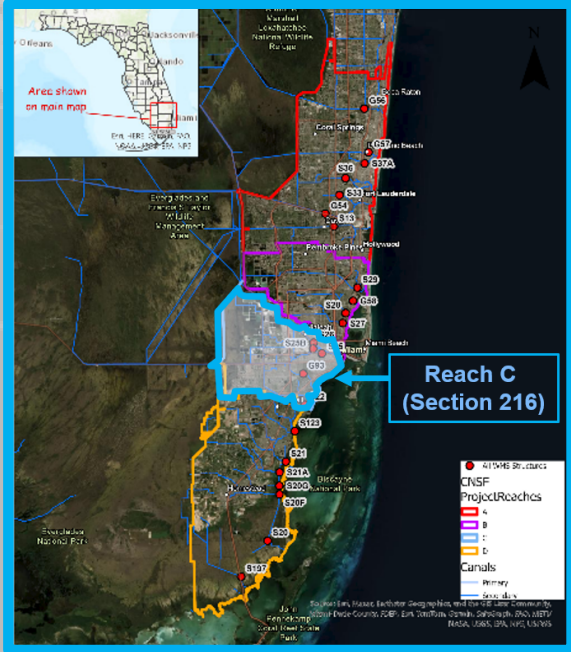
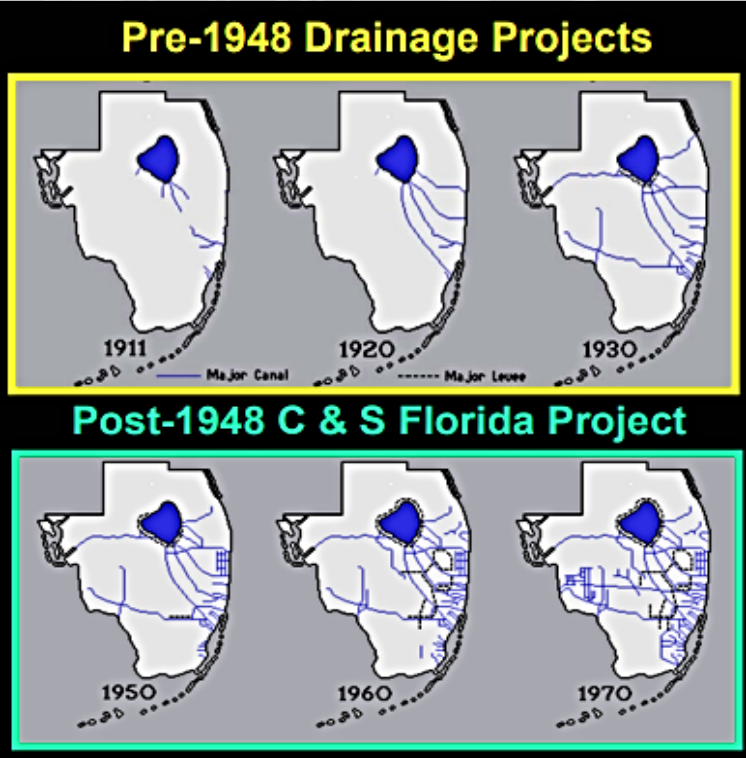
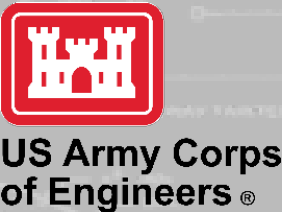


CENTRAL AND SOUTHERN FLORIDA (C&SF) FLOOD RESILIENCY (SECTION 216) STUDY

DRAFT INITIAL ALTERNATIVES

February 5, 2026
Virtual Meeting

Working Today to Build a Better Tomorrow





OPENING REMARKS AND PROJECT STATUS

Presenters:

Jennifer Smith, Project Manager, USACE

Tim Gysan, Chief, Ecosystems Projects Section and Resilience Coordinator, USACE



C&SF FLOOD RESILIENCY (SECTION 216) STUDY

PURPOSE AND AGENDA – FWOP IPR

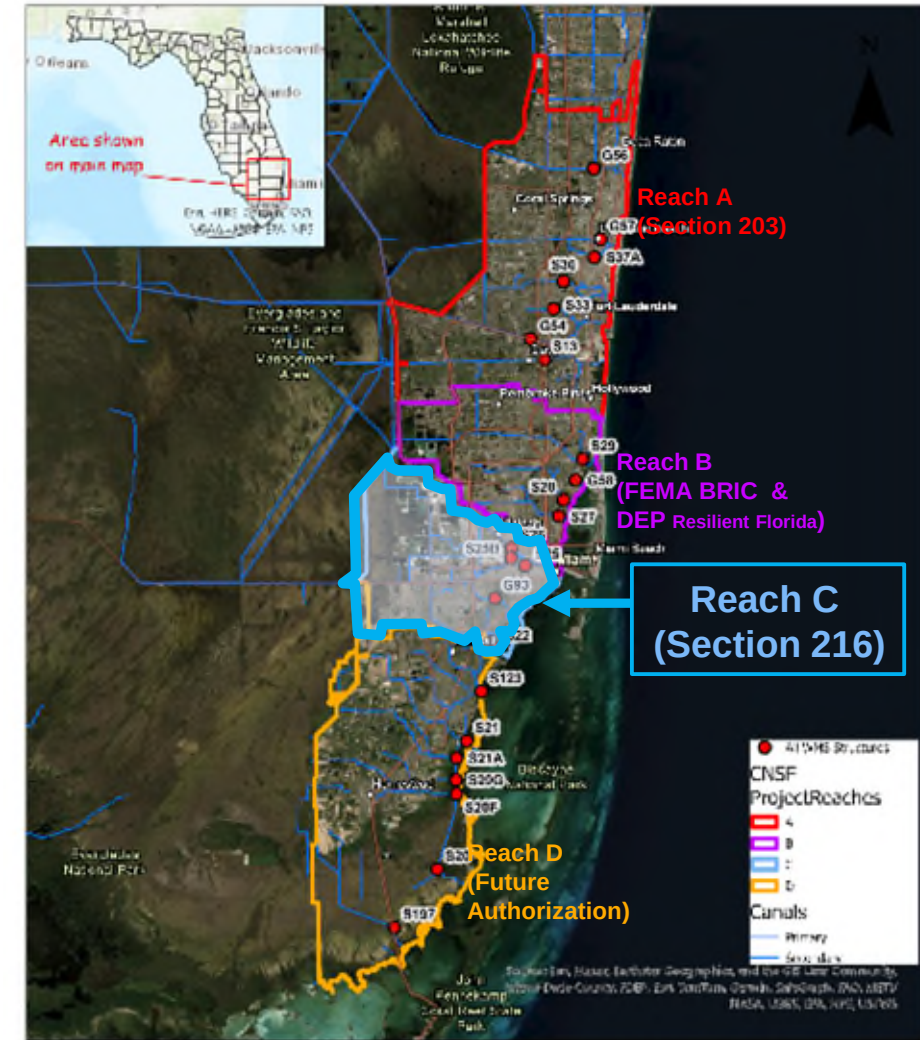


Purpose:

1. Discussion of the FWOP analysis to include modeling results, and initial draft alternatives for the C&SF Flood Resiliency (Section 216) Study, Reach C, Miami Basin.

Agenda:

- Opening Remarks and Project Status
- Present FWOP H&H results
- Present status of the FWOP Econ analysis
- Present the draft initial array of alternatives
- Coordinate future engagements- FWOP workshop





C&SF FLOOD RESILIENCY (SECTION 216) STUDY AUTHORITY AND SCOPE



Authority

Section 216 of the Flood Control Act of 1970 (33 U.S.C. 549a).

*"The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects... when found advisable **due to significantly changed physical or economic conditions**, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation..."*

Non-Federal Sponsor

Study Scope

- Primary Canal Enhancements Upstream – increases in pump capacity should be tied to increases in canal conveyance capacity.
- Operational improvements will be considered to address potential impacts of increased capacity.
- When considering canal conveyance capacity, secondary system integration and discharges will be evaluated to ensure conditions in the primary canal can provide relief to secondary system discharges.
- Suggested enhancements to control structures will include hardening, refurbishment, and/or replacing the existing structure.



C&SF FLOOD RESILIENCY (SECTION 216) STUDY PLANNING REACHES



Slide 5

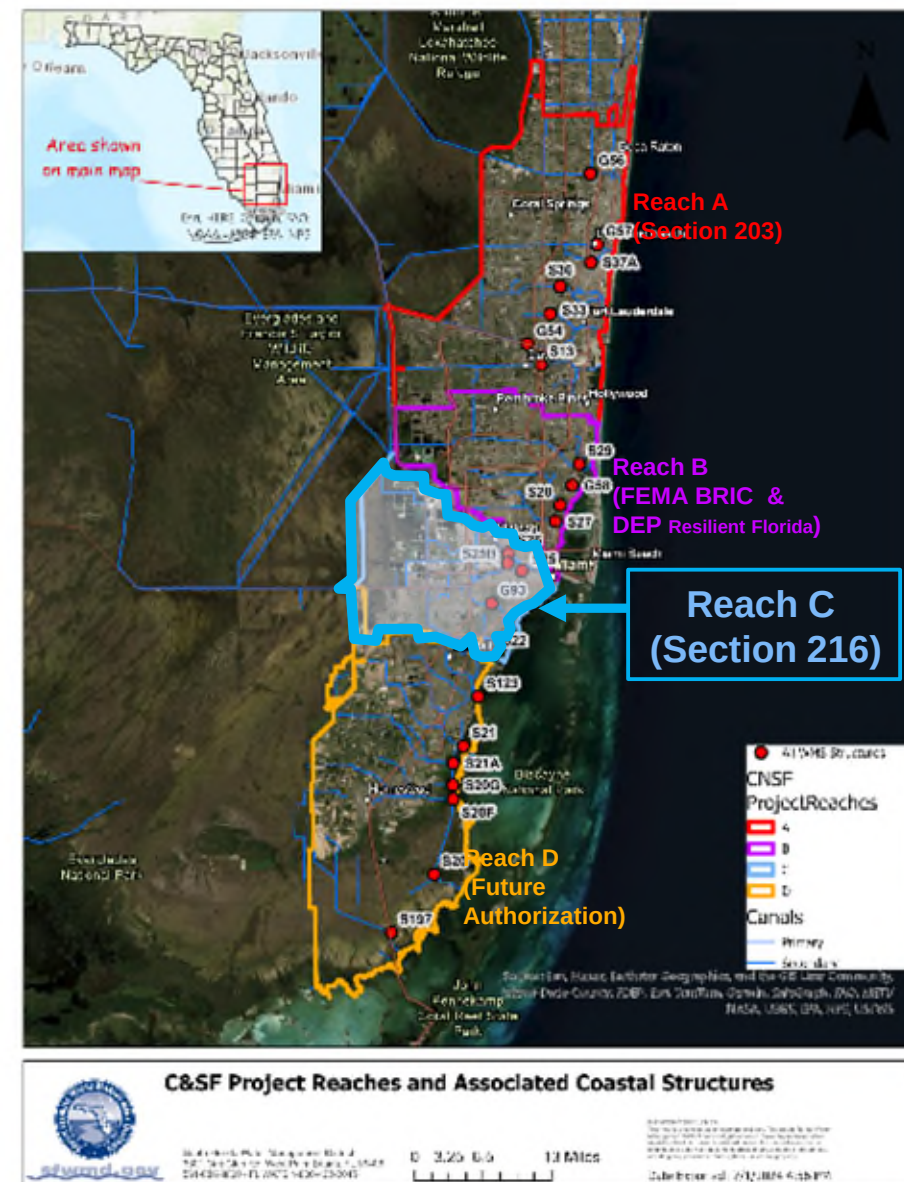


PURPOSE

- The Study will identify flood risk management (FRM) recommendations to build flood resiliency, now and into the future, and reduce flood risks within Miami-Dade County.

PATH FORWARD CURRENT IMPLEMENTATION

- Reach C: Current Section 216 Study**
- Reach A: Section 203 with associated USACE agreements for technical assistance
- Reach B: FEMA Building Resilient Infrastructure and Communities (BRIC) / Resilient Florida Grant Funding Available with associated Section 408 requests
- Reach D: integration into the upcoming C&SF Comprehensive Study or future planning study





C&SF FLOOD RESILIENCY (SECTION 216) STUDY

FOCUS: REACH C



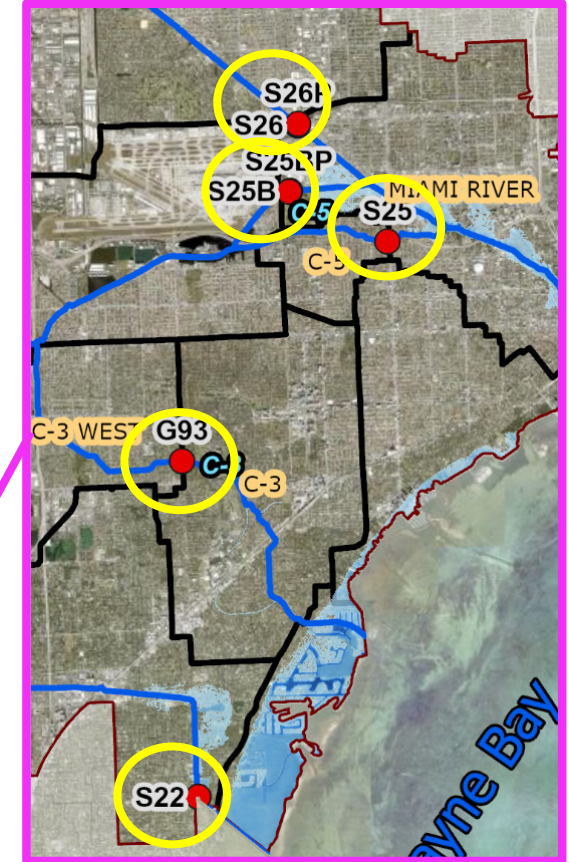
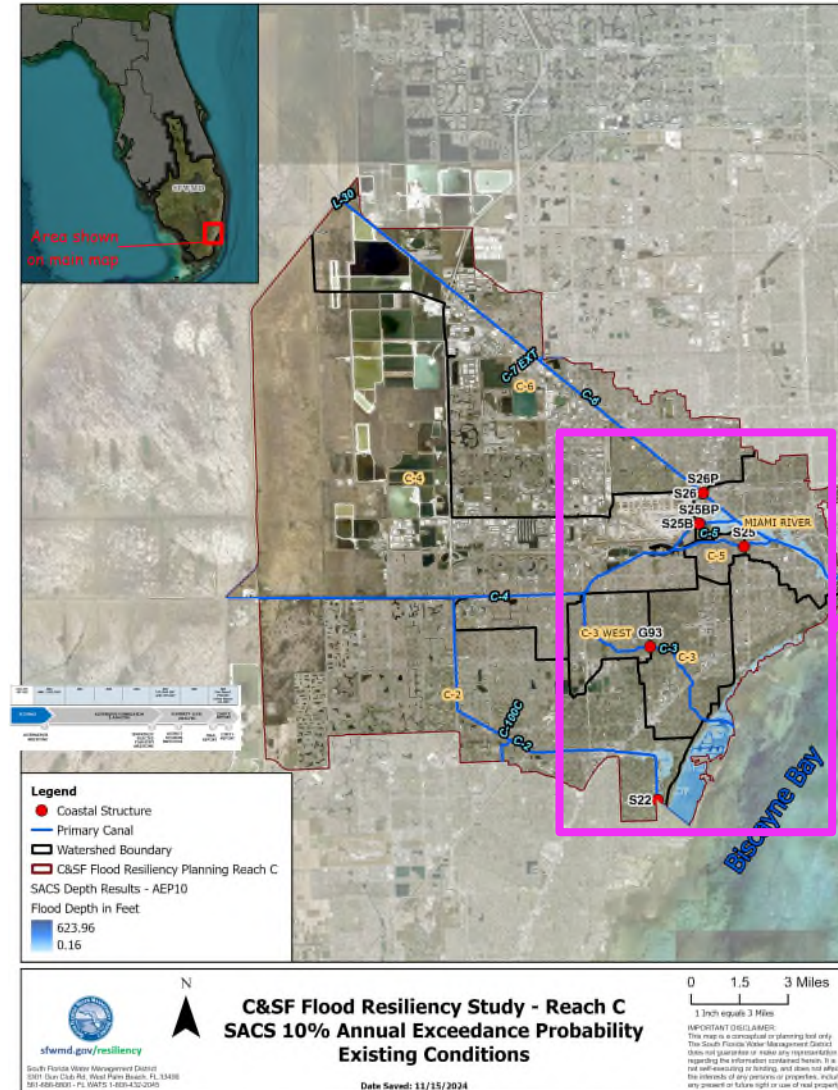
Slide 6



This Reach includes five managed watersheds in the Miami River study area which are the C-2, C-3W, C-5, C-6, and C-4 watersheds and includes watersheds downstream of the coastal structures.

The following canals and structures (locations) are included in Reach C:

- **C2 (S-22)**
- **C-3 (G-93)**
- **C-4 (S-25B)**
- **C-5 (S-25)**
- **C-6 (S-26)**



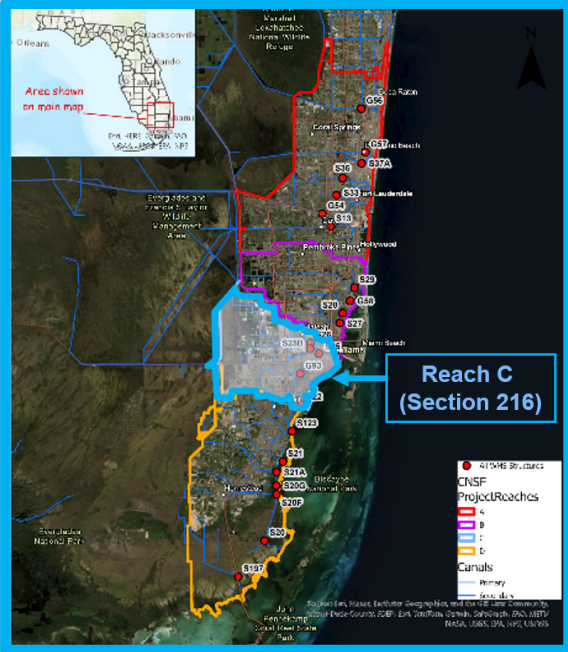
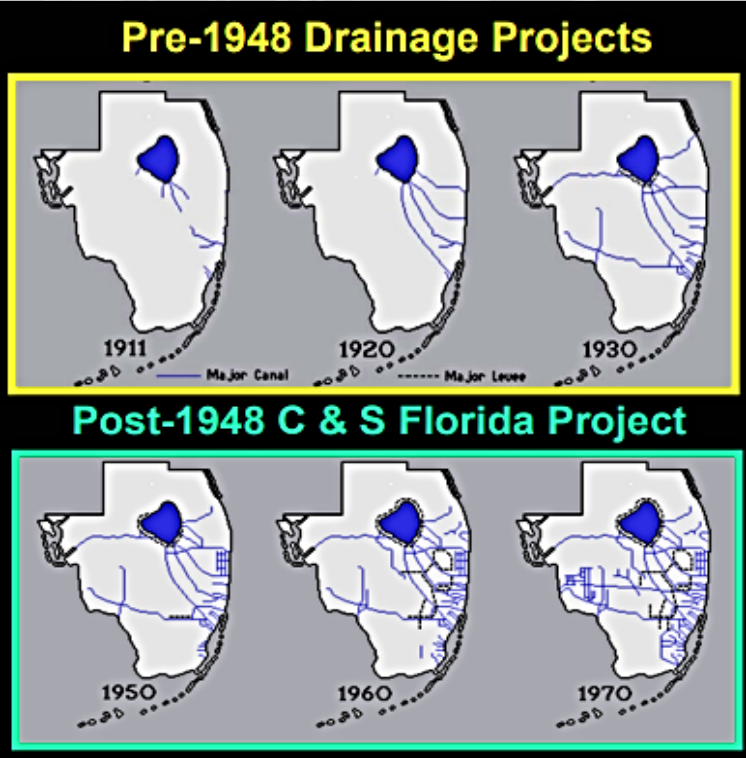
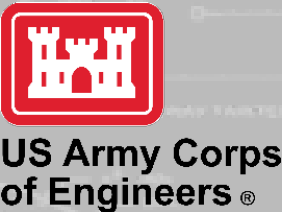
Reach C existing structures

CENTRAL AND SOUTHERN FLORIDA (C&SF) FLOOD RESILIENCY (SECTION 216) STUDY

DRAFT INITIAL ALTERNATIVES

February 5, 2026
Virtual Meeting

Working Today to Build a Better Tomorrow





USACE PLANNING PROCESS AND DRAFT INITIAL ALTERNATIVES

Presenter:

Gustavo Suarez-Narvaez, Lead Planner, USACE

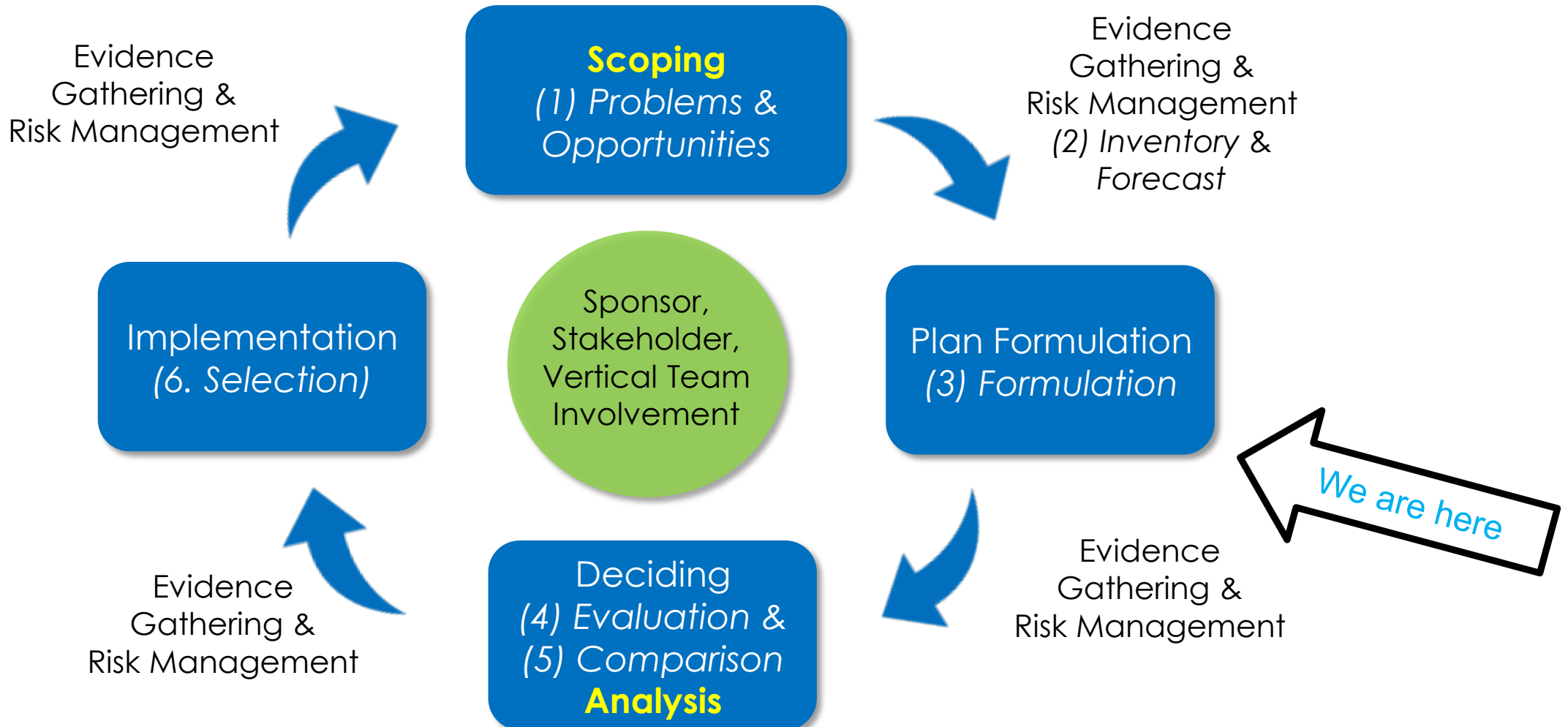


C&SF FLOOD RESILIENCY (SECTION 216) STUDY ADDRESSING CHANGING CONDITIONS

Slide 3



USACE -Risk-Informed Planning Process



(#) Shows the planning steps within the risk-informed planning process



C&SF FLOOD RESILIENCY (SECTION 216) STUDY

PROBLEMS, OPPORTUNITIES, OBJECTIVES & CONSTRAINTS



Problems:

- Changed conditions will continue to worsen over the 50-year period of analysis related to:
- Flood damages attributable to deteriorating C&SF system and changed conditions.
- Life-safety risk.
- Aging infrastructure (70-year-old gravity driven C&SF system).

Opportunities:

- Manage risk to historical and cultural resources
- Manage life safety caused by inland inundation
- Unify coordination and build trust with stakeholders and the public

Planning Objective:

Enhance aging C&SF system water control structure's functionality and capacity to reduce flood damages and improve resiliency caused by inland inundation, sea level rise and other changed conditions within Miami-Dade County Reach C over 50-year period of analysis from 2035-2085.

Constraints:

1. Minimize and/or mitigate impacts to water quality in the project area over the period of analysis.
2. Minimize and/or mitigate impacts to at risk communities in the project area over the period of analysis.
3. Minimize and/or mitigate induced flood risk to other areas within the study area over the period of analysis.
4. Minimize, avoid and/or mitigate impacts to objectives and authorized benefits of other Federal studies and projects within the study area.



C&SF FLOOD RESILIENCY (SECTION 216) STUDY PLAN FORMULATION



Slide 5



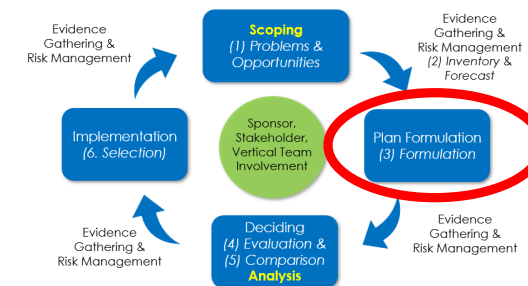
FLOOD RISK MANAGEMENT (FRM) AND MEASURES

Type of measures:

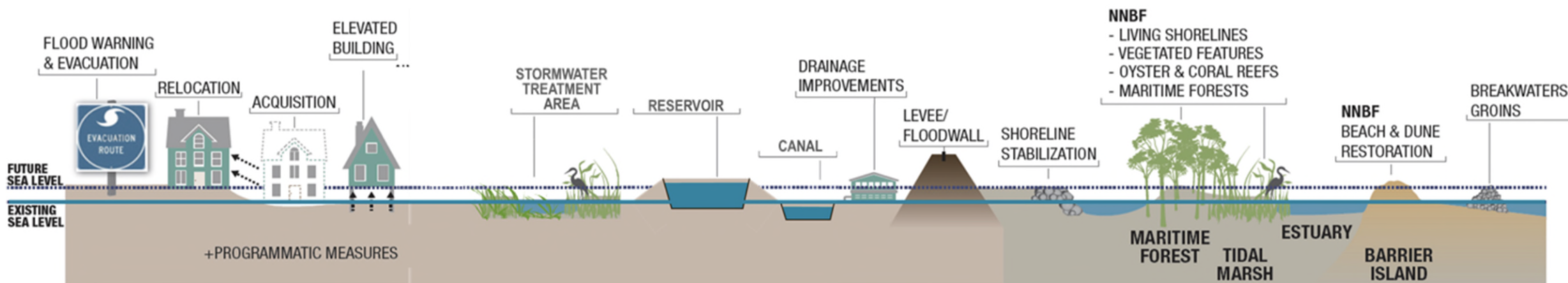
- **Structural**
- **Non-Structural***
- **Natural and Nature-Based Features (NNBF)**

* *Policy Changes*

USACE -Risk-Informed Planning Process



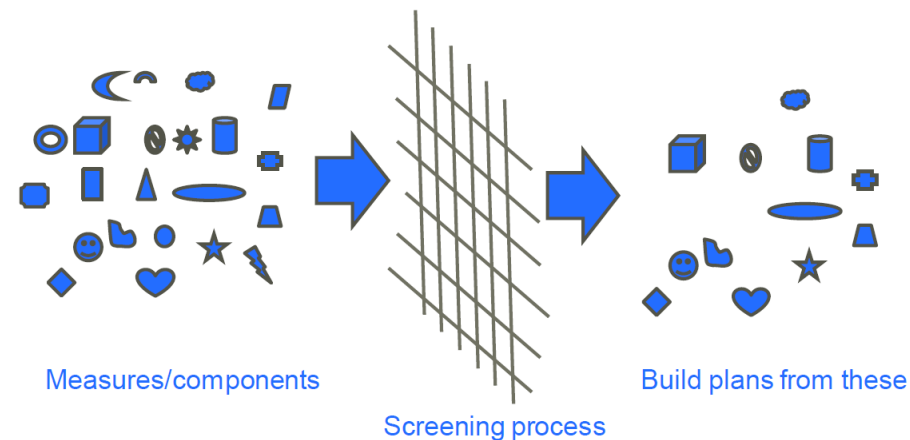
POTENTIAL MEASURES TO IMPROVE RESILIENCE AND SUSTAINABILITY



Graphic modified from https://ewn.el.erdc.dren.mil/nnbf/other/5_ERDC-NNBF_Brochure.pdf

Measures

- **Structure Change**
 - Widening the gates
 - Hardening of the structure
- **Pumps**
 - Forward pumps
- **Canal Improvements**
 - Improve canal conveyance
 - Dredging and widening
- **Non-Structural**
 - Structure operational changes
 - Flood warning systems
- **Nature and Nature-Base Features (NNBF)**
 - Green space storage





C&SF FLOOD RESILIENCY (SECTION 216) STUDY

PLAN FORMULATION



Initial Draft Array

- No Action
- Structural - Structure Hardening and Canal Improvements (retrofitting or increasing structure capacity)
- Structural - Active management (forward pumps)
- Nature and Nature-Base Features (NNBF)
- Non-Physical (Non-Structural)
- Structural Hardening and Forward Pumps
- Structural - Structure Hardening and Canal Improvements (retrofitting or increasing structure capacity) Add forward pumps + canal improvements



C&SF FLOOD RESILIENCY (SECTION 216) STUDY EVALUATION AND COMPARISON OF ALTERNATIVES



Evaluation of Initial Alternative Plans

- Principles and Guidelines (P&G) criteria
 - Effectiveness
 - Acceptability
 - Completeness
 - Efficiency
- Meet Objectives and Avoid Constraints

Evaluation of Alternative Plans

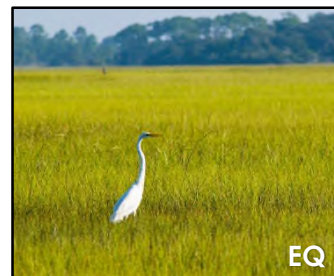
- *Principles and Guidelines (P&G) criteria (Complete, Efficient, Effective, Acceptable)*
- *Meet Objectives and Avoid Constraints*
- *P&G Accounts (NED, EQ, OSE, RED)*
 - *At Risk Communities*
 - *Life Safety analysis*
 - *National Environmental Policy Act (NEPA)*

NATIONAL ECONOMIC
DEVELOPMENT



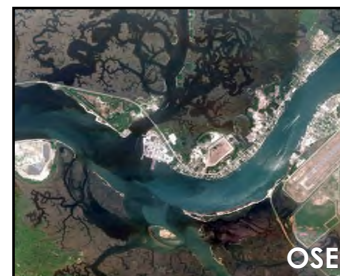
Changes in the economic value of the national output of goods and services.

ENVIRONMENTAL
QUALITY



Non-monetary effects on ecological, cultural, and aesthetic resources including positive and adverse effects of ecosystem restoration plans.

OTHER SOCIAL
EFFECTS



Plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, and others.

REGIONAL ECONOMIC
DEVELOPMENT



Changes in the distribution of regional economic activity, such as job creation.



C&SF FLOOD RESILIENCY (SECTION 216) STUDY

DRAFT INITIAL ARRAY



		A-1	A-2	A-4	A-5	A-6	A-7	A-8
		No Action	Structure Hardening and Canal Improvements	Structural - Active management (forward pumps)	NNBF	Non-Physical	High Ranking (Structural Hardening and Forward Pumps)	Structural - Structure Hardening, Canal Improvements, and forward pumps
Screening								
Planning Objective								
Meet the Planning Objective		No	Yes	Yes	Yes	Yes	Yes	Yes
Constraints								
Constraint 1		High	Medium	Medium	Low	Low	Low	Medium
Constraint 2		High	Medium	Medium	Low	Low	Low	Low
Constraint 3		High	Low	Medium	Medium	Medium	Low	Low
Constraint 4		High	Low	Medium	Low	Low	Low	Low
Principles and Guidelines (P&G) criteria								
Effectiveness		High	Medium	Medium	Medium	Medium	Low	Low
Acceptability		High	Low	Medium	Low	Low	Low	Low
Completeness		Low	Medium	Medium	High	High	Low	Low
Efficiency		Low	Low	Medium	Medium	Low	Low	Medium

Low

Medium

High





C&SF FLOOD RESILIENCY (SECTION 216) STUDY



Slide 10



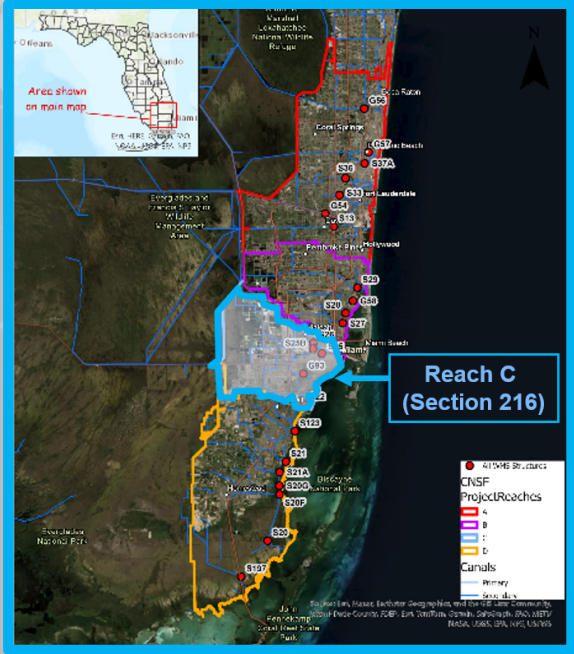
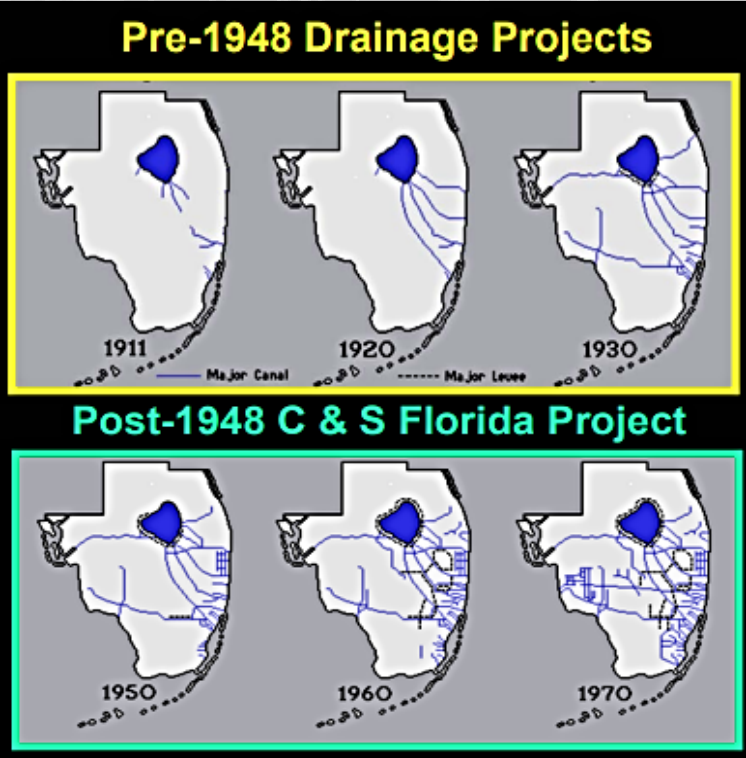
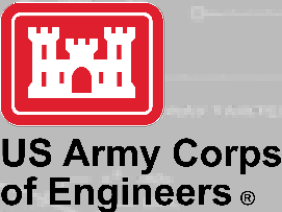
Thank you

CENTRAL AND SOUTHERN FLORIDA (C&SF) FLOOD RESILIENCY (SECTION 216) STUDY

FUTURE WITHOUT PROJECT (FWOP)

February 5, 2026
Virtual Meeting

Working Today to Build a Better Tomorrow





MODEL ASSUMPTIONS, BRIEF OVERVIEW OF METHODOLOGY

Presenter:

