

VIRTUAL WORKSHOP AGENDA
BROWARD COUNTY PLANNING COUNCIL
JULY 27, 2023
10:00 A.M.
ZOOM LINK ONLY

Call to Order – Chair Thomas H. DiGiorgio, Jr.

- **Introduction – Barbara Blake Boy**
- **Presentation: Climate Resilience: Shared Challenges, Regional Planning and County-wide Action (45 minutes)**
 - **Jennifer L. Jurado, Ph.D., Deputy Director and Chief Resilience Officer, Broward County Resilient Environment Department**
- **Planning Council Member Comments and Questions (45 minutes)**

Adjournment

The presentation materials will be posted at the following link on Tuesday, July 25, 2023:
<https://www.broward.org/planningcouncil/Pages/Default.aspx>

Notice to Members of the Public: This is a virtual workshop only and can be viewed via the following Vimeo link: <https://vimeo.com/showcase/7896825>

Next Regular Scheduled Planning Council Meeting – August 24, 2023, at 10:00 a.m., in Room 422 of the Broward County Governmental Center.

Planning for Sea Level Rise and Resilience in Broward County

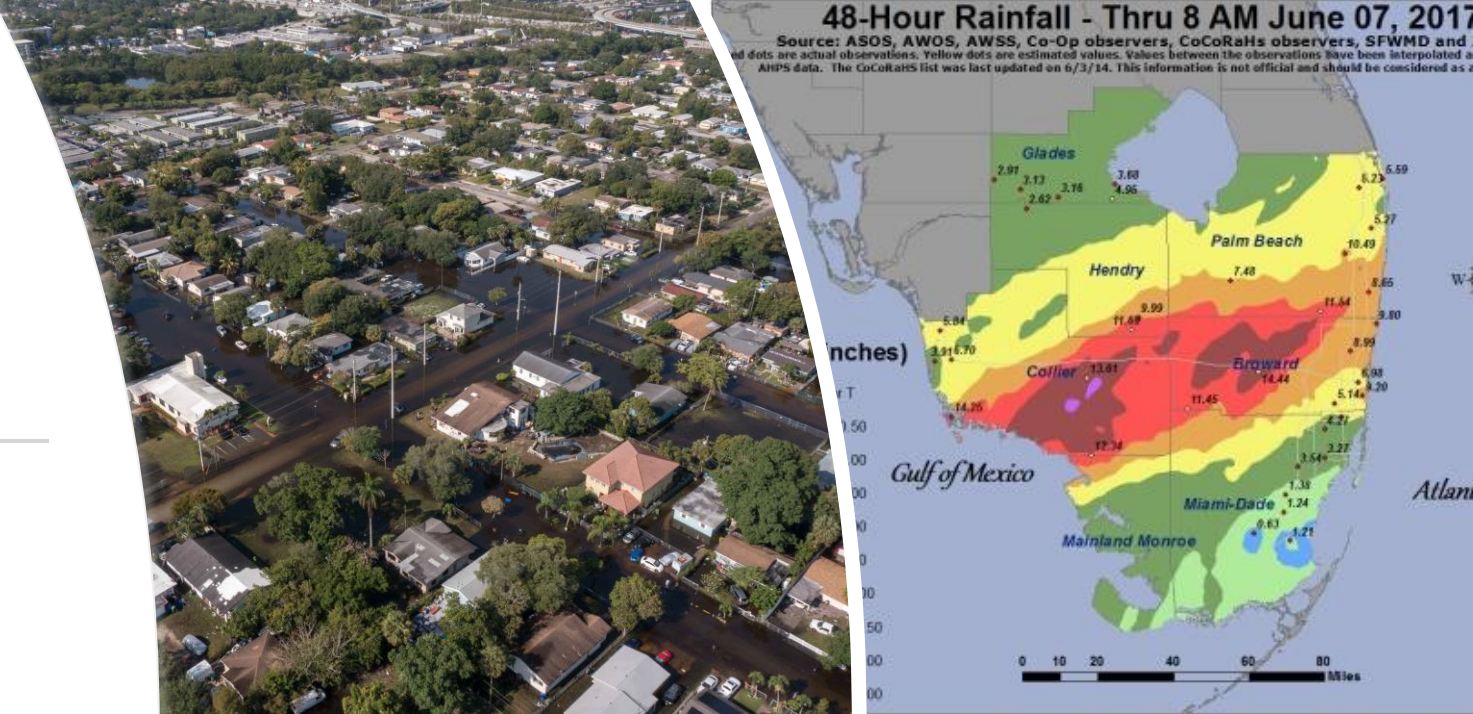
Presented to the
Broward Planning Council

July 27, 2023



Community Resilience Challenges

- Rising sea level, rainfall and storm surge
- Increases in flood severity, impacts and disruptions
- Infrastructure damage and safety concerns
- Economic implications
- Quality of life considerations



Implications: Planning and Investments

- Land Use
- Infrastructure Siting
- Design Standards
- Drainage
- Level of Service
- Finished Floor Elevations
- Development Strategies
- Shoreline Management



Flood Risk is Prominent, and On the Rise

Climate change is already making parts of America uninsurable

"It's actually reinsurers that have been sounding the alarm about climate change and disaster risk for decades," said Hecht ... The federal government created the National Flood Insurance Program to ...

How climate change, rising sea levels are transforming coastlines around the world

Long-term erosion and strong storms are chipping away at the shore.



Storm surge in Naples, Fla. (Photo: Naples Fire Department)

WEATHER

Area waterways will see impacts days after Ian's landfall

Local News

'This is a nightmare': Flooding in Fort Lauderdale brings frustration, homelessness



Severe Community and Economic Disruptions

🕒 SEPTEMBER 6, 2021

Sea-level rise becoming a hazard for South Florida neighborhoods miles from ocean

by David Flesher



Credit: CC0 Public Domain



By –
Stacy
Morford, The
Conversation

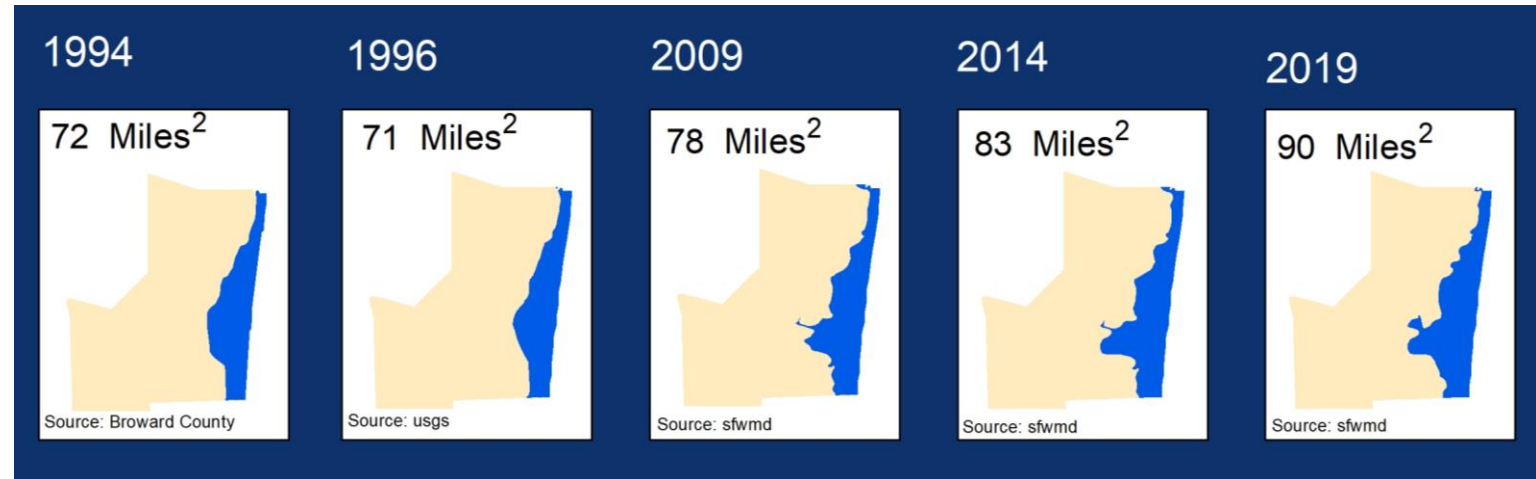
By –
Angela
Antipova,
The
Conversation

By –
Dorian J.
Burnette,
The
Conversation

By –
Matthew

Climate change helped fuel 18 billion-dollar disasters in 2022, NOAA says

Saltwater Intrusion and Water Supplies



Climate Consequences for the Environment



SCIENCE • ENVIRONMENT

Red Tide Is Spreading to Florida's East Coast. Here's What to Know About It

f t e

SCIENCE

Miles of Algae and a Multitude of Hazards

By LES NEUHAUS JULY 18, 2016



How pollution and climate change may have caused the Florida seaweed blob

2.6k

Ben Adler · Senior Editor
Updated March 17, 2023 · 4 min read

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THE STATUS OF CORAL HEALTH IN SOUTHEAST FLORIDA

October 2, 2015
Walker and Klug, 2015

October 29, 2015
Walker and Klug, 2015

Reinforcing the Need for Investments



Climate Risk and Economics – A Strong Basis for Action

Moody's warns cities to prepare for climate change. Here's why it matters

Business | Climate
Changed

Moody's Warns Cities to Address Climate Risks or Face Downgrades

- Communities in Texas, Florida, other coastal states at risk
- Credit rating agency says it's adding climate to credit risks

Water management risks pose growing credit threats as demand soars, climate change intensifies: Moody's

1 min read • 11 Jul 2023, 06:04 PM IST

[Saurav Anand](#)

CLIMATE

Here are the U.S. cities most vulnerable to climate change, according to Moody's

PUBLISHED FRI, FEB 24 2023 4:02 PM EST

- “Absent policy changes, large coastal states like California, Florida and New York are especially vulnerable, while more inland northern economies will emerge only slightly worse off,” wrote Adam Kamins, senior director at Moody's.

MOODY'S

Acute Local Needs and Economic Drivers

- Protect infrastructure
- Reduce flood risk and property losses
- Improve insurance affordability
- Protect property values/tax base
- Protect credit ratings

Cities and states could see their credit ratings crash if they don't start preparing for climate change



Jeremy Berke

Dec. 1, 2017, 9:16 AM 2,407

BUSINESS
INSIDER



Bloomberg

MOODY'S
INVESTORS SERVICE

SECTOR IN-DEPTH
28 November 2017

Rate this Research >>

Environmental risks

Evaluating the impact of climate change on US state and local issuers



National Institute of
BUILDING SCIENCES

Natural Hazard Mitigation Saves:
2017 Interim Report



An Authoritative Source of Innovative Solutions for the Built Environment

Engaging on Economic Resilience



SE FL – Resilience Business Case Analysis

Project Purpose

To identify the **return on investment** for resilience and adaptation measures in Southeast Florida.



Key Findings



There is a **regional business case** for resilience in Southeast Florida.

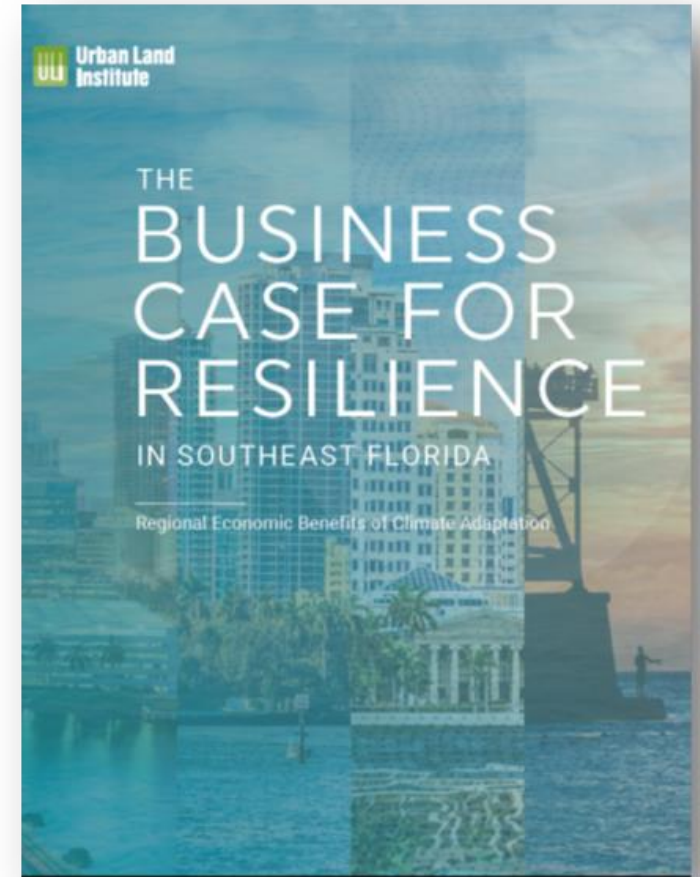
4:1

Building-level
adaptation
strategies outweigh
the costs 4:1

2:1

Community-wide
adaptation
strategies
outweigh the
costs 2:1

Note: Community-wide and building-level adaptation strategies work together.



