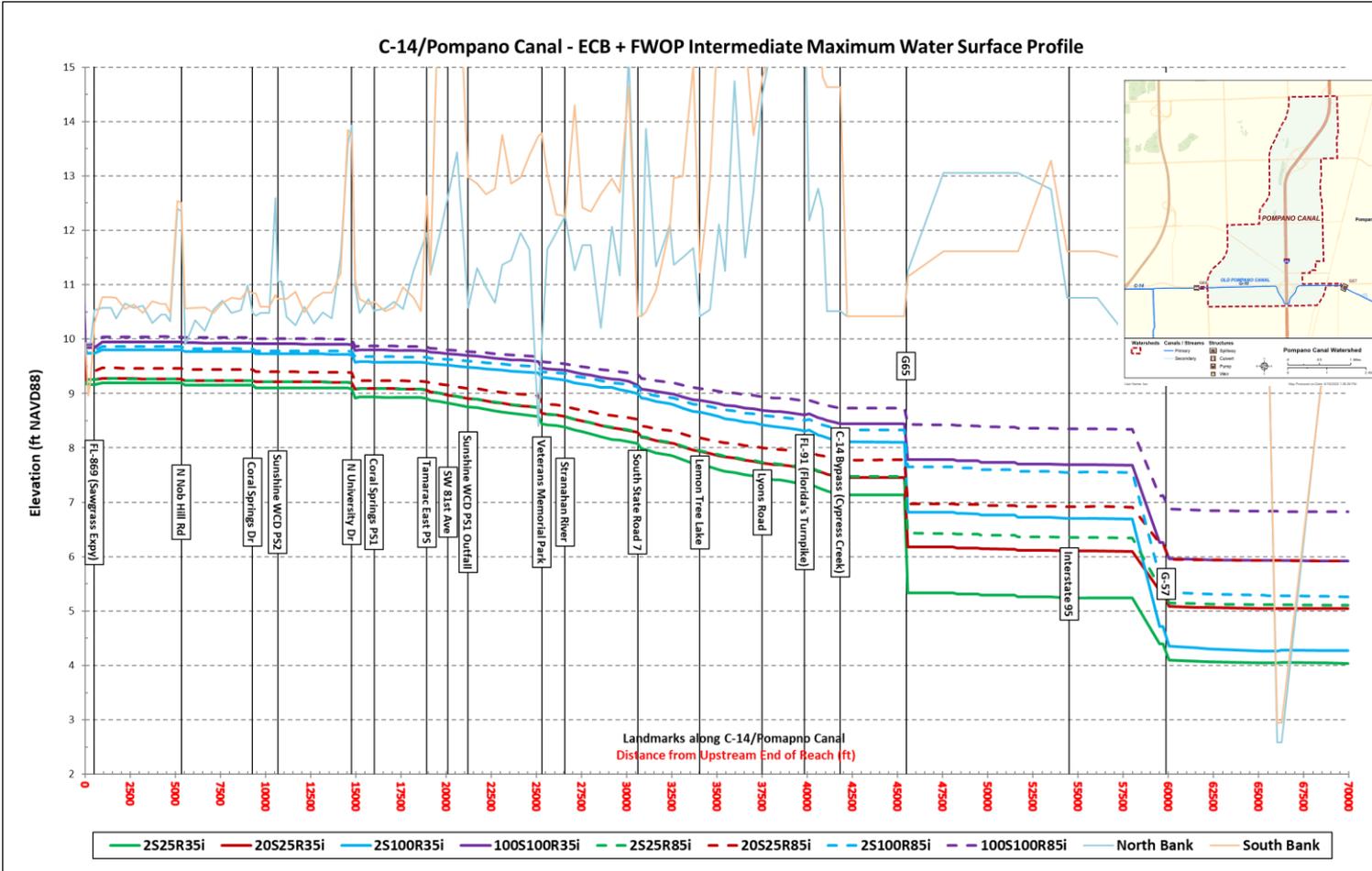




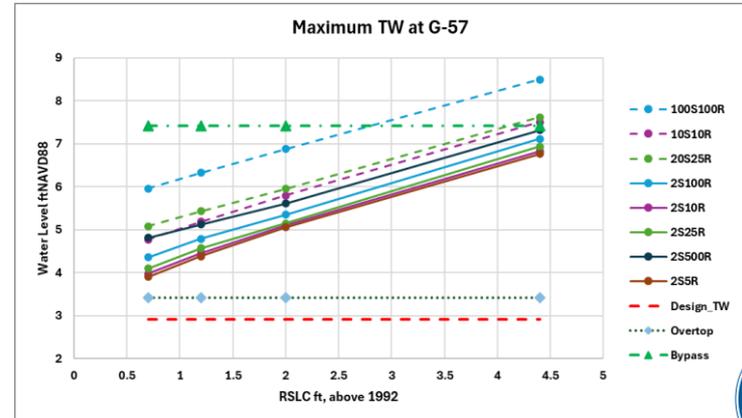
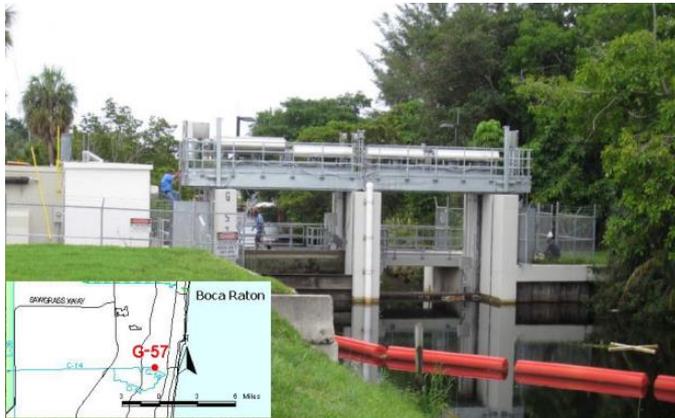
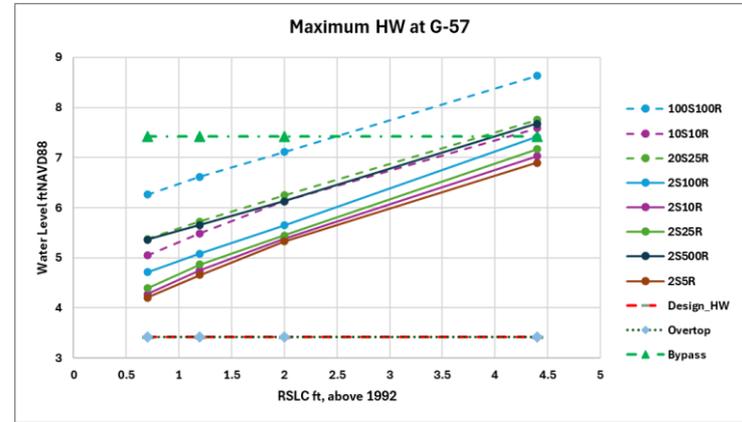
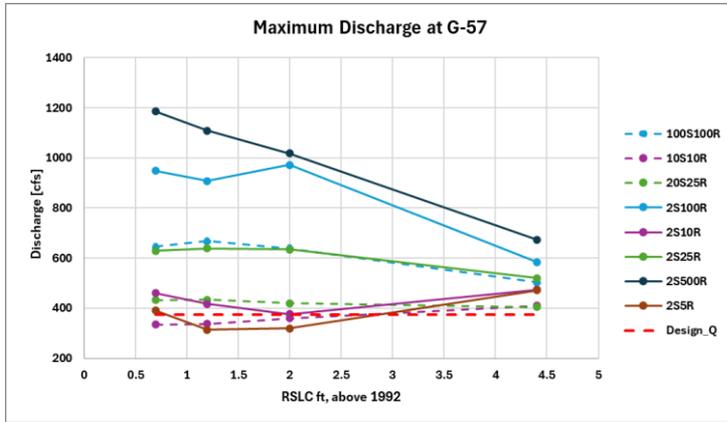
# EXAMPLE: MAXIMUM DEPTHS 100-YEAR RAINFALL, 100-YEAR SURGE



# EXAMPLE: MAXIMUM CANAL STAGE PROFILE PLOT



# EXAMPLE: ASSESSING STRUCTURE PERFORMANCE





# FLOOD RISK MANAGEMENT- ECONOMIC ANALYSIS

- Helps answer the question “which proposed flood damage reduction plan is the best from an economic standpoint?”
  - Evaluate the existing condition
  - Evaluate the future without project condition
  - Analyze alternative damage reduction plans
- Compare plans using expected annual flood damage and flood damage reduction benefits