Jennifer Gervais, Water Resources, USACE

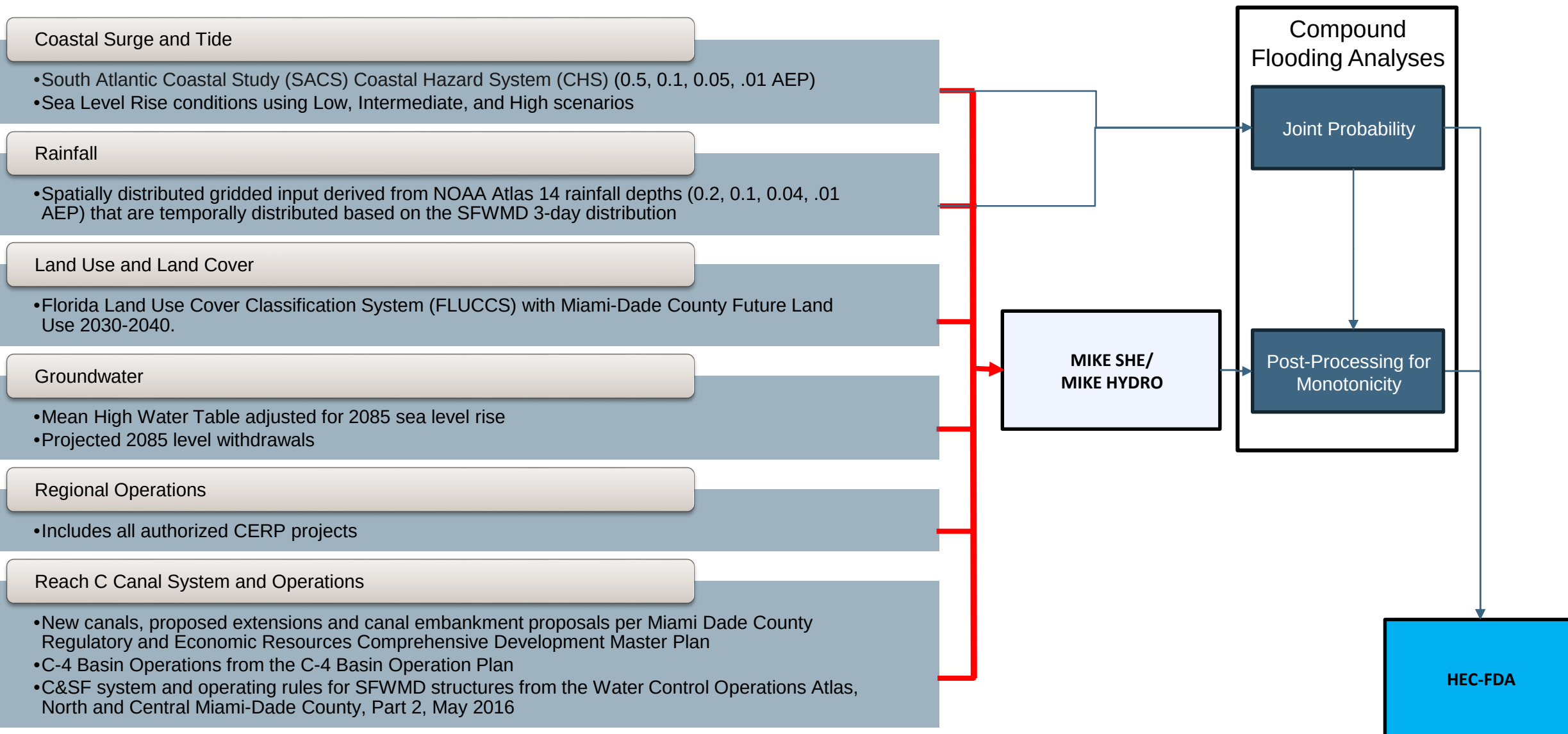


C&SF FLOOD RESILIENCY (SECTION 216) STUDY

MODELING ASSUMPTIONS AND APPROACH



Slide 3





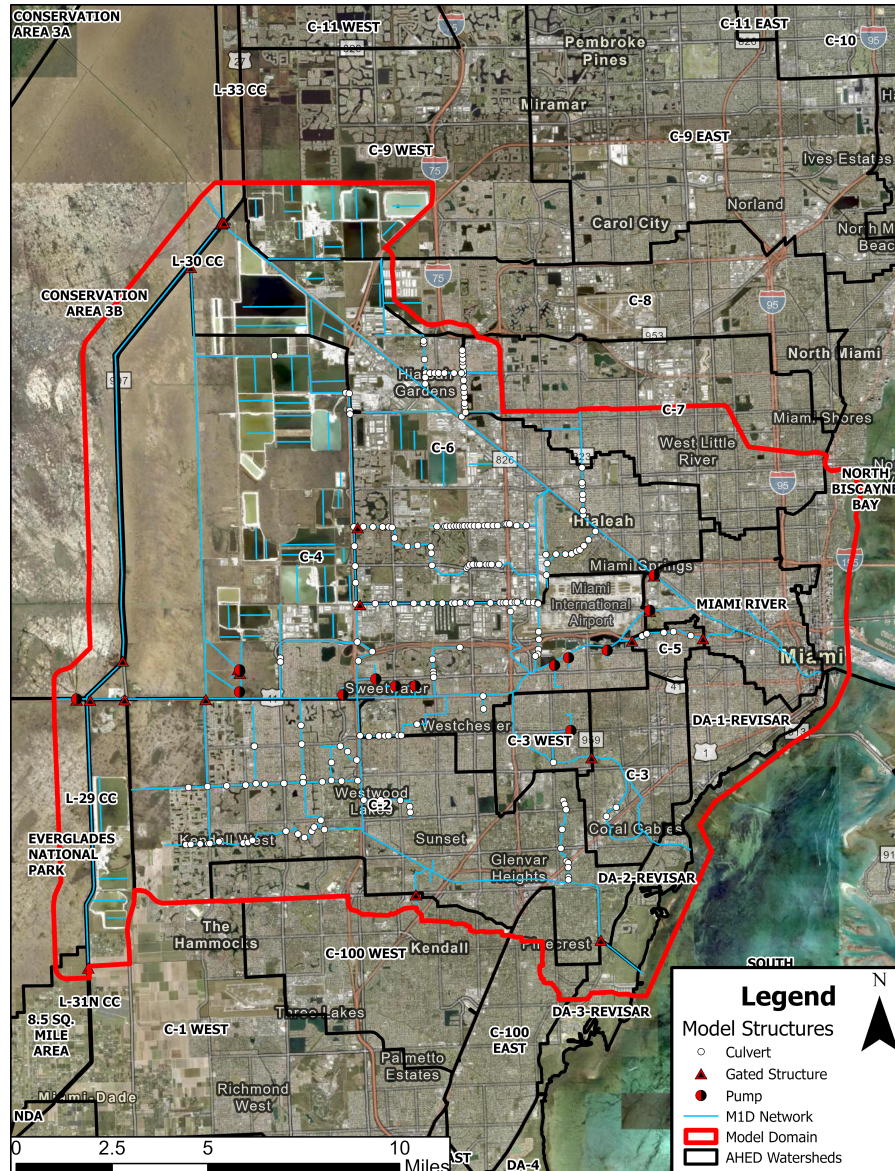
MODELING RESULTS FOR MIAMI RIVER BASINS (REACH C) FUTURE WITHOUT PROJECT (FWOP)

Presenter:

Jennifer Gervais, Water Resources, USACE



C&SF FLOOD RESILIENCY (SECTION 216) STUDY FWOP RESULTS OVERVIEW



- H&H model output is being assessed to support metric analysis including economic analysis and consequences due to future storm events
 - ✓ Flood inundation
 - ✓ Canal peak stage profile
 - ✓ Structure performance

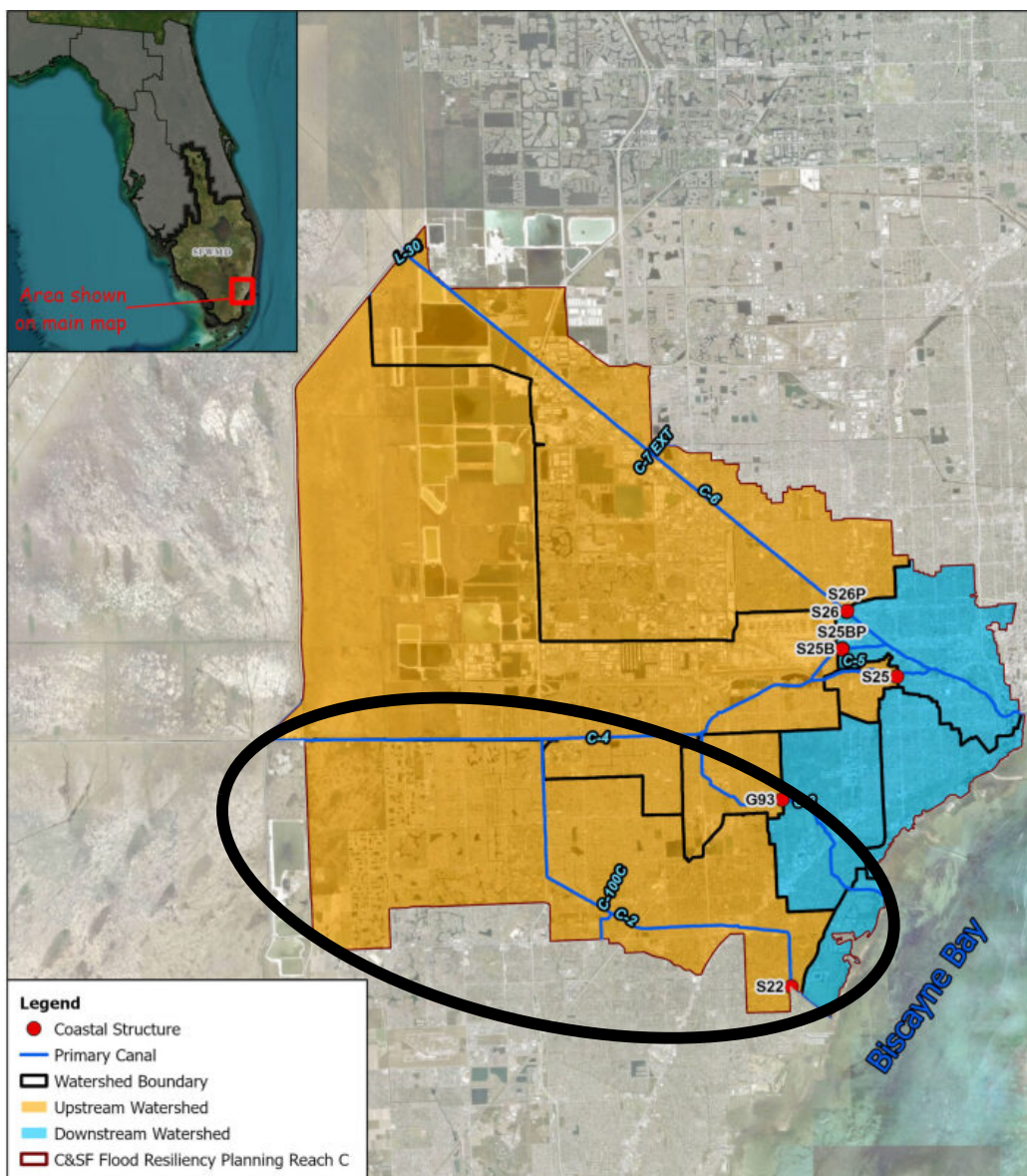
Event Return Periods		
Coastal Water Level	Rainfall Depth	Joint
2-year	5-year	8-year
	10-year	14-year
	25-year	30-year
	100-year	110-year
	500-year	538-year
10-year	10-year	42-year
20-year	25-year	100-year
100-year	100-year	690-year

Simulated with Low, Intermediate and High Sea level rise conditions.



C&SF FLOOD RESILIENCY (SECTION 216) STUDY

FWOP RESULTS OVERVIEW



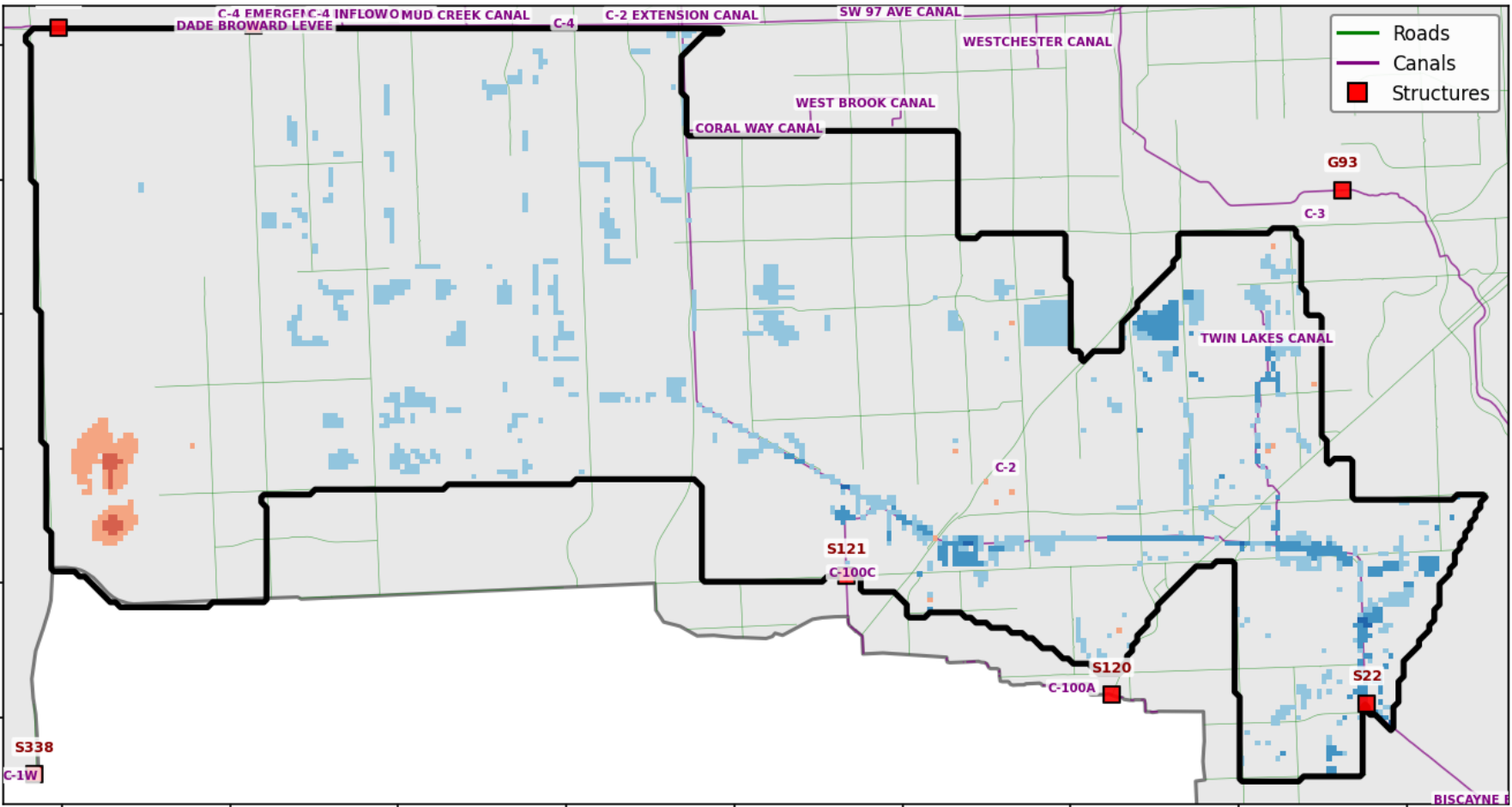
- Example detailed results
 - C-2 (S-22)
- Results summary
 - C-2 (S-22)
 - C-3 (G-93)
 - C-4 (S-23B)
 - C-5 (S-25)
 - C-6 (S-26)



C&SF FLOOD RESILIENCY (SECTION 216) STUDY DEPTH DIFFERENCE RASTER 25-YEAR RAINFALL, 20-YEAR COASTAL



Maximum Depth Difference FWOP INT – ECB C-2 Basin



Existing Conditions Baseline (ECB) to FWOP Intermediate Sea Level (INT SLR) = 1.3 ft



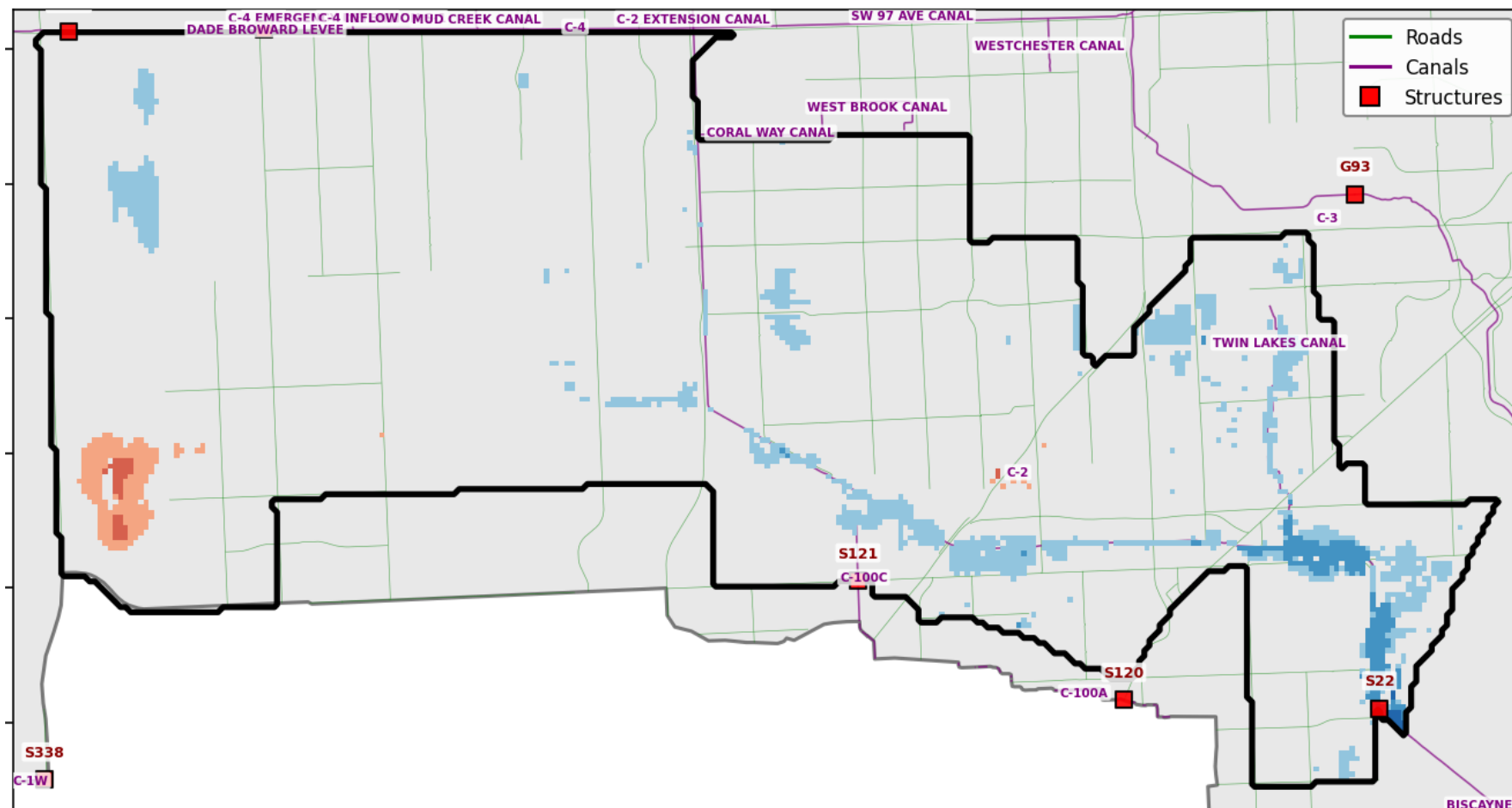
C&SF FLOOD RESILIENCY (SECTION 216) STUDY DEPTH DIFFERENCE RASTER 100-YEAR RAINFALL, 100-YEAR COASTAL



Slide 8



Maximum Depth Difference FWOP INT – ECB C-2 Basin



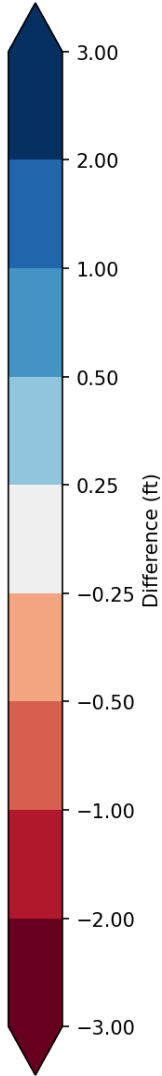
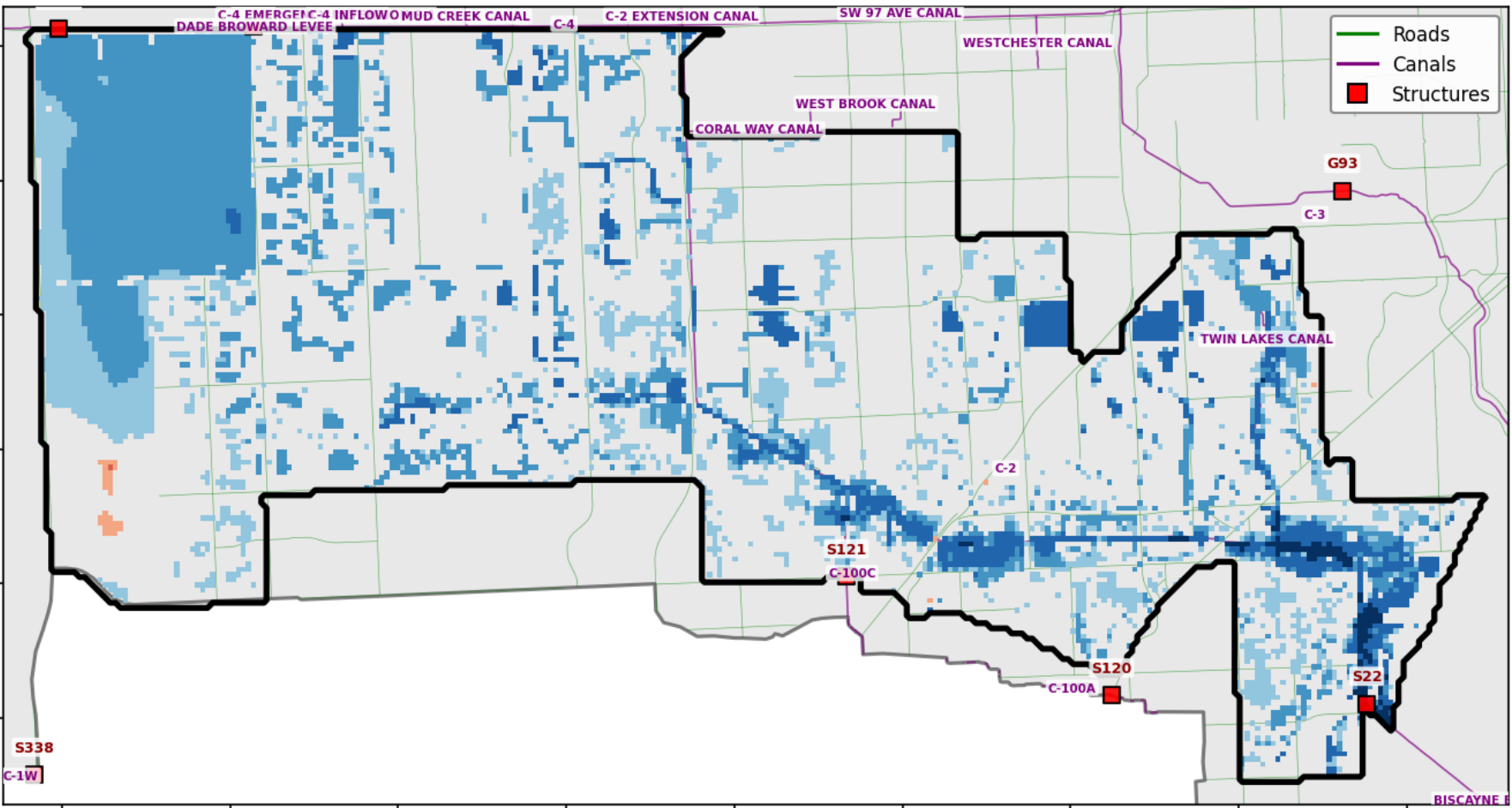
Existing Conditions Baseline (ECB) to FWOP Intermediate Sea Level (INT SLR) = 1.3 ft



C&SF FLOOD RESILIENCY (SECTION 216) STUDY DEPTH DIFFERENCE RASTER 25-YEAR RAINFALL, 20-YEAR COASTAL



Maximum Depth Difference FWOP HIGH – ECB C-2 Basin



Existing Conditions Baseline (ECB) to FWOP High Sea Level (HIGH SLR) = 3.7 ft

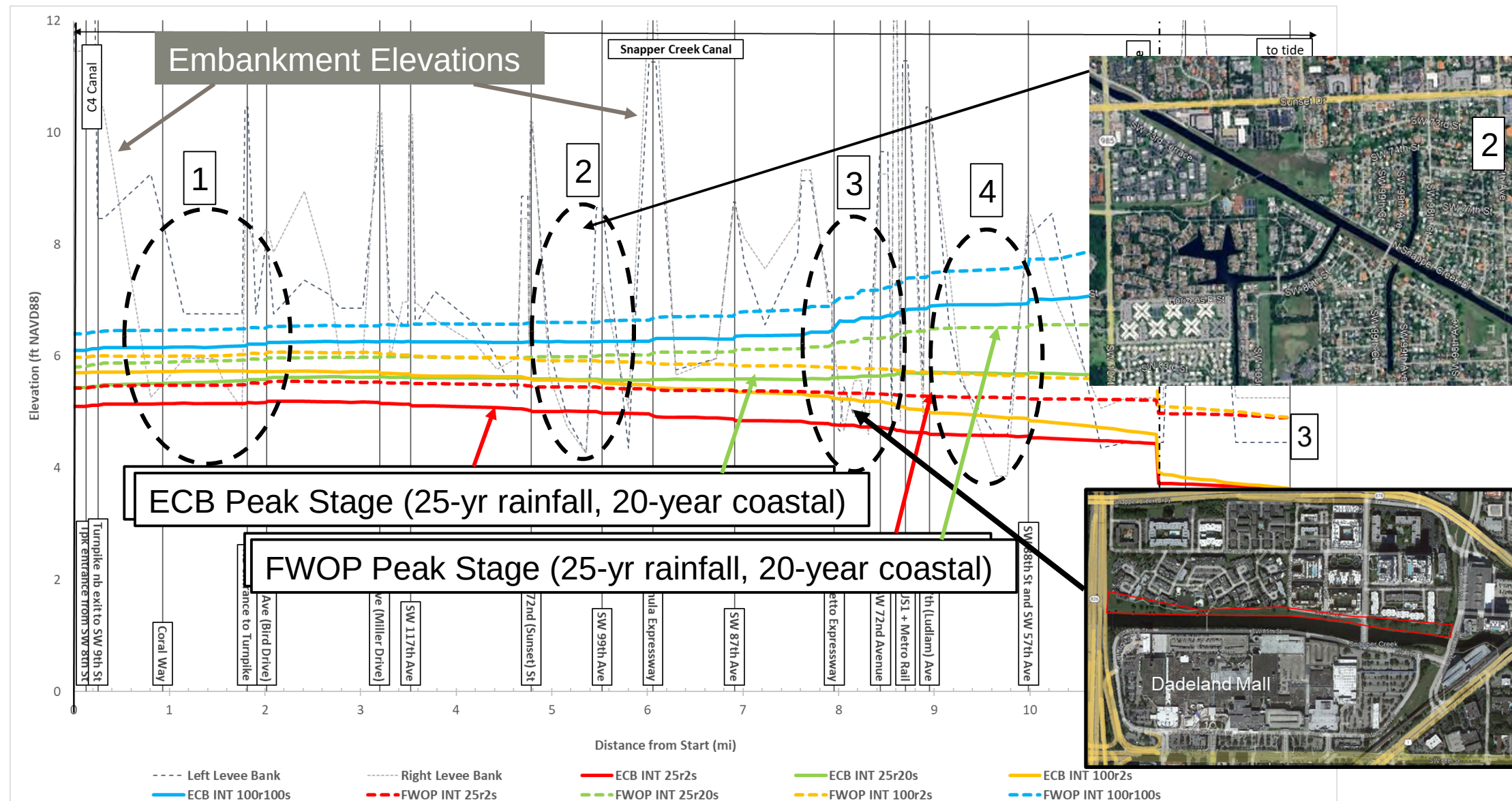


C&SF FLOOD RESILIENCY (SECTION 216) STUDY

MAXIMUM STAGE PROFILE PLOT – SNAPPER CREEK CANAL (C2)



Slide 10



"25r20s" represents the event with 20-yr coastal surge + 25-yr rainfall

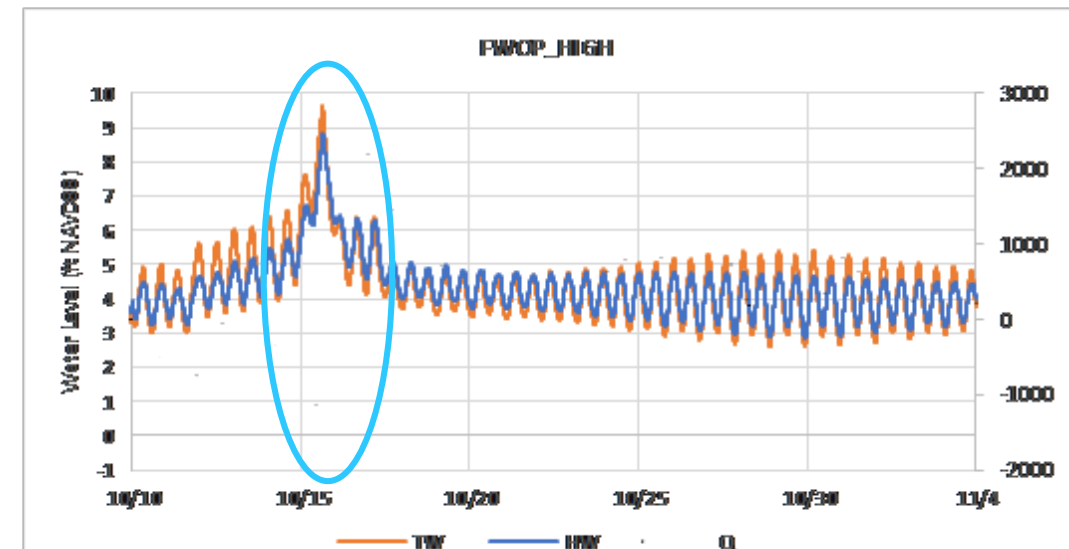
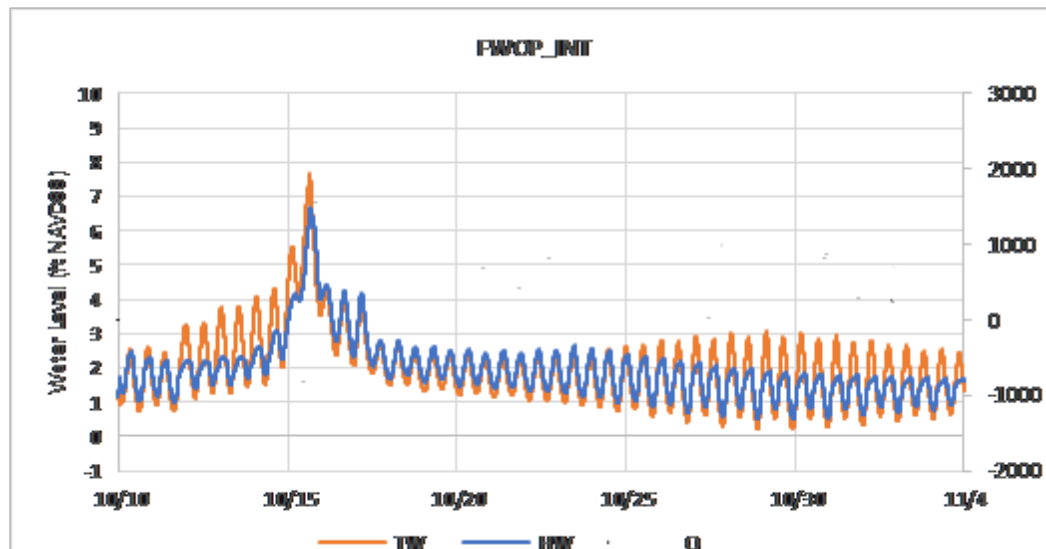
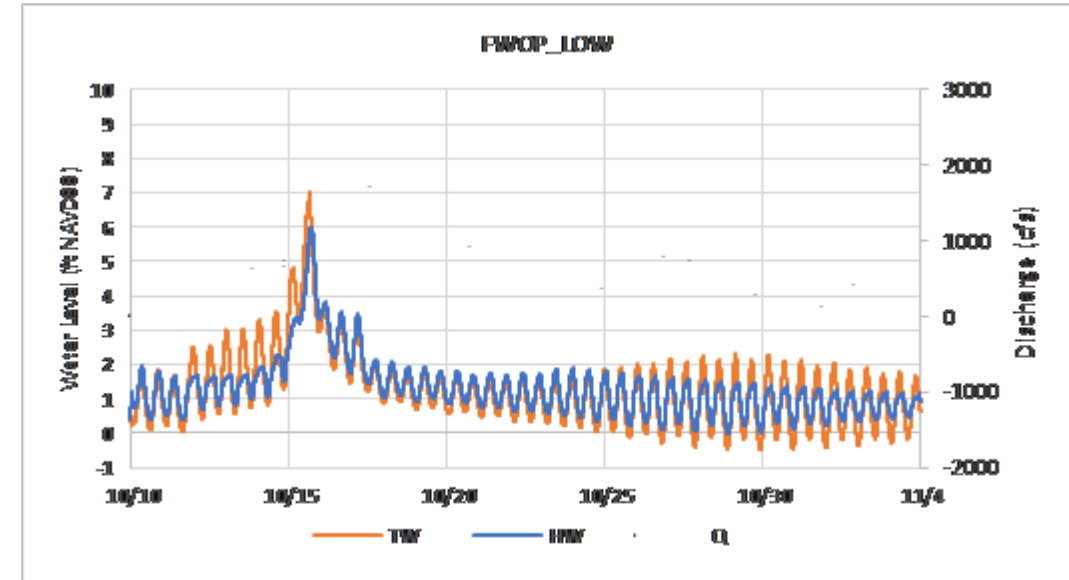
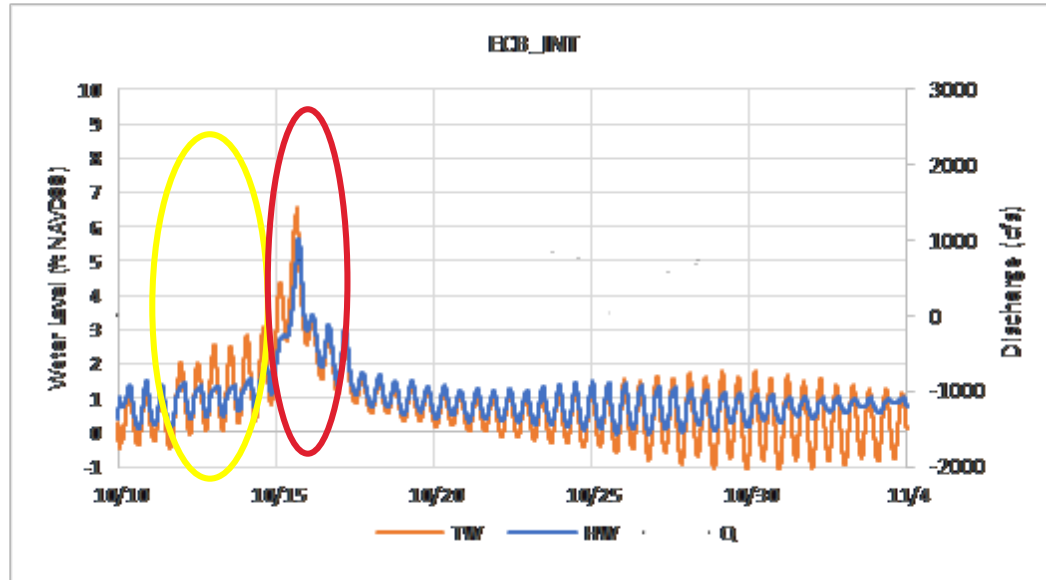


C&SF FLOOD RESILIENCY (SECTION 216) STUDY

STRUCTURE PERFORMANCE, S-22



Slide 11

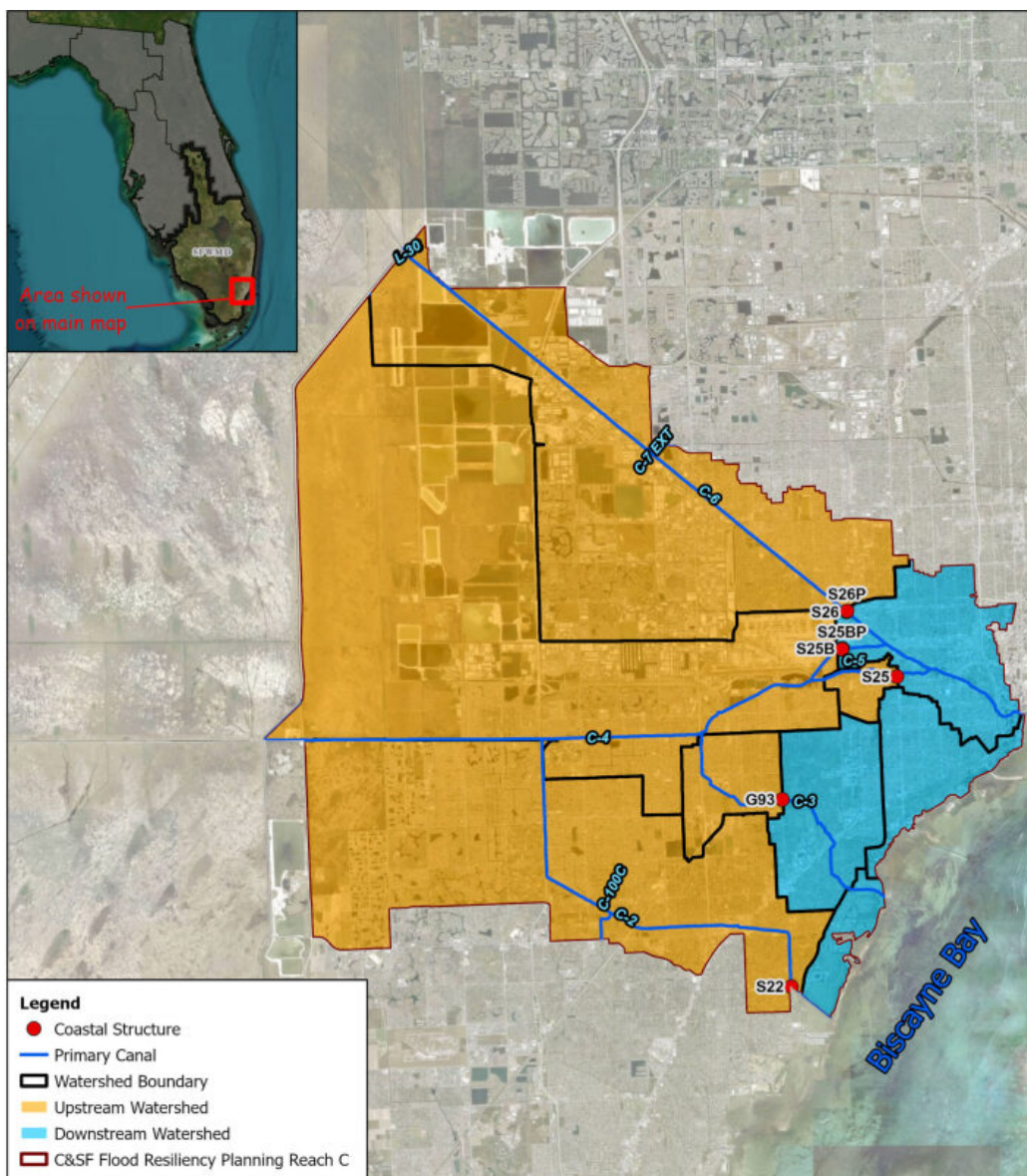


Model results for the 20-yr Coastal surge + 25-yr Rainfall event



C&SF FLOOD RESILIENCY (SECTION 216) STUDY

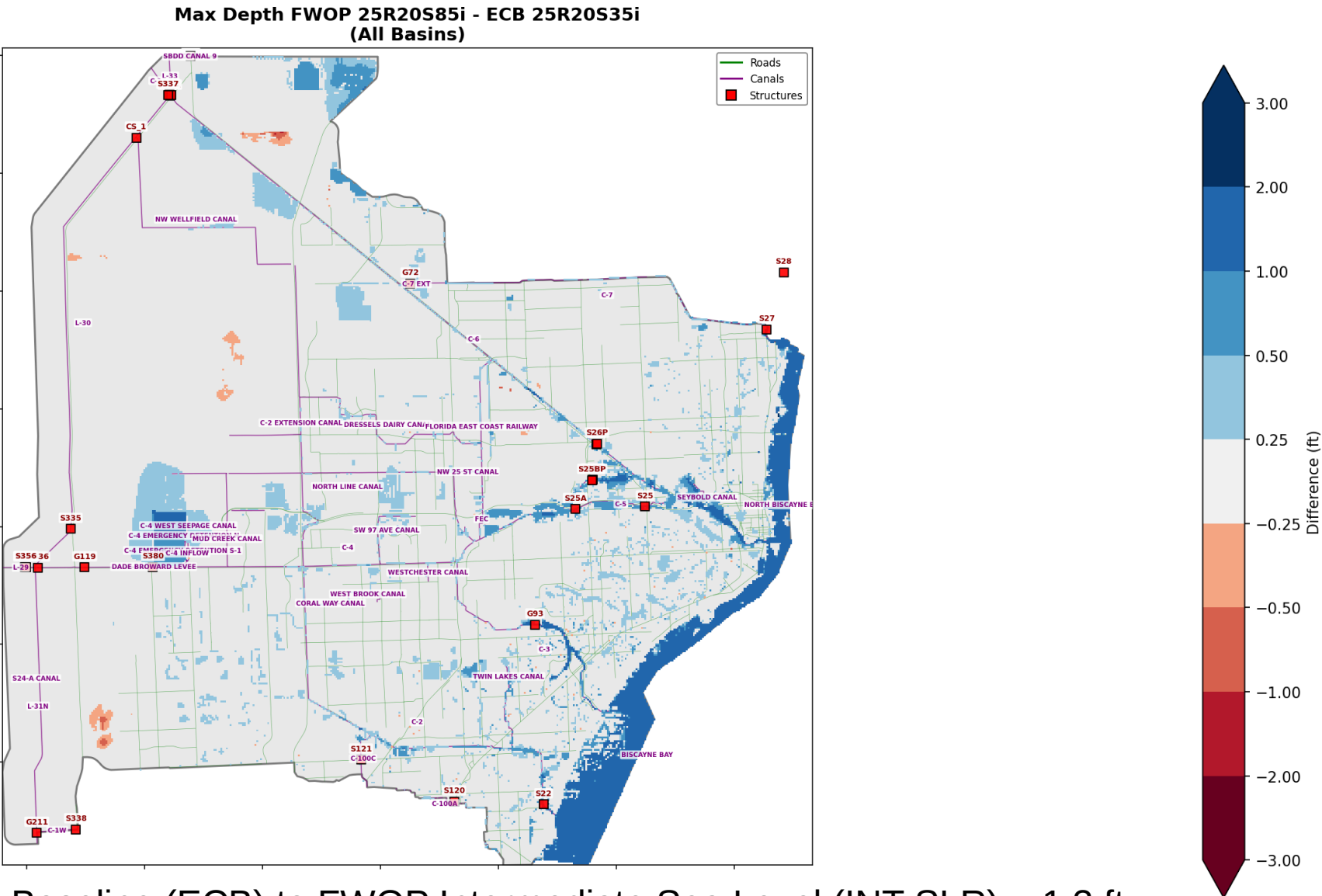
FWOP RESULTS OVERVIEW



- Example detailed results
 - C-2 (S-22)
- Results summary
 - C-2 (S-22)
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 - C-4 (S-23B)
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 - C-6 (S-26)