Community-wide Adaptation

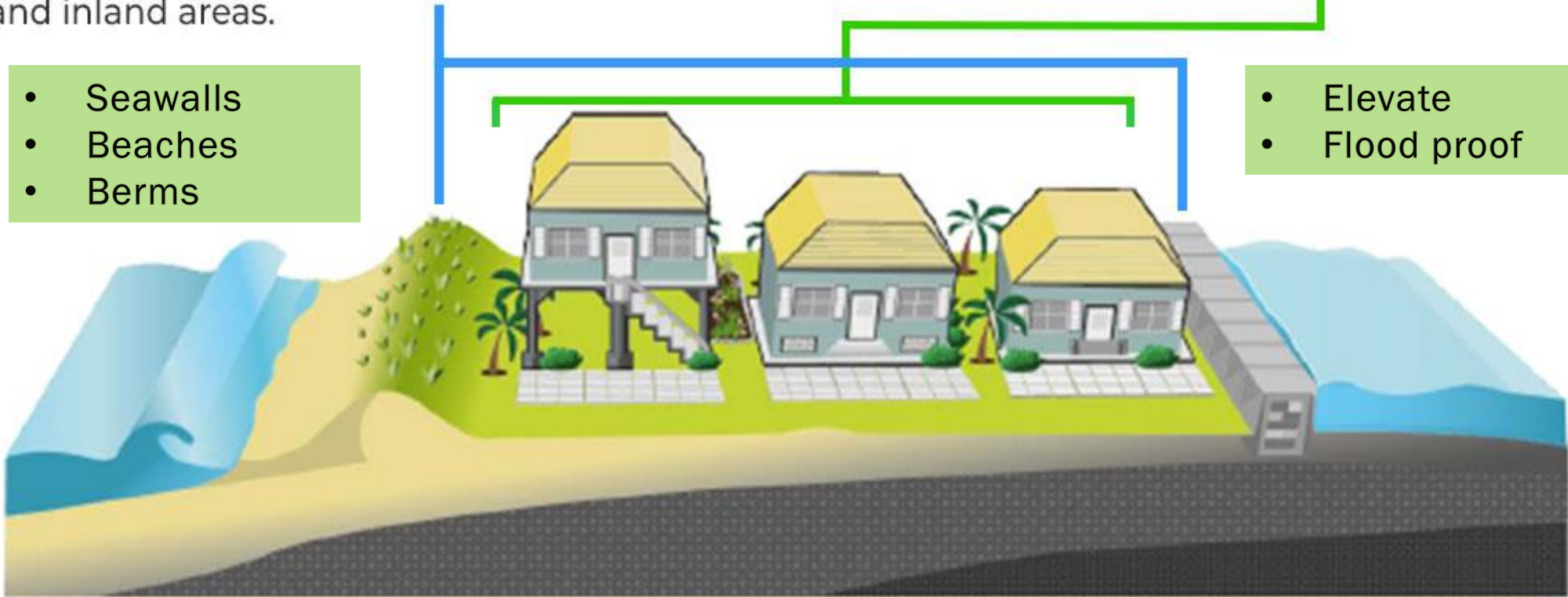
- A combination of soft and hard engineering investments at the open coast, intracoastal and inland areas.

- Seawalls
- Beaches
- Berms




Building-level Adaptation

- A combination of structural improvements to property itself.

- Elevate
- Flood proof

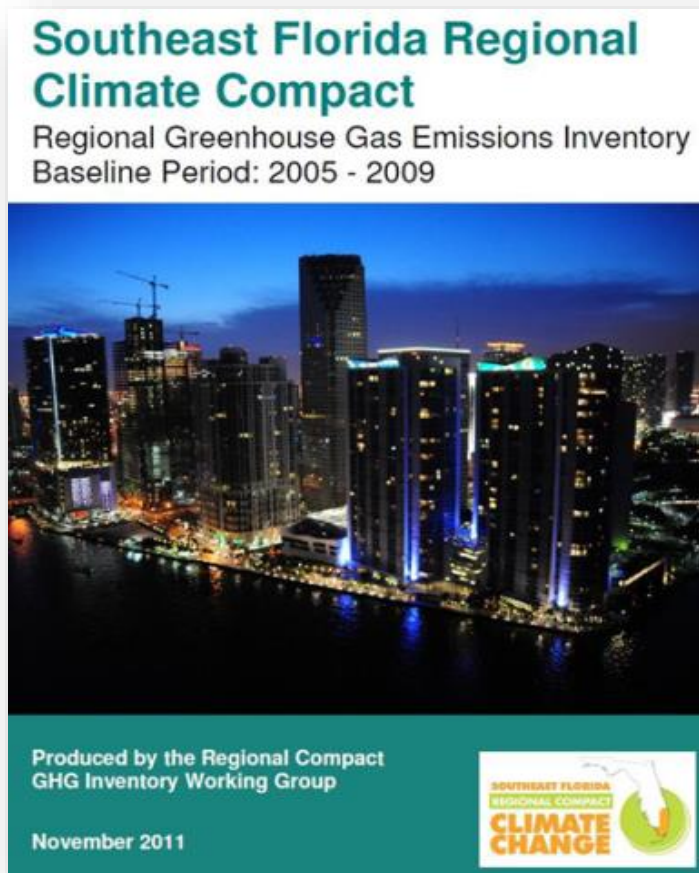
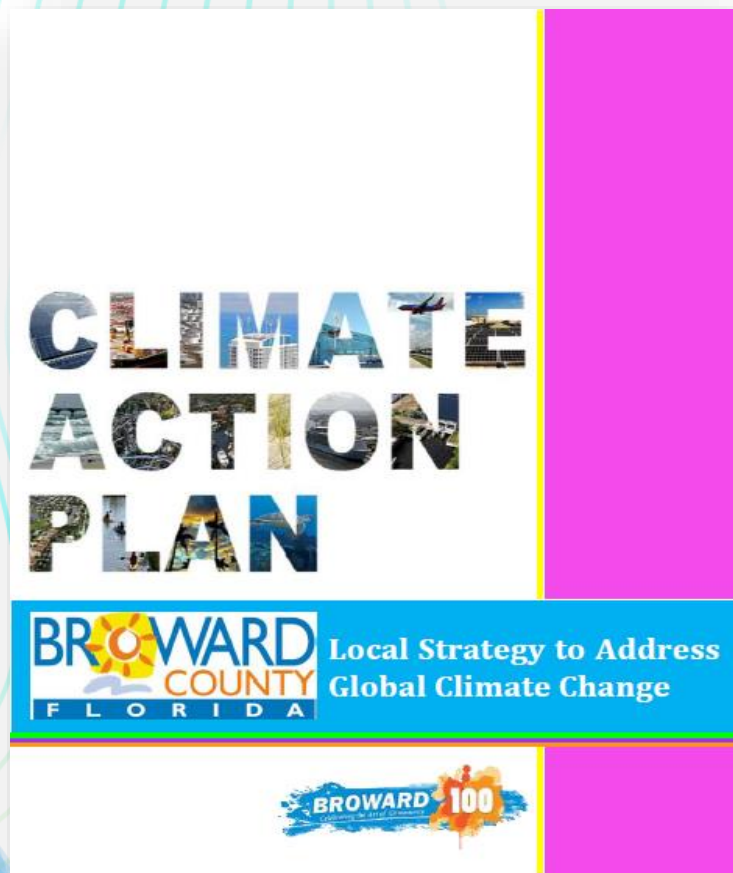


Building-level adaptation will not provide benefit to regional infrastructure or to coastal resources such as beaches.

Highlight of No Action with Rising Seas	Permanent Damages 2040	Permanent Damages 2070
 <p>Direct Property Impacts</p>	<p>\$4.2bil</p> <p>In property value exposed to daily tidal inundation in 2040.</p>	<p>\$53.6bil</p> <p>In property value exposed to daily tidal inundation in 2070.</p>
 <p>Business and Employment Impacts</p>	<p>720</p> <p>Impacted by daily tidal inundation in 2040.</p>	<p>17,800 jobs</p> <p>Impacted by daily tidal inundation in 2070.</p>
 <p>Fiscal Impacts</p>	<p>\$28mil</p> <p>Fiscal loss from daily tidal inundation in 2040.</p>	<p>\$384mil</p> <p>Fiscal loss from daily tidal inundation in 2070.</p>

**Results shown here are not adjusted to account for financial discounting. Parcels impacted by daily tidal inundation are excluded from the 10-year tide damages. The 10-year tide results account for the impacts of one storm event and are not adjusted for probability of the storm event occurring.*

Comprehensive Action: Climate Policy and Planning

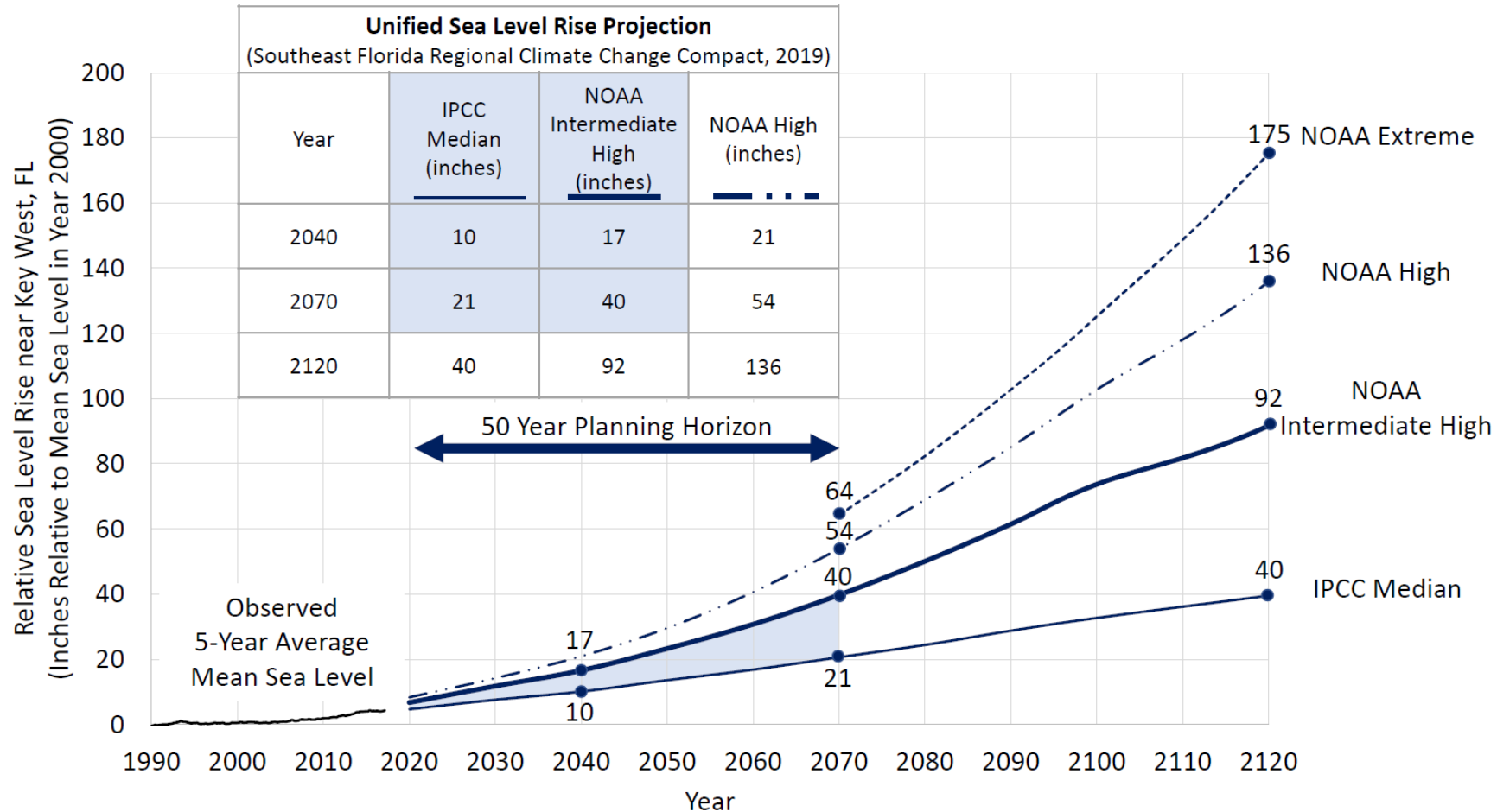


Resilience Planning and Standards

- Sea Level Rise Projection – 2012, 2015, 2019
- Priority Planning Area Map – 2012, 2015, 2020
- Future Conditions Map Series – 2017
- Resilience Standards
 - Drainage infrastructure - 2017
 - Tidal flood barriers - 2020
 - 100-Yr Flood elevations – 2021
 - Design storms – 2021



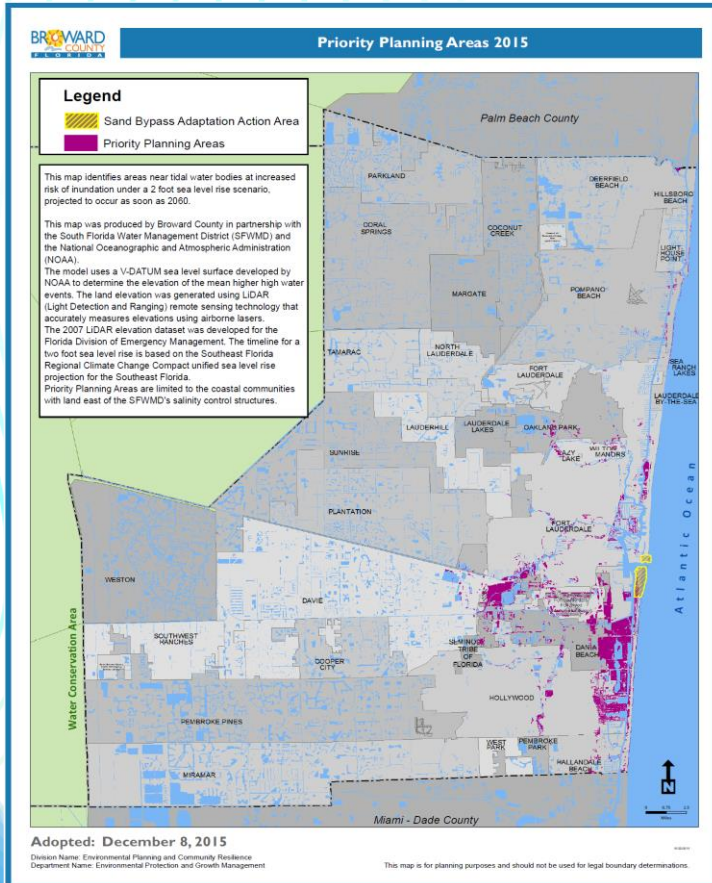
2019 Regional Sea Level Rise Projection



Priority Planning Area Map

2015 Adopted Map
2 ft SLR = 6.8 mi²

2020 Updated Map
3.3 ft SLR = 17.6 mi²

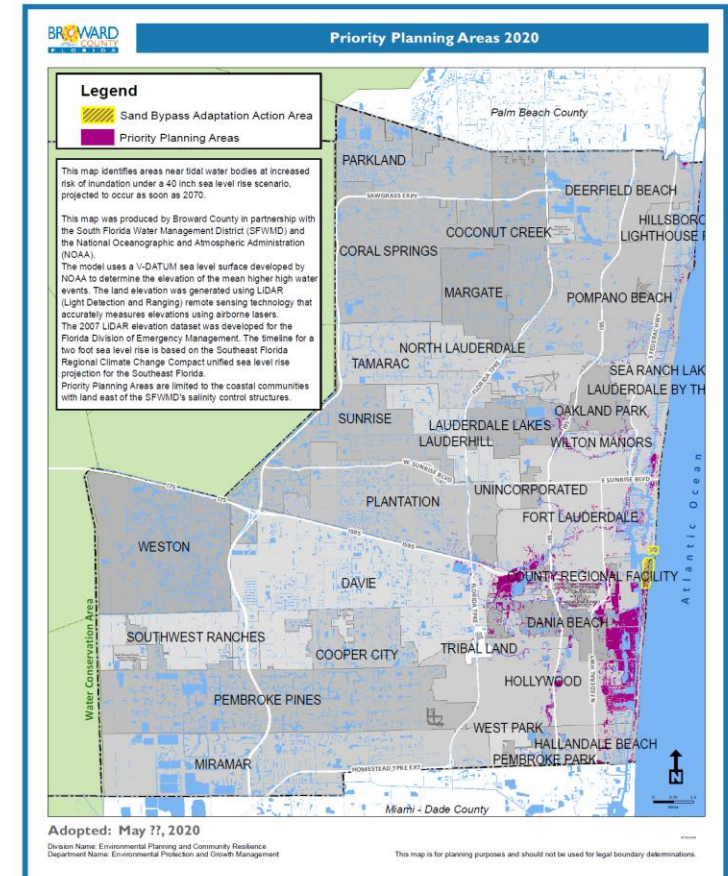


County Land Use Plan:

- Delineates areas at increased risk of flooding with Sea Level Rise (SLR)

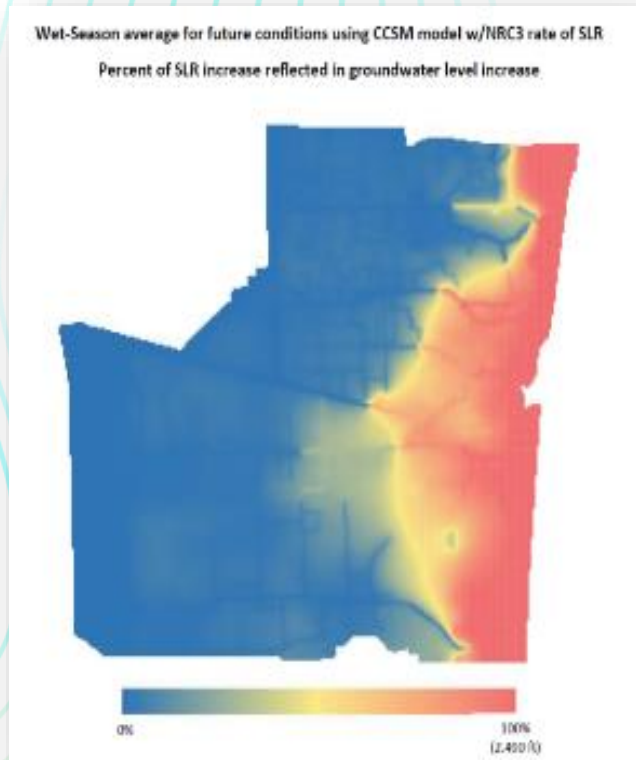
Application:

- Criteria Applied to Land Use Amendments
- County Capital Project Planning
- Elevation and Location

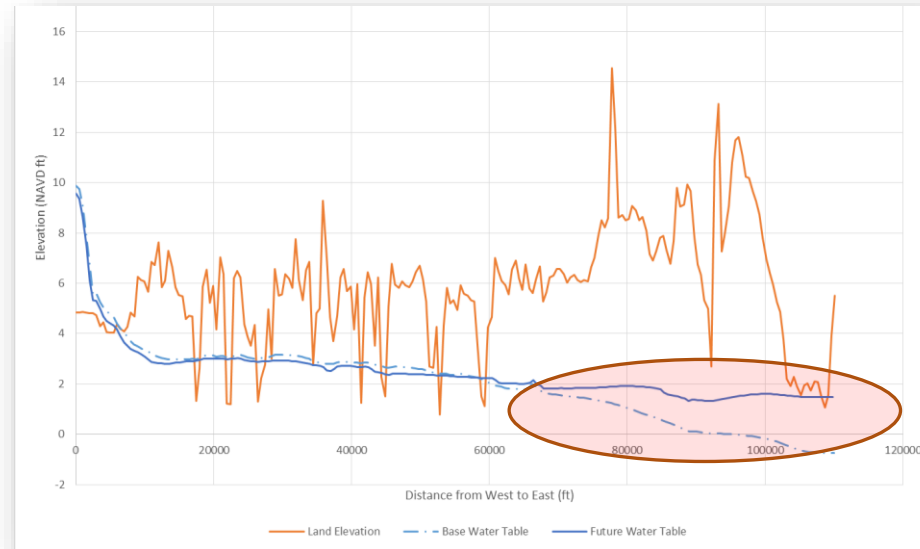


Future Conditions Groundwater Table Map

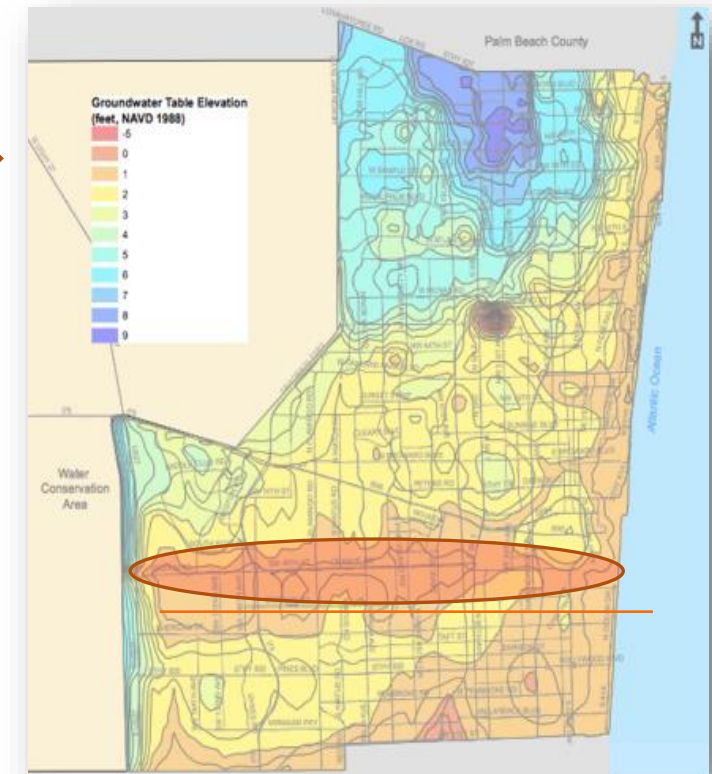
Effective July 1, 2017
Section 27-200, Plate WM 2.1
Code of County Ordinances



Modeled Change



Modeled W-E Cross Section



Future Conditions
Wet Season
Groundwater Table Map

Resilience Standard for Tidal Flood Barriers

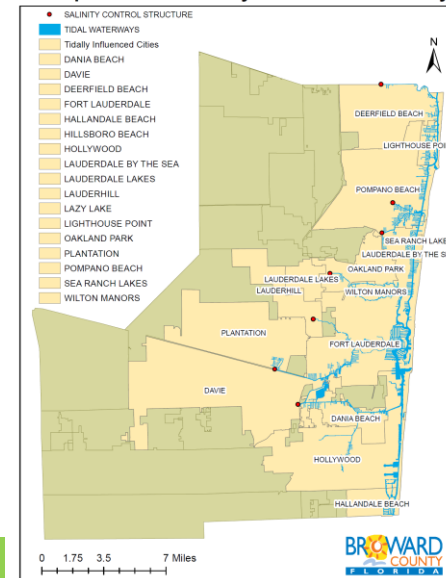
- Approved March 31, 2020
- Modeled water levels:
 - 2 feet sea level rise
 - High tides
 - 25-yr storm surge
- Requires **5 feet NAVD by 2050**, allows **4 feet NAVD until 2035**
- Requires municipal adoption in 2 years and real estate disclosure.



Hollywood Marina



Municipalities with Tidally Influenced Waterways



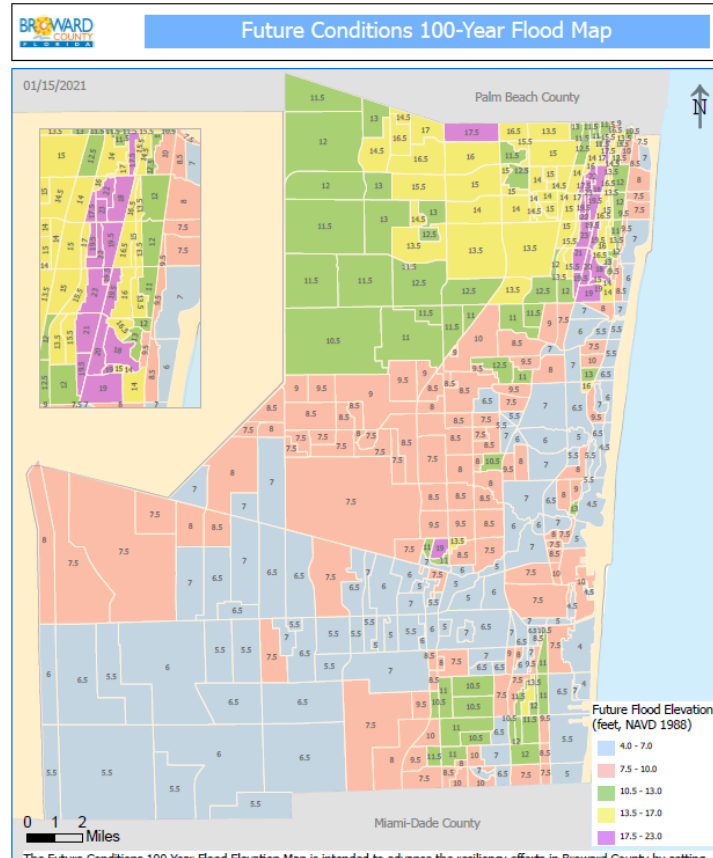
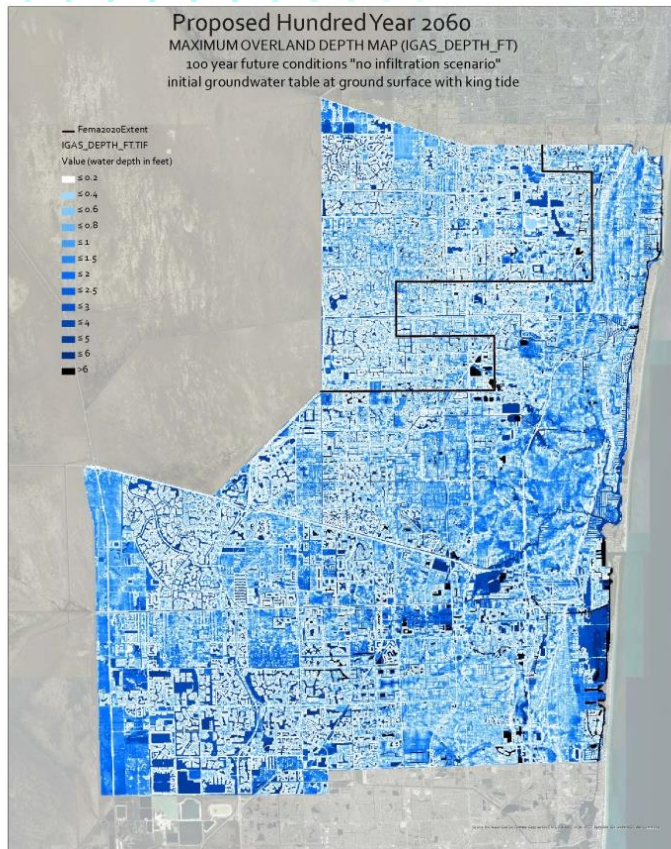
Finished Floor Elevations and the NFIP

County code NOW requires higher of the following:

- Current 100-yr flood map developed in 1977
- Future Conditions 100-year Flood Map
- FEMA maps - existing conditions
- Site specific 100-year calculation
- 18 inches above crown of road



Future Conditions 100-Year Flood Map

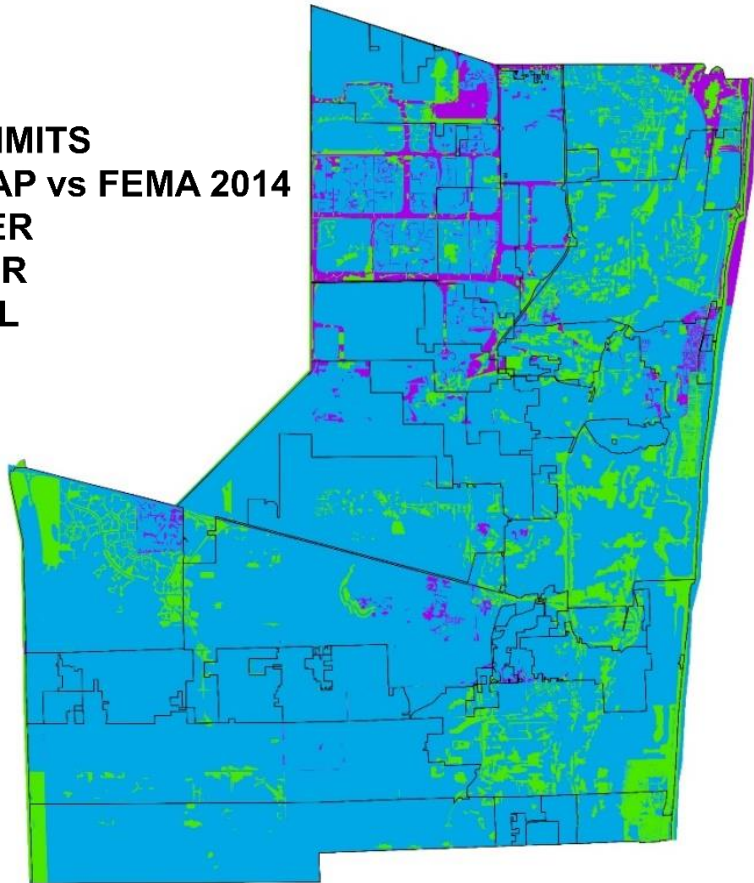


- Accounts for:
 - 2 Feet SLR
 - King tides
 - Ground saturation
 - Increase rainfall (13%)
- Advanced down-scaling techniques
- 368 discrete flood areas
- Informed by basins, topographic features, drainage