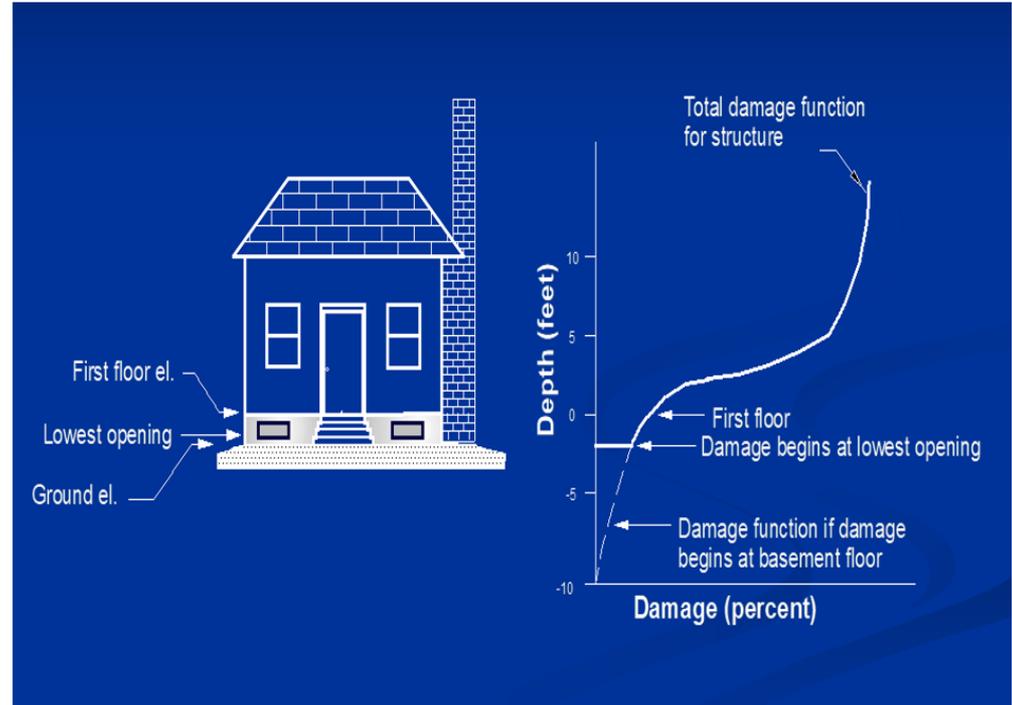




# COMPARING WITH & WITHOUT PROJECT DAMAGES

## Broadly Defined Steps

1. Delineate Affected Area
2. Determine Floodplain Characteristics
  - Identify damage reaches
  - Inventory Occupancy Types: Residential, Commercial, Industrial, Public, Others
  - Estimate first floor elevations – with uncertainty
3. Estimate structure/content values
4. Apply depth-damage curves
5. Estimate Damages (\$)



Conceptual layout of depth-relationship for a residential structure

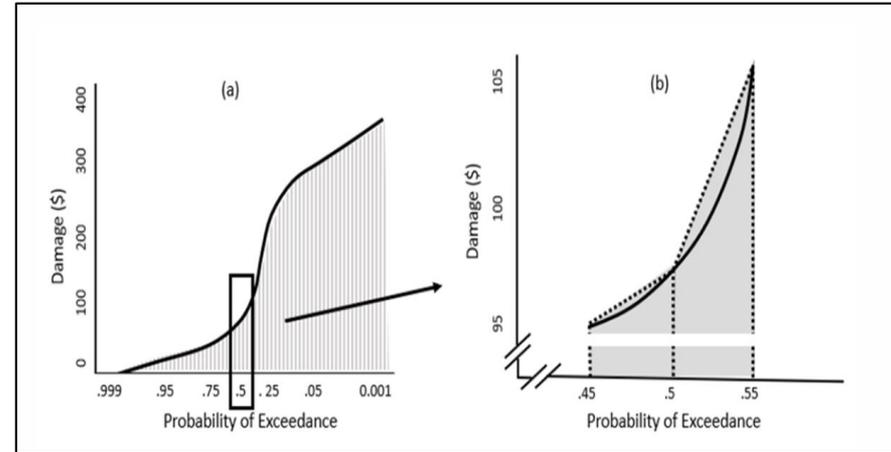




# USACE APPROVED ECONOMIC MODEL: HEC-FDA

## Hydrologic Engineering Center's Flood Damage Analysis software (HEC-FDA)

- Developed by USACE Hydrologic Engineering Center, Institute for Water Resources
- Integrates hydrology/hydraulics/economics in a single model.
- Incorporates risk analysis and uncertainty
- On 216 Study will incorporate flood stage data for **eight distinct probably events** from MIKE-SHE outputs to estimate ***Expected Annual Damage (EAD)***





# QUESTIONS & DISCUSSION





## 7. Next Steps

- Finalize Technical Assistance and Federal Activities requirements with the Jacksonville District
  - Execute of Memorandum of Agreements
  - Transfer funding to Jacksonville District for Technical Assistance and Federal Activities
  - Negotiate, finalize and implement scopes of work for Technical Assistance and Federal Activities
- Initiate project data collection (structure as-builts, geotechnical investigations, environmental assessments, historical and cultural resources)
- Schedule and host formal project scoping meeting – targeting mid November
  - Contingent on execution of Federal Activities and Technical Assistance MOAs and Scopes of Work
- Begin identifying and testing possible management measures (structural, non-structural, and natural/nature-based features)





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## 8. Q&A Session





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## 9. Public Comment





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## 10. Closing Remarks





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# 11. Adjourn