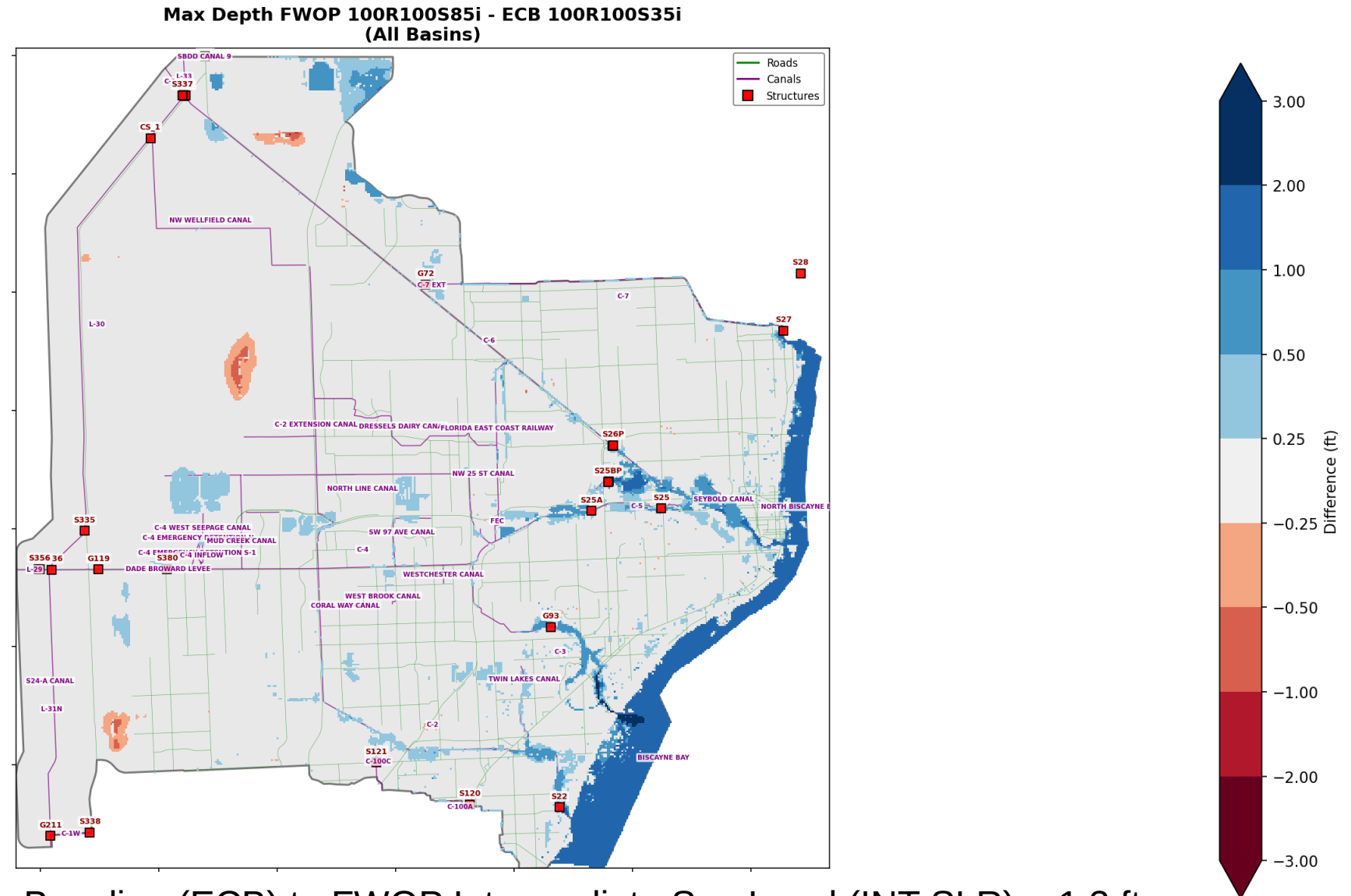
C&SF FLOOD RESILIENCY (SECTION 216) STUDY DEPTH DIFFERENCE RASTER 25-YEAR RAINFALL, 20-YEAR COASTAL



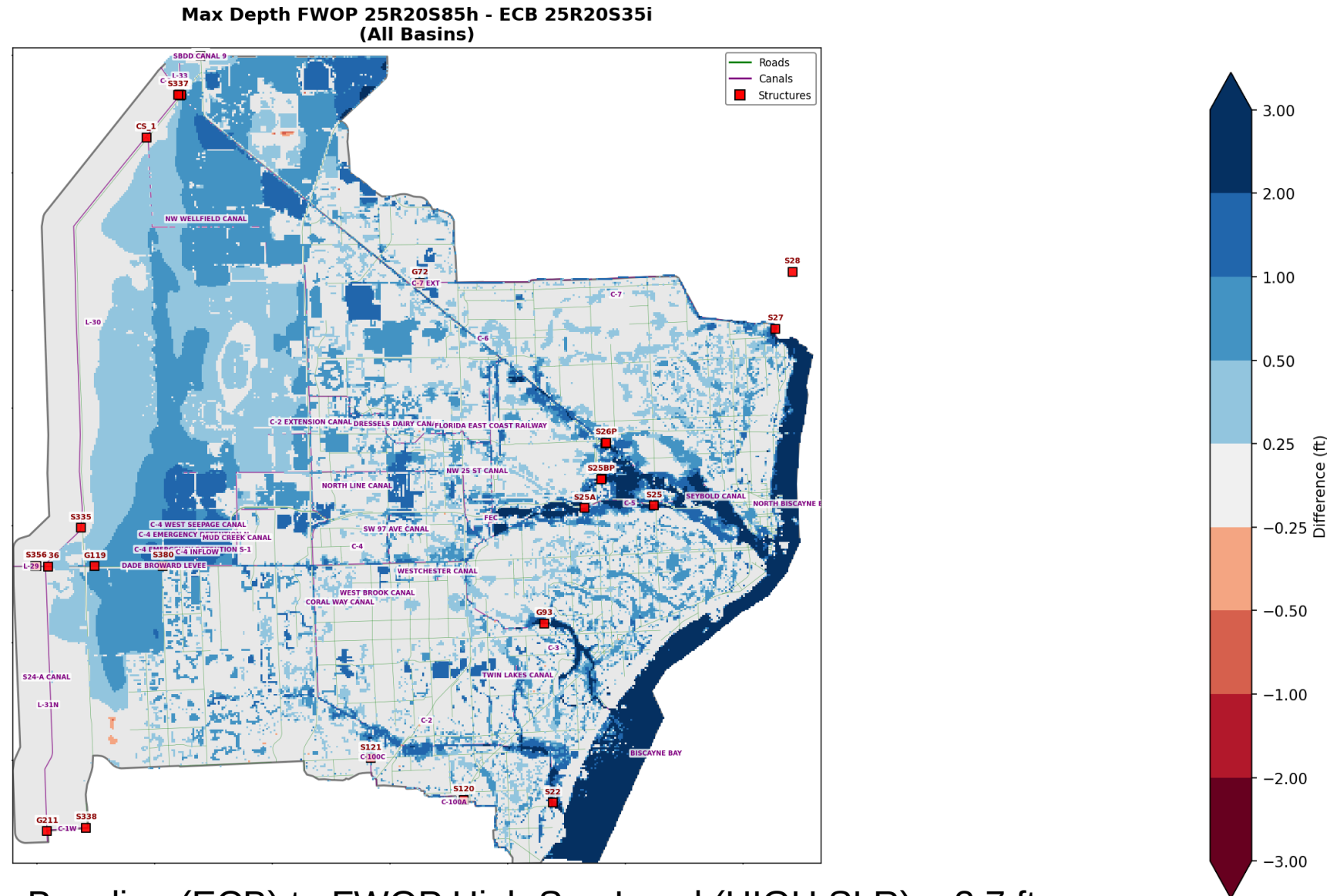
Existing Conditions Baseline (ECB) to FWOP Intermediate Sea Level (INT SLR) = 1.3 ft



C&SF FLOOD RESILIENCY (SECTION 216) STUDY DEPTH DIFFERENCE RASTER 100-YEAR RAINFALL, 100-YEAR COASTAL



Existing Conditions Baseline (ECB) to FWOP Intermediate Sea Level (INT SLR) = 1.3 ft



Existing Conditions Baseline (ECB) to FWOP High Sea Level (HIGH SLR) = 3.7 ft



C&SF FLOOD RESILIENCY (SECTION 216) STUDY

FWOP RESULTS SUMMARY, 20-YR COASTAL, 25-YR RAINFALL



Slide 16



Canal	Stage Profile	Structure	Performance Trends with Increasing SLC					
			Forward Discharge Capability	Peak HW/TW	Peak Discharge	Peak Discharge Delay	Peak Backflow	Pump Operation
C2	Peak stage > embankment (4.5 of 13 miles) - Residential - Natural - Commercial - Residential	 S-22				FWOP High		
C3	Peak stage > embankment (2.5 of 8 miles) Residential/golf course	 G-93				FWOP Int and FWOP High		
C4	Peak stage > embankment (2.5 of 16 miles) High density residential and commercial The C4 Emergency Detention contributes to a reduction in the peak canal stages	 S-25B				FWOP Int and FWOP High		 No pumping in FWOP High
C5	Peak stage > embankment (3.2 of 3.5 miles) Residential	 S-25				FWOP Int and FWOP High		
C6	Peak stage > embankment (3 of 20 miles) - Industrial - Park/natural areas	 S-26				FWOP High		 No pumping in FWOP High



C&SF FLOOD RESILIENCY (SECTION 216) STUDY FWOP AGENCY TECHNICAL REVIEW SUMMARY



Targeted H&H ATR held 15 SEP 25 to 5 DEC 25.

Review Role	Products	No. Comments Submitted	No. Comments Open	Notes
Hydrology and Hydraulics	• Mike SHE/HYDRO Model and Results files • Monotonicity Post Processing Scripts • Modeling Assumptions • Joint Probability Estimates for the C&SF Flood Resiliency (Section 216) Study • Central and Southern Florida (C&SF) Flood Resiliency (Section 216) study, Flood Risk Management, Hydrologic and Hydraulic (H&H) Model Status and Overview of Compound Flooding Methodology - MFR	9	0	Many comments made that will be addressed within future Model Documentation Report.
Joint Probability	• Joint Probability Estimates for the C&SF Flood Resiliency (Section 216) Study • Central and Southern Florida (C&SF) Flood Resiliency (Section 216) study, Flood Risk Management, Hydrologic and Hydraulic (H&H) Model Status and Overview of Compound Flooding Methodology - MFR	7	0	Comments have been addressed via updates to documentation products.
Coastal Engineering	• Sea Level Change Sensitivity • Hydrograph Metadata • Preliminary CHS Savepoint Selection	10	0	Climate analysis documentation update in progress to align with current guidance.
Infrastructure and Installation Resilience	• Climate Preparedness and Resilience Strategy • Sea Level Change Sensitivity	5	0	Climate analysis documentation update in progress to align with current guidance.



C&SF FLOOD RESILIENCY (SECTION 216) STUDY



*Supporting Slides
If needed*



H&H ANALYSIS AND RESULTS

ADDITIONAL DETAILS

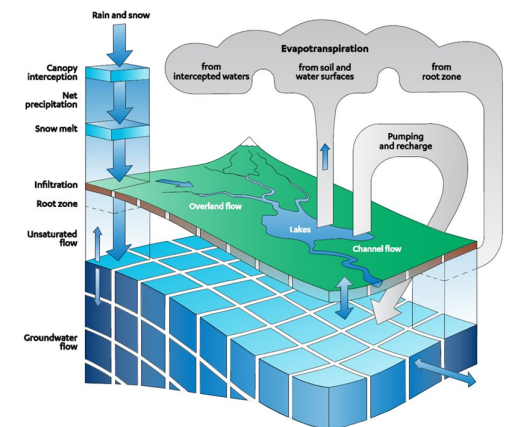
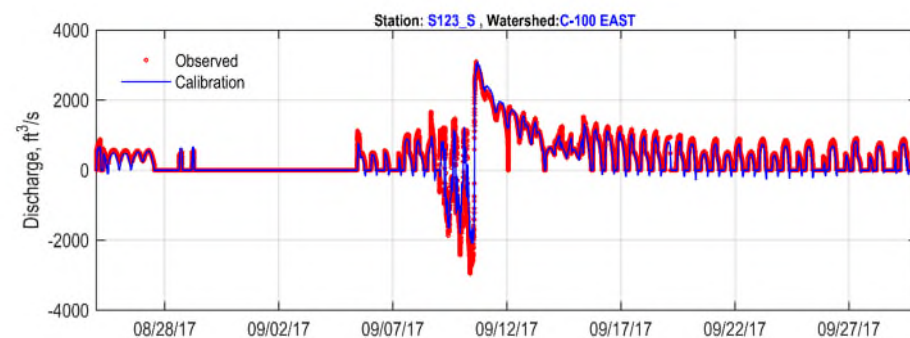
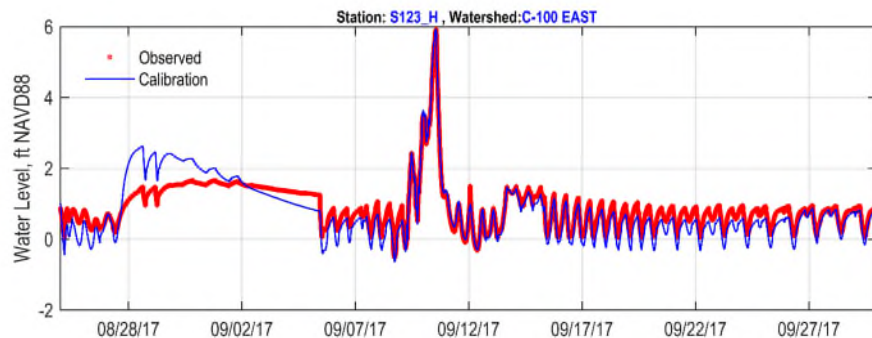


HYDROLOGIC & HYDRAULIC MODELING TOOL



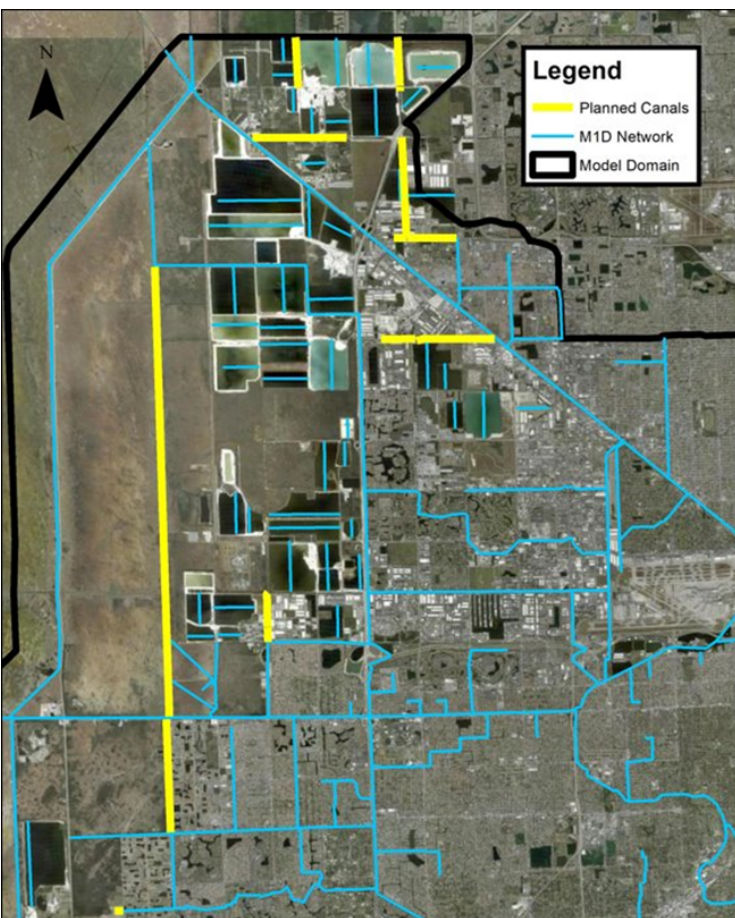
The integrated/coupled surface-groundwater model MIKE SHE/MIKE Hydro (2022) is used to simulate the hydraulics and hydrology for the project area. Models were developed and calibrated under the SFWMD FPLOS program and Broward Resiliency and further refined for the Section 216 study

- Capability of conducting regional scale simulations
- Simulate surface water and groundwater interactions
 - Allows for the accounting of rising water tables and reduced soil storage
 - Reduced soil storage
 - Increase runoff during storms
- Simulate structure gate operating rules at canal structures
 - Structure operating rules during event simulations can be programmed including rules for operating coastal structures to close when tailwater is greater than headwater (salinity operations)
- Able to conduct event simulations while including the effects of different tidal boundary conditions such as storm surge-influenced tailwater conditions with future sea-level rise scenarios





H&H MODEL REFINEMENT



- Models are being expanded to include the downstream tidal reaches to the intracoastal/bay
- The focus of this study is on the primary system with a high level of detail placed on the secondary/tertiary canal systems; new canals and proposed extensions from Miami Dade County to be included, and Broward County Resiliency model additional canal network included
- Future land use will be updated with changes to parameterization in the model including topography where appropriate to the scale of the model



LAND USE AND LAND COVER

Miami-Dade

- Reach C land-use based on the Florida Land Use Cover Classification System (FLUCCS) categorization codes is available for the model domain through the Florida Department of Environmental Protection (FDEP) for a range of years between 2017 and 2019. Reach B and D Land Use and Land Cover Classification use 2014-2016 Land Use dataset as prepared by the SFWMD.
- The future land use was informed by Miami-Dade County Future Land Use 2030.



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, as they are both a major source of discharge into the primary system and storage prior to discharging into the primary system.
- 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)
- SFWMD structure flow parameters from SFWMD flow rating analysis reports and the SFWMD Atlas of Flow Computations (2015)

Miami-Dade

- C&SF system and operating rules for SFWMD structures from the Water Control Operations Atlas, North and Central Miami-Dade County, Part 2, May 2016.
- Miami Dade County Flood Mitigation Program, C-4 Basin Operating Plan (SFWMD, 2010) will be utilized to develop a simulated representation utilizing the “Logical Operands” parameterization scheme within the MIKE framework for operation of the C-4 Emergency Detention Basin



METEOROLOGIC DATA

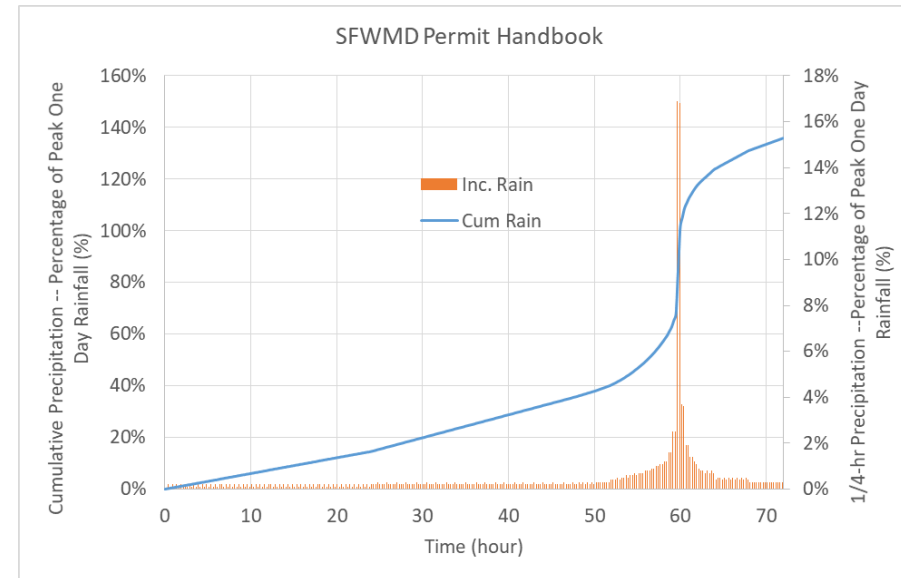


The design storm will use spatially distributed gridded input derived from NOAA Atlas 14 rainfall depths that are temporally distributed based on the SFWMD 3-day distribution.

- The 72-hour rainfall distribution is found in the District's Surface Water Environmental Resource Permit Manual (SFWMD, Environmental Resource Permit Applicant's Handbook Volume II (2016) – Frequency Analysis of One and Three Day Rainfall Maxima for central and southern Florida, Paul Trimble, October 1990).

Time (hours)	Cumulative Percentage of Peak One Day Rainfall
0	0
24	14.6
48	35.9
58	57.2
59	62.8
59.5	67.8
59.75	82.8
60	101.5
60.5	108.8
61	112.6
62	117.7
72	135.9

100% One Day Rainfall



Rainfall Temporal Distribution



COASTAL INPUT DATA

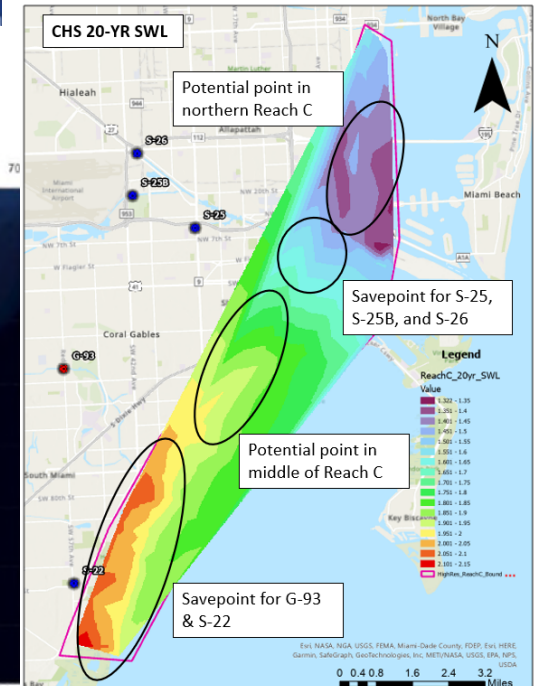
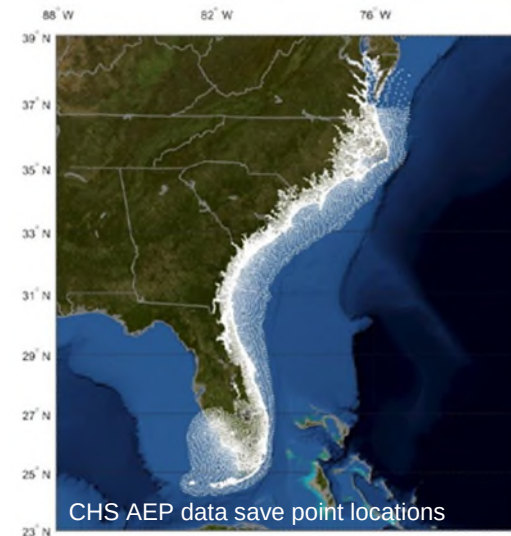
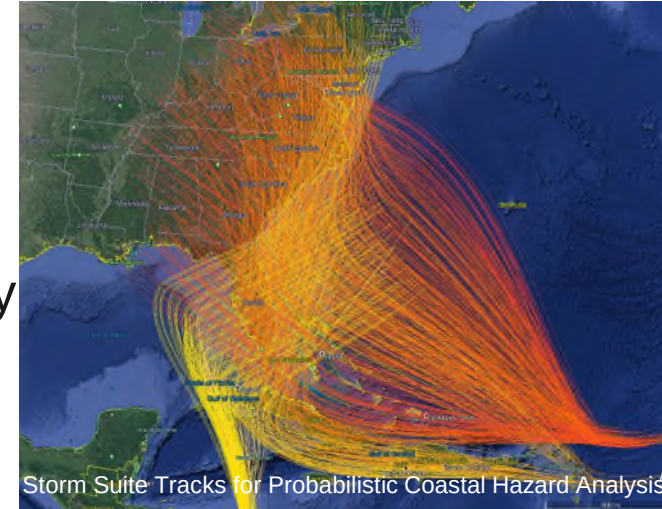
The South Atlantic Coastal Study (SACS) Coastal Hazard System (CHS) provides numerical and probabilistic modeling results for coastal forcings, including storm surge. The CHS stage-hydrographs are applied as a downstream boundary condition within the MIKE model.

CHS Savepoint & Storm Selection

- CHS savepoints are grouped based on peak still water levels to identify representative savepoints throughout each model reach.
- Tropical events were selected for various return periods

Tidal Hydrograph Development

- Developed based on historic, predicted tides in the months of September through November to capture steric effects.
- Tides combined with storm data to create 28-day hydrographs





RESILIENCE STRATEGY

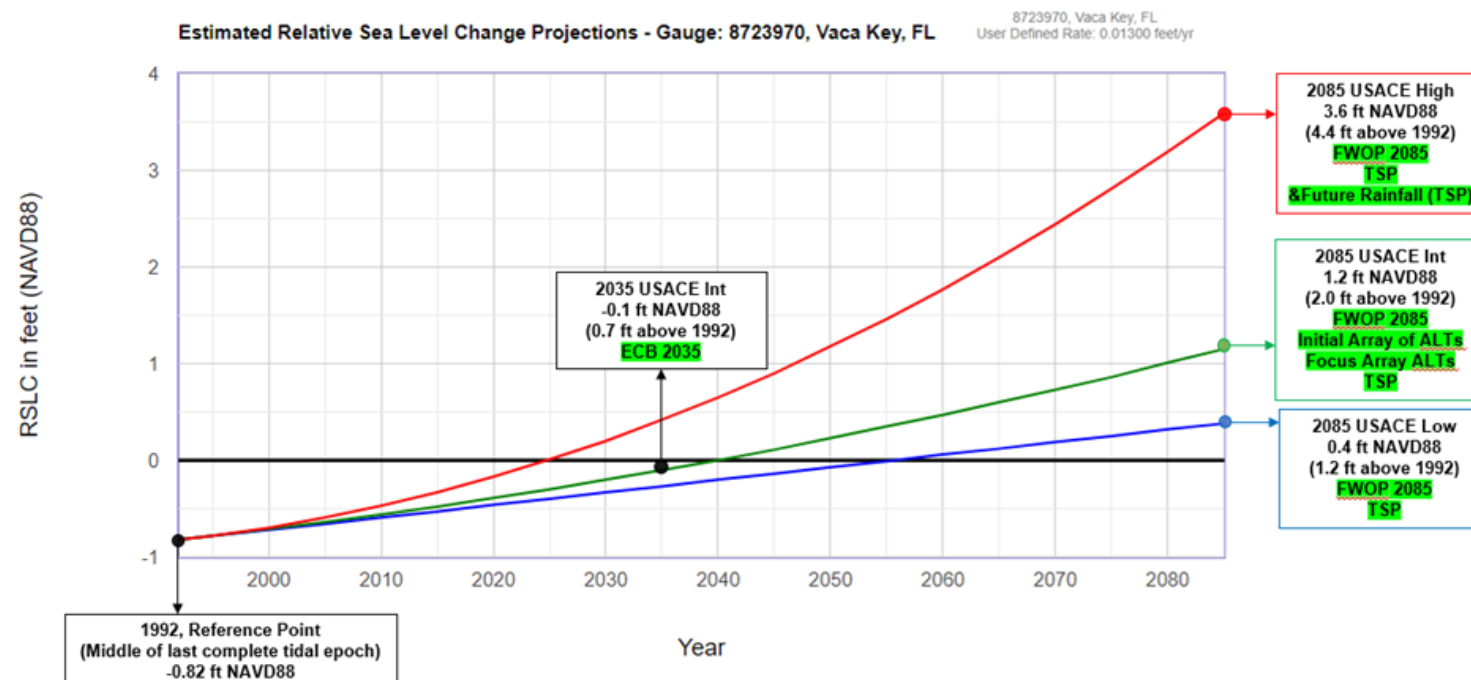


Sea Level Change

- Vaca Key gauge
- SLC will be incorporated into the modeling as a boundary condition. The coastal water level for the Base Year (2035) was modified using linear superposition, using the Int. curve. The Future conditions will assess project performance for the Low, Int., and High curves for 2085



MODELING FOR SELECTED SLC SCENARIOS





C&SF FLOOD RESILIENCY (SECTION 216) STUDY

COMPOUND FLOODING



Compound Flooding

- The total water level (i.e., compound flooding) due to multiple flood sources, including rainfall runoff, groundwater and coastal forcings must be captured to widely characterize the flood risk and uncertainty for planning and design purposes.
- H&H model simulations include an array of rainfall and coastal storm events ranging from the 0.5 Annual Exceedance Probability (AEP) to 0.01 AEP (2-year through 100-year recurrence interval).
- No formulation will be performed for coastal surge propagation inland; however, it is important to identify and understand the risk of surge events that limits primary system design and operation.

Joint Probability Analysis

Conducted by subject matter experts at the University of Central Florida.

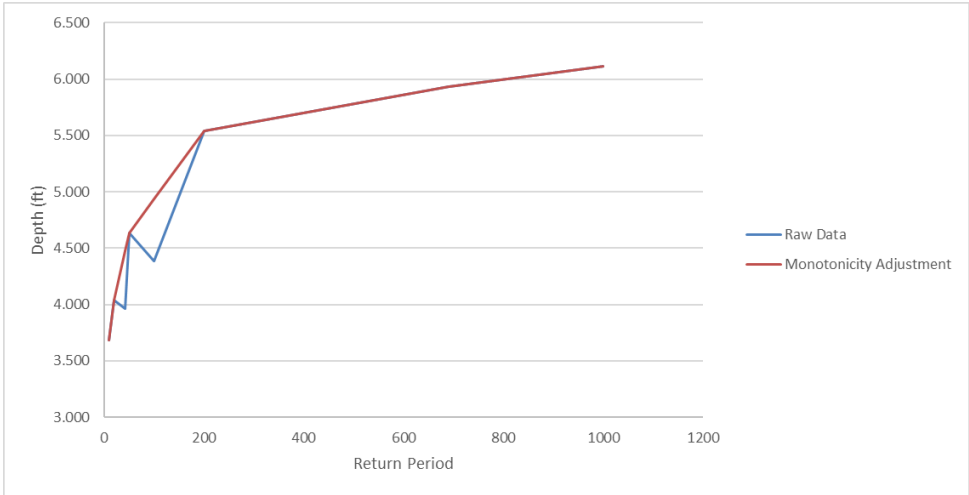
- Applied a framework that combines two-way conditional sampling of variables with copula-theory, to account for the correlations between variables.
- Used to provide estimates for the joint exceedance probabilities of the eight compound events

Event Return Periods			
Coastal Water Level	Rainfall	Independence	Correlated Joint
2-year	5-year	10-year	10-year
	10-year	20-year	20-year
	25-year	50-year	50-year
	100-year	200-year	200-year
10-year	10-year	100-year	42-year
20-year	25-year	500-year	100-year
100-year	100-year	10,000-year	690-year

Incorporating MIKE Output into Hec-FDA

Primary flooding driver (coastal surge vs rainfall) differs spatially across the model domain, such that at some locations, water depth does not always increase with decreasing compound event frequency.

MIKE Model output data was post-processed to facilitate import to HEC-FDA.





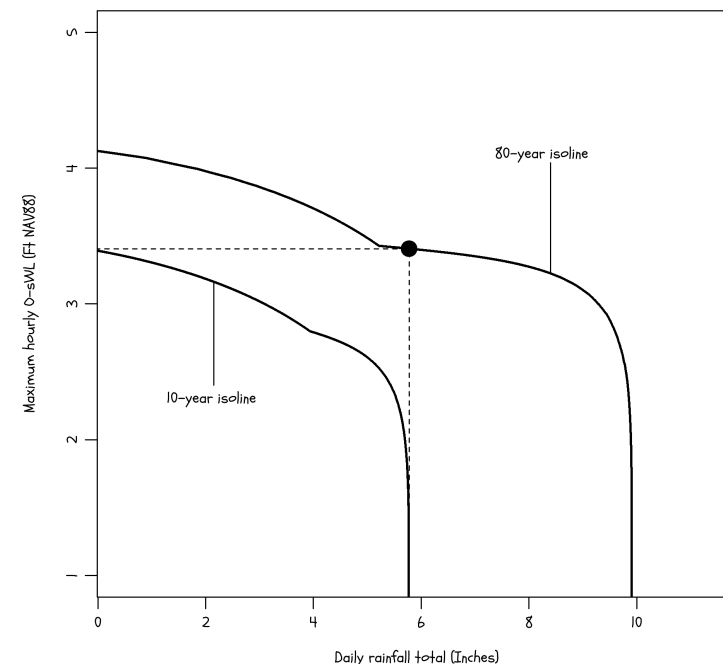
JOINT PROBABILITY ANALYSIS

Joint Probability Analysis: Determination of Combined Frequencies of Compound Events was conducted by subject matter experts at the University of Central Florida.