Flood Elevation Change Comparison

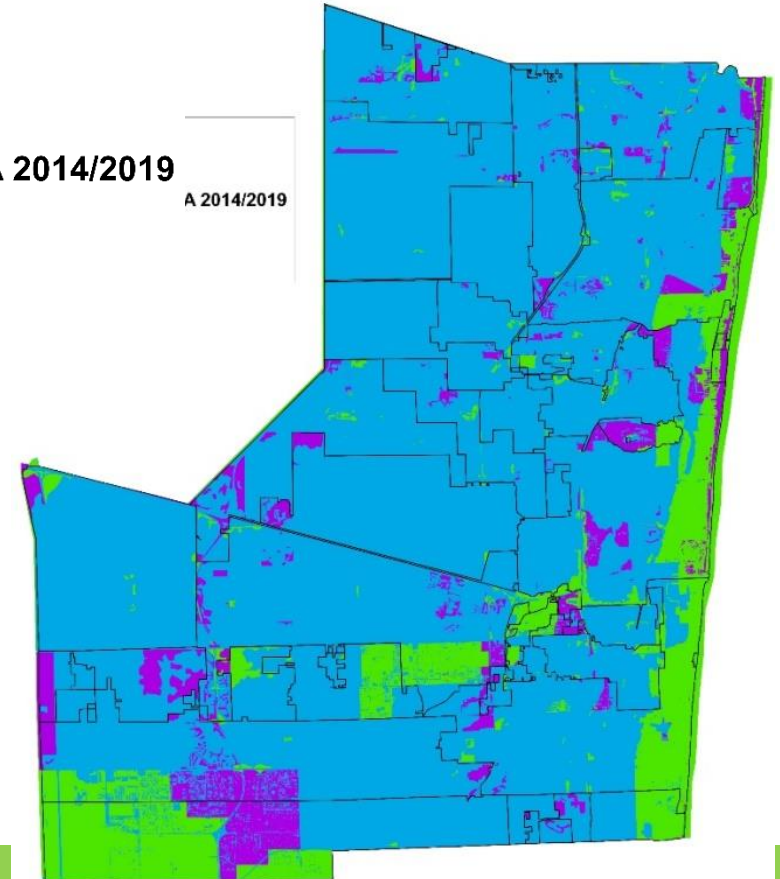
1977 COMMUNITY MAP COMPARED TO
ADOPTED FEMA 2014 FLOOD ELEVATIONS

Legend
=CITY LIMITS
1977 MAP vs FEMA 2014
■ HIGHER
■ LOWER
■ EQUAL

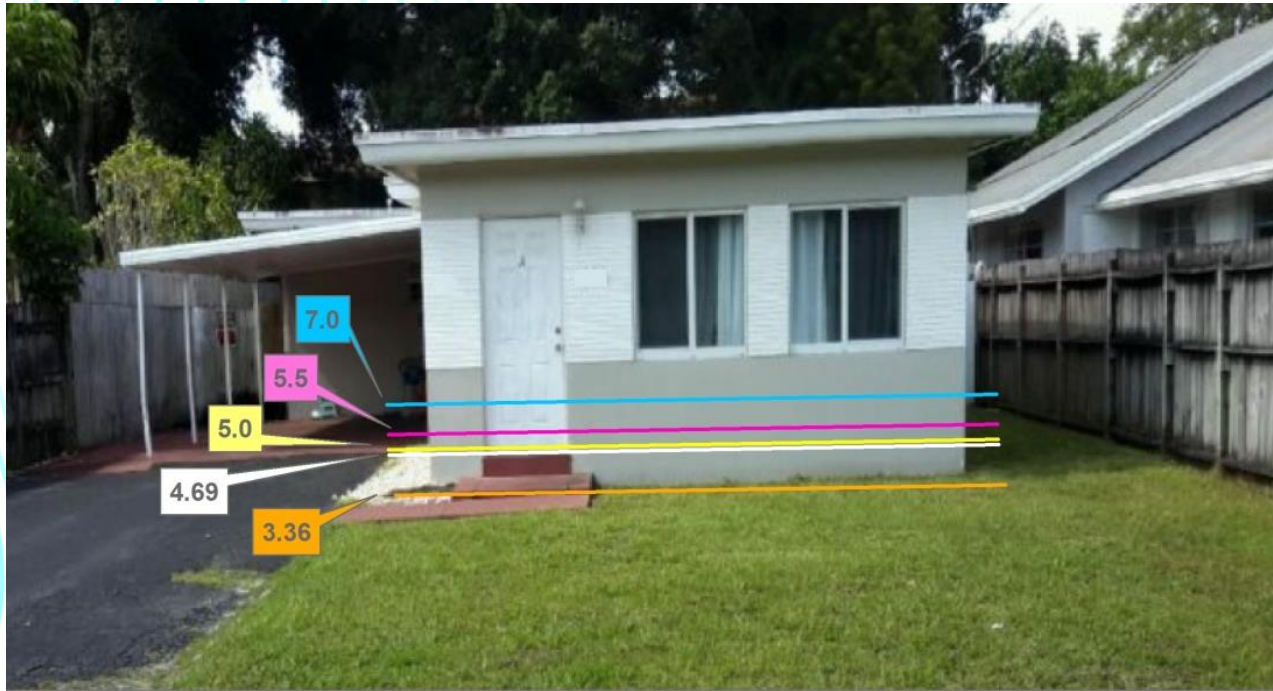


PROPOSED FUTURE FLOOD MAP COMPARED
TO HIGHER OF
ADOPTED FEMA 2014 / PROPOSED FEMA
2019 FLOOD ELEVATIONS

Legend
=CITY LIMITS
FLOOD_UNION
NEW MAP vs FEMA 2014/2019
■ HIGHER
■ LOWER
■ EQUAL



Commercial and Residential Relevance



Future Conditions 100-Year Flood Map 7.0 Ft
 Existing 100-Year flood map 5.5 Ft
 FEMA 2014 Flood Elevation 5.0 Ft
 Finished Floor Elevation 4.69 Ft
 Lowest Adjacent Grade next to Building 3.36 Ft

County Property Appraiser
 AVD 1988



Future Conditions 100-Year Flood Map: 7.0 Feet
 Minimum Floor Elevation per SFWMD ERP: 6.5 Ft
 FEMA 2014 Flood Elevation 6.0 Feet
 Existing 100-Year Flood Map 5.5 Feet

Photo: Broward County Property Appraiser
 All Elevations NAVD 1988

Financial Benefits vs. Liabilities



Credit: L. Vialpando

Resilience and Land Use Planning Considerations

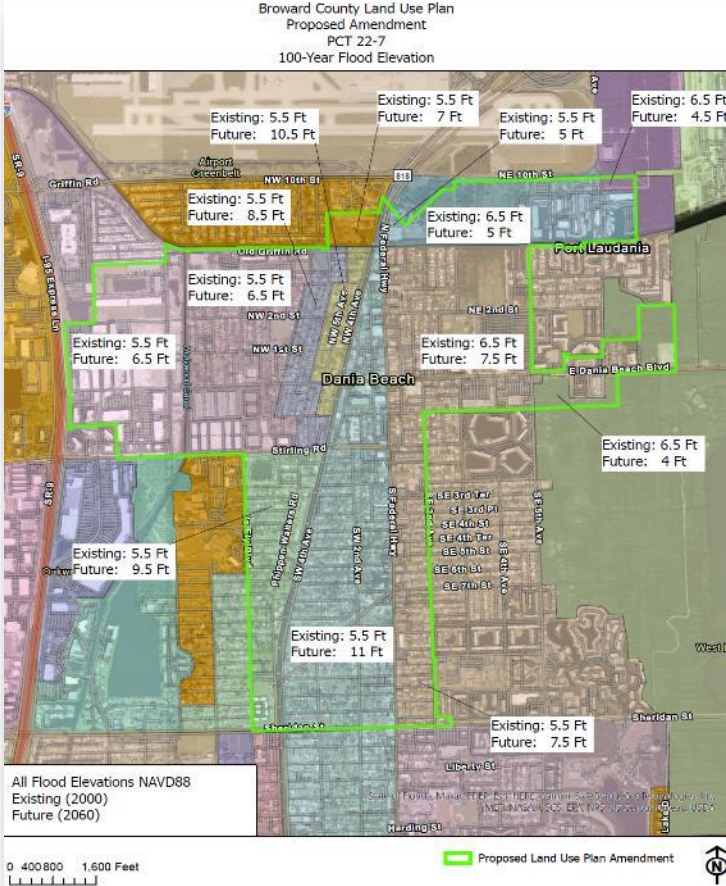
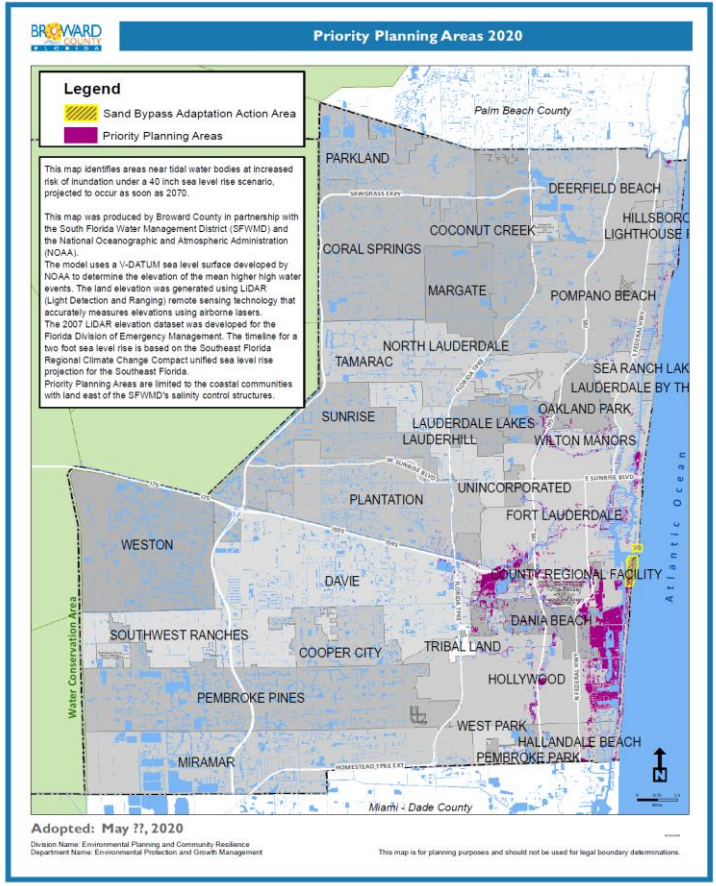
Broward County shall designate areas that are at increased risk of flooding due to, or exacerbated by, sea level rise within the Broward County Land Use Plan Priority Planning Areas for Sea Level Rise Map (and others), and work to make these areas more climate resilient by encouraging the use of adaption and mitigation strategies or discouraging density increases (CC 2.14)



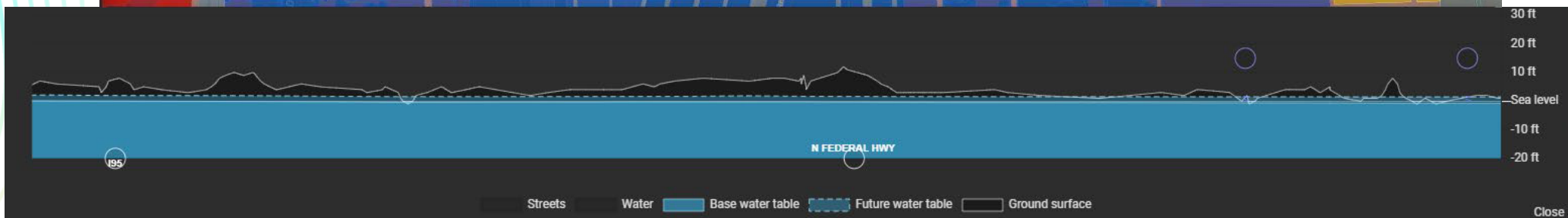
Resilience and Land Use Policy

- Broward County shall evaluate plan amendments within Priority Planning Areas for Sea Level Rise...In review of such amendments, the county shall consider a. Sea level rise/flood protection mitigation strategies and requirements included within local comprehensive plans and/or development regulations; or b. Flood protection improvements committed to by amendment applicants which could mitigate or enhance flood protection and adaption from rising sea levels. (2.21.1)
- Broward County shall, prior to approving land use plan amendments in the areas prone to flooding and/or the impacts of sea level rise, as identified on Priority Planning Areas for Sea Level Rise Map, determine that the subsequent development will be served by adequate storm water management and drainage facilities, not adversely affect groundwater quality or environmentally sensitive lands or increase saltwater intrusion or areawide flooding. (2.21.5)

Resilience Assessments and Land Use Considerations



Assessing Groundwater Change



Notable Examples and Outcomes

- Private Developer with Municipal Commitment - Commitment to adopt resilience standards under development
- Private Developer with Developer Commitment – Forego existing permit conditions, apply future conditions
- Municipal Applicant with Municipal Commitment – Commitment to update city-wide stormwater plan and adopt interim standards supporting resilience and addressing future conditions
- Municipal Application on behalf of Developer – Application withdrawn

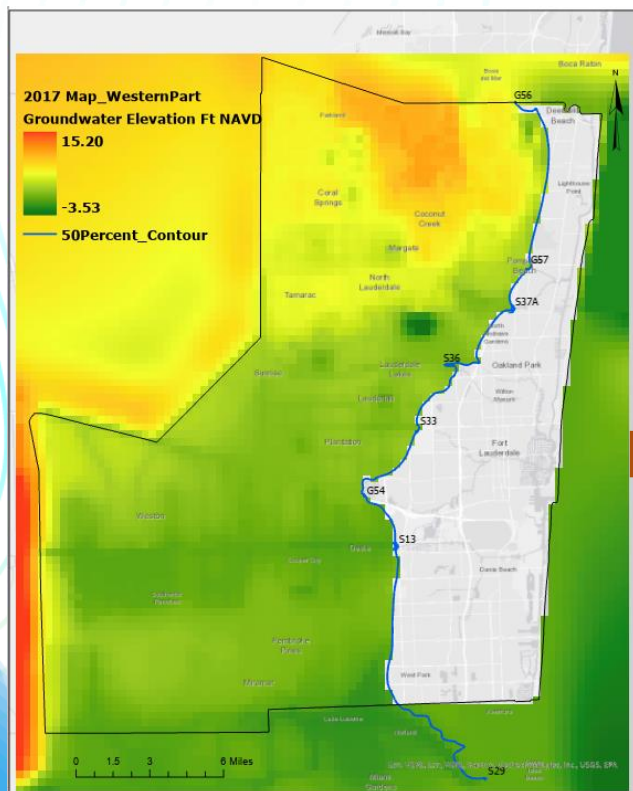
Efforts Underway

- Update to Future Conditions Groundwater Table Map
- Update to Future Conditions Flood Map
- Completion of County-wide Adaptation Plan
- Launch of Shared Planning Platform