- The framework combines two-way conditional sampling to identify bivariate “extremes” with copula-theory, to account for the correlations between them in the modeling of their joint probability distribution.
- This framework was used to estimate the joint exceedance probabilities of the eight compound events

Joint exceedance probability estimates were performed by assessing multiple study sites (one per reach), using both the Virginia Key tidal gauge and water control structure tailwater measurements as input for oceanic forcing

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





MODELING APPROACH



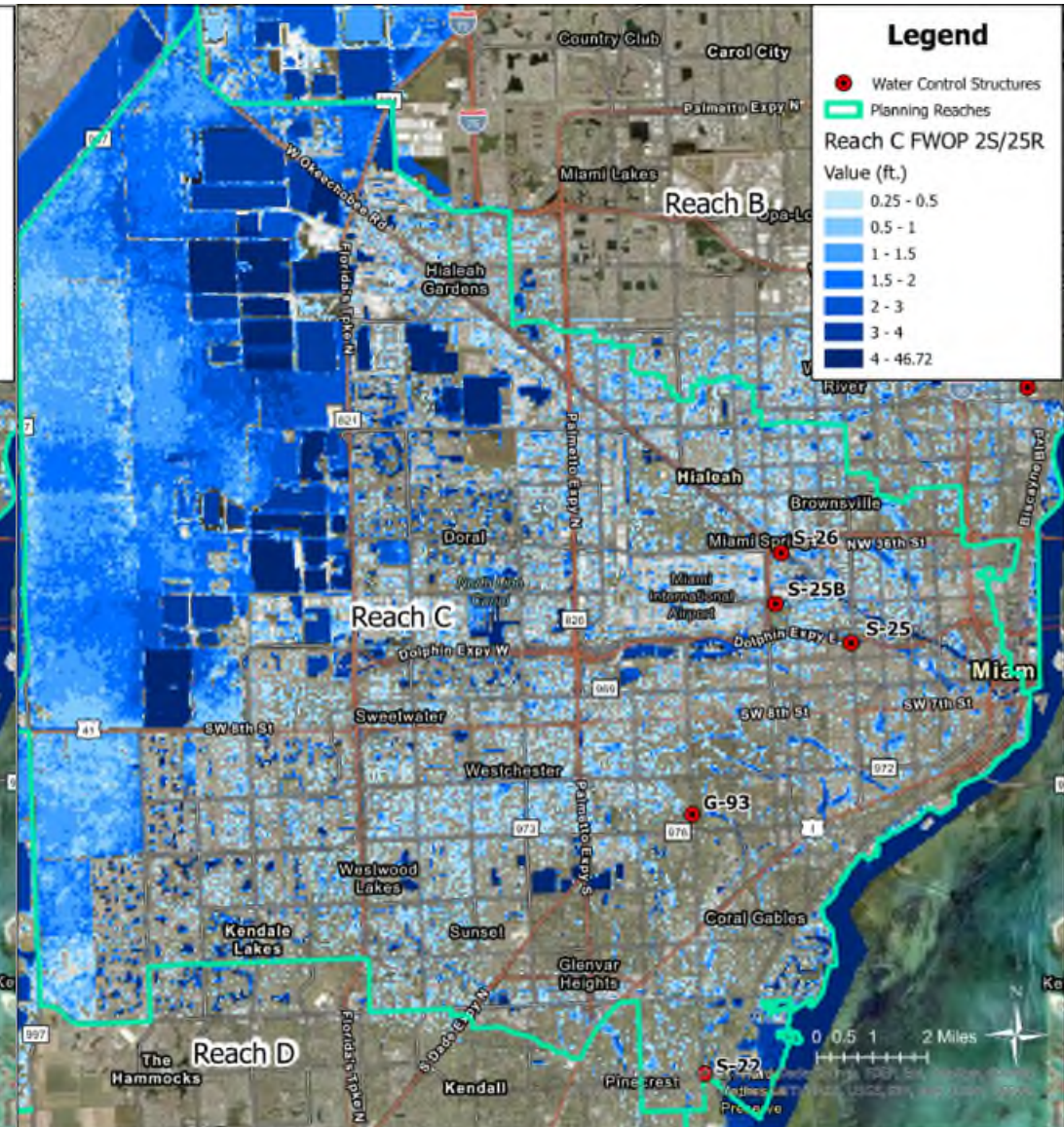
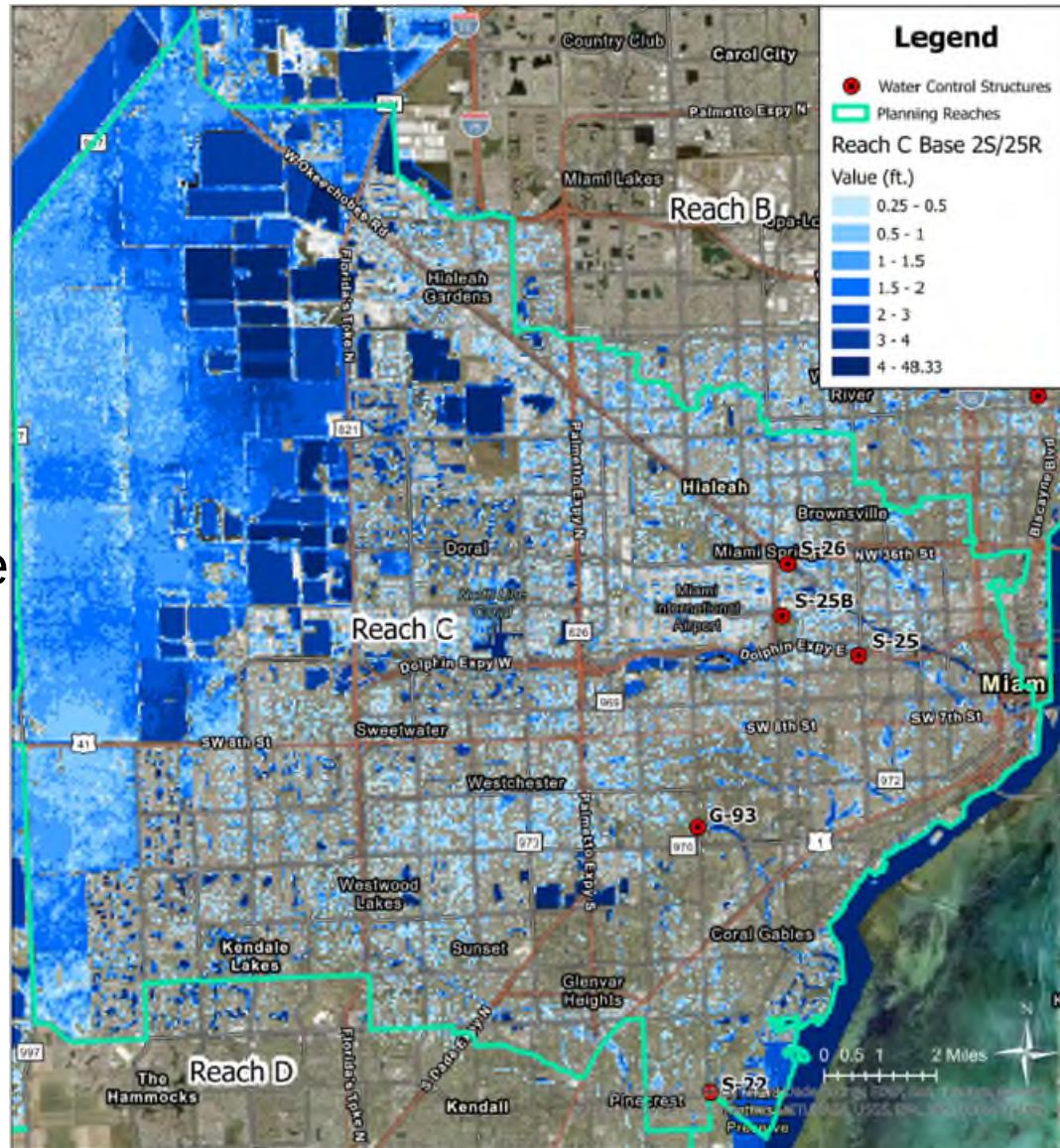
- C&SF Flood Resiliency (Section 216) Study Focus
 - Flood Risk Management (FRM) recommendations to increase the resilience and function of vulnerable coastal structures and the conveyance of the primary inflow canals.
- H&H model output is being assessed to support metric evaluation of most vulnerable areas
 - Structure performance
 - Canal peak stage profile
 - Flood inundation



C&SF FLOOD RESILIENCY (SECTION 216) STUDY MAXIMUM DEPTH RASTER 25-YEAR RAINFALL, 2-YEAR COASTAL



Base
Year



FWOP
Int SLR

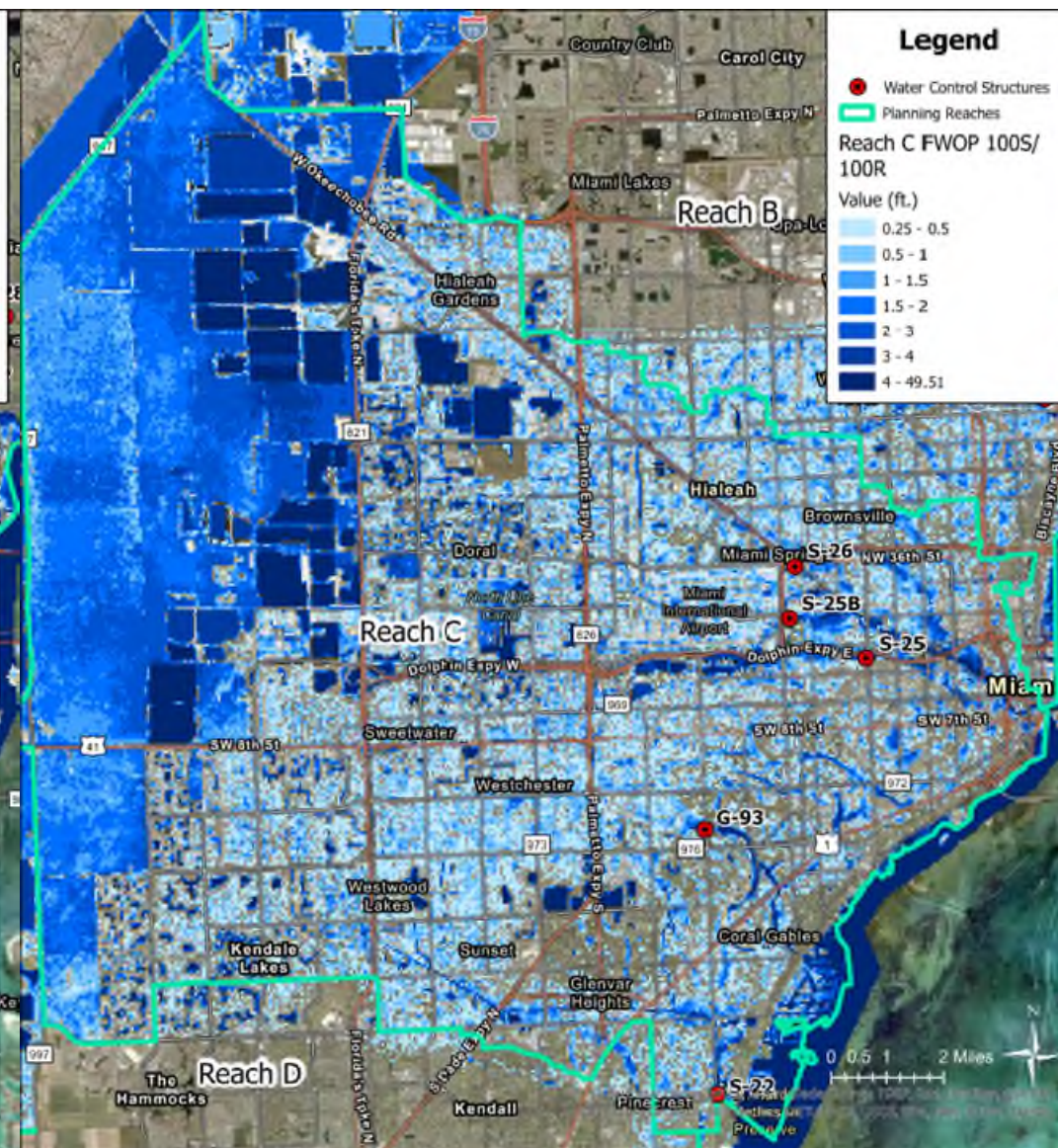
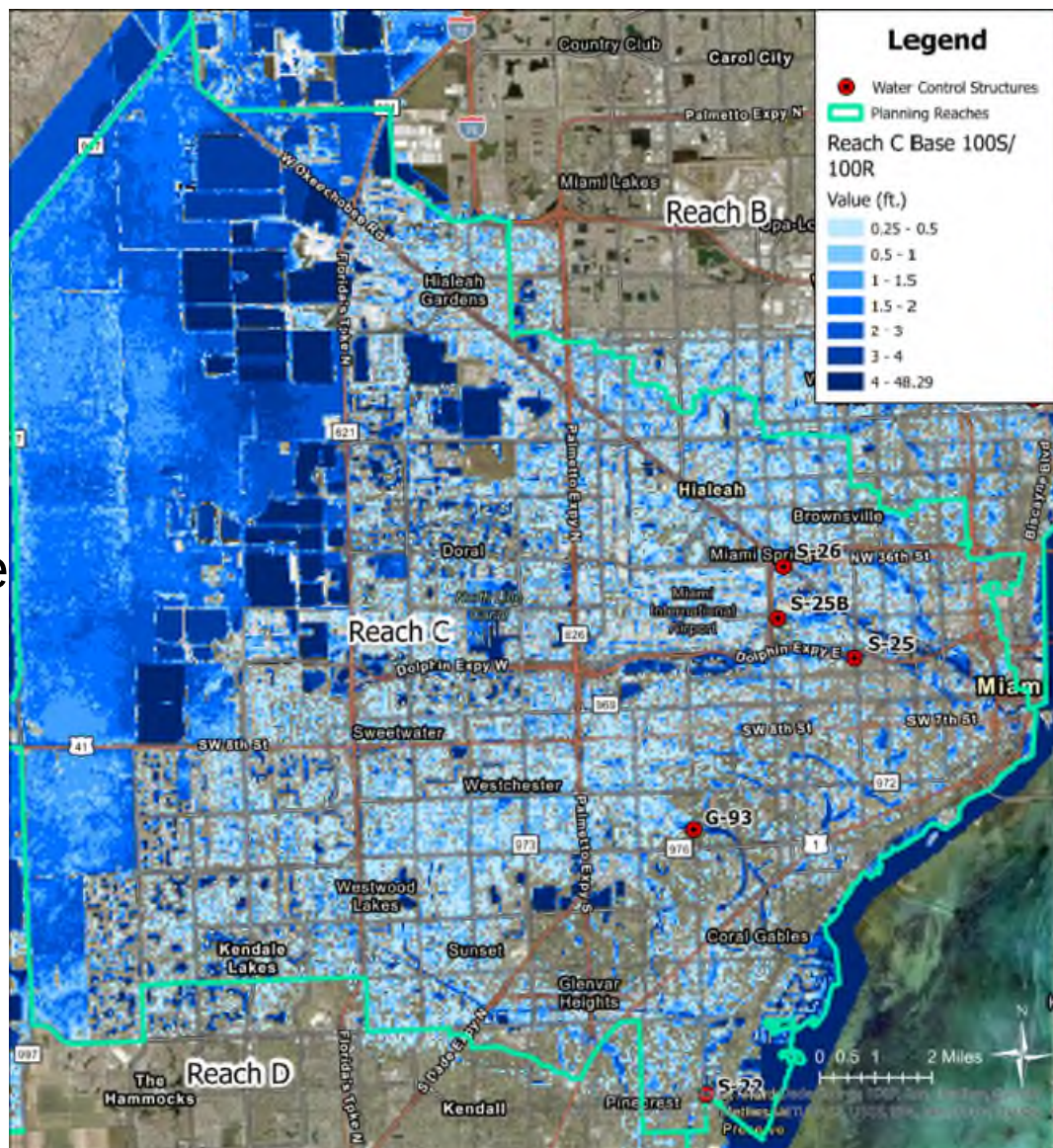


C&SF FLOOD RESILIENCY (SECTION 216) STUDY

MAXIMUM DEPTH RASTER 100-YEAR RAINFALL, 100-YEAR COASTAL



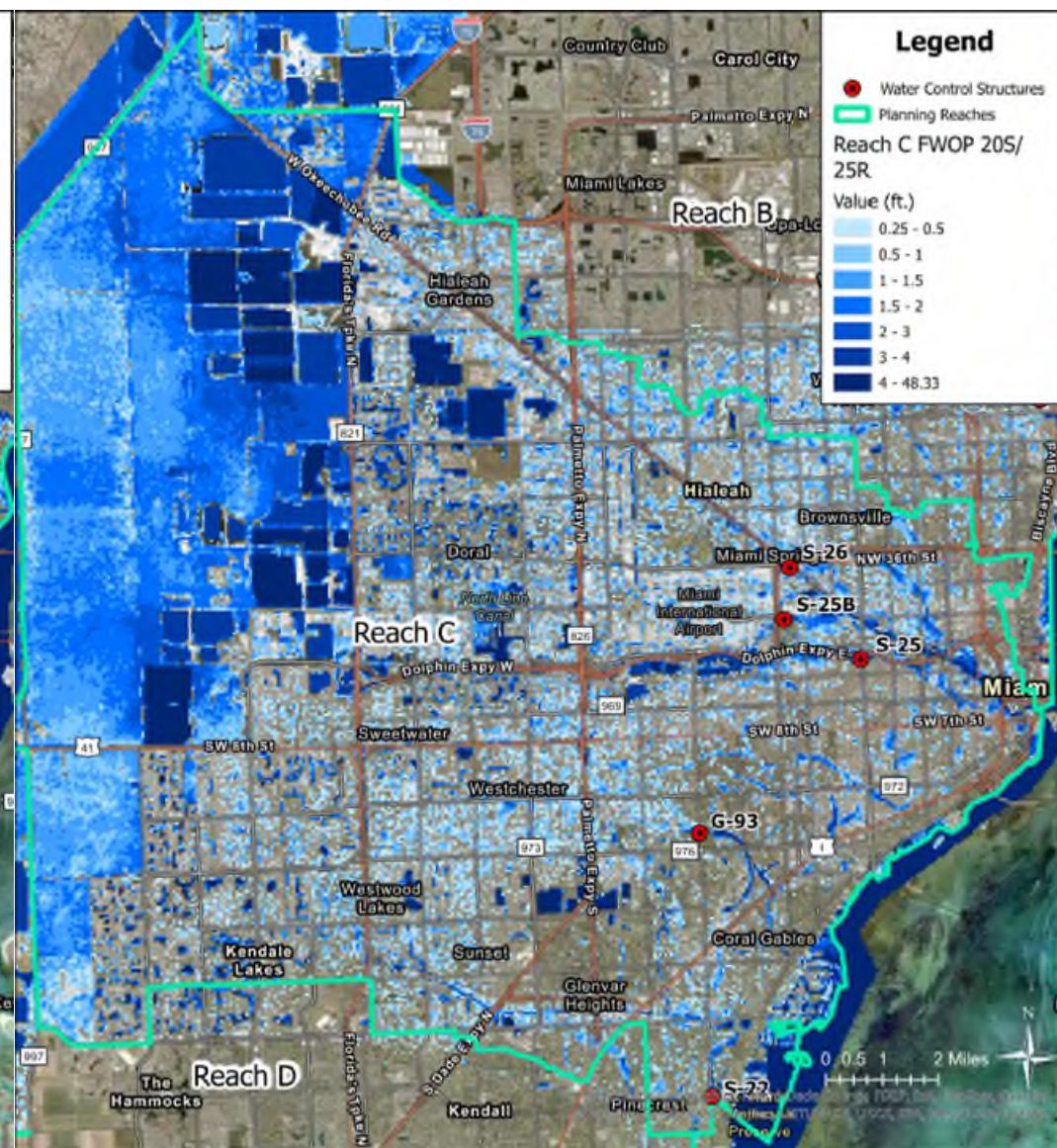
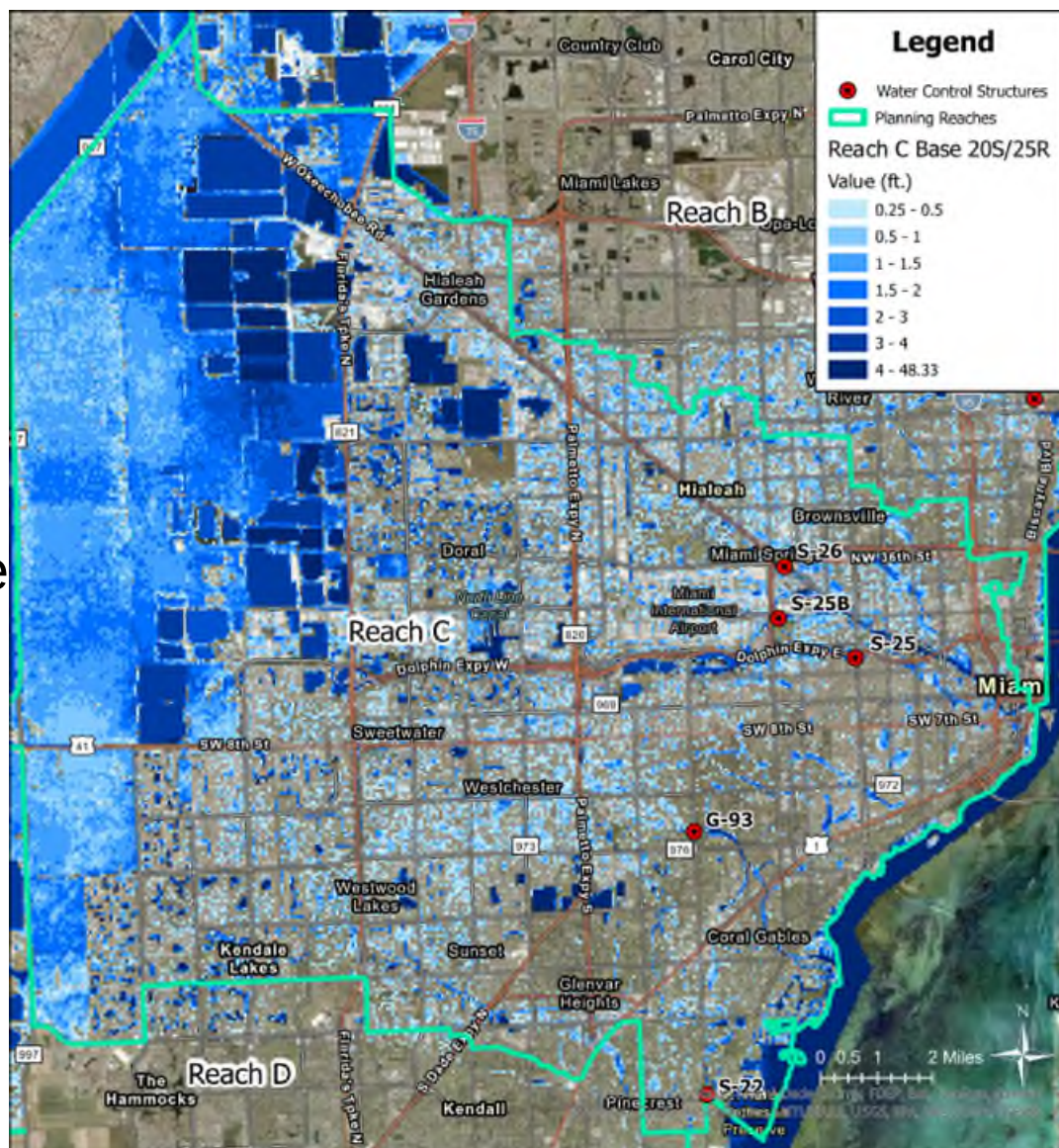
Base
Year



FWOP
Int SLR



MAXIMUM DEPTH RASTER 25-YEAR RAINFALL, 20-YEAR COASTAL

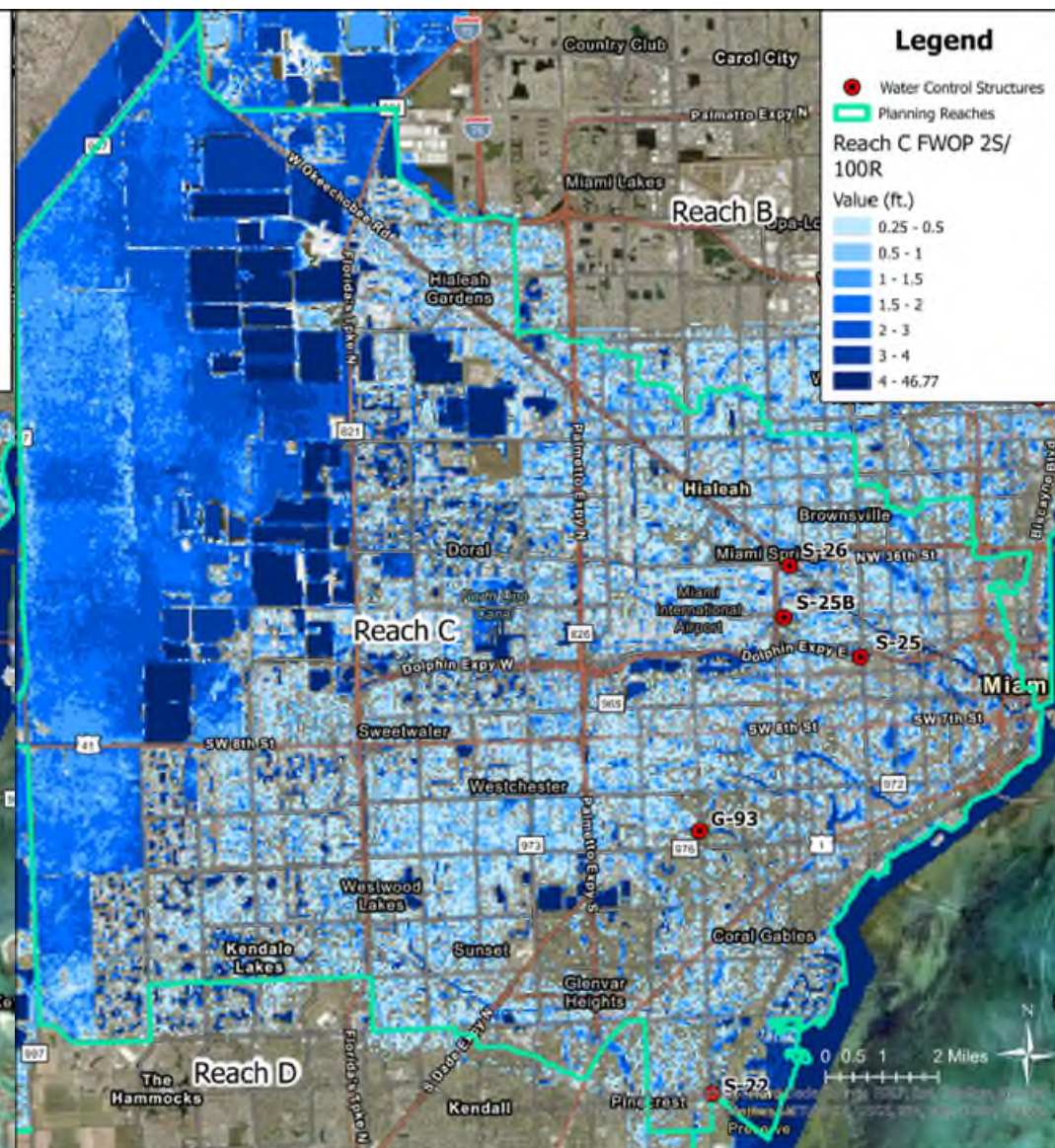
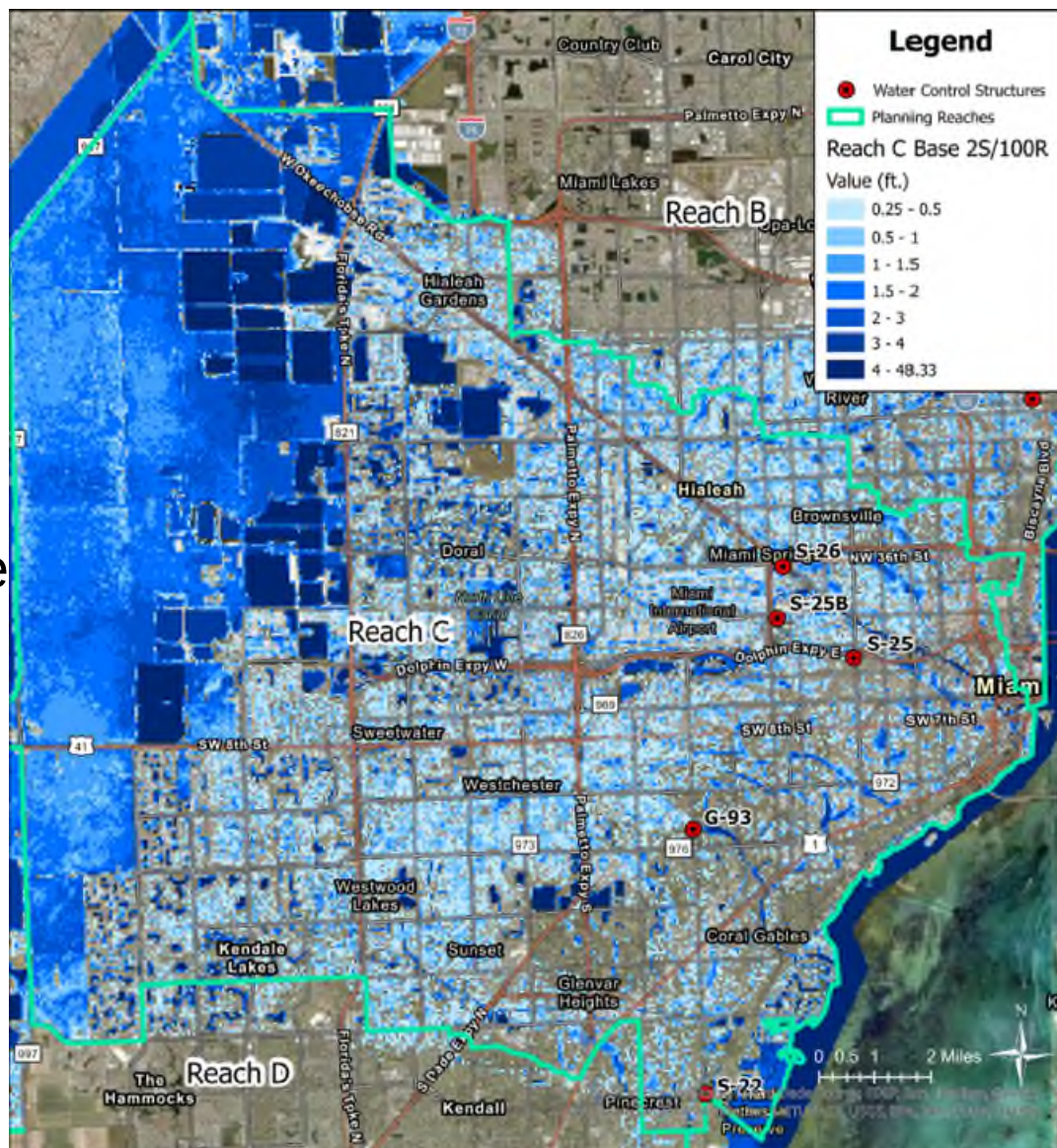


Base
Year

FWOP
Int SLR



MAXIMUM DEPTH RASTER 100-YEAR RAINFALL, 2-YEAR COASTAL



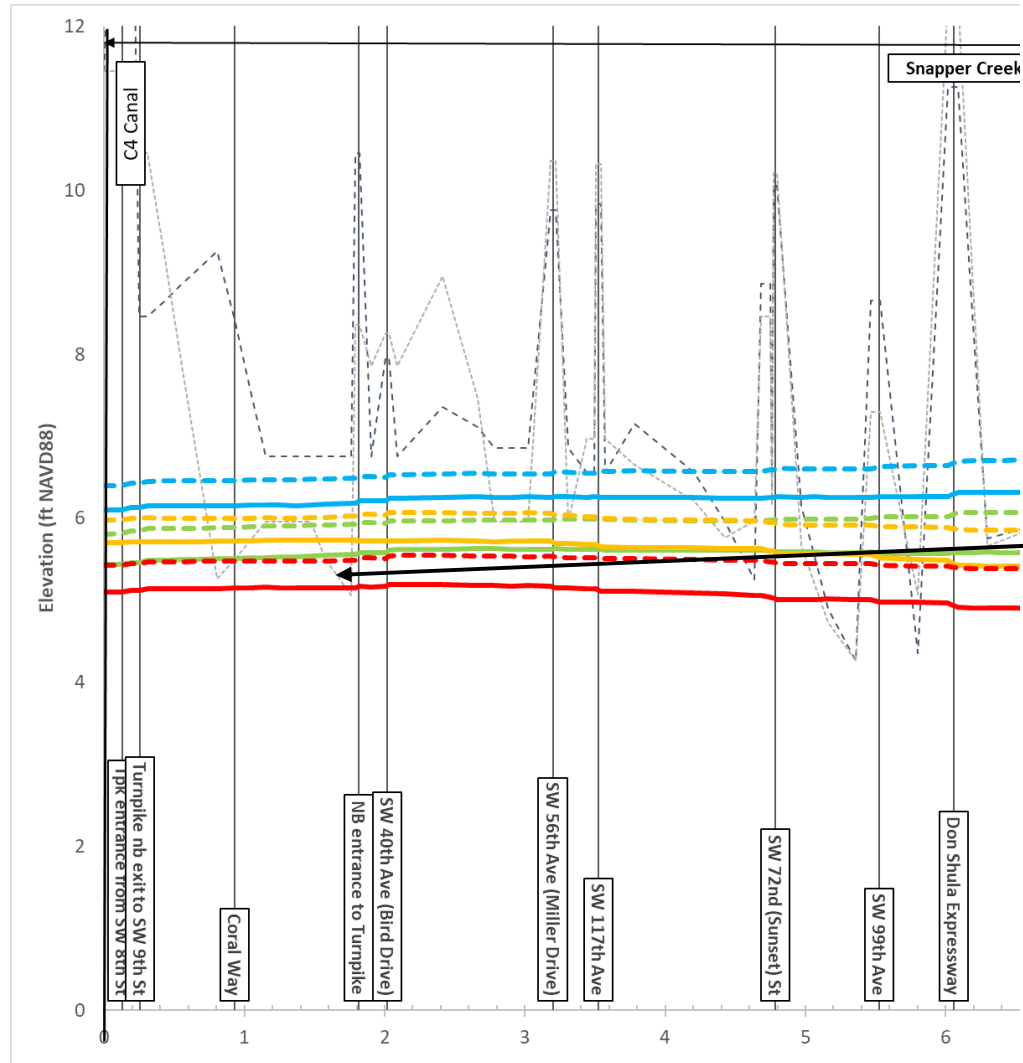
Base
Year

FWOP
Int SLR



MAXIMUM STAGE PROFILE PLOT – SNAPPER CREEK CANAL

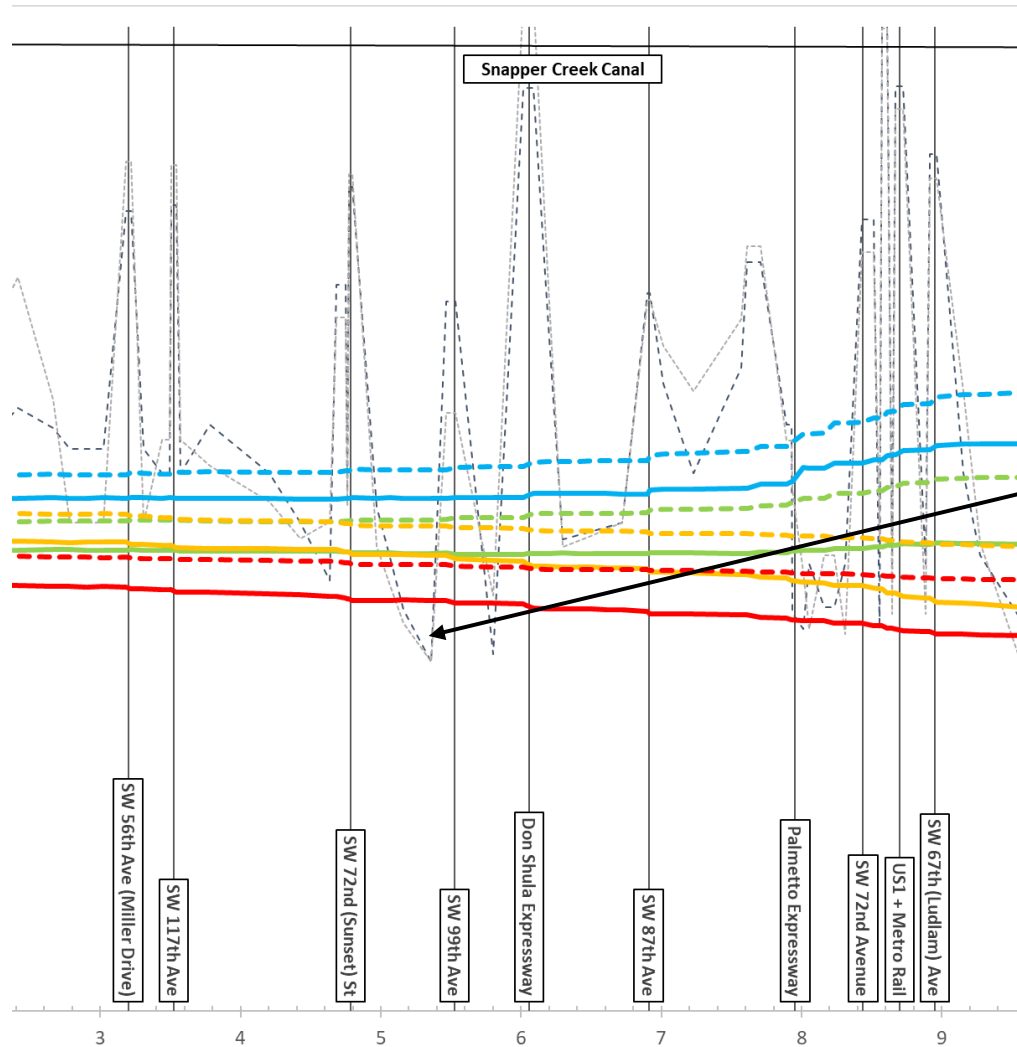
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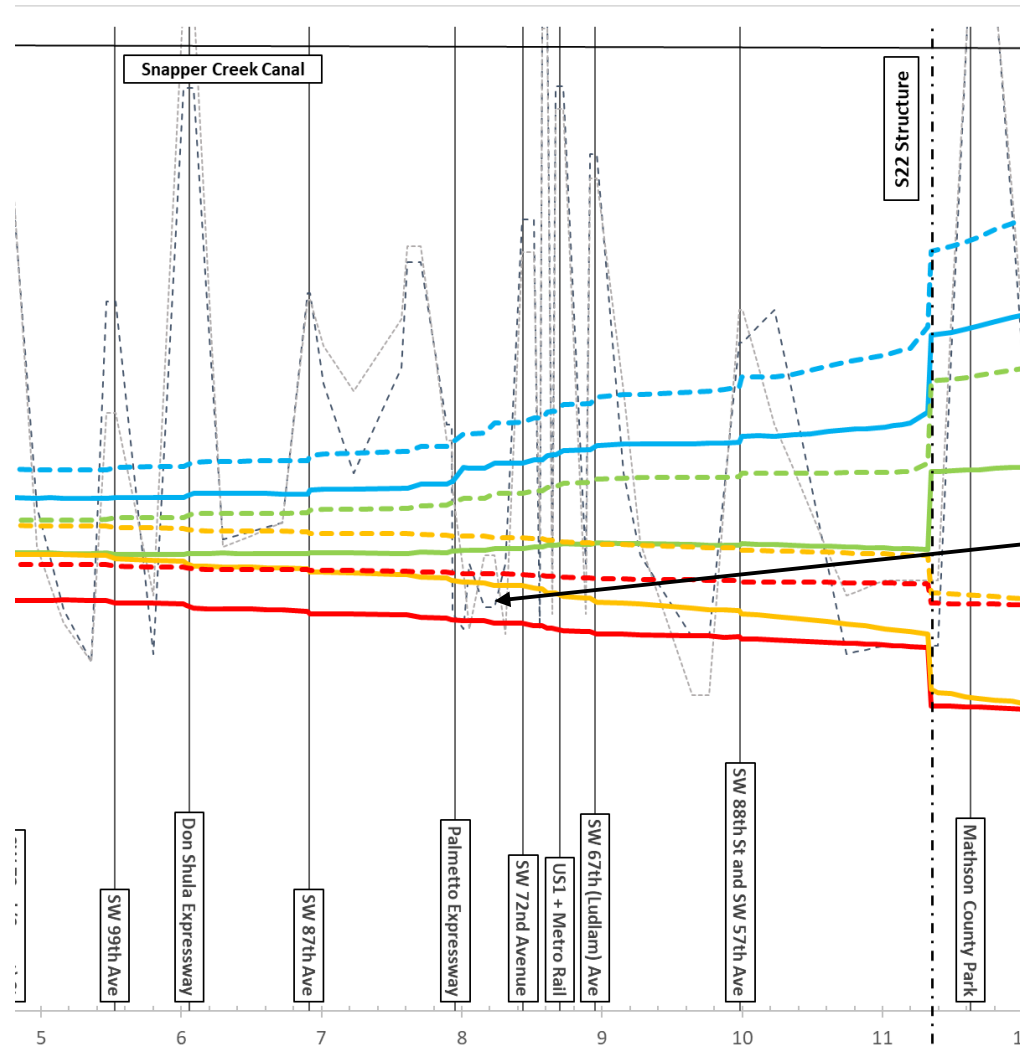
MAXIMUM STAGE PROFILE PLOT – SNAPPER CREEK CANAL

2





MAXIMUM STAGE PROFILE PLOT – SNAPPER CREEK CANAL

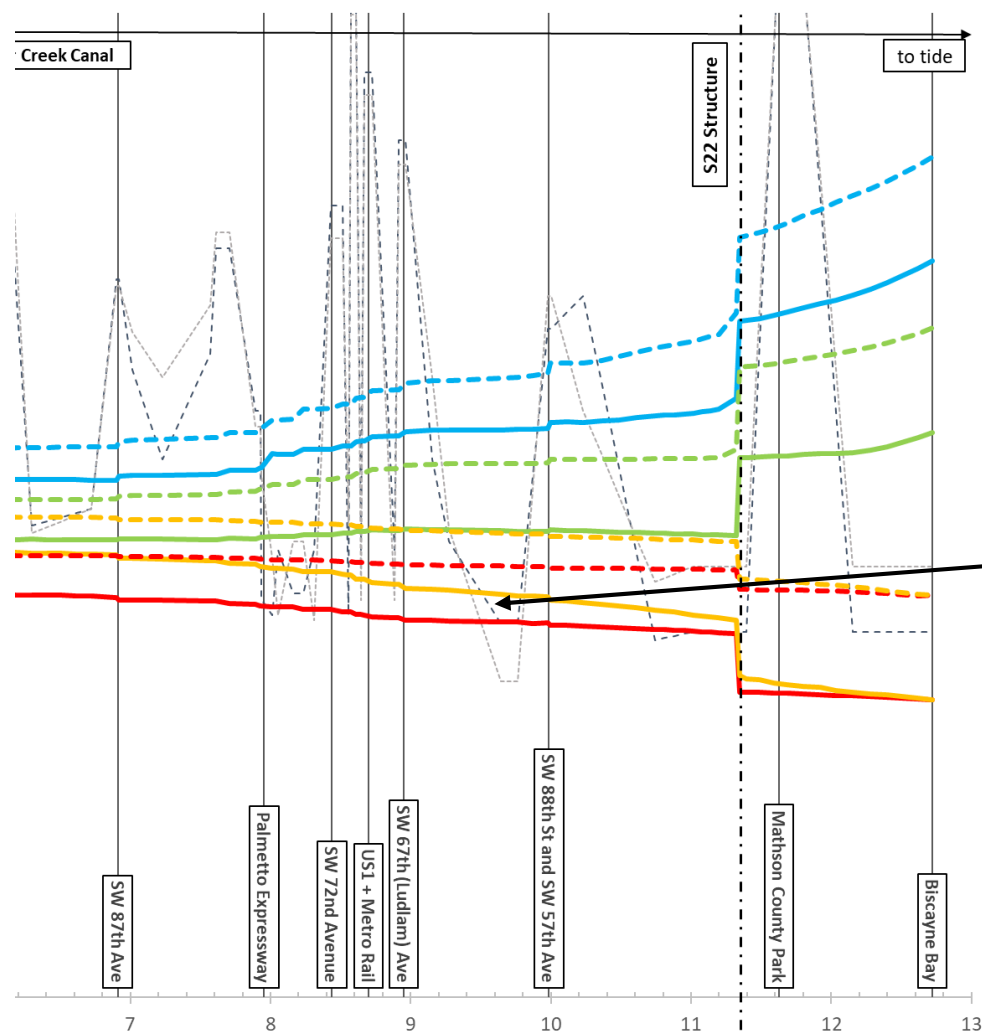


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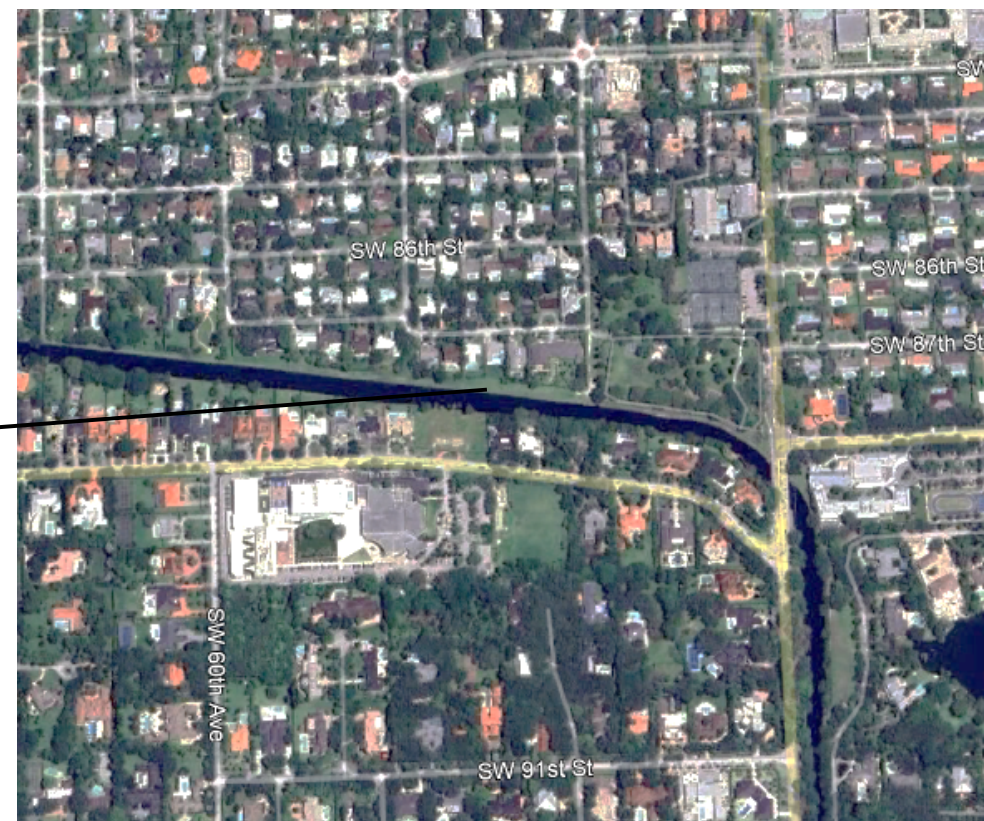




MAXIMUM STAGE PROFILE PLOT – SNAPPER CREEK CANAL



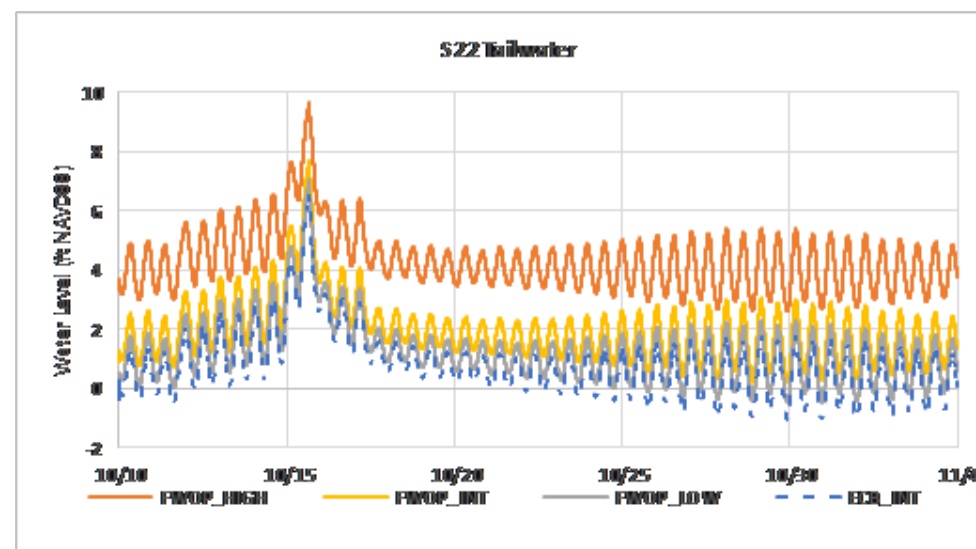
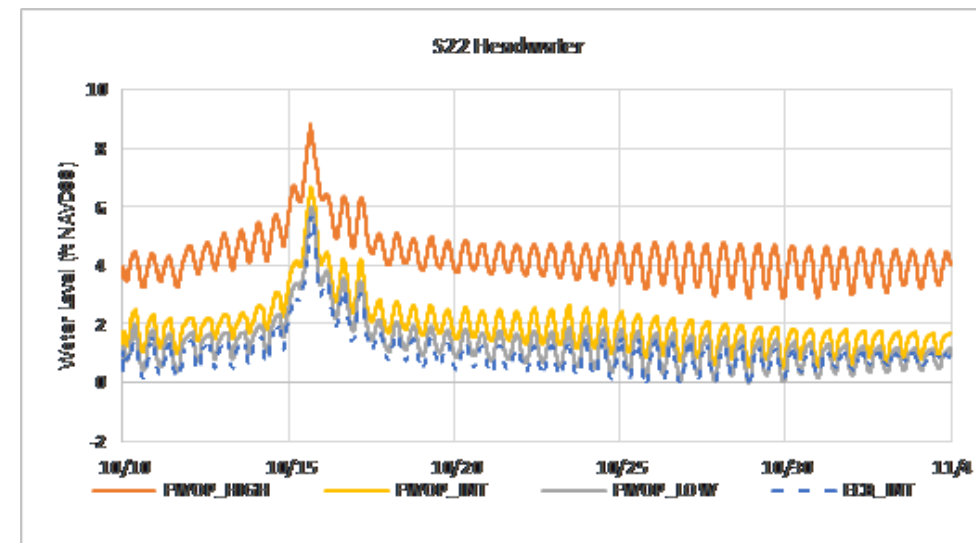
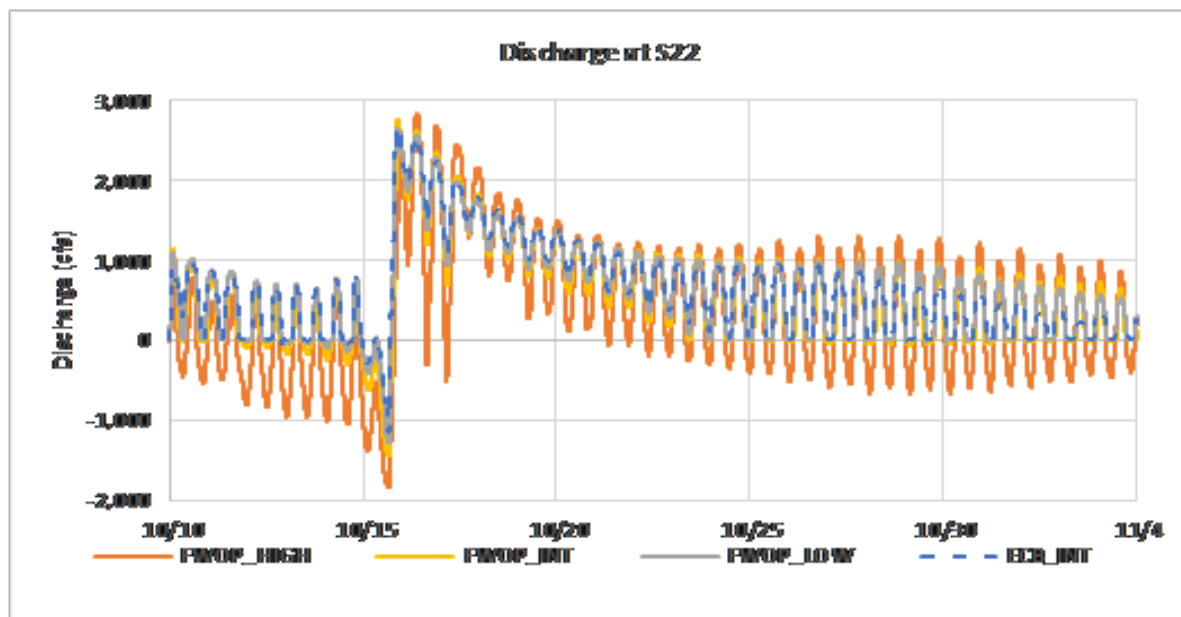
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C&SF FLOOD RESILIENCY (SECTION 216) STUDY

STRUCTURE PERFORMANCE, S-22

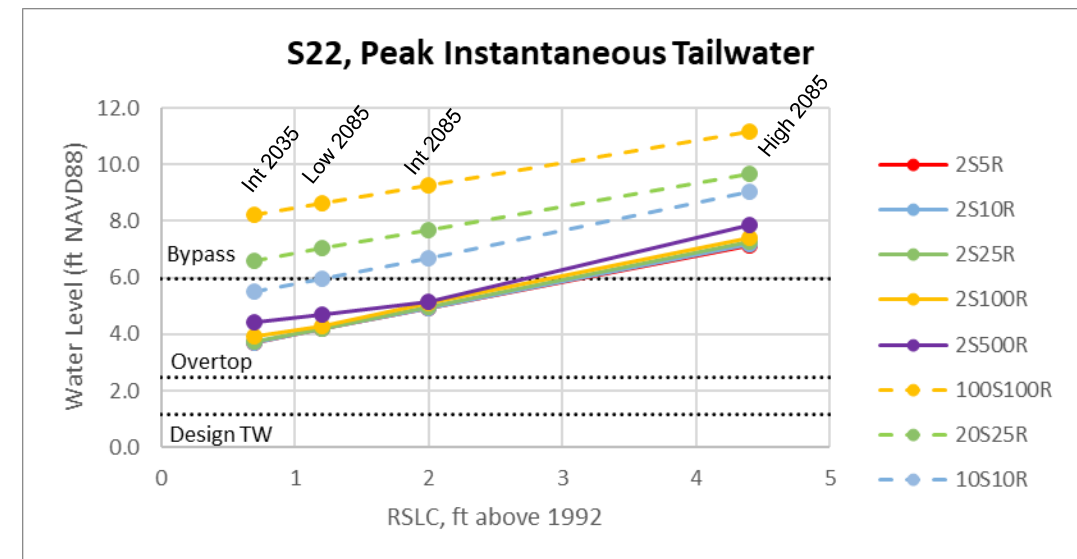
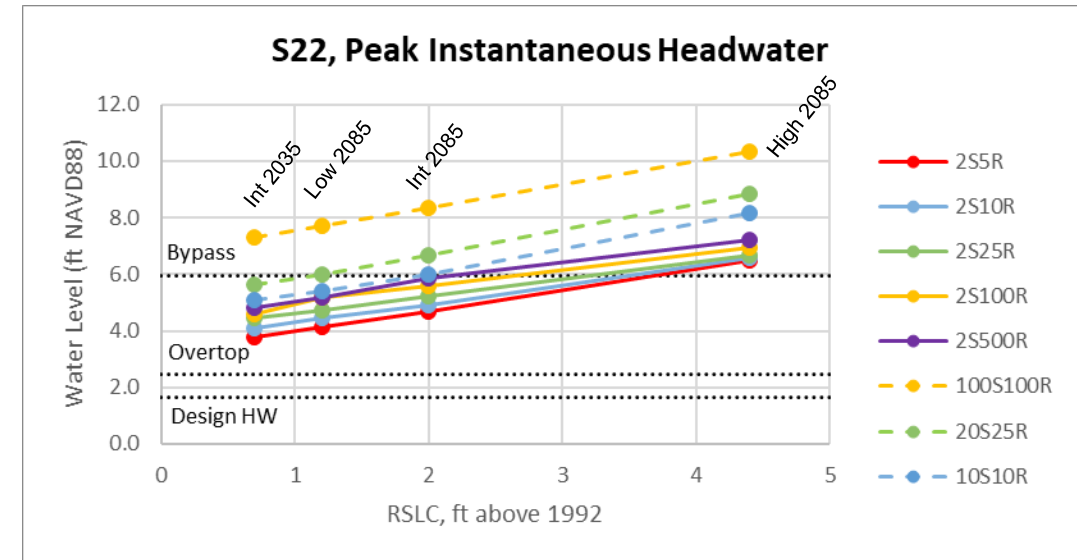
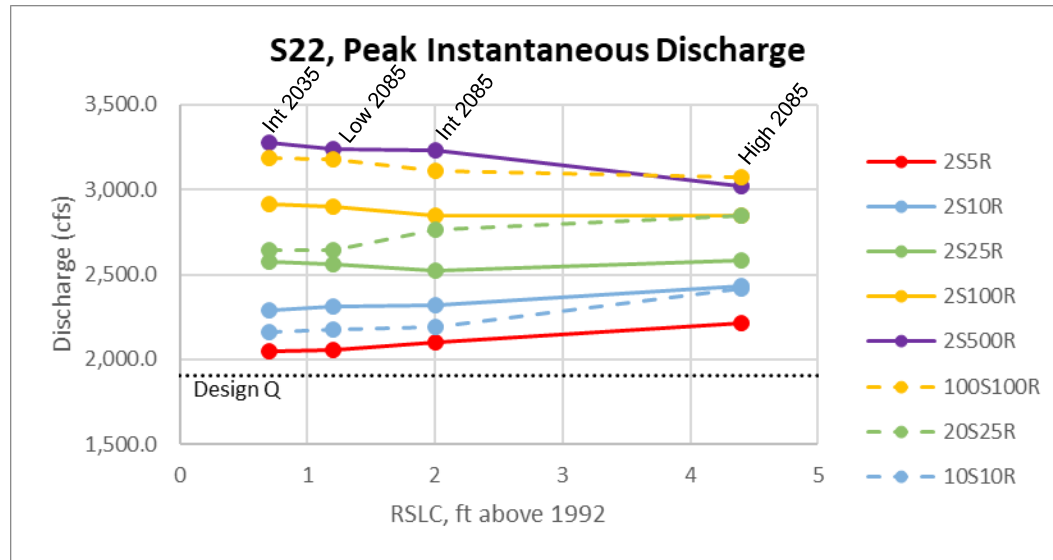


Model results for the 20-yr Coastal surge + 25-yr Rainfall event



C&SF FLOOD RESILIENCY (SECTION 216) STUDY

STRUCTURE PERFORMANCE, S-22



"2S5R" represents the event with 2-yr coastal surge event + 5-yr rainfall event

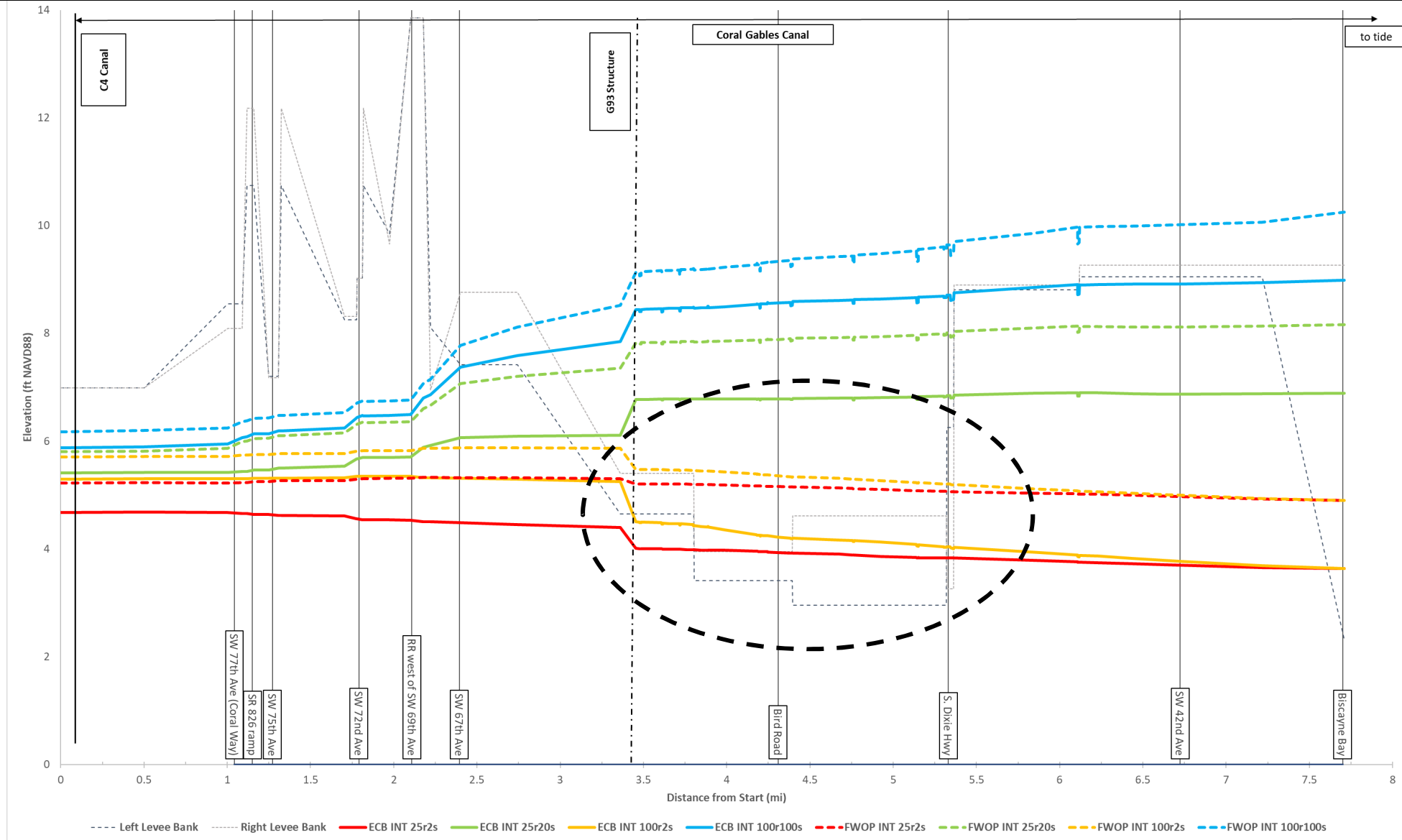


CORAL GABLES CANAL (C3)



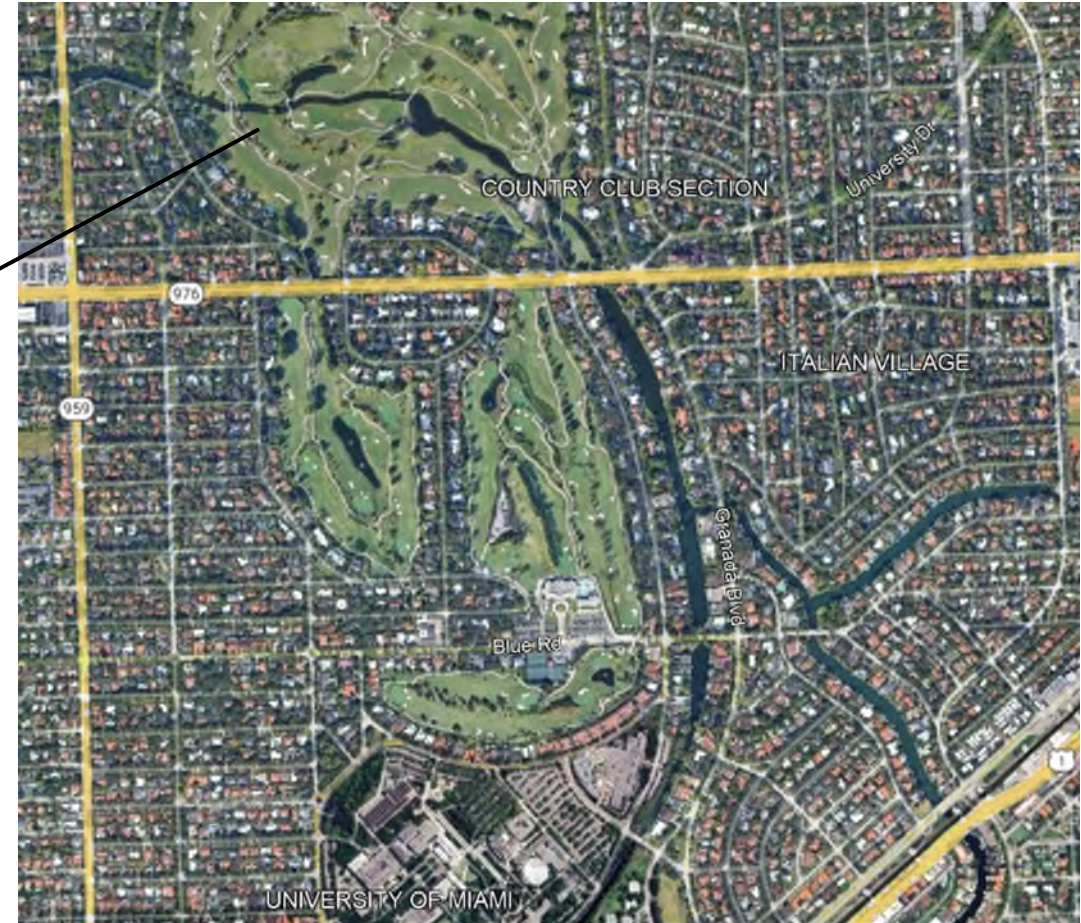
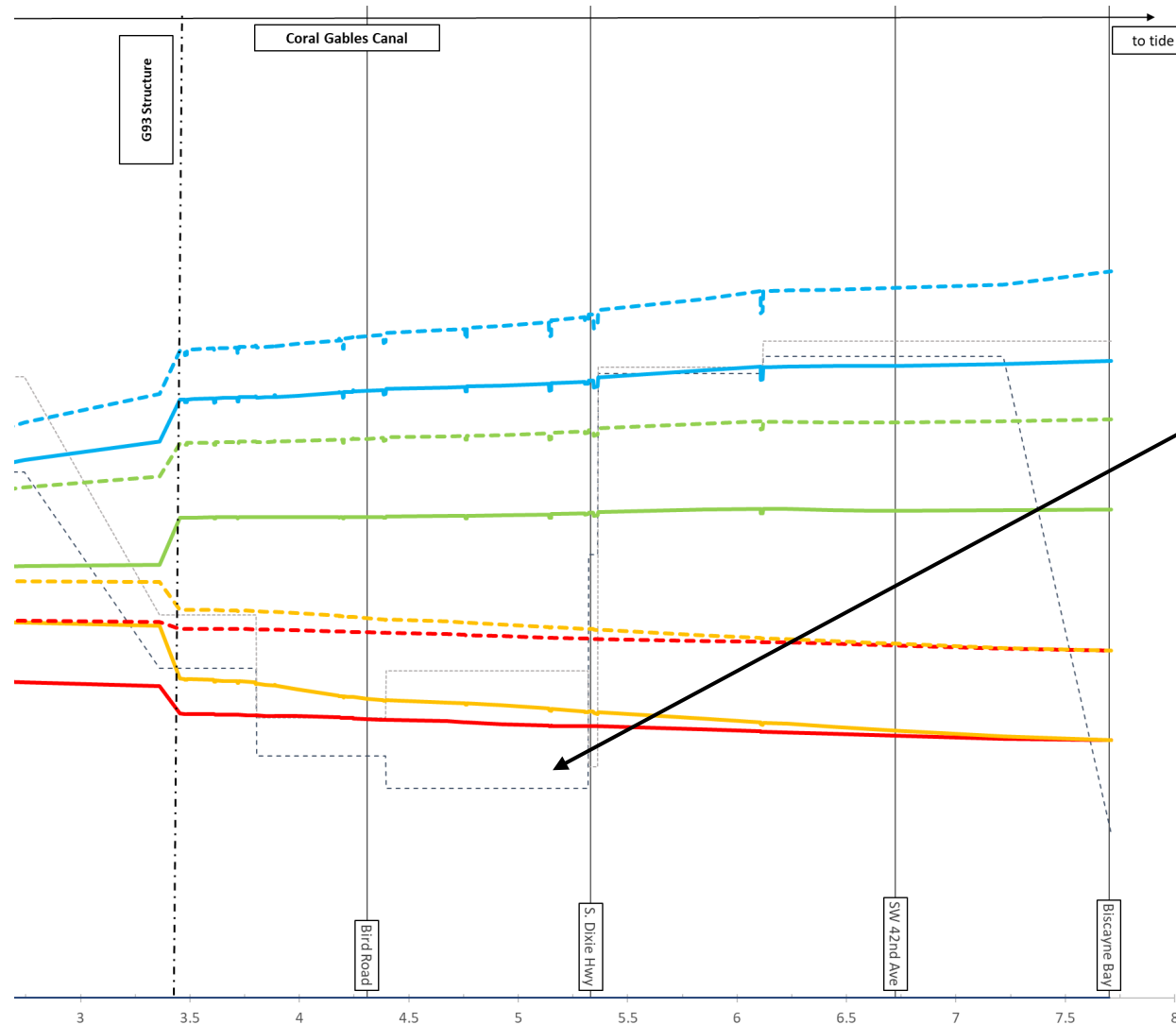


MAXIMUM STAGE PROFILE PLOT – CORAL GABLES CANAL





MAXIMUM STAGE PROFILE PLOT – CORAL GABLES CANAL

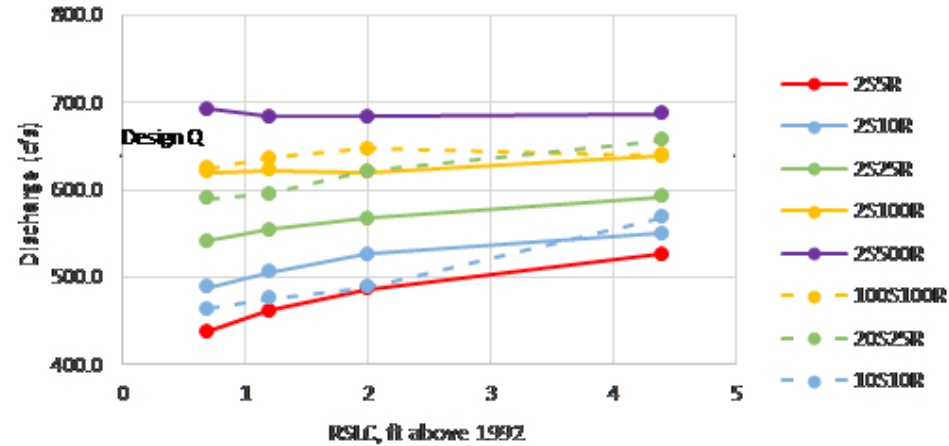




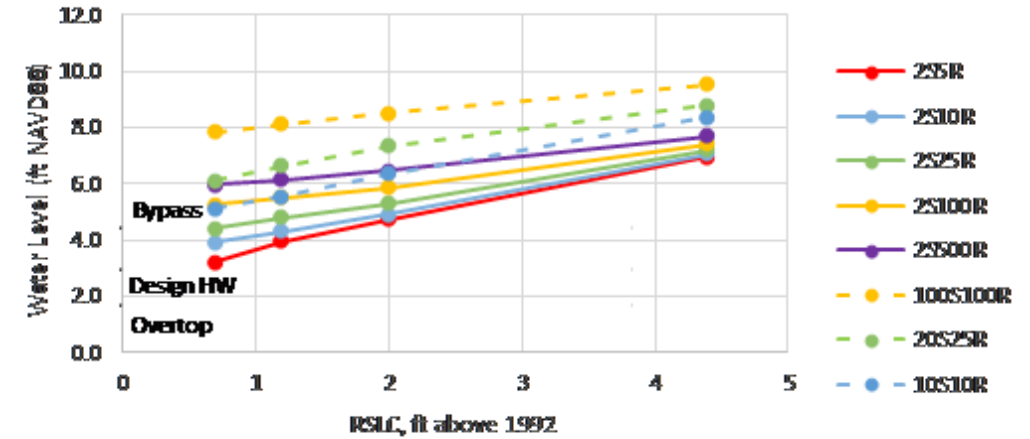
STRUCTURE PERFORMANCE, G93



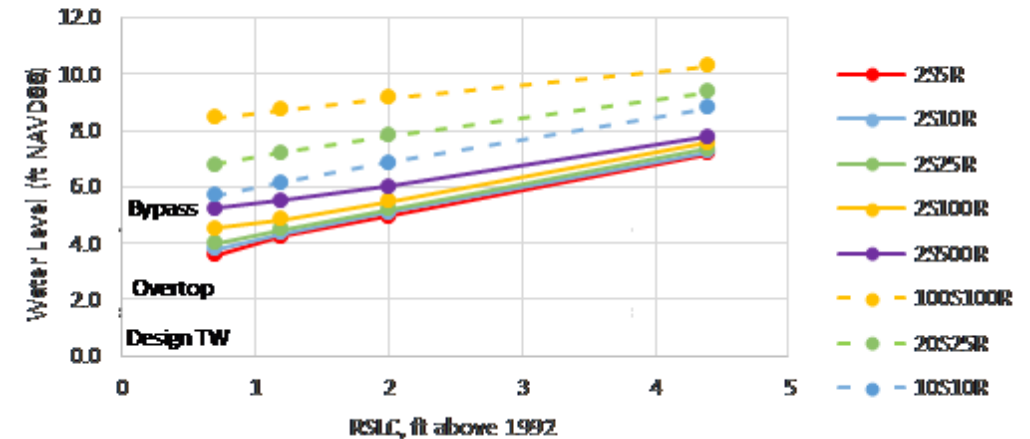
G93, Peak Instantaneous Discharge



G93, Peak Instantaneous Headwater

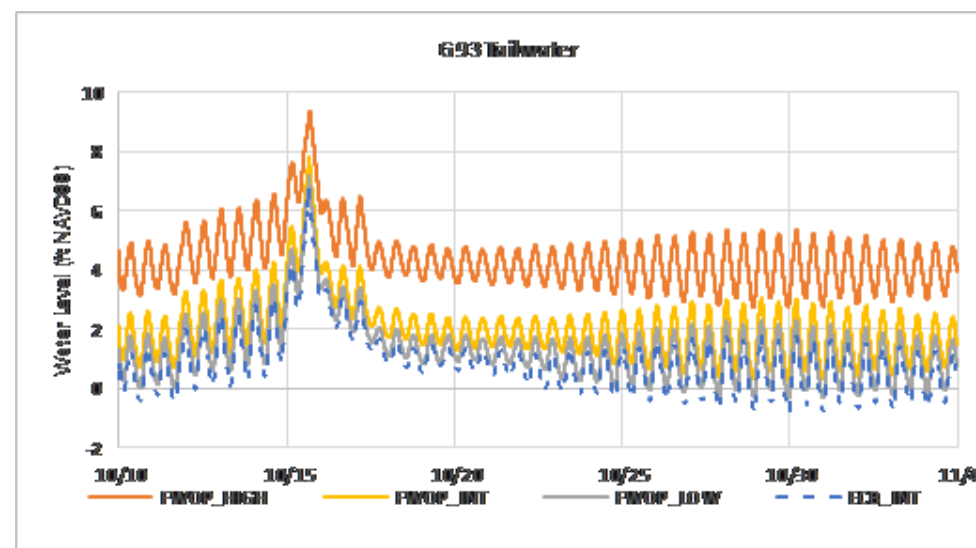
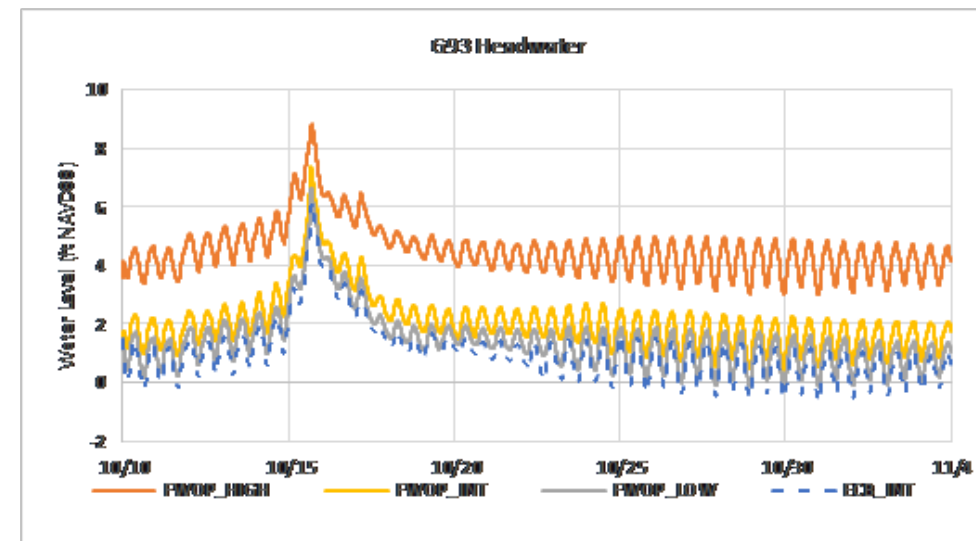
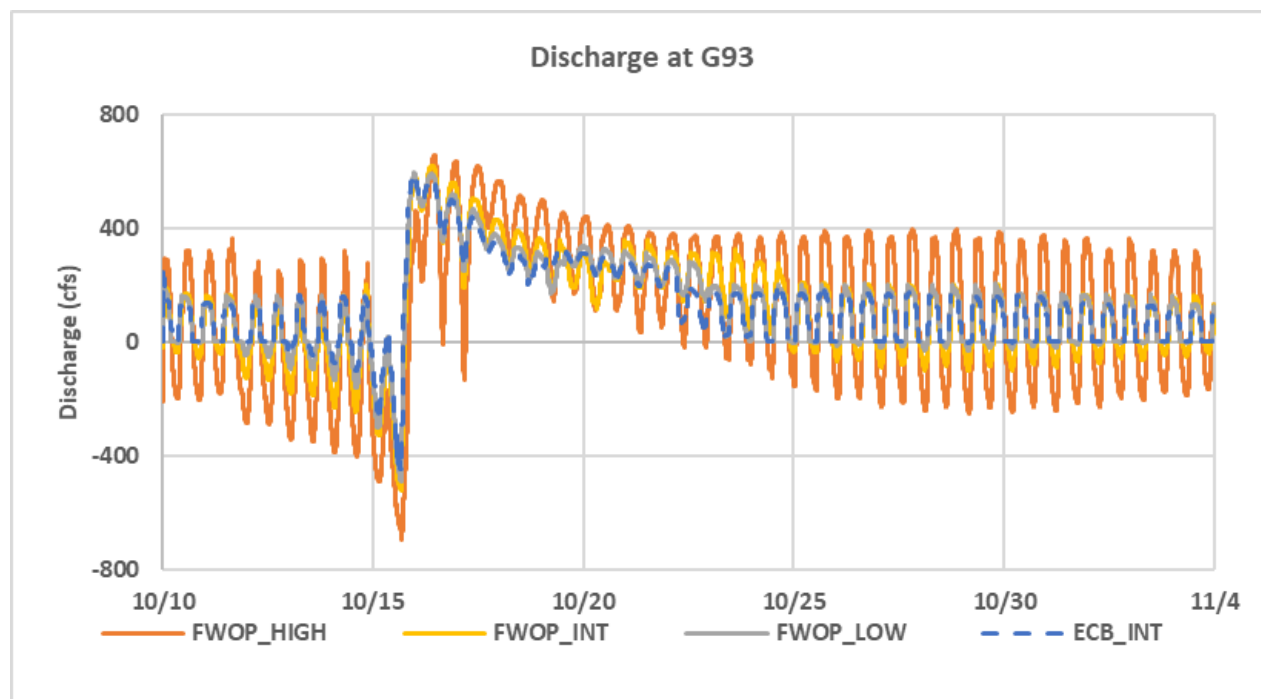