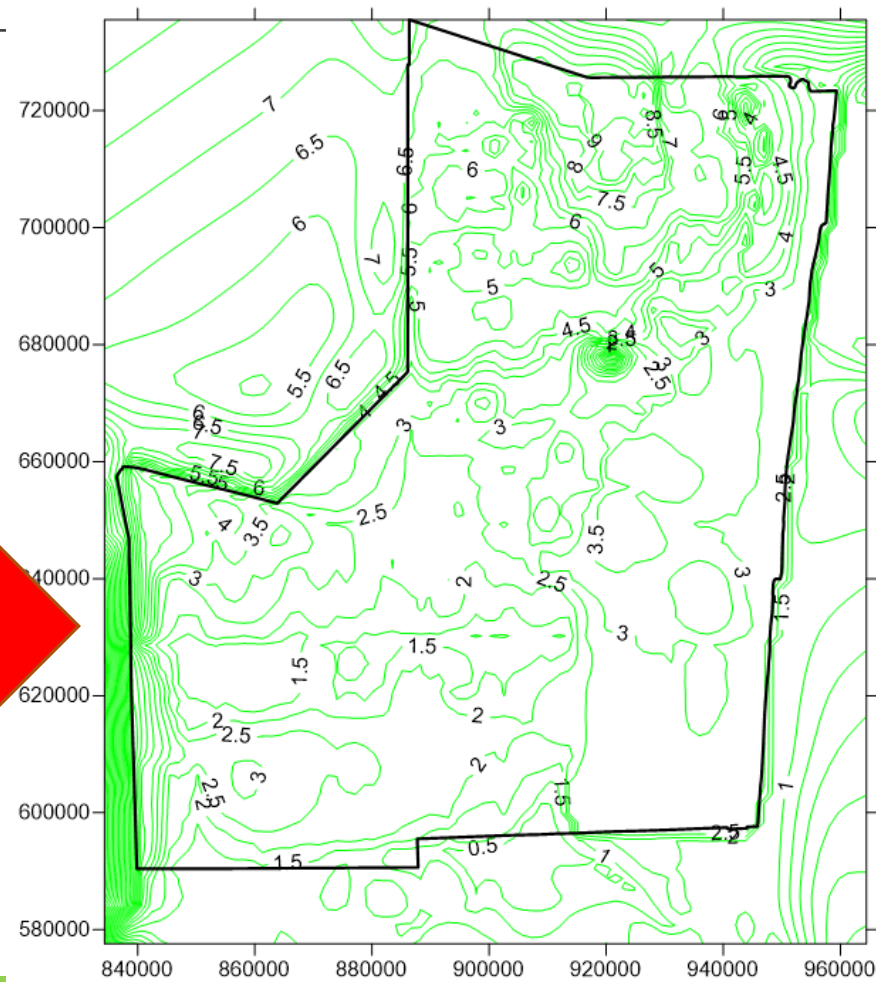
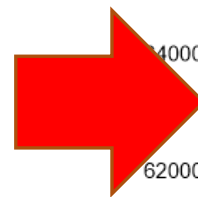
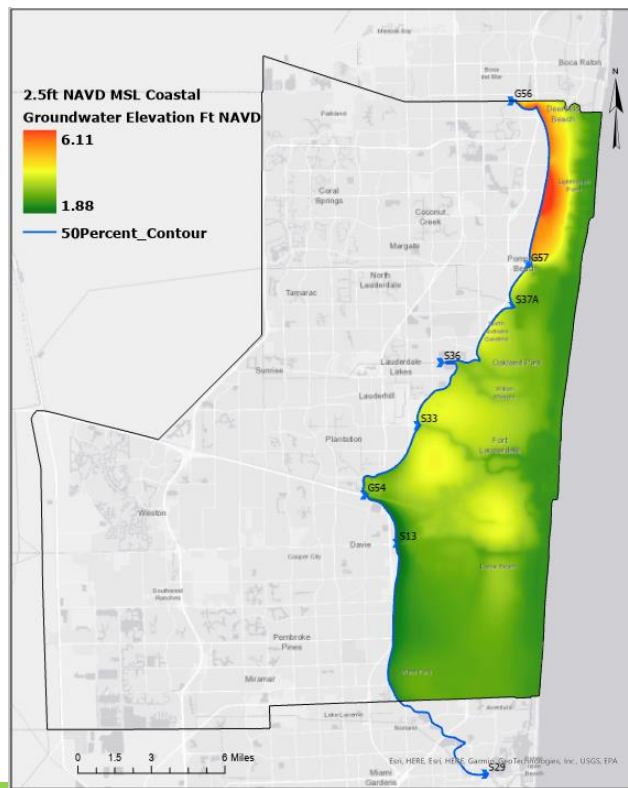


Wet Season Groundwater Table Map (2070)

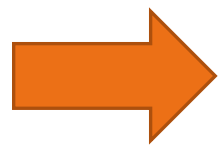
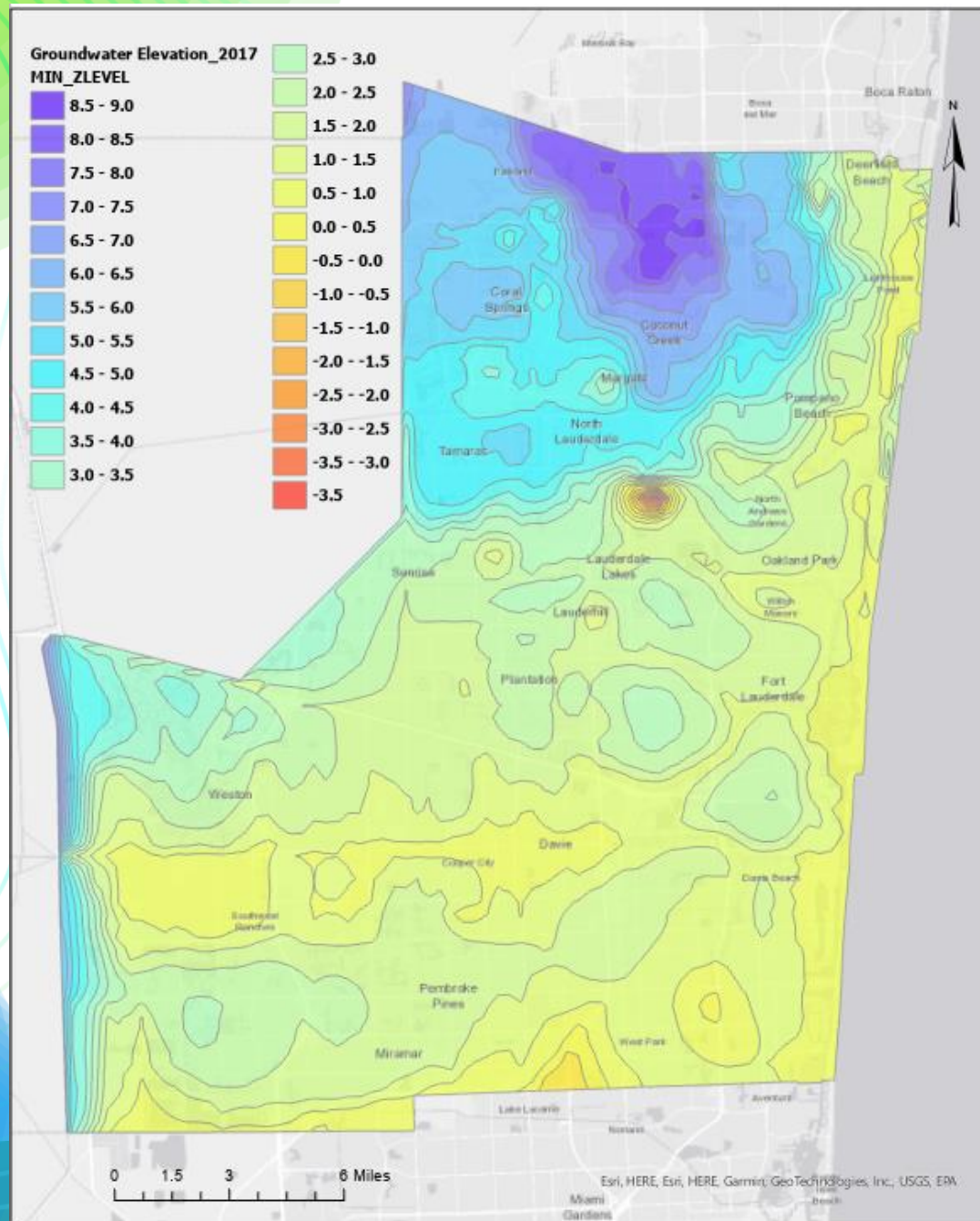
2017 Map Modeling



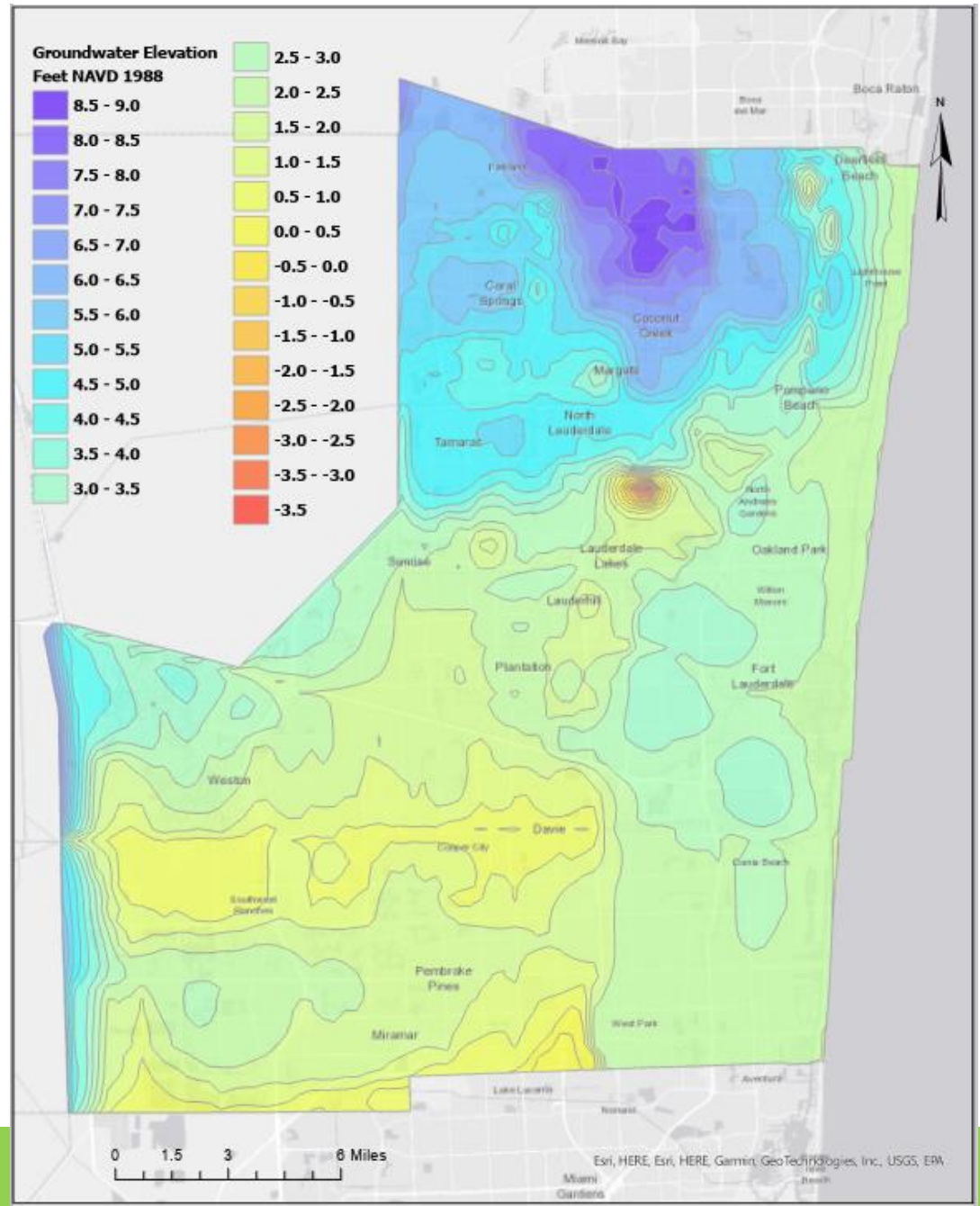
2023 Modeling



2017 – Future Conditions Groundwater Elevation

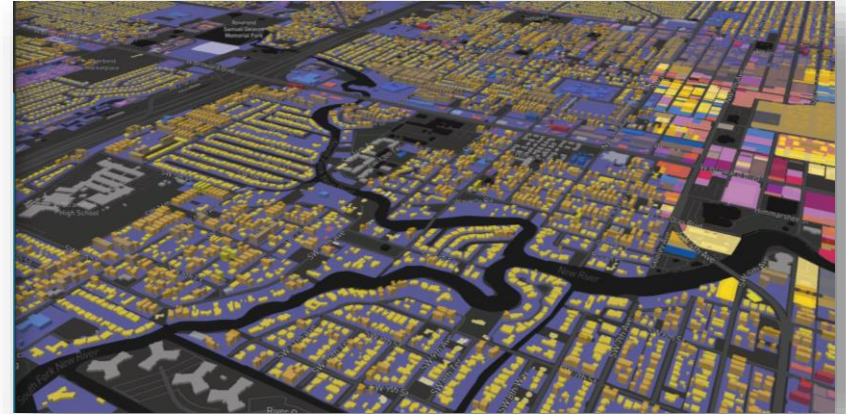


2023 Update – Future Conditions Groundwater Elevation



County-wide Resilience Plan

- Climate Risk Assessment and Resilience Plan
 - Basin-level analysis
 - Critical infrastructure and services
 - Mitigation strategies
 - Planning level cost estimates
 - Redevelopment strategies
 - Priority capital improvements
 - Quantified risk reduction
 - Alternative planning scenarios