G93, Peak Instantaneous Tailwater



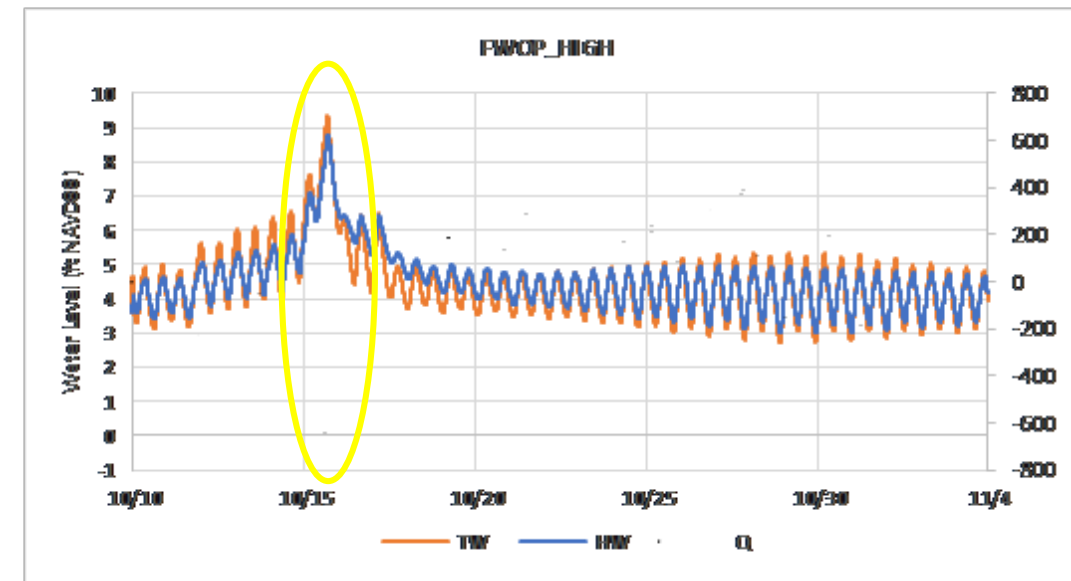
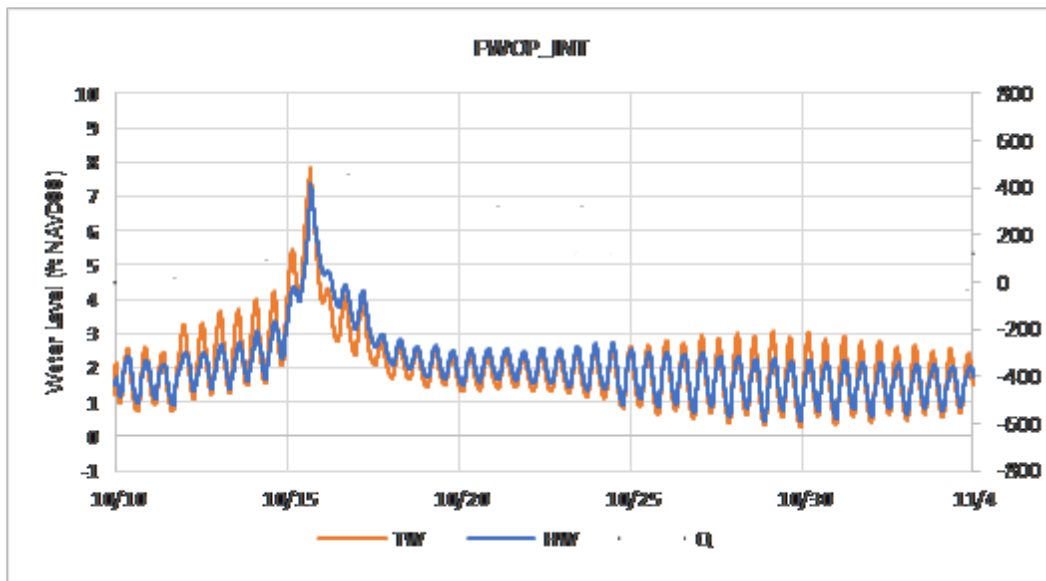
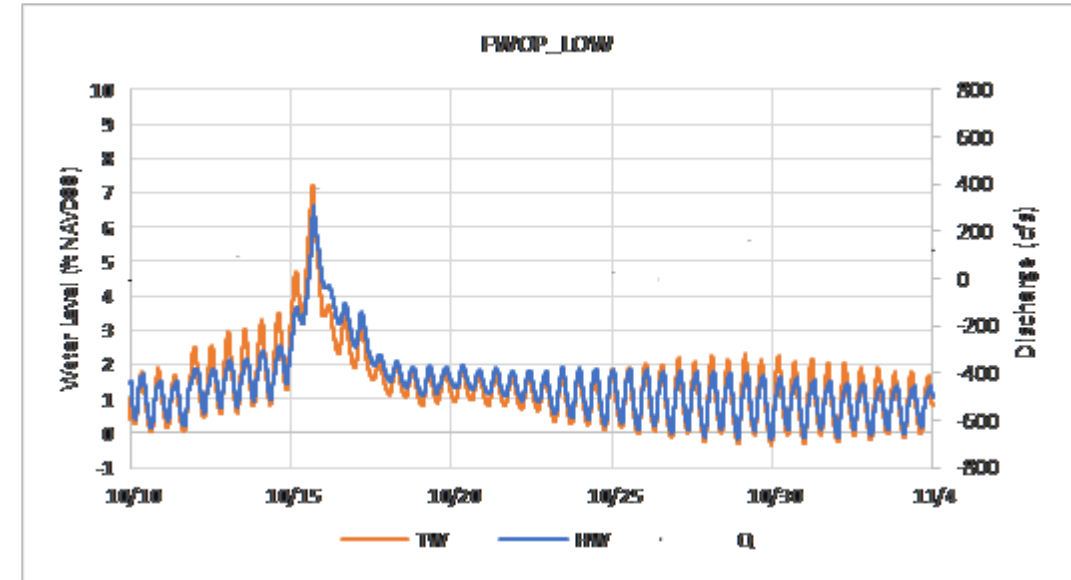
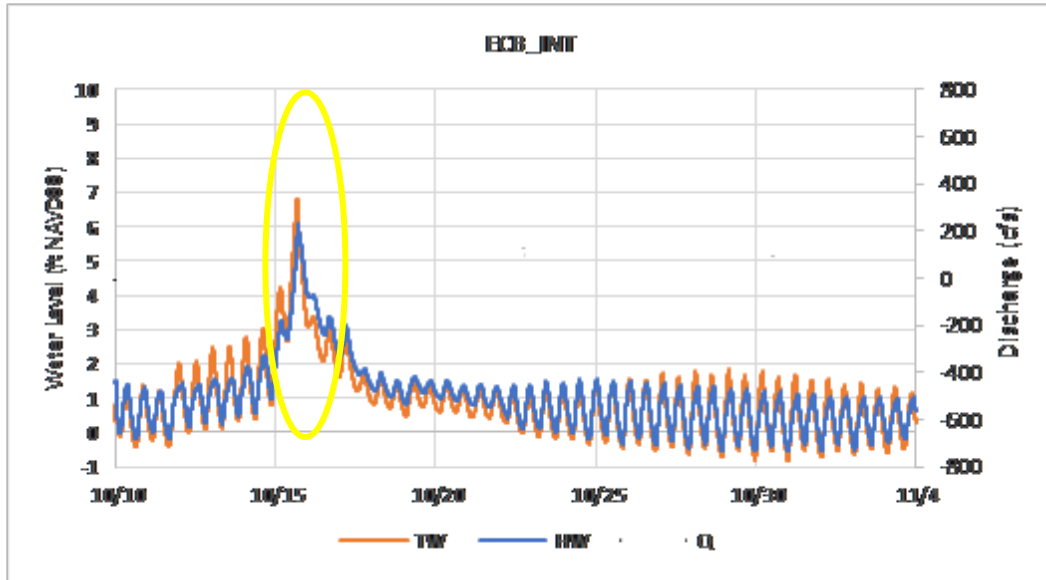


STRUCTURE PERFORMANCE, G93 – 20S25R





STRUCTURE PERFORMANCE, G93 – 20S25R



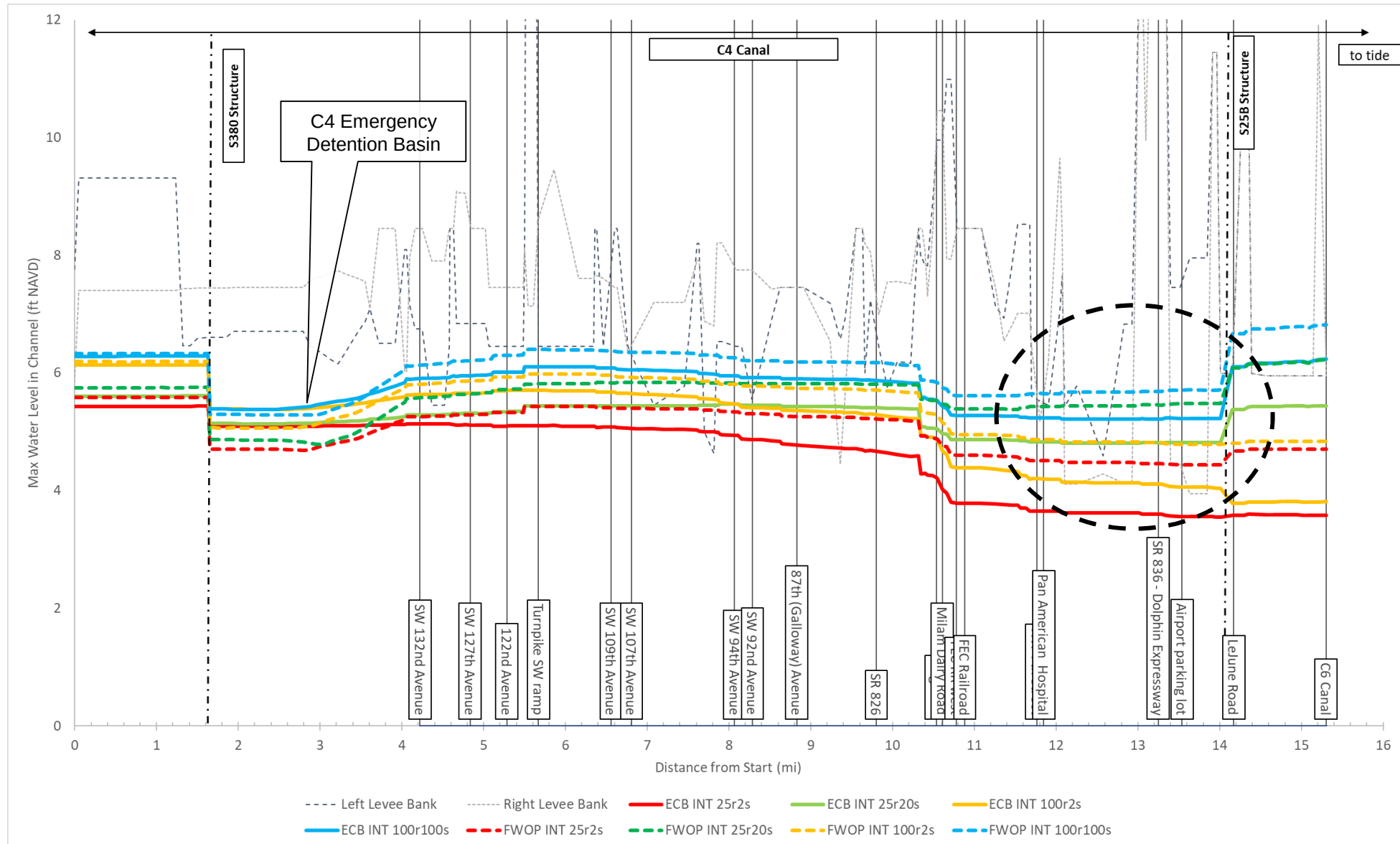


C4 CANAL



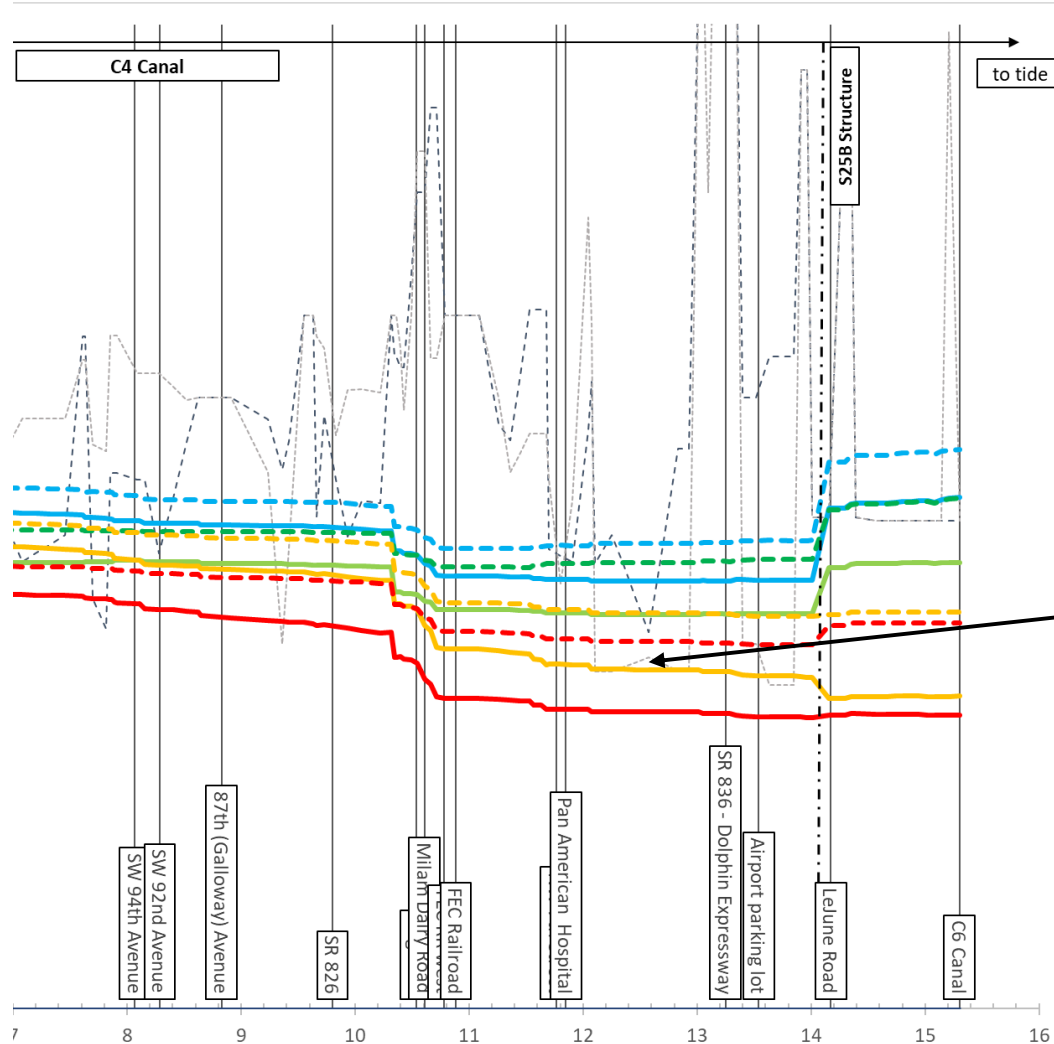


MAXIMUM STAGE PROFILE PLOT – C4 CANAL





MAXIMUM STAGE PROFILE PLOT – C4 CANAL

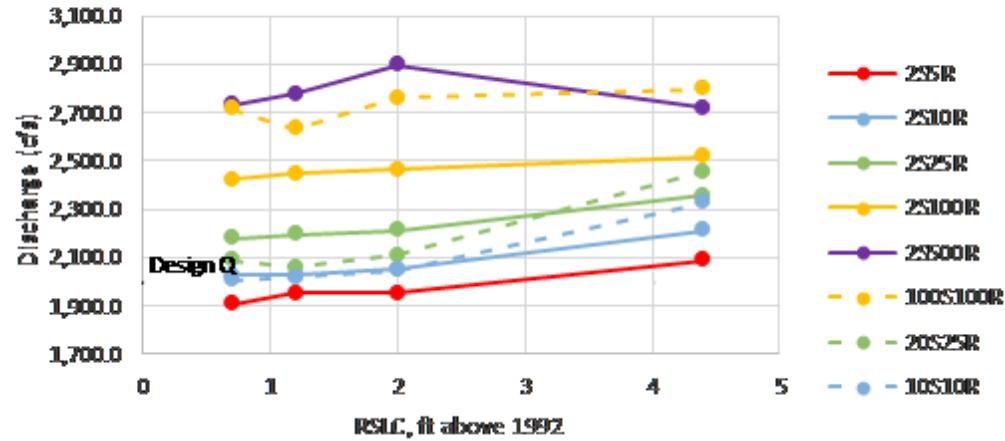




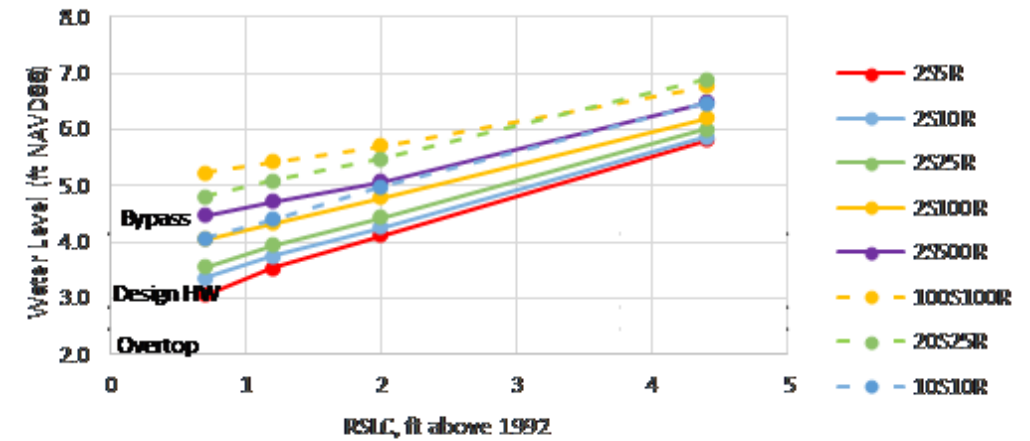
STRUCTURE PERFORMANCE, S25B



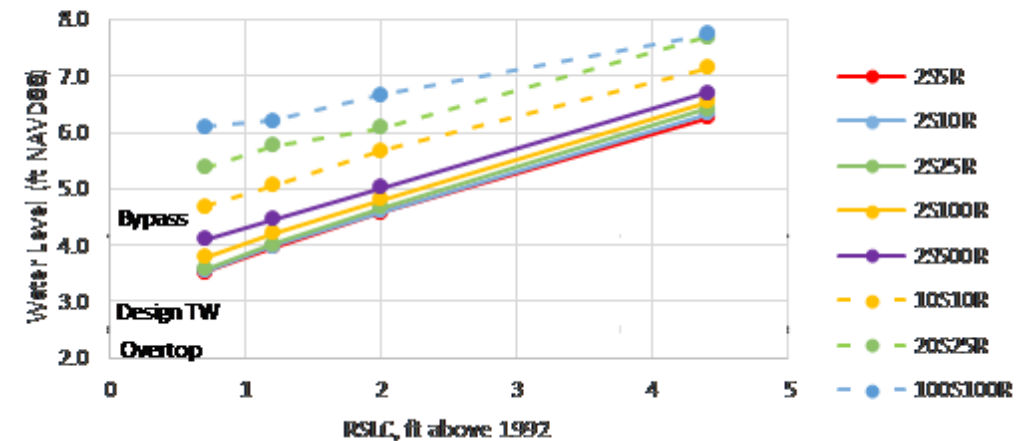
S25B, Peak Instantaneous Discharge



S25B, Peak Instantaneous Headwater

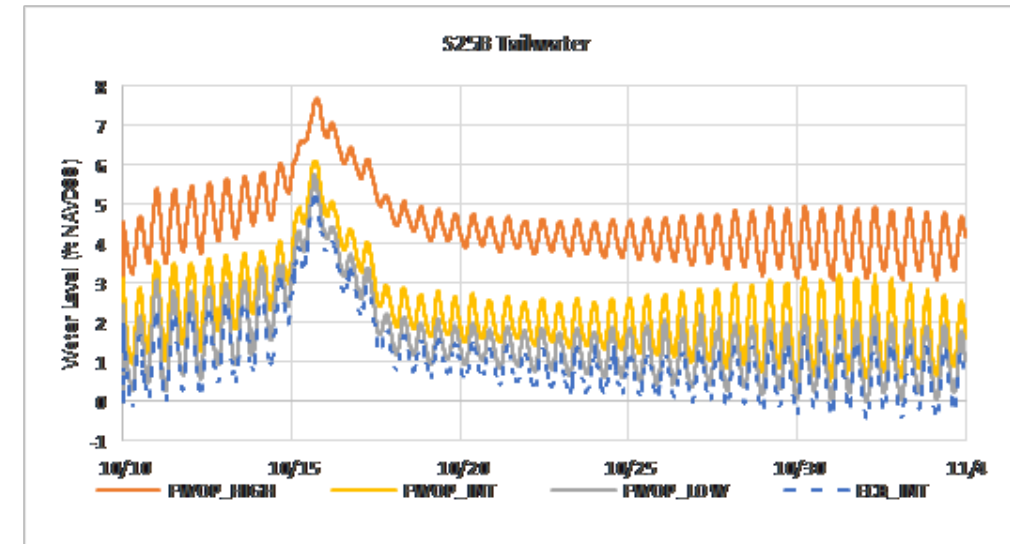
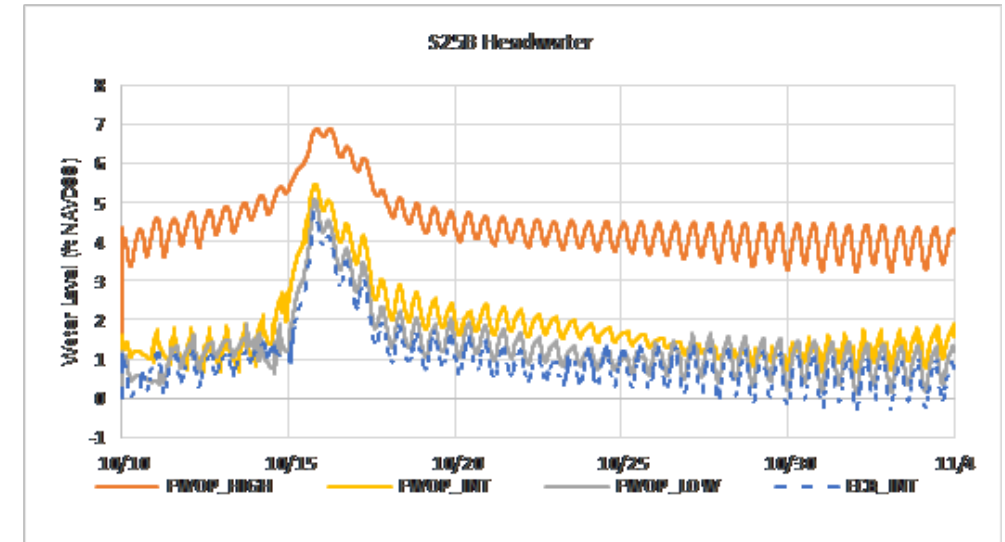
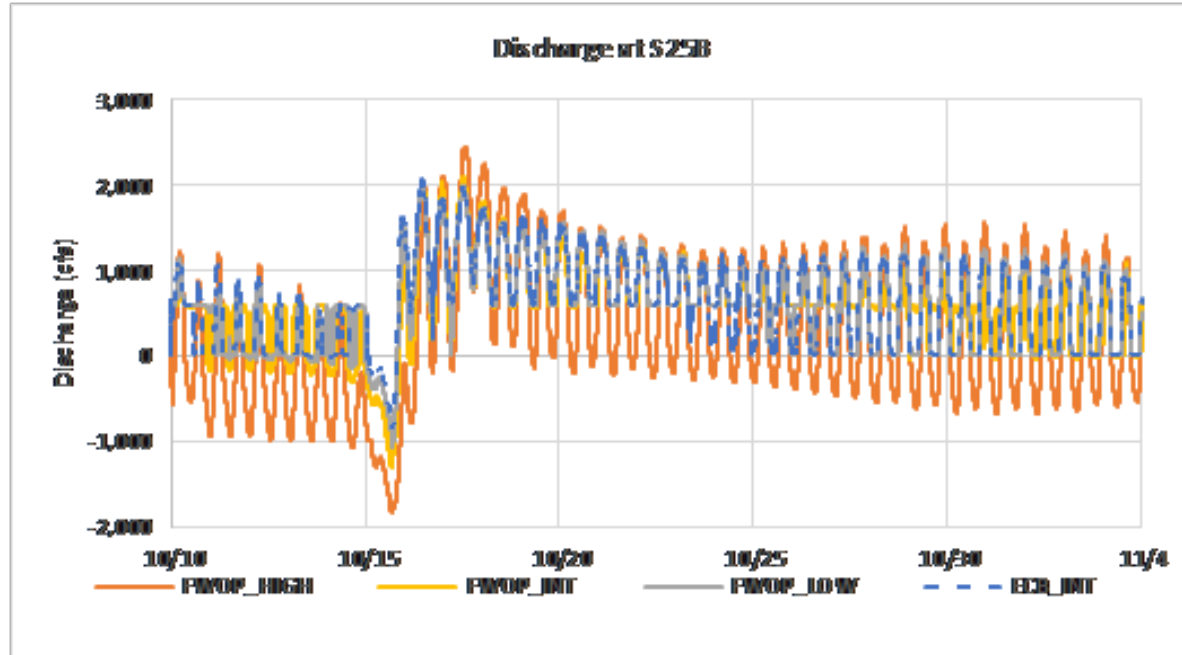


S25B, Peak Instantaneous Tailwater



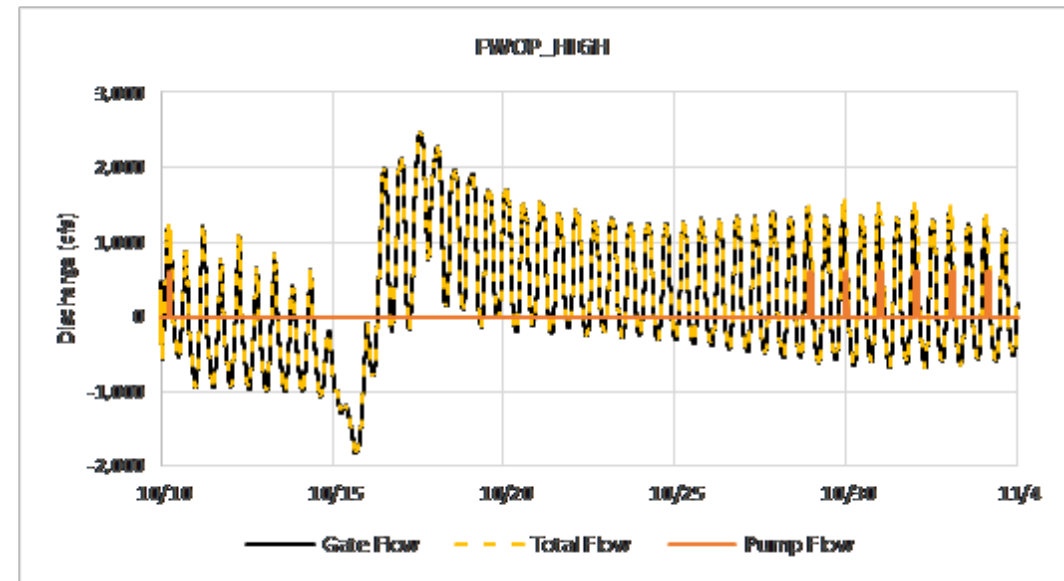
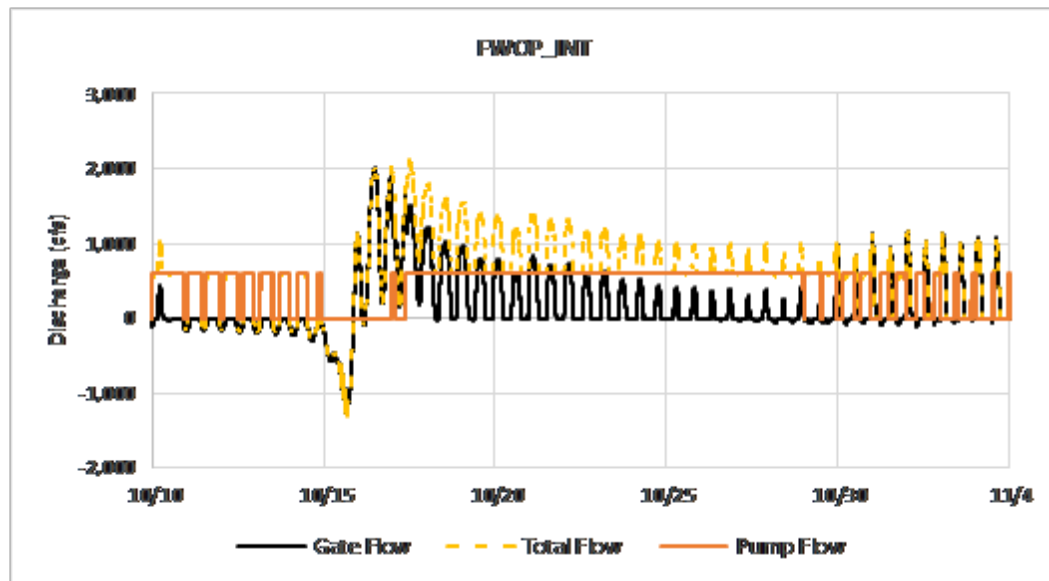
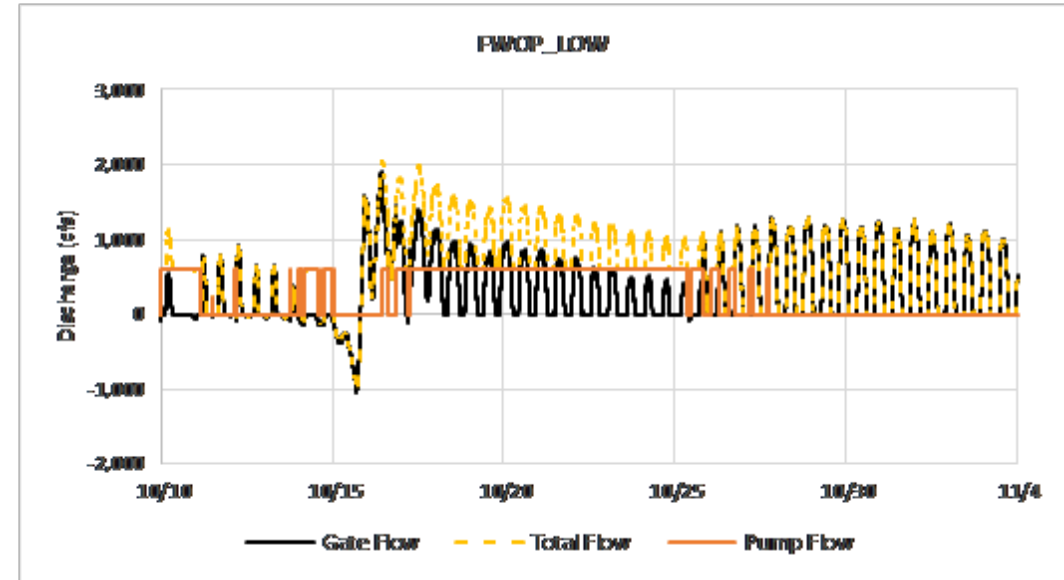
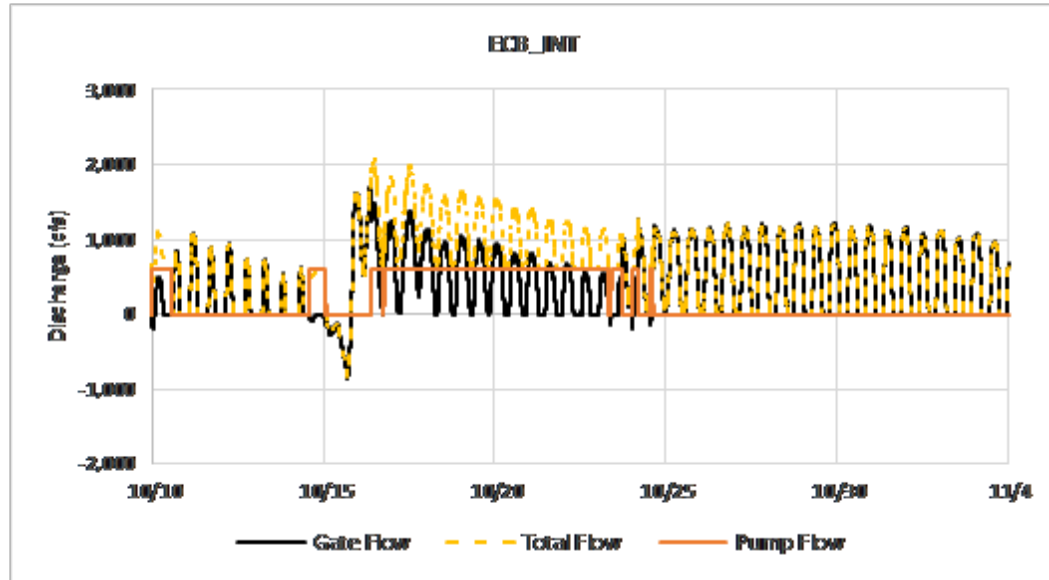


STRUCTURE PERFORMANCE, S25B – 20S25R





STRUCTURE PERFORMANCE, S25B – 20S25R



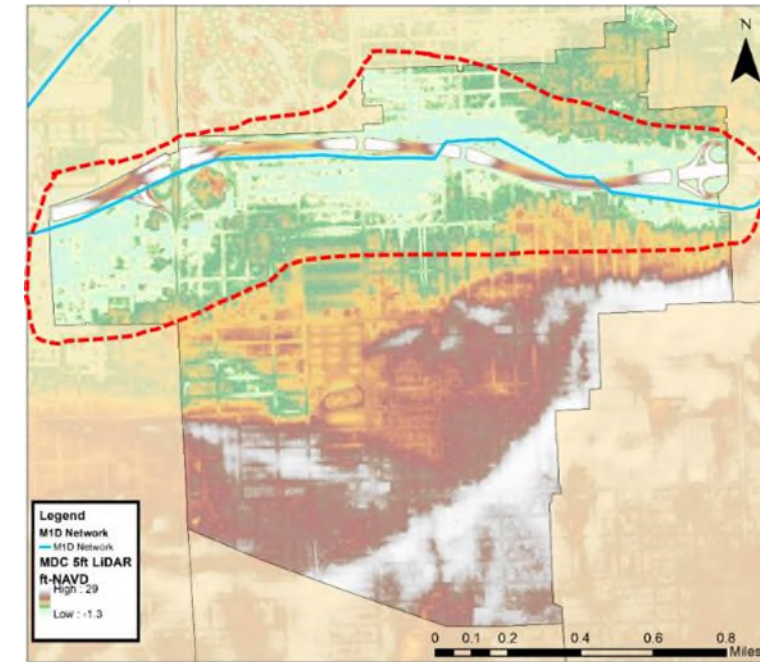
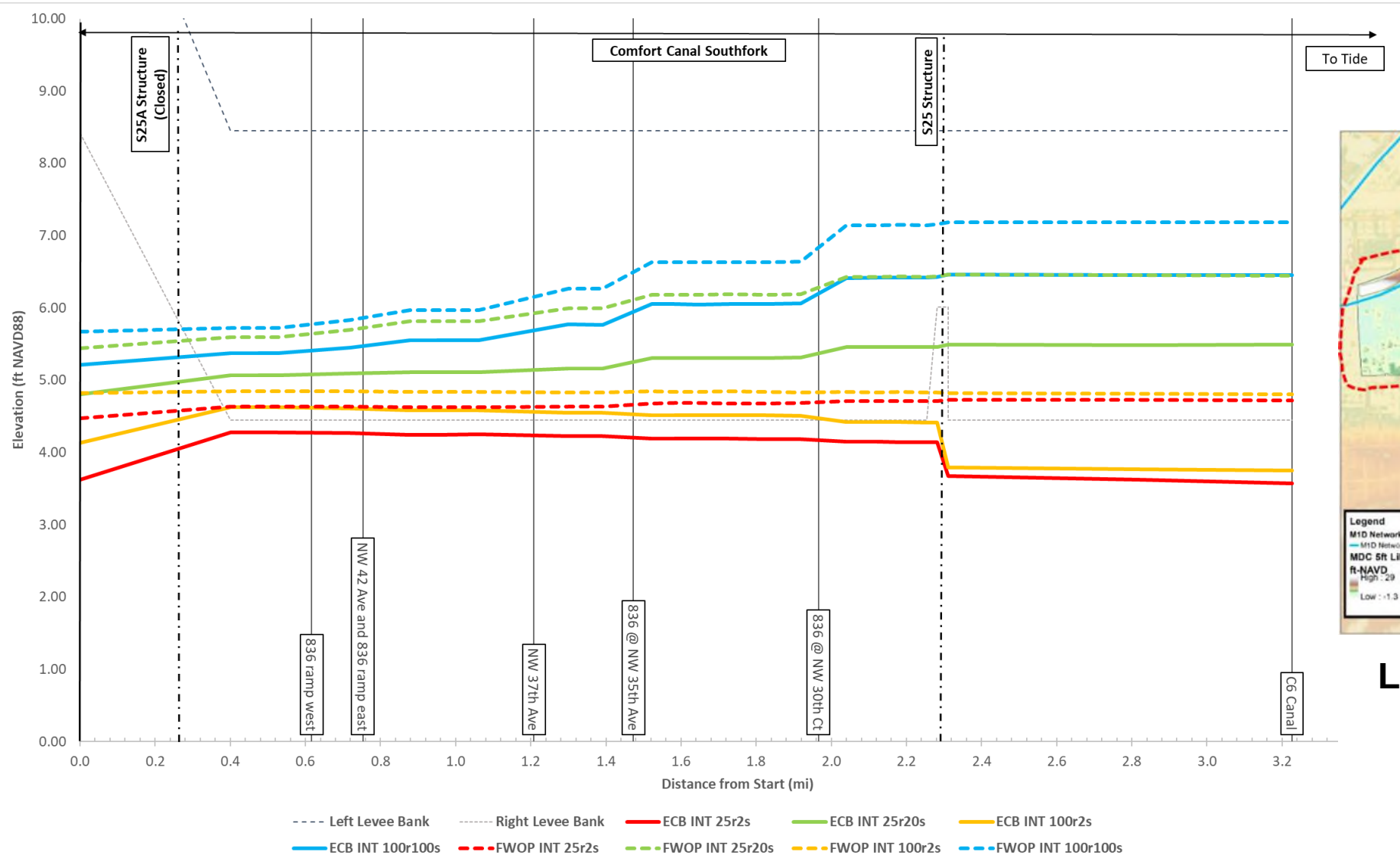


C5/ COMFORT CANAL





MAXIMUM STAGE PROFILE PLOT – COMFORT CANAL



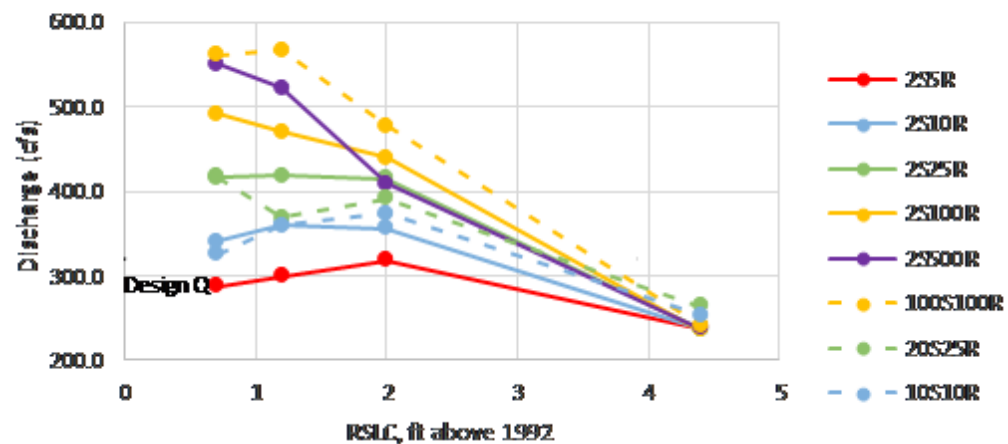
**Low topography region near
Comfort Canal Southfork**



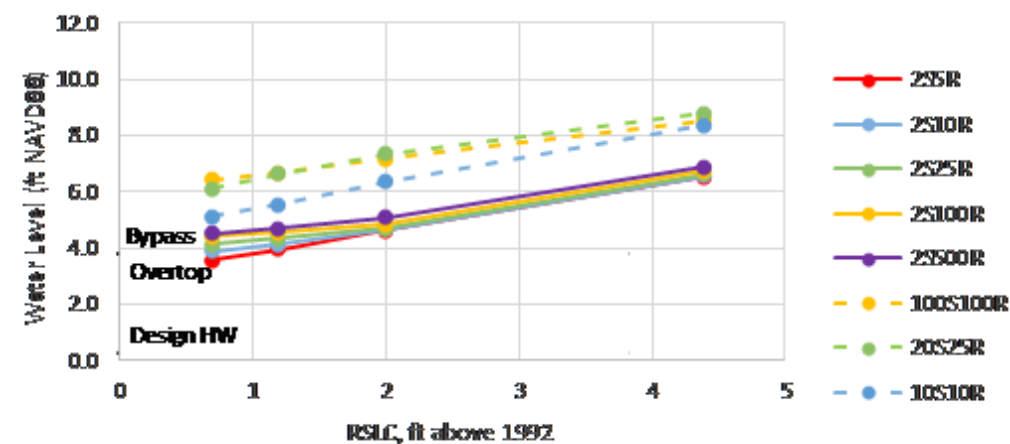
STRUCTURE PERFORMANCE, S25



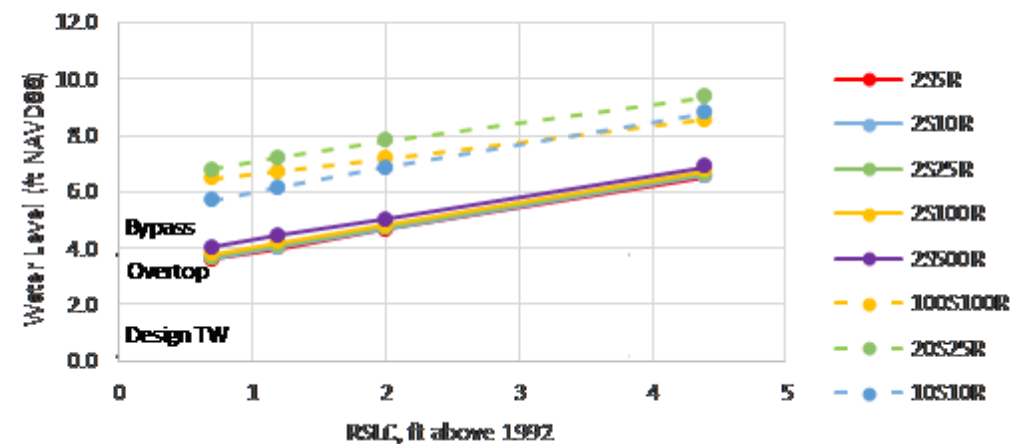
S25, Peak Instantaneous Discharge



S25, Peak Instantaneous Headwater



S25, Peak Instantaneous Tailwater



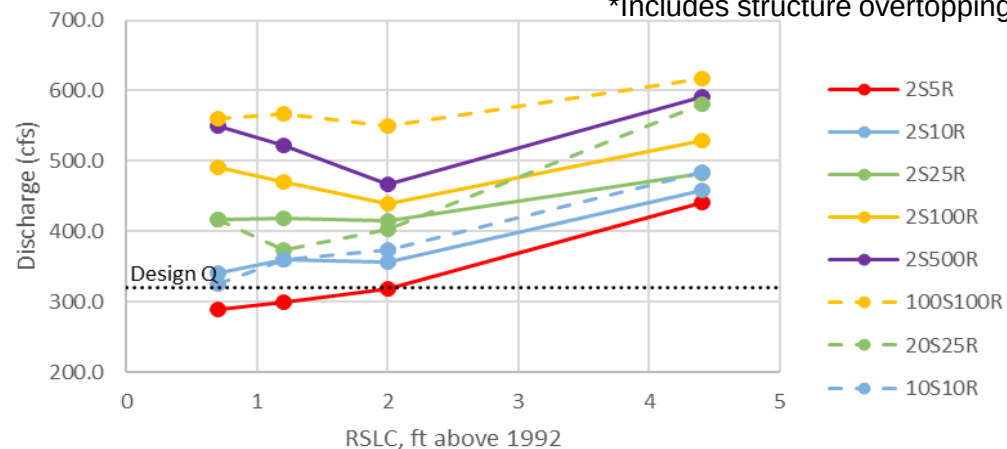


STRUCTURE PERFORMANCE, S25

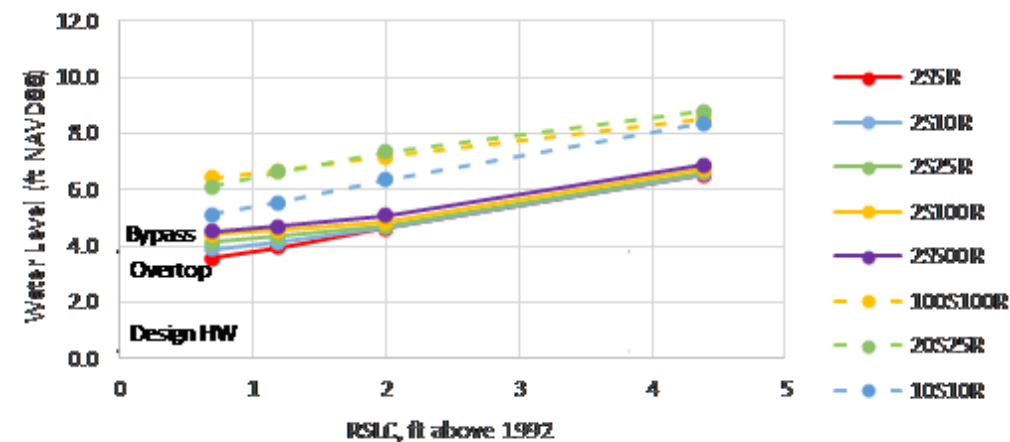


S25, Peak Instantaneous Discharge

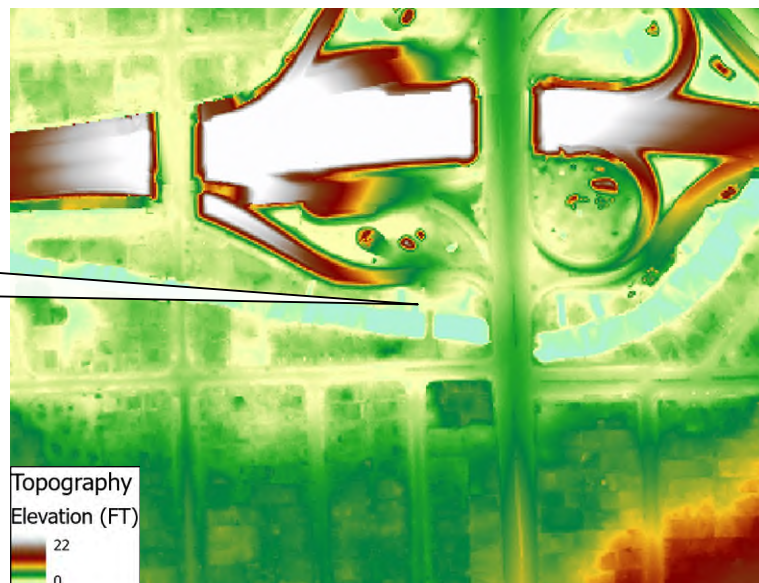
*Includes structure overtopping



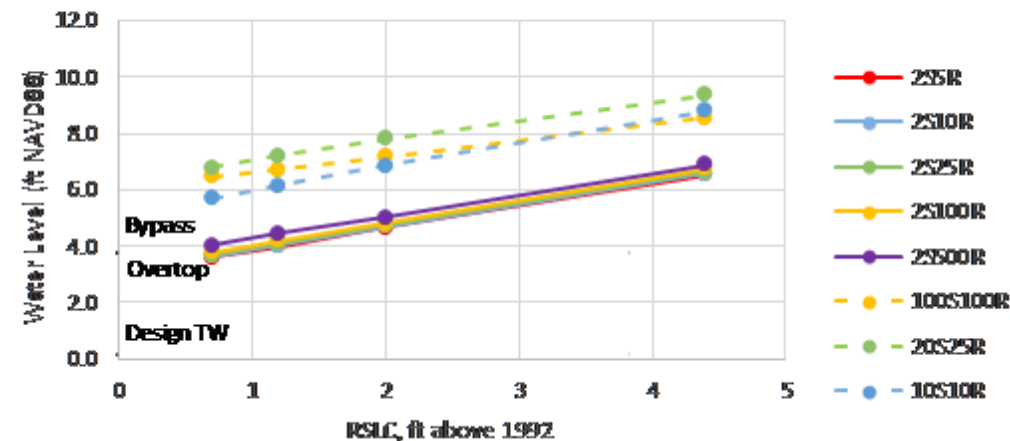
S25, Peak Instantaneous Headwater



Low areas around S25

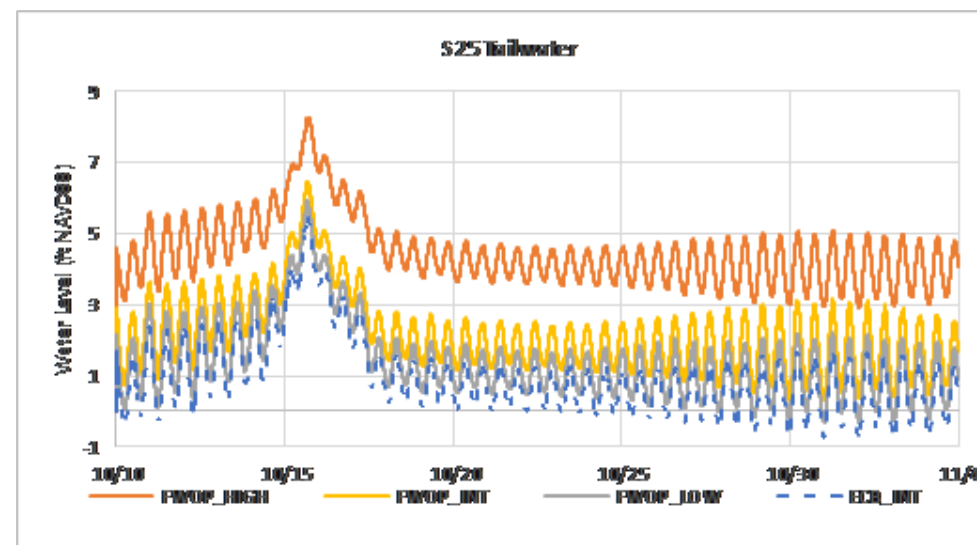
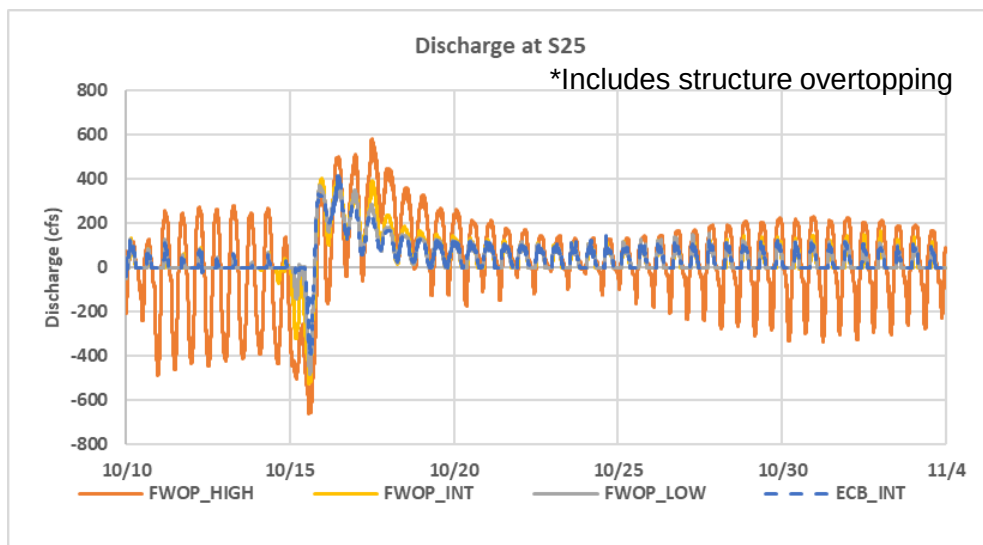
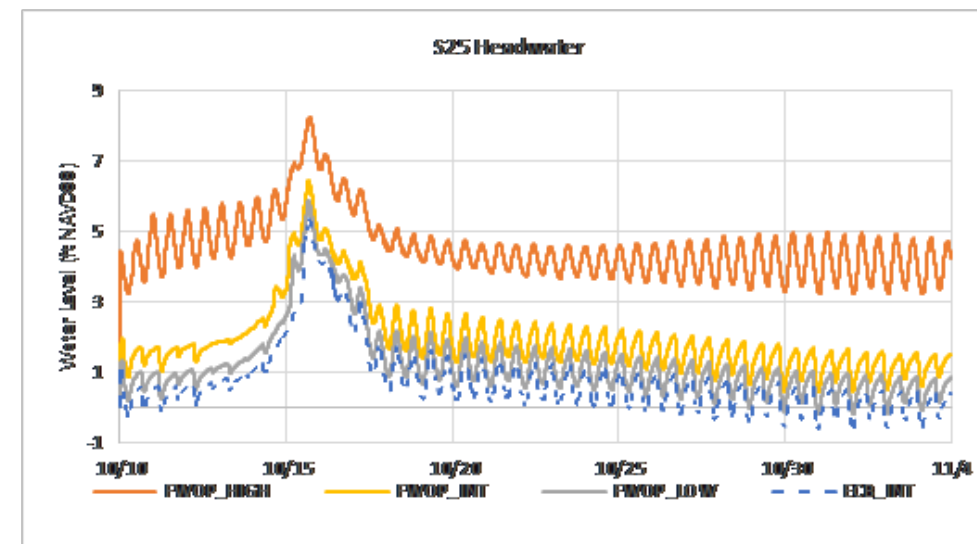
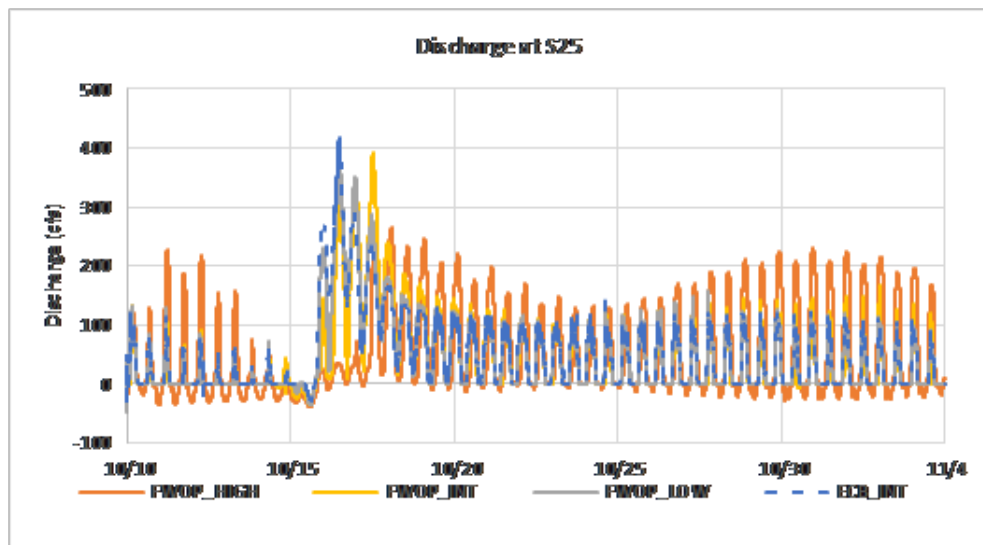


S25, Peak Instantaneous Tailwater





STRUCTURE PERFORMANCE, S25 – 20S25R



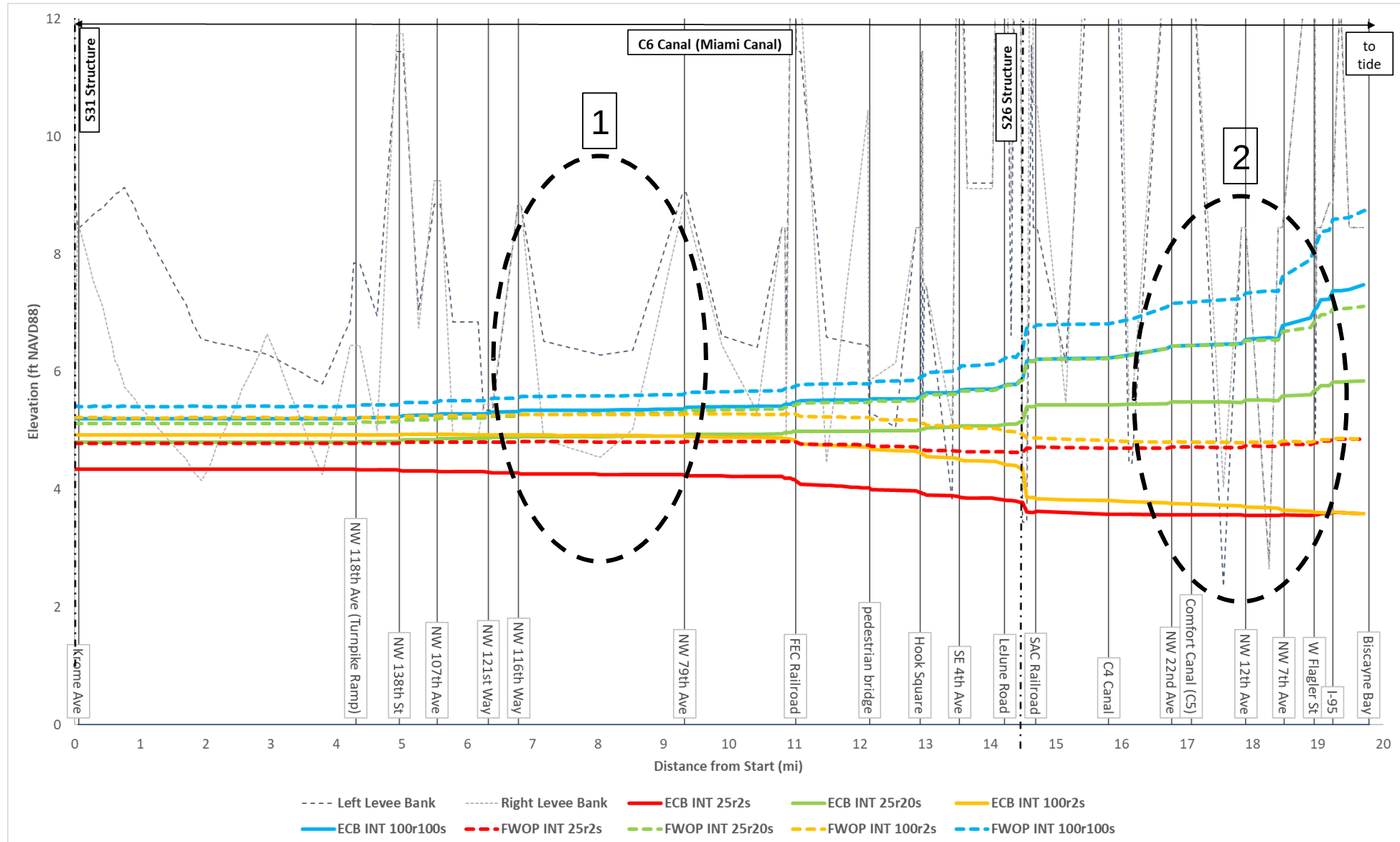


C6 CANAL





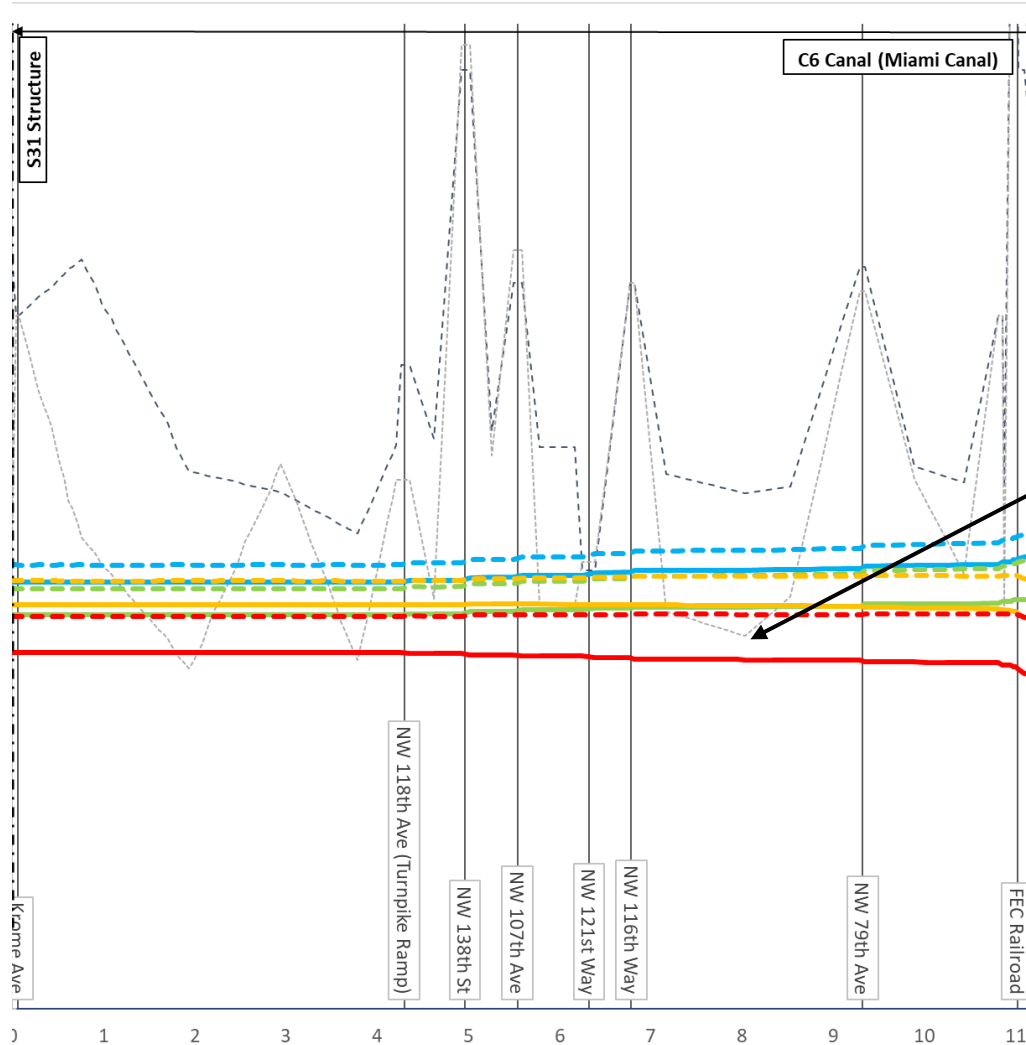
MAXIMUM STAGE PROFILE PLOT – C6 CANAL





MAXIMUM STAGE PROFILE PLOT – C6 CANAL

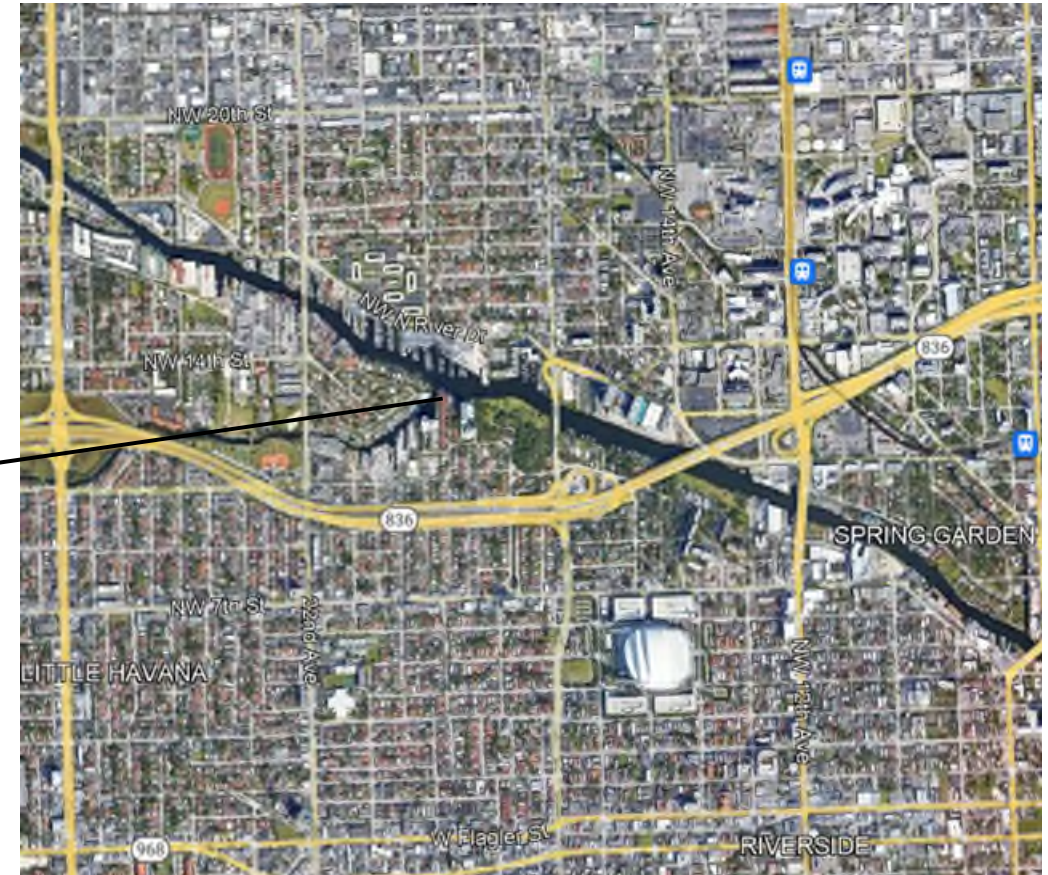
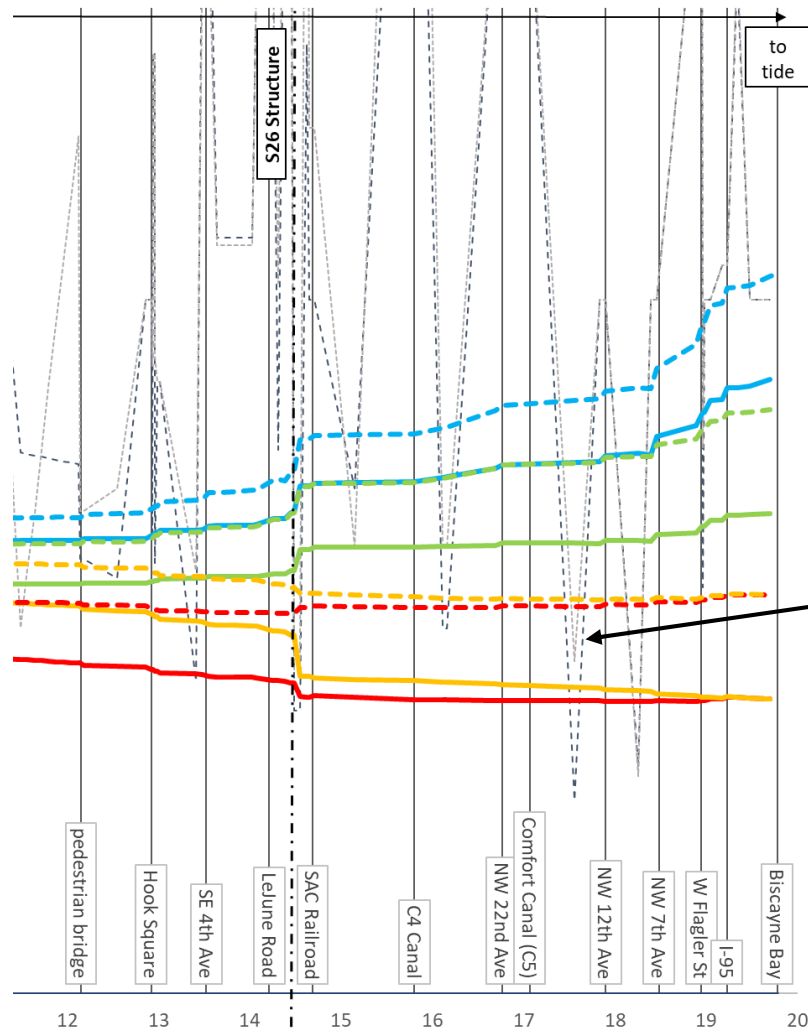
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MAXIMUM STAGE PROFILE PLOT – C6 CANAL

2

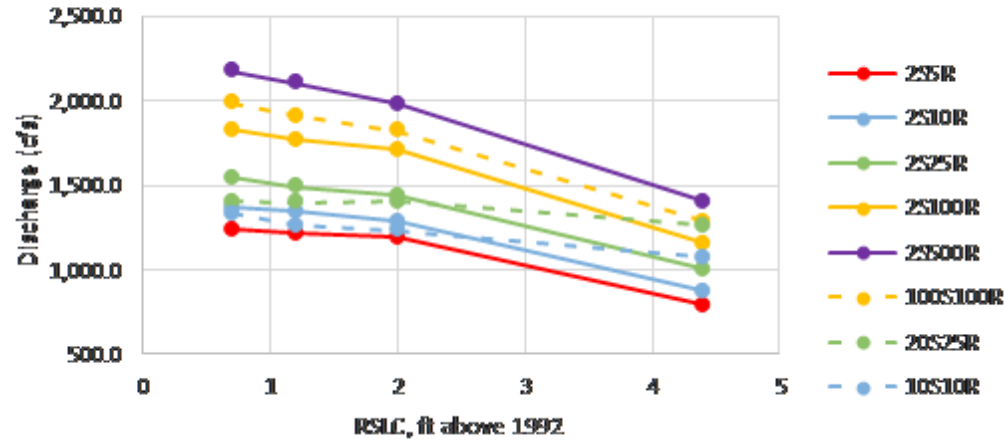




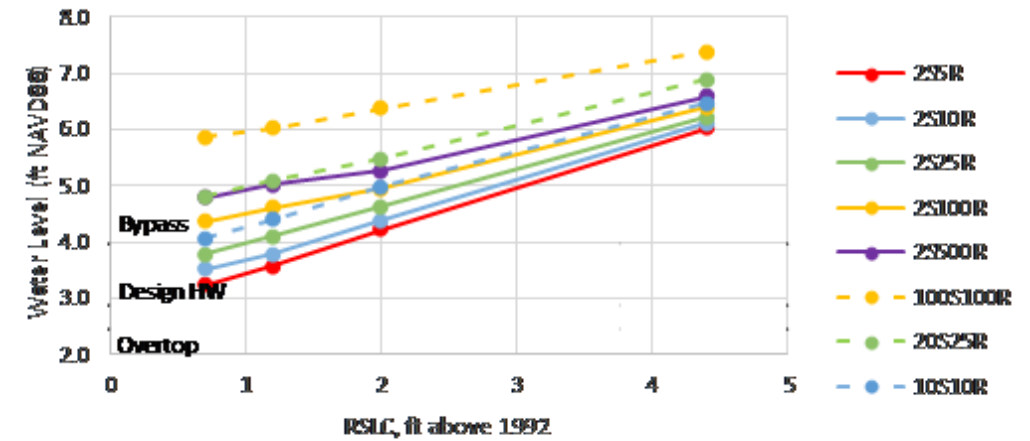
STRUCTURE PERFORMANCE, S26



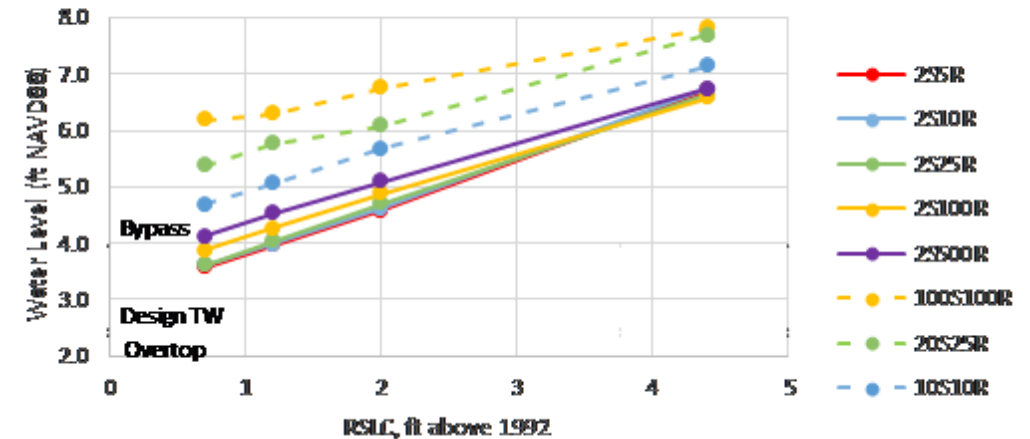
S26, Peak Instantaneous Discharge



S26, Peak Instantaneous Headwater

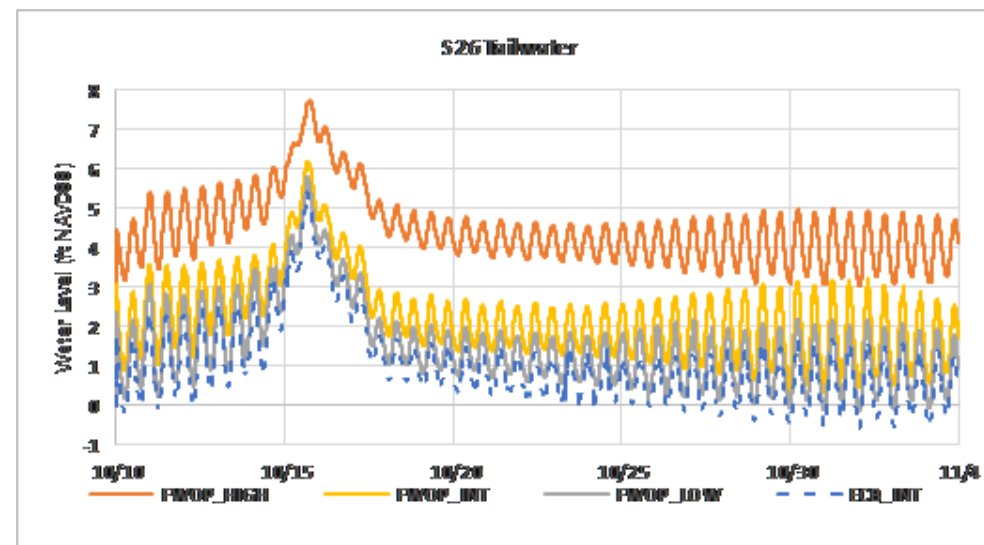
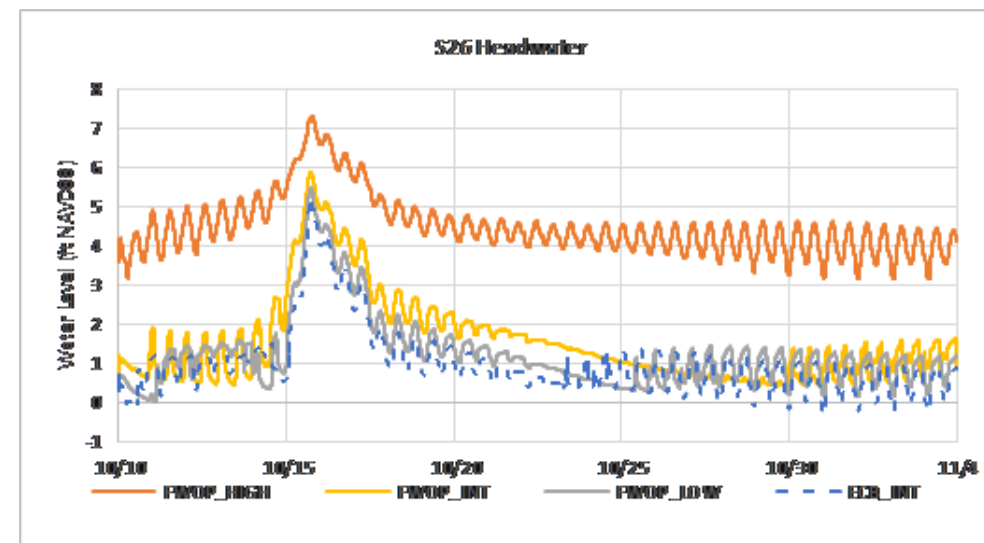
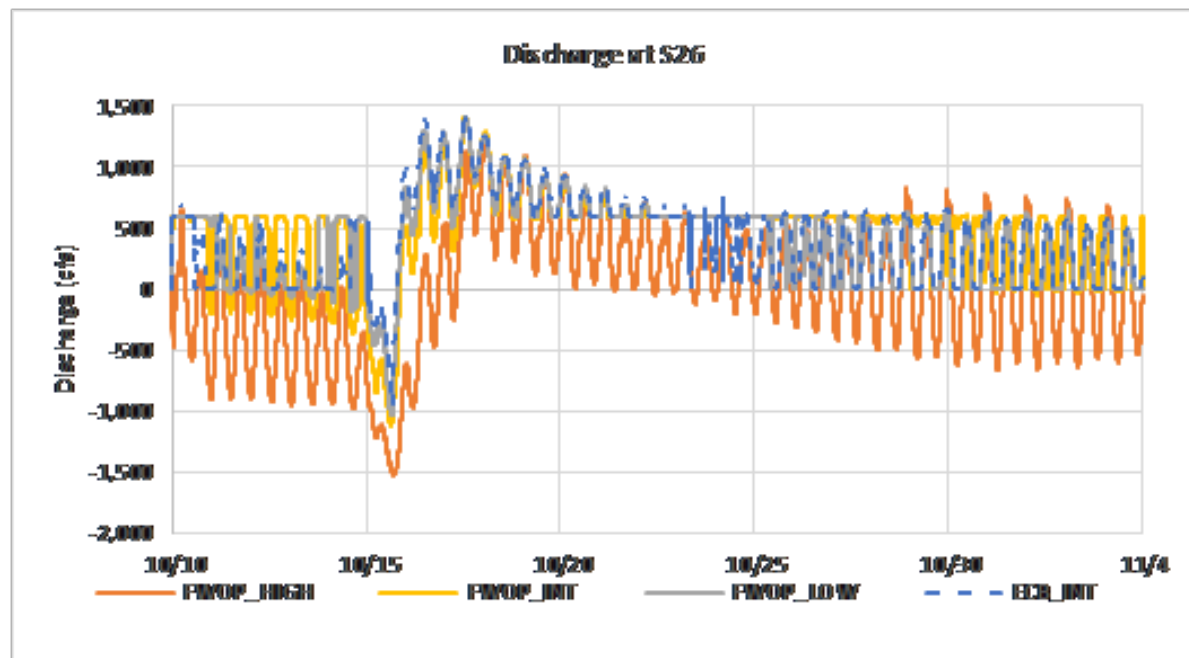