Resilience Plan Components



**COMMUNITY
OUTREACH**



**RISK
ASSESSMENT**



**ECONOMIC
MODELING**

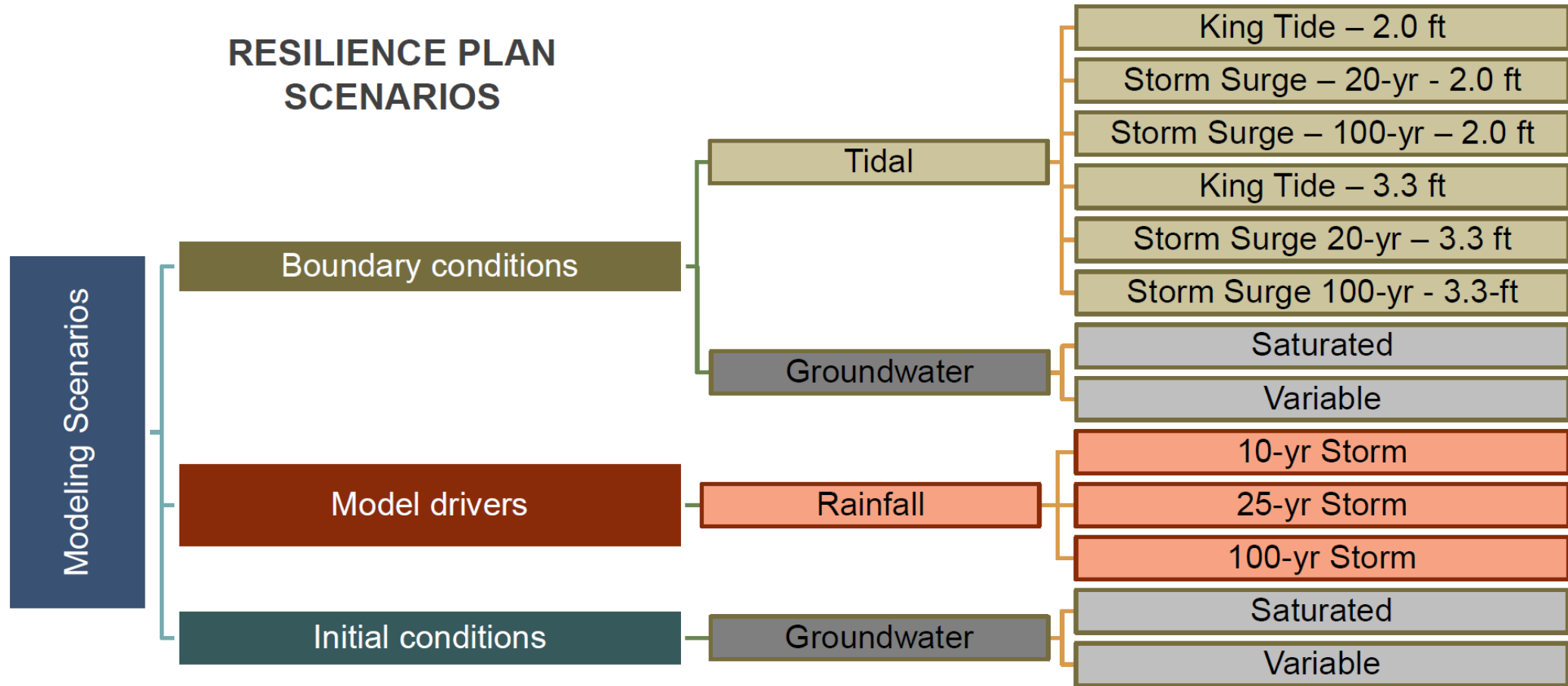


**ADAPTION
PLAN**



**ONLINE
PLATFORM**

Planning Scenarios



+ 20%
Change
Factor

Beyond Vulnerability...What are our Exposures?



Hazard Exposure

Frequency, duration, extent of flooding – properties, roads, essential infrastructure

Flood damage repair costs

Heating degree days

Socio-economic projections



First Party Loss

Building and asset damage

Lost income from business interruption

Cost of lost access to services

Humanitarian (health) impacts



Indirect Impacts

Resident and business income

Population, Jobs, Investment

Economic Growth

Beaches, recreation areas

Natural environment

Insurance availability and affordability

Real estate values

Tax revenue and government spending/Credit quality



Key Impact Metrics

Economic activity (by sector)

Household impacts

Asset values

County finances

Distribution of impacts

And...What are the Benefits?

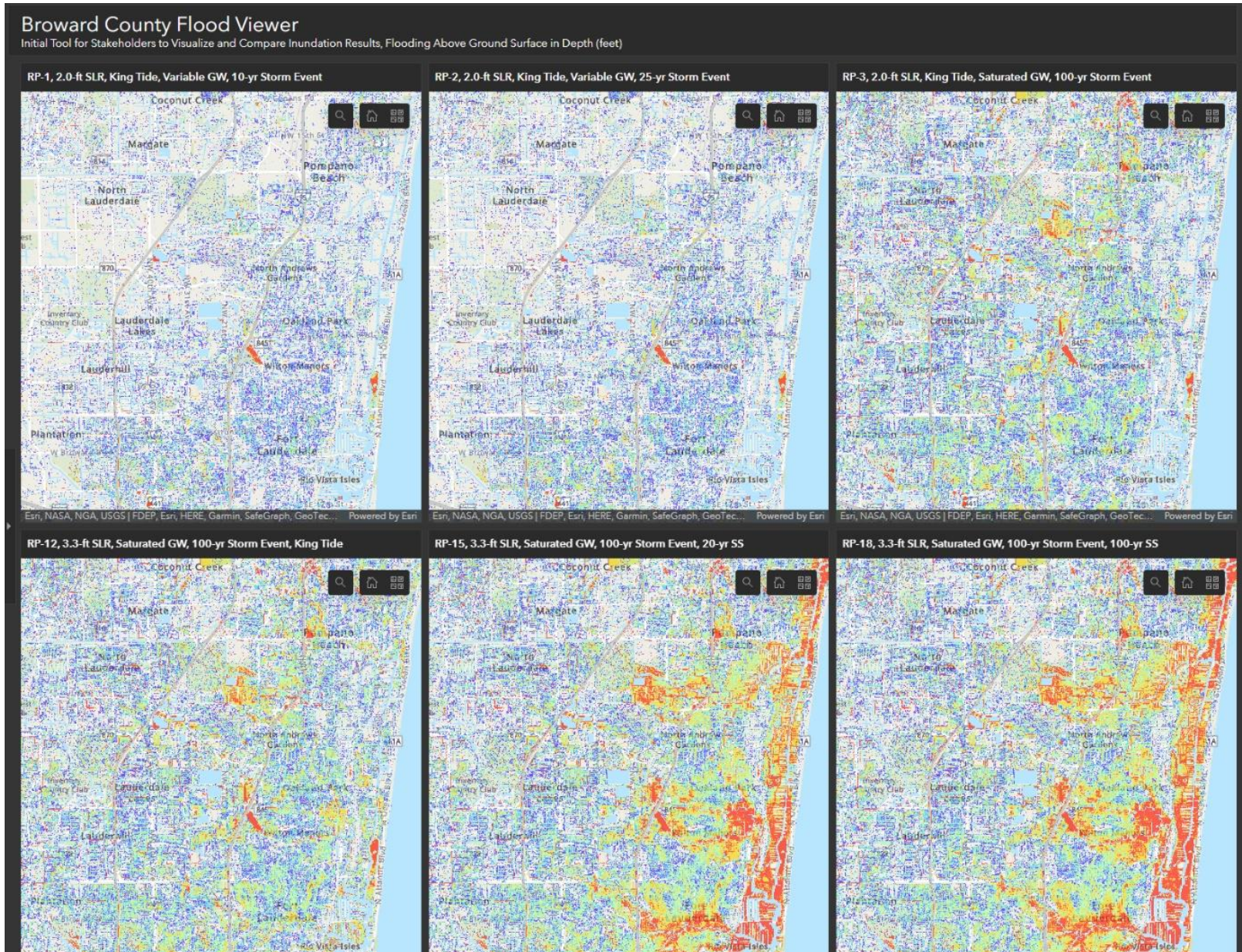
Avoided Loss in:	Avoided Cost of:	Avoided Reduction in:
Resident and Business income	Emergency services	Property values
Neighborhood amenities (a.k.a. - Increases in quality and availability of goods and services)	Property insurance premiums	Value of Recreation days (willingness-to-pay)
	Mortgage interest rates	Value of Environmental amenities (willingness-to-pay)
	Electricity cost to cool properties	
Tax revenue to County and local governments	County borrowing and credit	Government services



Flood and Risk Analyses

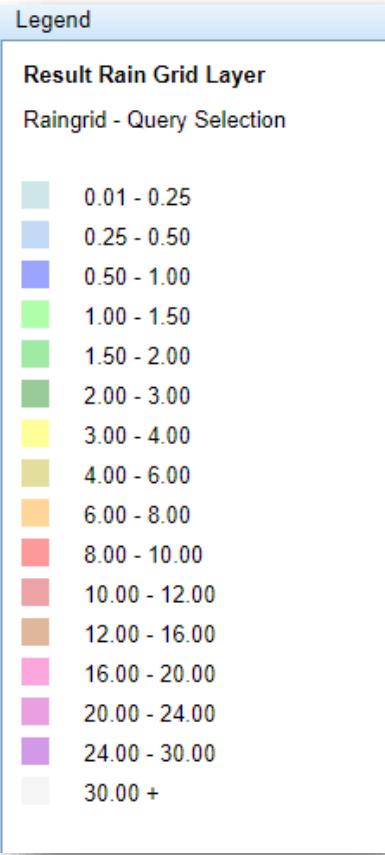
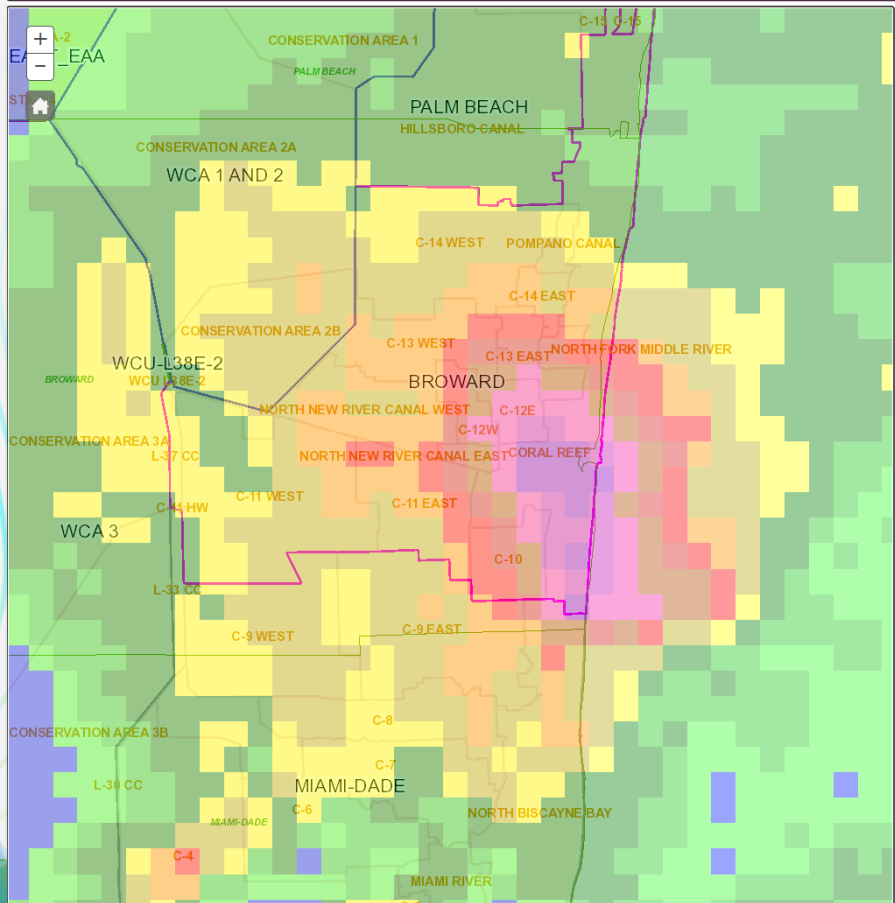
Site-based information to support adaptation planning

bit.ly/RiskAnalyses



Results Mirror Flooding April 12, 2023

NEXRAD Viewer : RainGrid Radar Rainfall estimates from 4/12/2023 7:00:00 AM to 4/13/2023 7:00:00 AM - Report Run date : 4/13/2023, 9:08:18 A