S26, Peak Instantaneous Tailwater



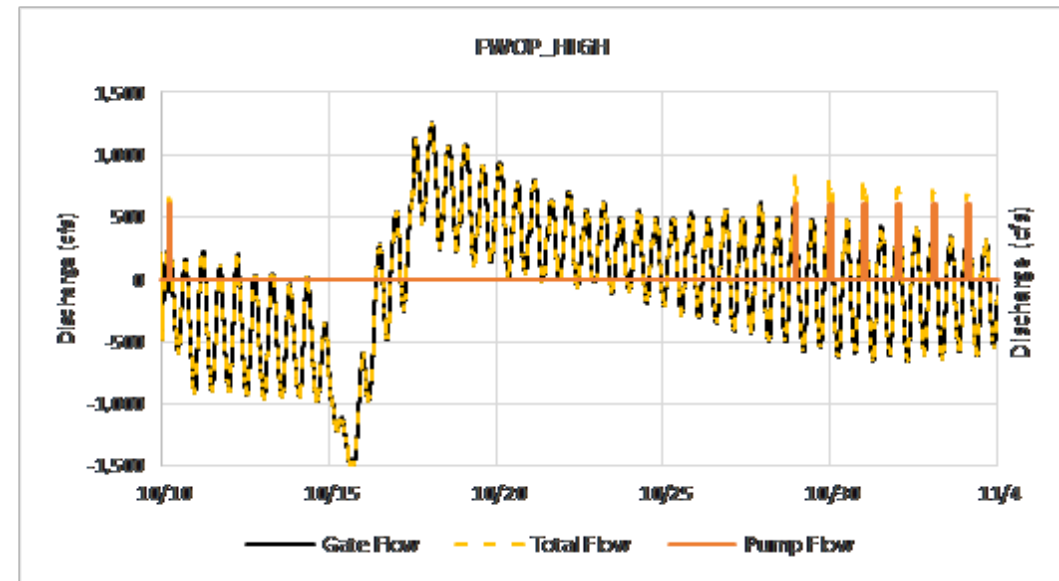
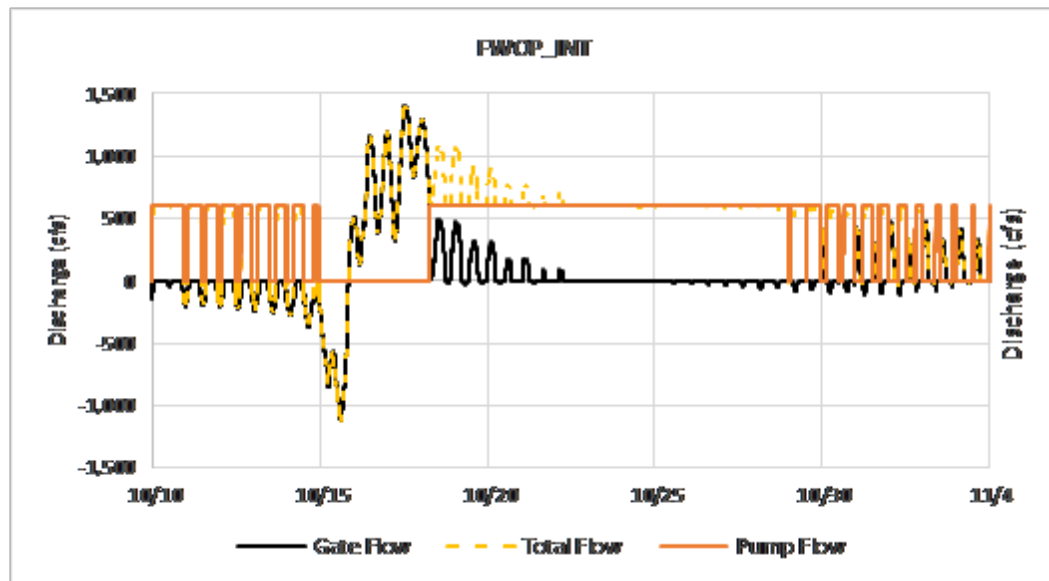
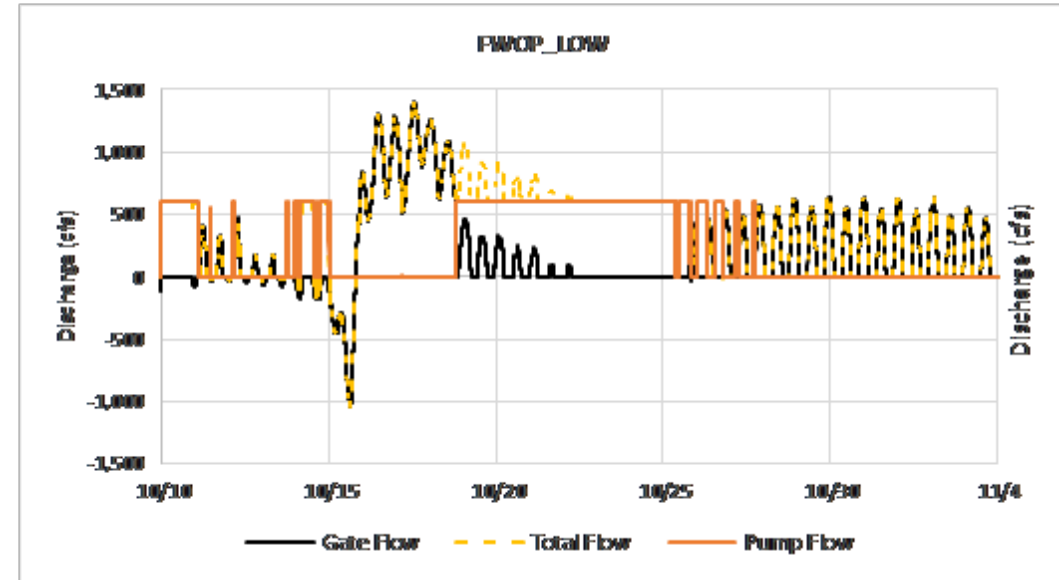
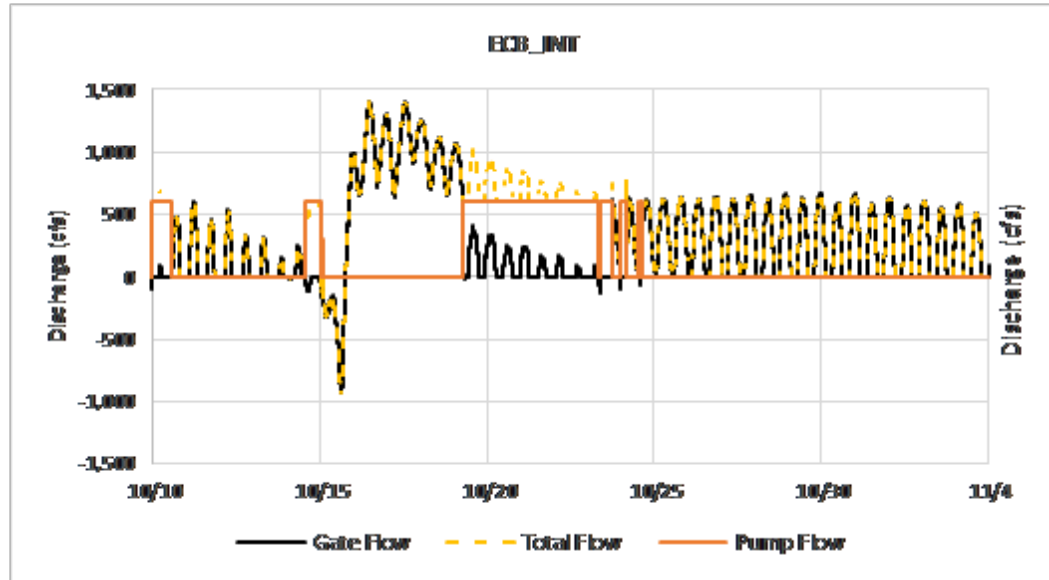


STRUCTURE PERFORMANCE, S26 – 20S25R





STRUCTURE PERFORMANCE, S26 – 20S25R





RESULTS OVERVIEW

Canal	Profile	Structure	Performance
C2	4 regions of low embankment - Residential - Natural - Commercial - Residential		- Peak HW elevations overtop structure gates for ECB and all FWOP SLR scenarios. - Peak HW and TW elevations exceed bypass elevation for all FWOP High SLR scenarios. - Overall forward discharge capability decreases with increasing SLR. - Peak forward discharge occurs later in the FWOP High SLR scenario due to increased retention and backflow. - Peak forward discharge trends vary with each FWOP scenario. - Peak “negative flow”, or backflow increases with increasing SLR.
C3	1 region of low embankment Residential/golf course		- Peak HW and peak TW elevations bypass the structure for all FWOP Int and High SLR scenarios. - Overall forward discharge capability decreases with increasing SLR. - Peak forward discharge occurs after the peak surge elevation due to retention and backflow. - Peak discharge tends to increase with increasing SLR, except for extreme rainfall events where peak discharge is flat with increasing SLR. - Peak “negative flow”, or backflow increases with increasing SLR.
C4	1 region of low embankment High density residential and commercial The C4 Emergency Detention Basin (C4 EDB) pulls water out of the C4 Canal, producing a reduction in the peak canal stages downstream of S-380.		- Peak HW and peak TW elevations bypass the structure for all FWOP Int and High SLR scenarios. - Overall forward discharge capability decreases with increasing SLR. - Peak forward discharge occurs after the peak surge elevation due to retention and backflow. - Pump operation duration increases with increasing SLR, except for FWOP High, as the pump does not operate due to high stages outside of operational range. - Peak “negative flow”, or backflow increases with increasing SLR.
C5	Low embankments throughout Residential		- Peak HW and Peak TW elevations bypass the structure for ECB and all FWOP SLR scenarios. - Overall forward discharge capability decreases with increasing SLR. - Peak forward discharge occurs after the peak surge elevation due to retention and backflow. - Peak gate discharge decreases with increasing SLR. - Total peak discharge (gate + overtopping) tends to decrease as SLR increases until RSLC > 2 when peak discharge increases, due to increasing backflow and retention.
C6	2 regions of low embankments - Industrial - Park/natural areas)		- Peak TW elevations bypass the structure for all FWOP SLR scenarios. - Overall forward discharge capability decreases with increasing SLR. - Peak forward discharge occurs after the peak surge elevation due to retention and backflow. - Peak discharge decreases with increasing SLR conditions. - Pump operation duration increases with increasing SLR, except for FWOP High, as the pump does not operate due to high stages outside operational range. - Peak “negative flow”, or backflow increases with increasing SLR.



ANALYSIS AND RESULTS

ADDITIONAL DETAILS



C&SF FLOOD RESILIENCY (SECTION 216) STUDY

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





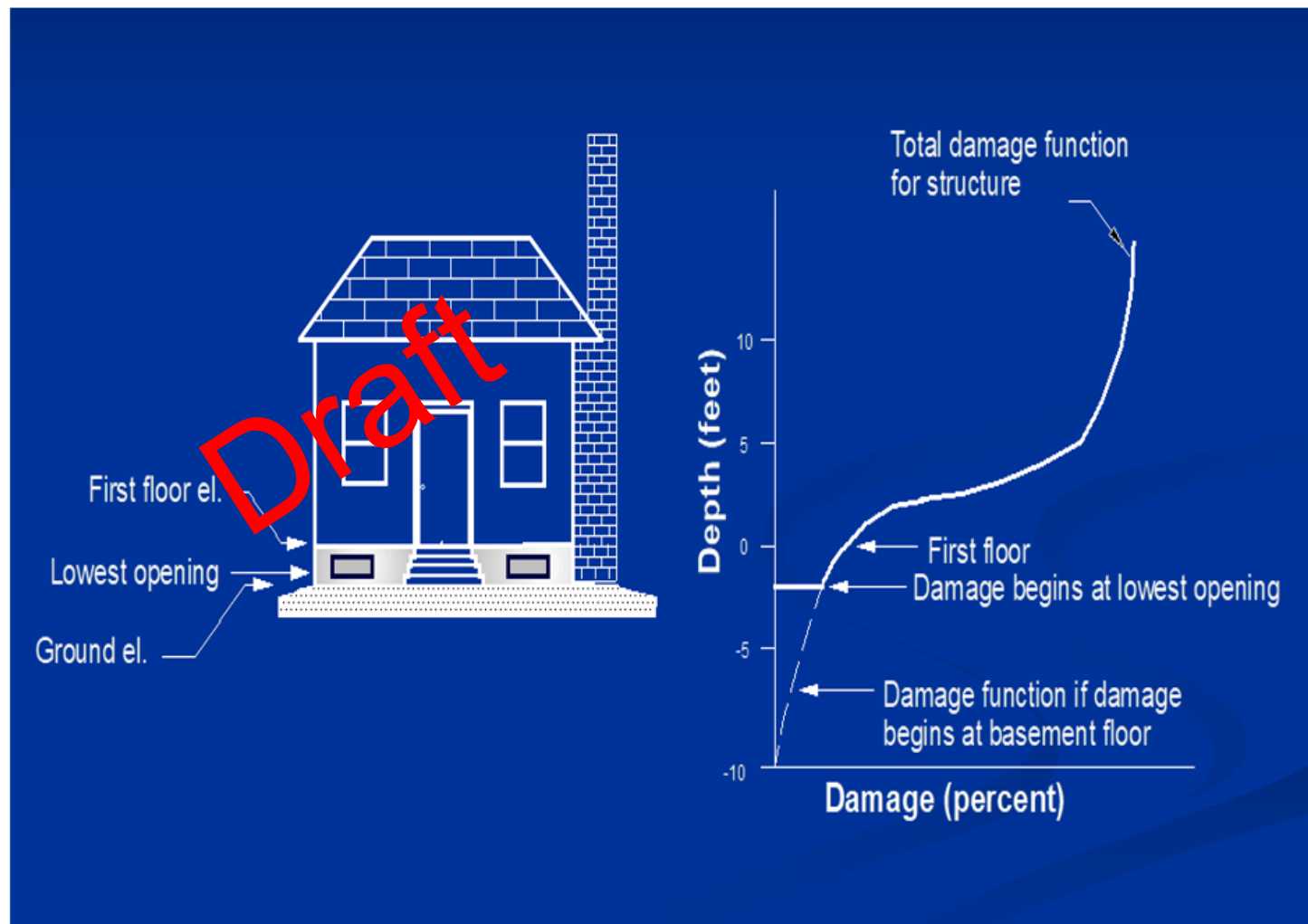
C&SF FLOOD RESILIENCY (SECTION 216) STUDY

EXISTING AND FUTURE 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

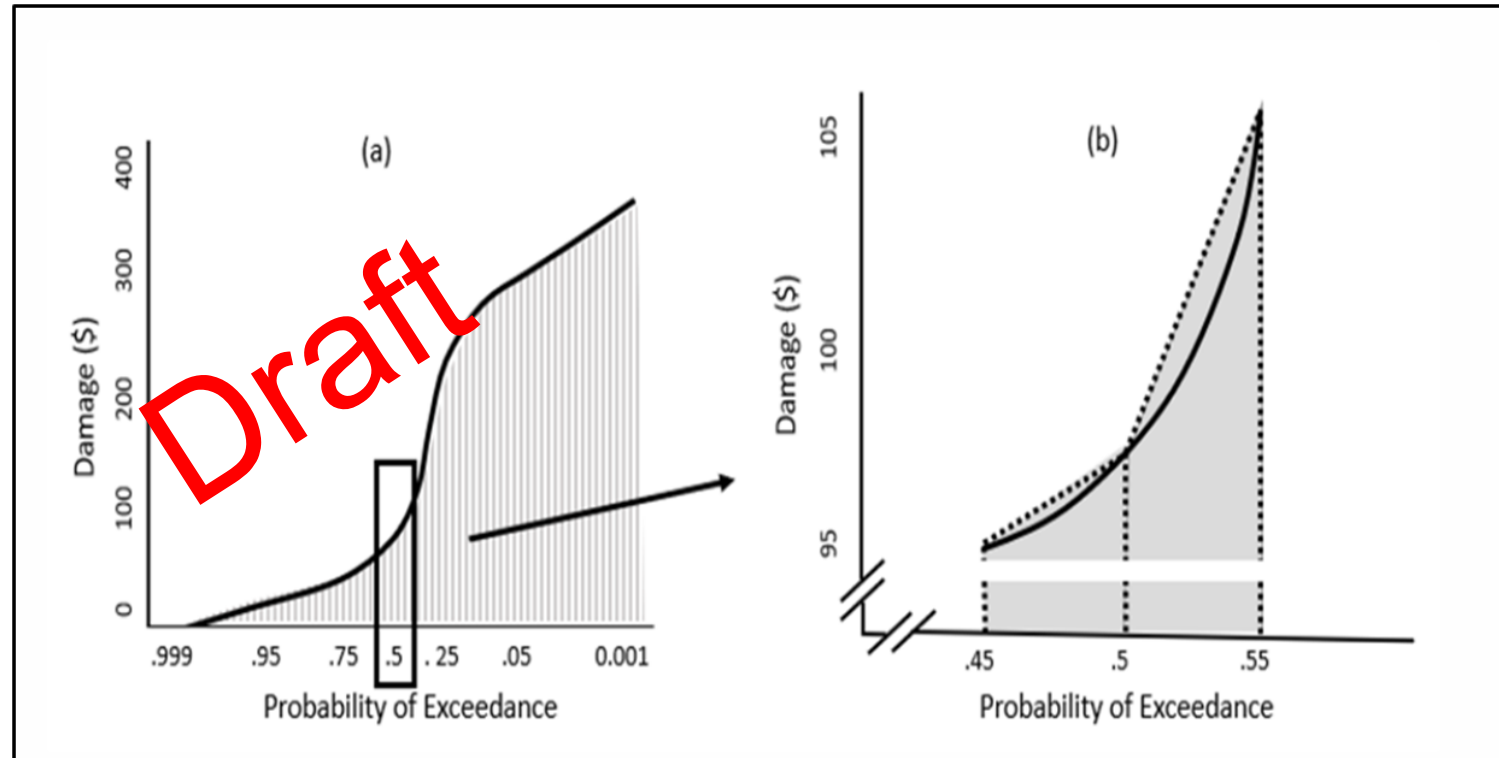


C&SF FLOOD RESILIENCY (SECTION 216) STUDY THE ECONOMIC MODEL: HEC-FDA



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 probable events** from MIKE-SHE outputs to estimate ***Expected Annual Damage (EAD)***

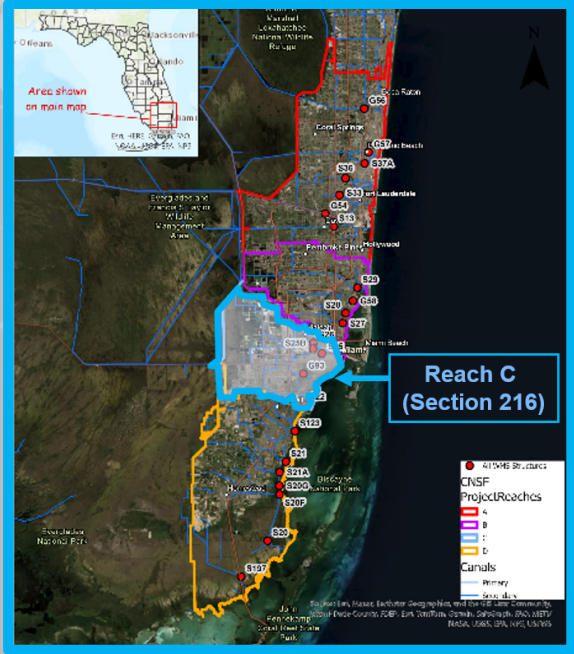
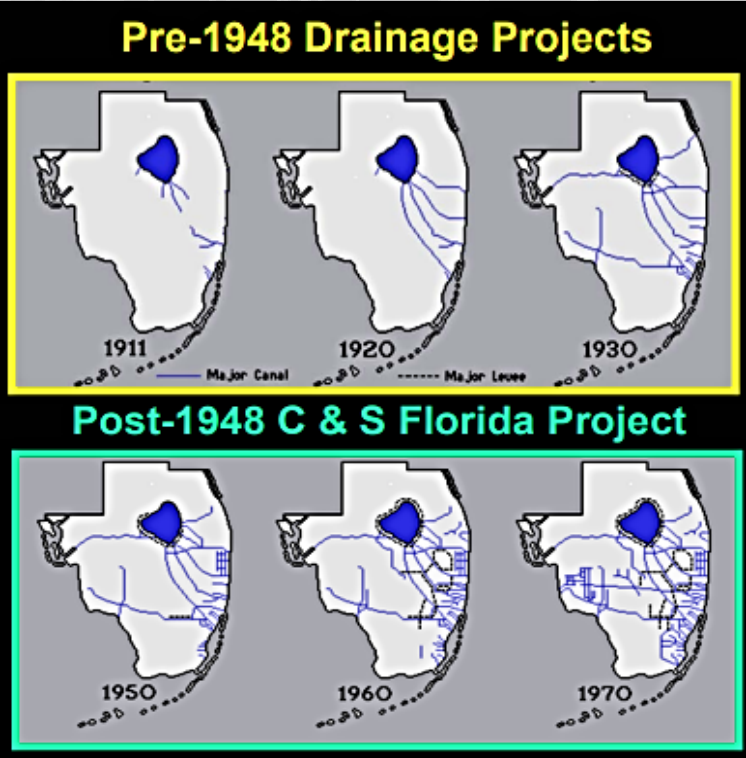
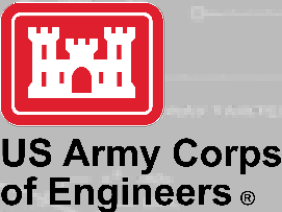


CENTRAL AND SOUTHERN FLORIDA (C&SF) FLOOD RESILIENCY (SECTION 216) STUDY

FUTURE WITHOUT PROJECT (FWOP)

February 5, 2026
Virtual Meeting

Working Today to Build a Better Tomorrow





HEC-FDA – ECONOMIC ANALYSIS MODELING FOR THE FWOP

Presenters:

Colin Rawls, Chief Socioeconomics Section, USACE

Erik Adamiec, Regional Economist, USACE

Del Cabeche, Lead Economist, USACE

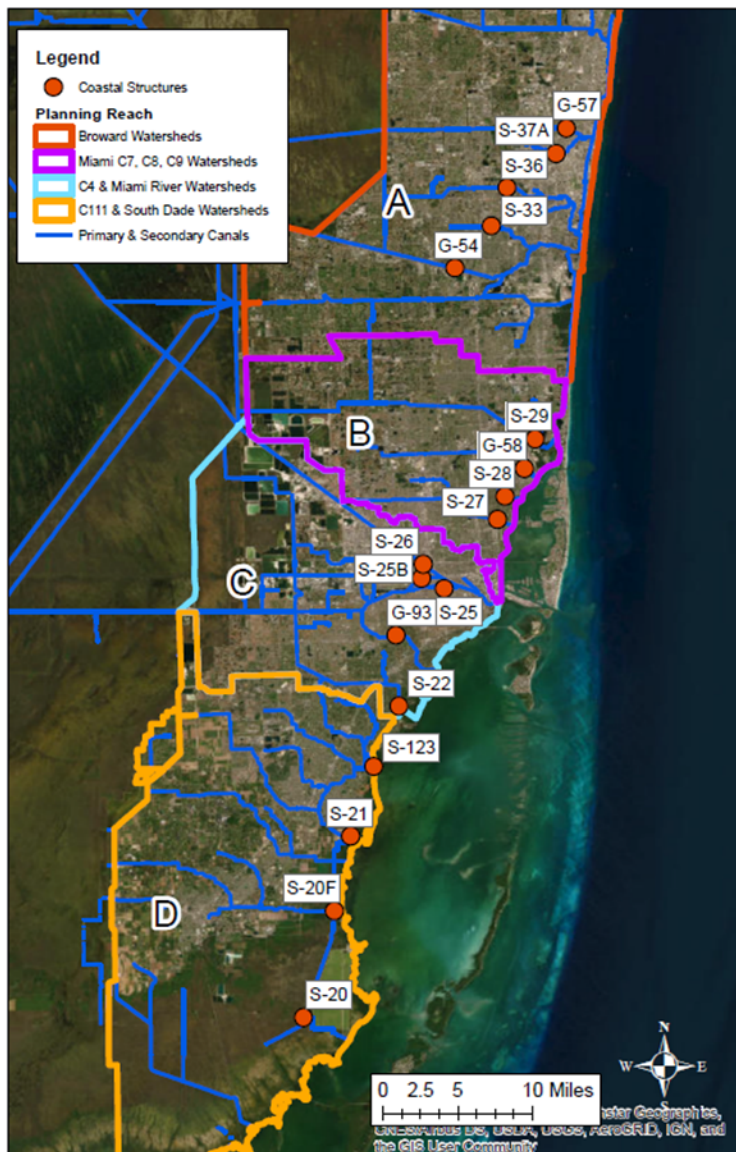


C&SF FLOOD RESILIENCY (SECTION 216) STUDY

MODELING THE 216 STUDY IN HEC-FDA



Slide 3



Reach C - ~\$75B in
Damageable Value

Structure Inventory Summary (Count)	Reach A	Reach B	Reach C	Reach D	
Agriculture, structure only	874	206	996	7,211	
Retail, structure only	4,562	2,763	3,238	1,514	
Prof/Tech Services	4,802	2,630	2,735	898	
Other Commercial	4,152	1,940	2,080	1,074	
Hospital	146	106	80	15	
Education	3,213	1,575	1,141	786	
Government Services	1,186	1,534	2,006	1,921	
Industrial	6,741	3,442	4,843	1,116	
Religious	1,486	942	634	407	
Residential	383,785	208,194	190,204	132,136	
Utility	142	72	56	36	
Vehicles			190,000		
Total	411,089	223,404	398,013	147,114	Total Inventory 1,179,620



C&SF FLOOD RESILIENCY (SECTION 216) STUDY

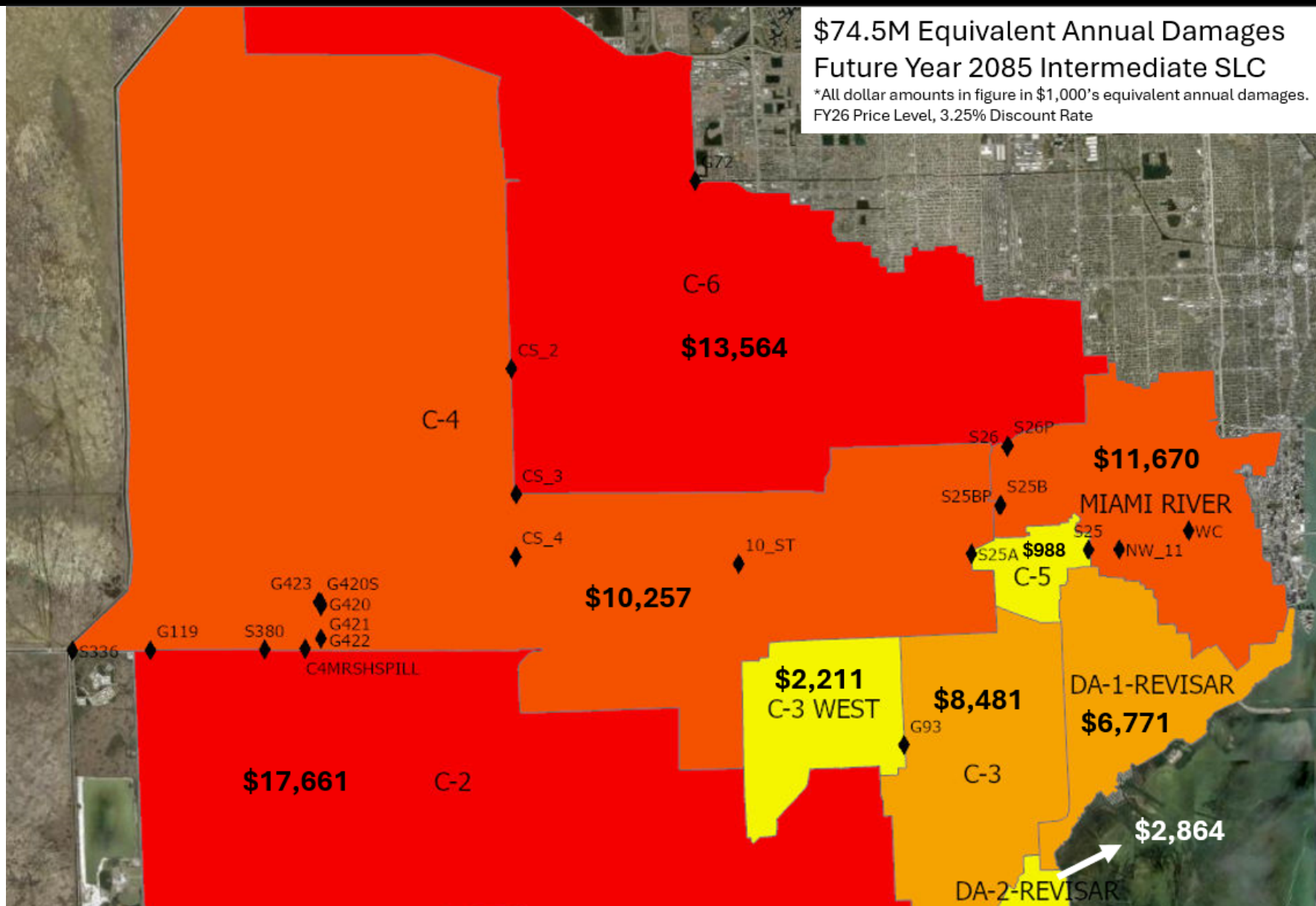
MODELING THE 216 STUDY IN HEC-FDA



Slide 4



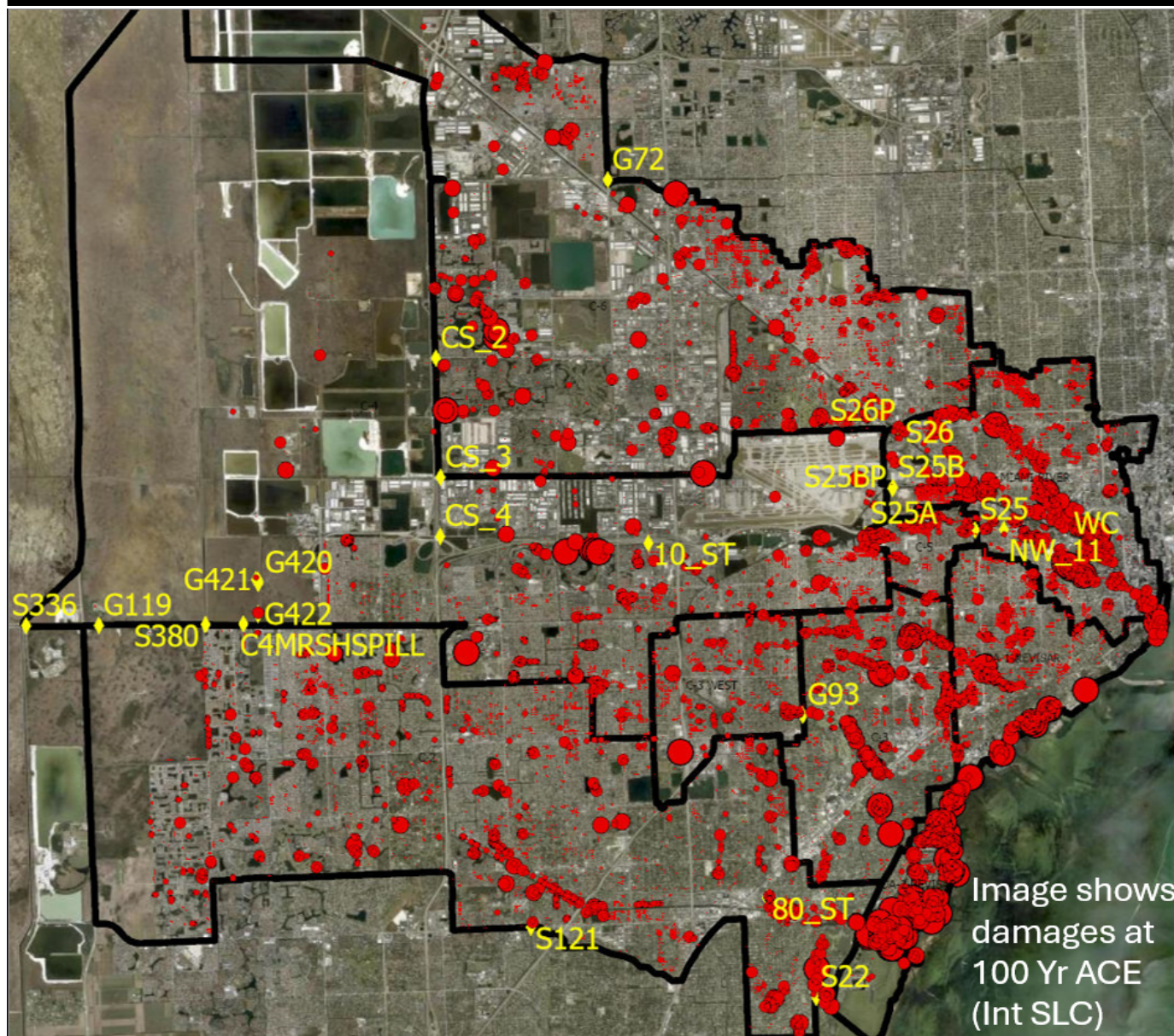
All modeling was completed using the new certified HEC-FDA Model Version 2.0.2 (mid-study conversion)





C&SF FLOOD RESILIENCY (SECTION 216) STUDY

MODELING THE 216 STUDY IN HEC-FDA



Model Reach	Equivalent Annual Damages (Int SLC)	% of Total	Equivalent Annual Damages (High SLC)	% of Total
DA-1-REVISAR*	\$6,771,400	9%	\$16,504,400	12%
C-4	\$10,257,100	14%	\$12,366,600	9%
C-6	\$13,564,300	18%	\$18,060,000	13%
MIAMI RIVER	\$11,670,500	16%	\$30,269,300	22%
C-3	\$8,481,900	11%	\$14,827,100	11%
C-2	\$17,661,200	24%	\$25,697,800	19%
C-5	\$988,000	1%	\$9,937,400	7%
DA-2-REVISAR*	\$2,864,400	4%	\$6,821,700	5%
C-3 WEST	\$2,211,000	3%	\$3,674,000	3%
Total	\$74,469,800	100%	\$138,158,300	100%

*Significant portions of damage in this reach will be residual

Category	Equivalent Annual Damages (Int SLC, \$1000)	% of Total	Equivalent Annual Damages (High SLC, \$1000)	% of Total
Residential	\$ 50,500	68%	\$ 96,800	70%
Commercial	\$ 7,400	10%	\$ 13,800	10%
Industrial	\$ 1,600	2%	\$ 2,500	2%
Utility	\$ 100	0%	\$ 100	0%
Vehicle	\$ 13,800	19%	\$ 23,400	17%
Roads	\$ 1,128	2%	\$ 1,531	1%
Total	\$ 74,528	100%	\$ 138,131	100%



C&SF FLOOD RESILIENCY (SECTION 216) STUDY MODELING THE 216 STUDY IN HEC-FDA



Slide 6



Model Reach	Total Available Business Days**	Business Disruptions (Expected Annual Days, Int SLC)	Shutdown Percentage (Int SLC)	Business Disruptions (Expected Annual Days, High SLC)	Shutdown Percentage (High SLC)
DA-1-REVISAR	383,615	2,100	1%	5,200	1%
C-4	605,900	3,100	1%	4,500	1%
C-6	996,815	5,800	1%	8,800	1%
MIAMI RIVER	1,100,475	9,200	1%	26,300	2%
C-3	384,345	1,800	0%	3,600	1%
C-2	884,395	2,500	0%	3,900	0%
C-5	88,330	300	0%	1,000	1%
DA-2-REVISAR	7,665	600	8%	1,200	16%
C-3 WEST	242,360	500	0%	700	0%
Total	4,693,900	25,900	1%	55,200	1%

**Total available business days serves as a baseline for comparison of losses in which each business is assumed to operate 365 days/year

Business Disruptions → \$ Lost Wages → \$ Lost Revenues (Business & Tax)



C&SF FLOOD RESILIENCY (SECTION 216) STUDY

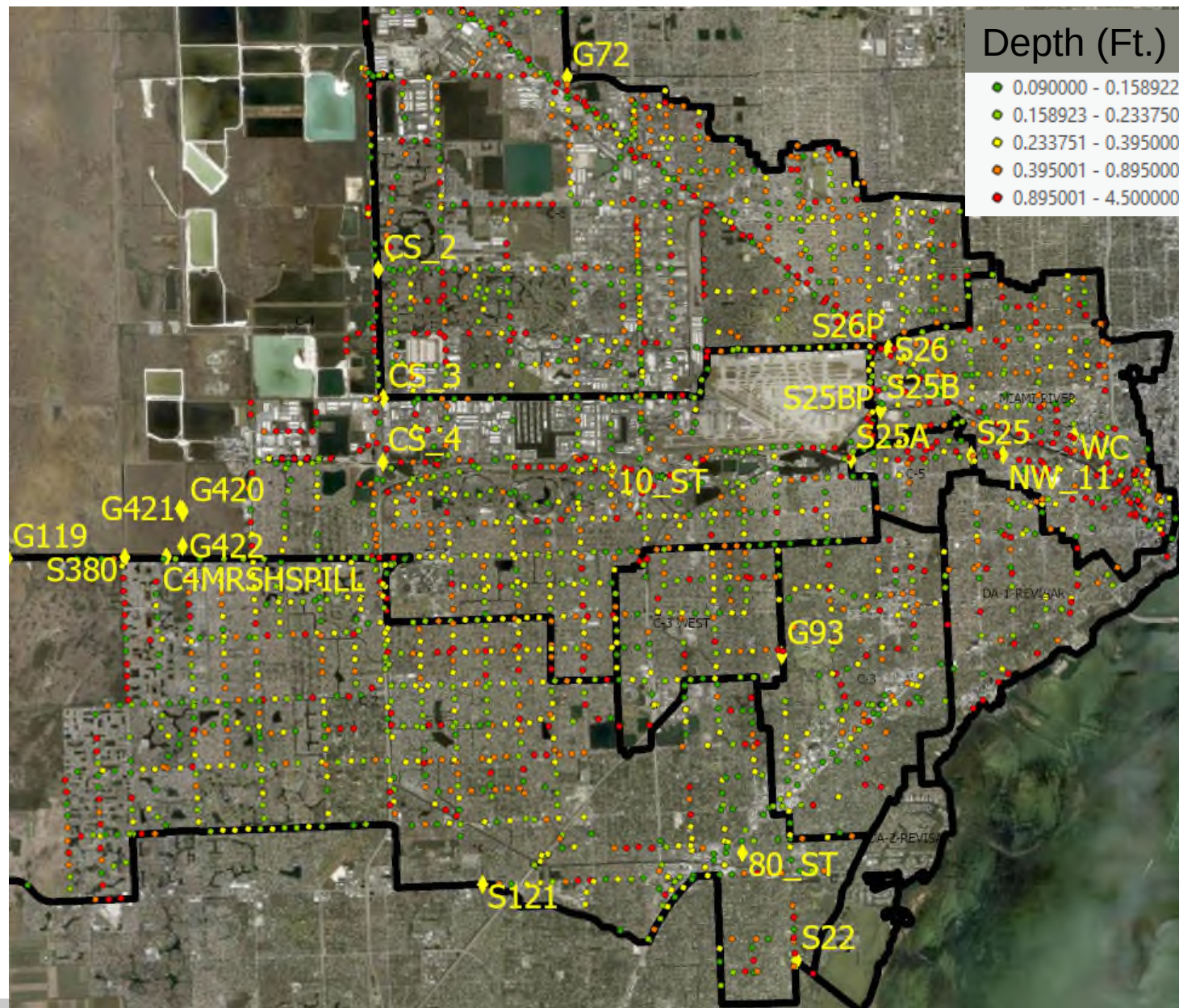
MODELING THE 216 STUDY IN HEC-FDA



Slide 7



Roadway
Depths in
the 100 Year
Event (Int
SLC)





C&SF FLOOD RESILIENCY (SECTION 216) STUDY



Slide 8



Thank you