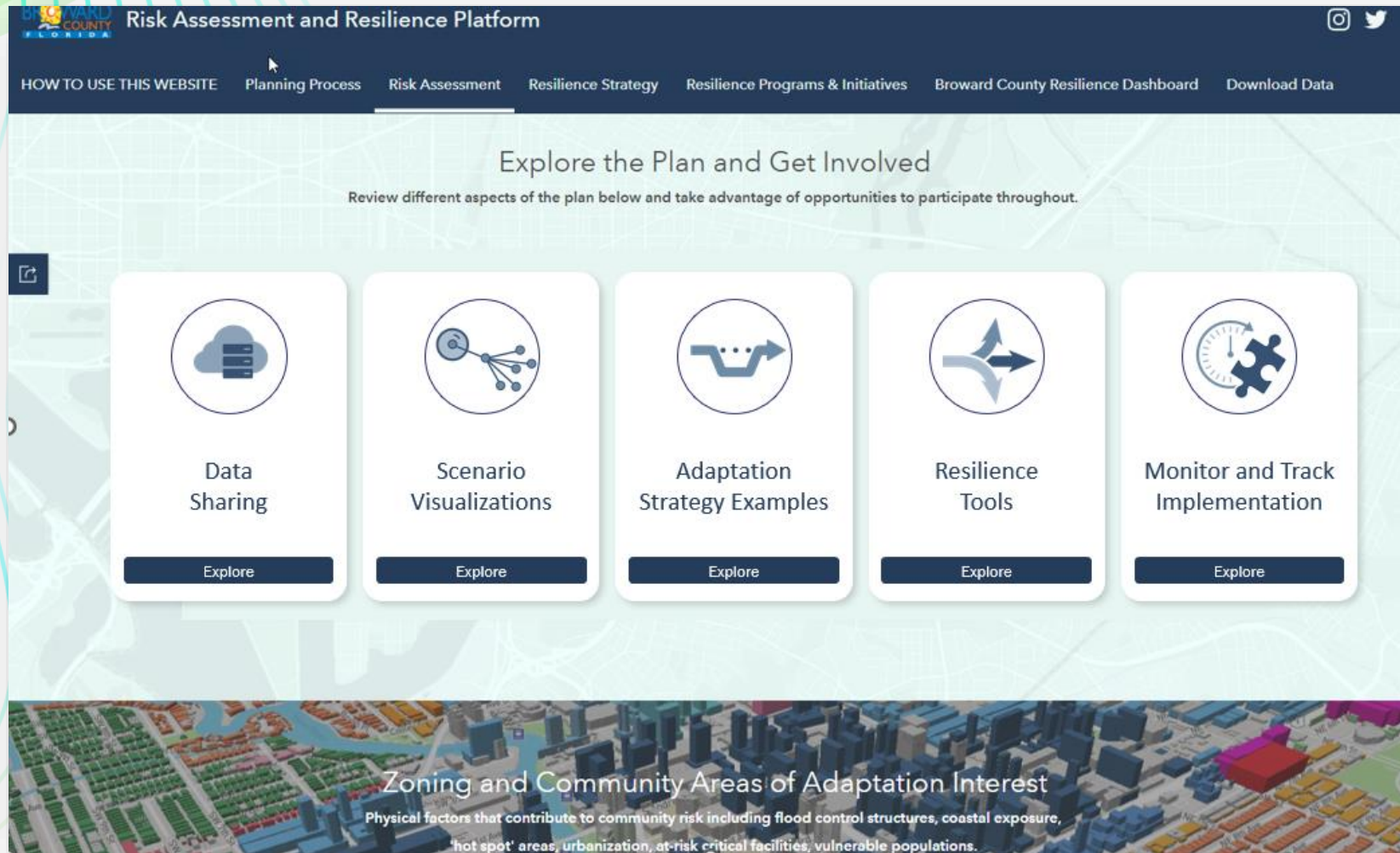




Resilience Plan Elements

- Prioritized adaptation roadmap
- Redevelopment strategies
- Green infrastructure emphasis
- Measured benefits and outcomes
- Planning level cost estimates
- On-line platform with project tracking
- Phased multi-decade implementation
- Funding strategies and cost-share

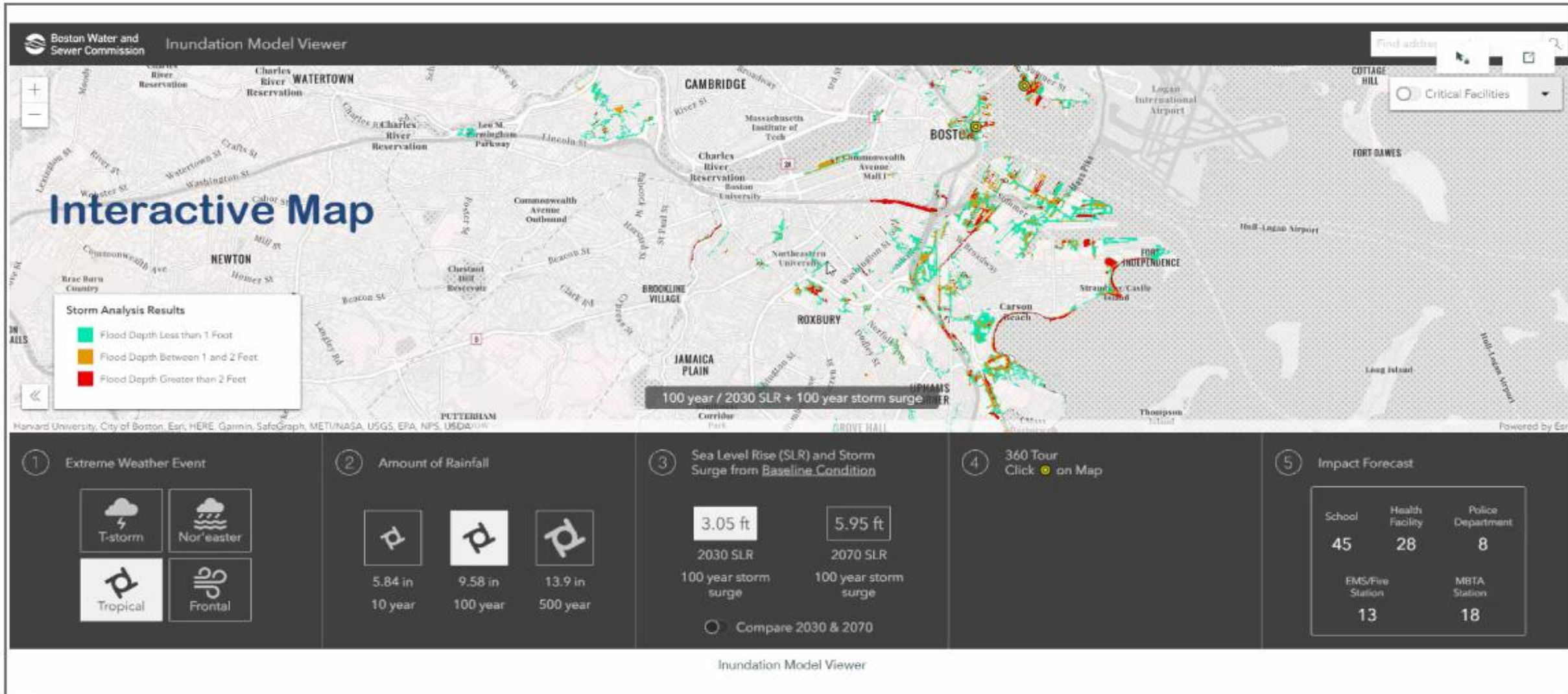
Dashboard Template



Public and Agency Portals

- County Agency
- Municipalities
- Water Districts
- Planning Agencies
 - Planning Council
 - RPC
 - MPO
 - DOT
 - SFWMD

Boston Inundation Model Viewer



Boston Inundation Model Viewer

Boston Water and Sewer Commission
Inundation Model Viewer
Find address

Storm Analysis Results

- Flood Depth Less than 1 Foot
- Flood Depth Between 1 and 2 Feet
- Flood Depth Greater than 2 Feet

10 year / 2030 SLR

10 year / 2070 SLR

1 Extreme Weather Event

T-storm

Nor'easter

Tropical

Frontal

2 Amount of Rainfall

1.83 in
2 year

3.20 in
10 year

3 Sea Level Rise (SLR) and Storm Surge from Baseline Condition

1.29 ft

2030 SLR

No storm surge

4.29 ft

2070 SLR

No storm surge

Compare 2030 & 2070

4 360 Tour

Click on Map

5 Impact Forecast

School	Health Facility	Police Department
--	--	--
EMS/Fire Station	MBTA Station	--
--	--	--

Inundation Model Viewer

⏸

⏪ ⏩ 02:20.42 🔊

What next?

- No Action Model Scenarios - Complete
- Economics Exposure - Summer
- 1st Stage Adaptation Alternatives – Fall/Winter
- Alternative Workshops – Winter
- Economic Benefits - Spring
- Shared Web Platform - Underway
- Project Finalization – June 2023

A two-year planning effort focused on building community resilience to the impacts of climate change in Broward County.

BROWARD COUNTY: A RESILIENCE PLAN IN THE MAKING

#ResilientBroward
April/May 2023 FOLLOW OUR PROGRESS: Broward.org/ResiliencePlan

The Resilience Plan Steering Committee held its sixth meeting on April 12, 2023, with progress reports on the Economic Modeling Memorandum, the initial hydrologic modeling results viewer and the County asset analysis.

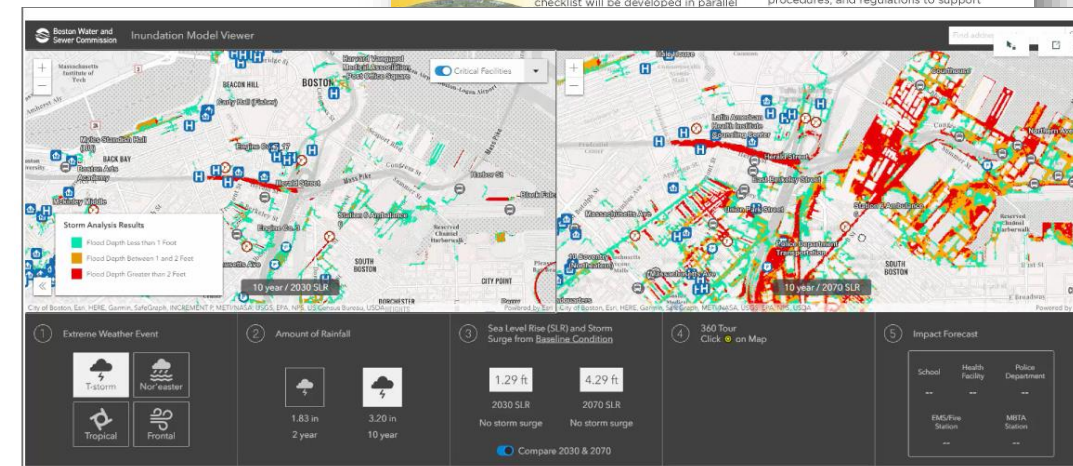
Economic Modeling
Economic Modeling Methodology: The economic consulting team provided a presentation on the final economic modeling methodology that has been accepted by the County. This represents the completion of a significant milestone and brings us closer to combining the hydrologic model results as an input to the economic model. County staff are currently engaged with delivering small business economic data to the consultants in support of this task. This effort is expected to continue through the summer and updates will be provided at future meetings.

County Asset Analysis
Hazen representatives held two meetings with agency staff to support the County asset analysis including the ranking and weighting criteria and methodology. Next steps will include a facilitated group exercise to refine the approach with application to selection of county sites. It is anticipated that experiences from the April 2023 rain event will inform this exercise (a timely misfortune). This task has broader community relevance as a capital project planning checklist will be developed in parallel.

Hydrologic Model Results Viewer
The consultant team shared the model results viewer with the Committee and gave a brief demonstration on how the tool works and will be used in the engagement with local governments to explore the validity of the model results and aid in the identification of adaptation priorities and opportunities. The viewer allows comparison of model outputs across scenarios and location-specific estimates of flood depth under compound flood conditions. The model results themselves will be useful in comparing to flood depths measured in April 2023. The Hazen team will be holding 6 sub-regional stakeholder meetings to review the results and solicit feedback during the months of May and June (to be announced shortly).

Adaptation Approaches
The Hazen team has begun to look at potential adaptation strategies that include changes to policy, infrastructure, procedures, and regulations to support

Photo: Street flooding along Riverland Road, Davie, 4/13/2023. Inset: Rescue vehicle, Fort Lauderdale.



Finally, Need for Upgrade of the Regional Flood Control System

Gravity driven structure



Gravity driven discharge

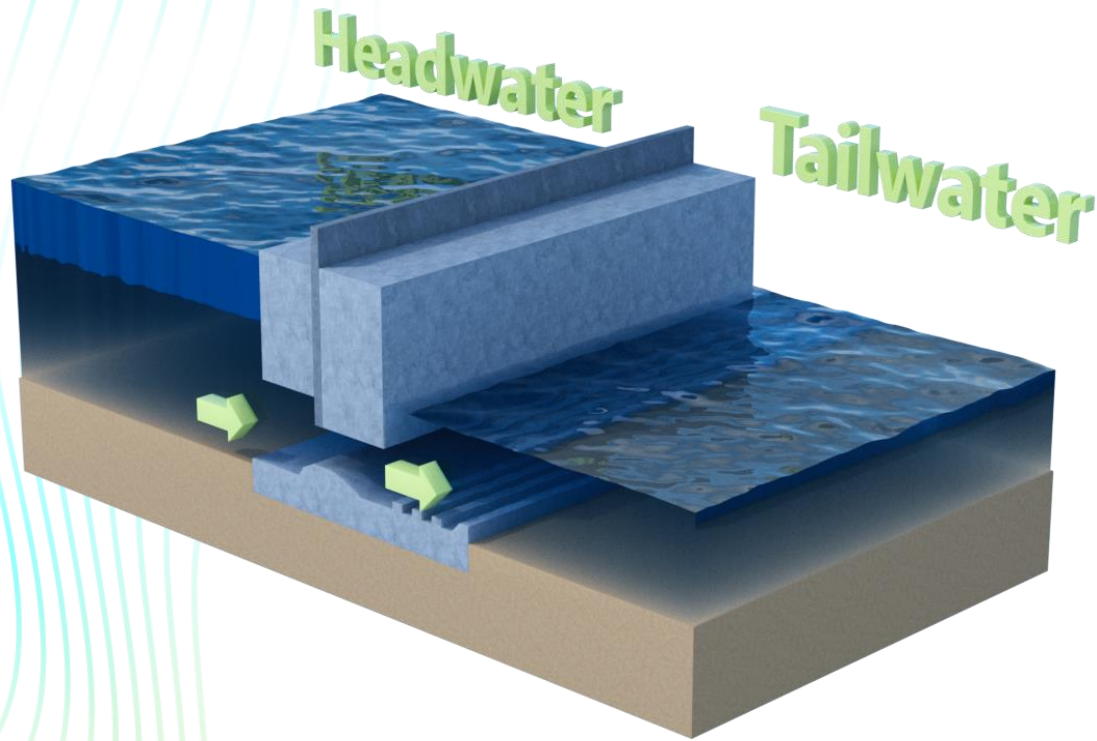


What happens if gates can't open?
What if the gates do open?

Today - Overtopping
Due to Sea Level Rise

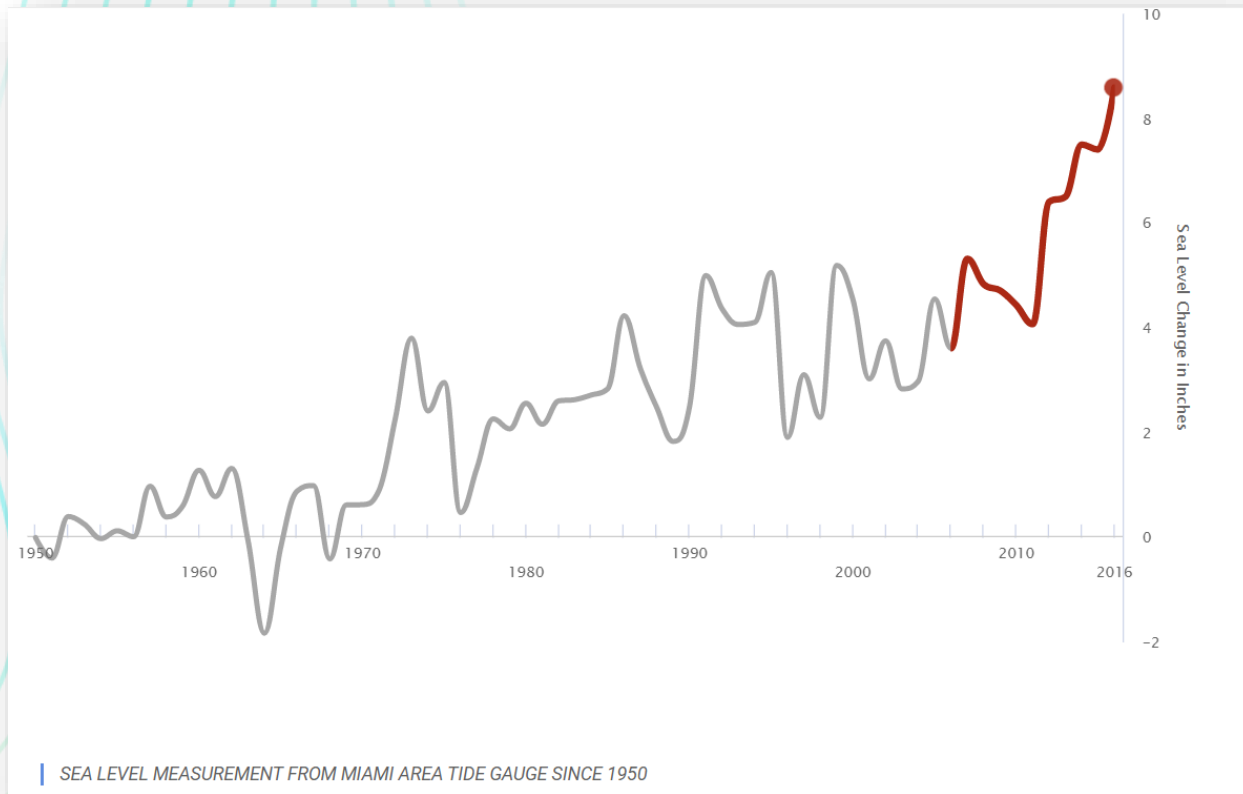


How it Works - Gated Coastal Structure for Water Management

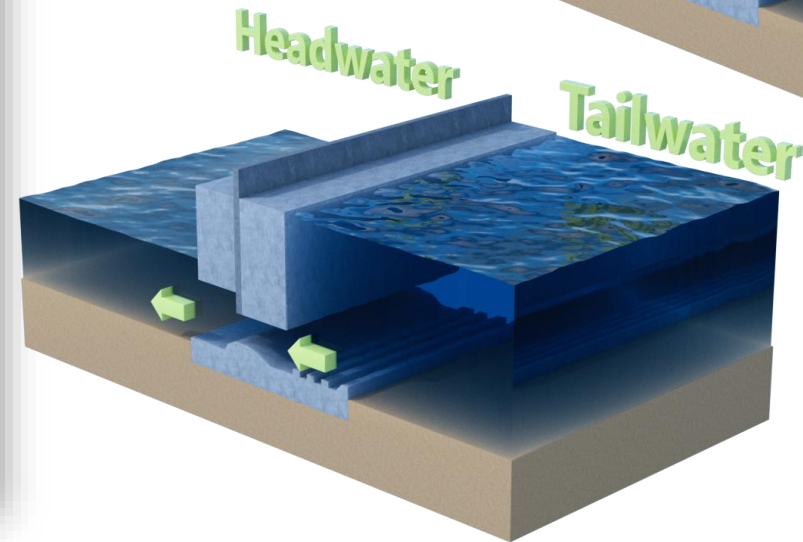
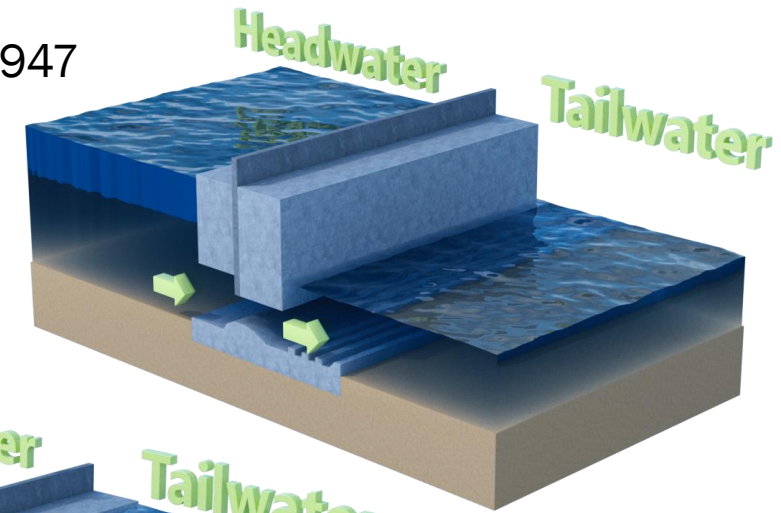


- Gated Structures are used to control water level upstream, preventing salt water from moving inland.
- The gate is lifted so the canal waters drains from the bottom, from the high water side (inland) to low water side (coast).

What has Changed ? Sea Level.



Design Condition - 1947



Current King Tide Condition

Functional Water Management System

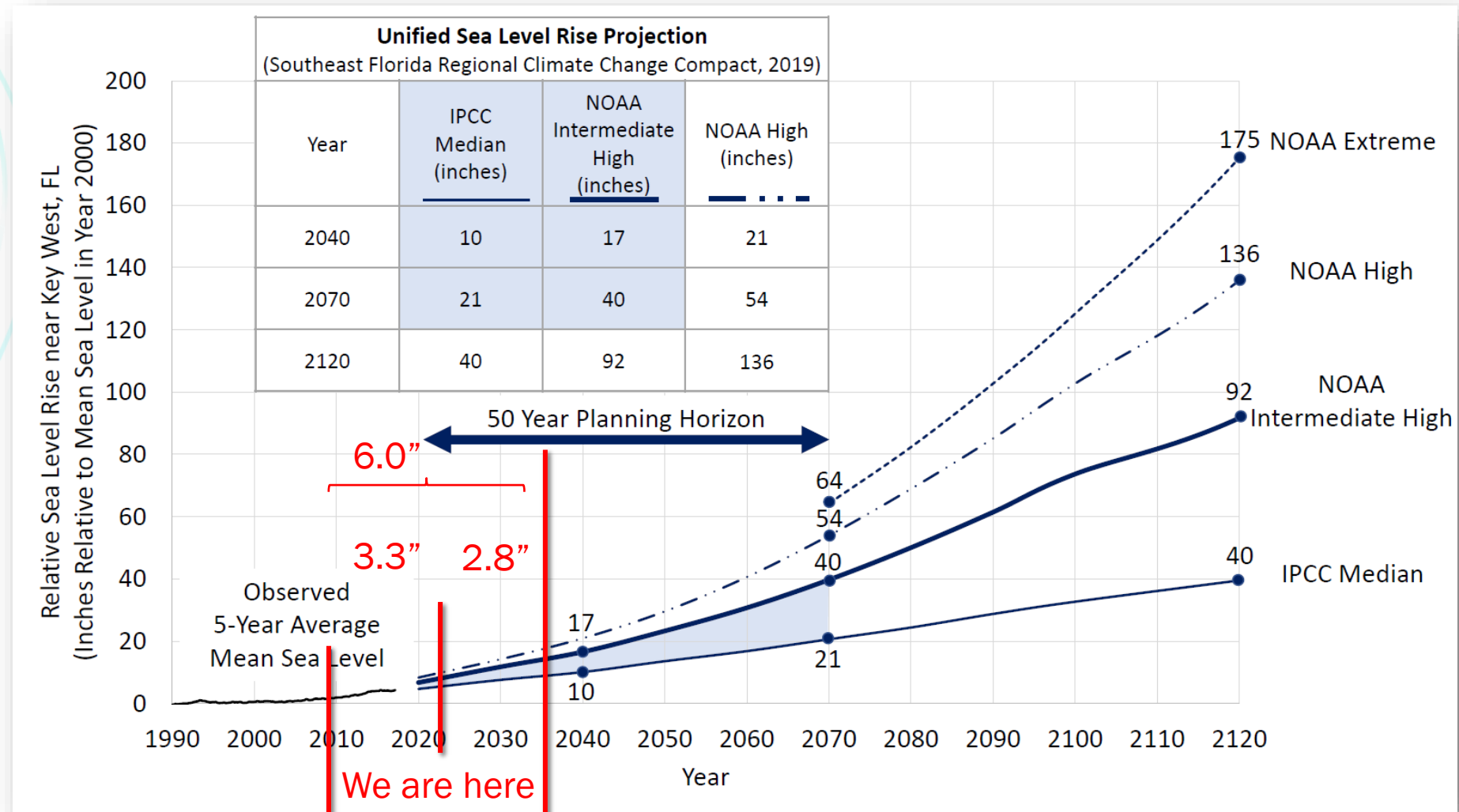


With reduced storage, increased rainfall, and sea level rise



System backs up with widespread flooding

Significant Risk is Here

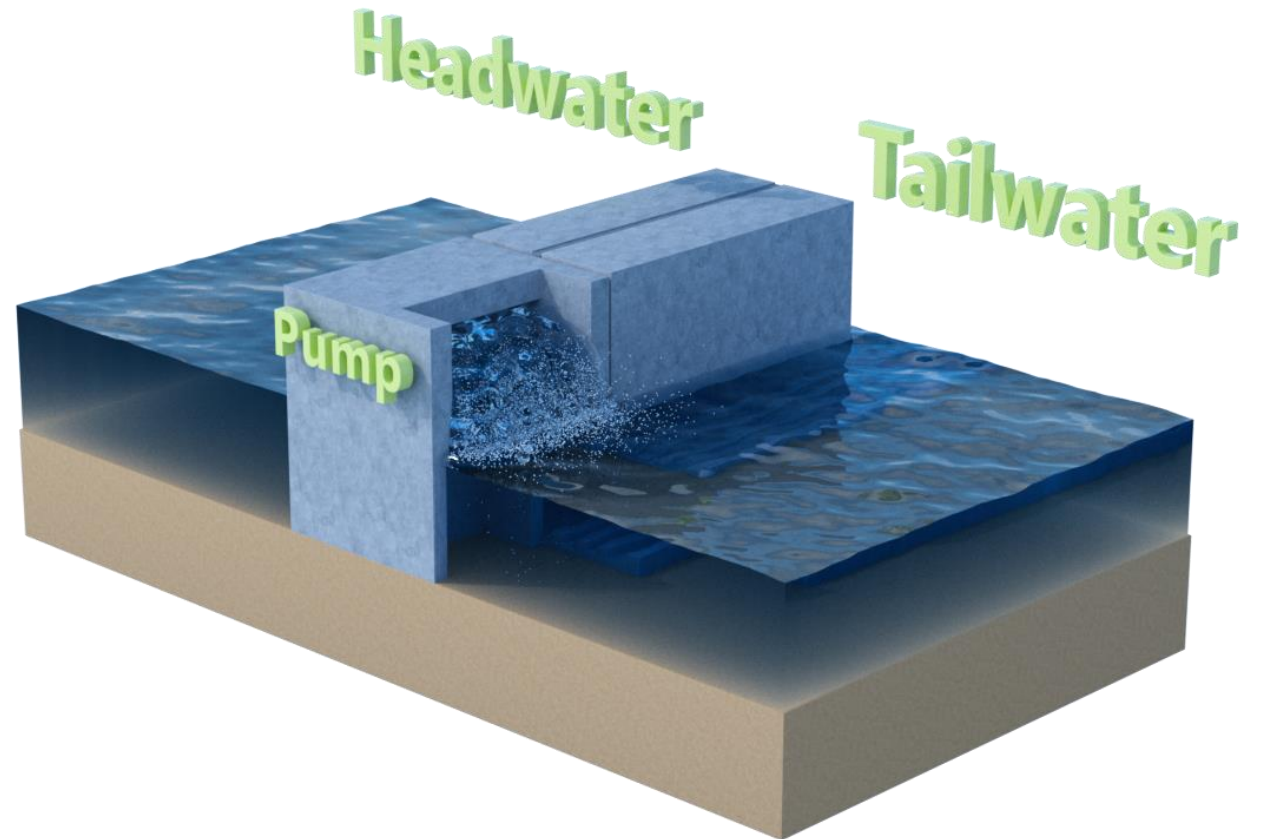


Early Warning
6" to threshold

Deadline for
Improvements

Requiring Adaptation and Storage

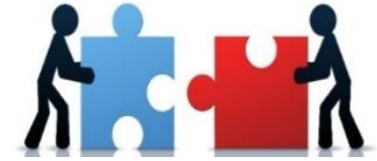
- **Scenario:** Tailwater is equal to or greater than headwater.
- **Solution:** Forward pumps could be added to existing structures to continue to move water when gates are closed.
- **Result:** Water can still be moved to tide, maintaining the ability to drain.



C&SF Status and Needs

- Section 216 Resilience Study underway but underfunded
- Comprehensive Study authorized but not funded
- Urgent need to complete Section 216 Study, and then authorize, fund and construct project recommendations (pumps)
- Section 216 Study Status:
 - Original study only authorized for \$3 M
 - Amended scope requires \$11.3 M
 - Pending Headquarters Approval and Additional Funding
- As a region we need to:
 - Express importance of project to resilience of region
 - Urge full funding of 216 Study
 - Note critical timeline for construction
 - Seek opportunities to acquire land for storage, throughout County

Summary



- Evolving and compound flood risk is one of South Florida's most pressing climate-related challenges
- Regional collaboration via Compact and Cities has accelerated planning and aided implementation
- Risk reduction requires a tiered approach addressing future conditions via standards, site specific improvements, land use practices, redevelopment strategies, systems, and storage
- Near-term economic consequences and benefits provide expanded basis for immediate action
- County-wide resilience plan will aid entire community but requires shared, coordinated, and sustained implementation

Questions ?

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