Sea Level Rise and Climate Resilience in Broward County, FL

RESILIENT BROWARD

Gulf Shore Association of Condominiums

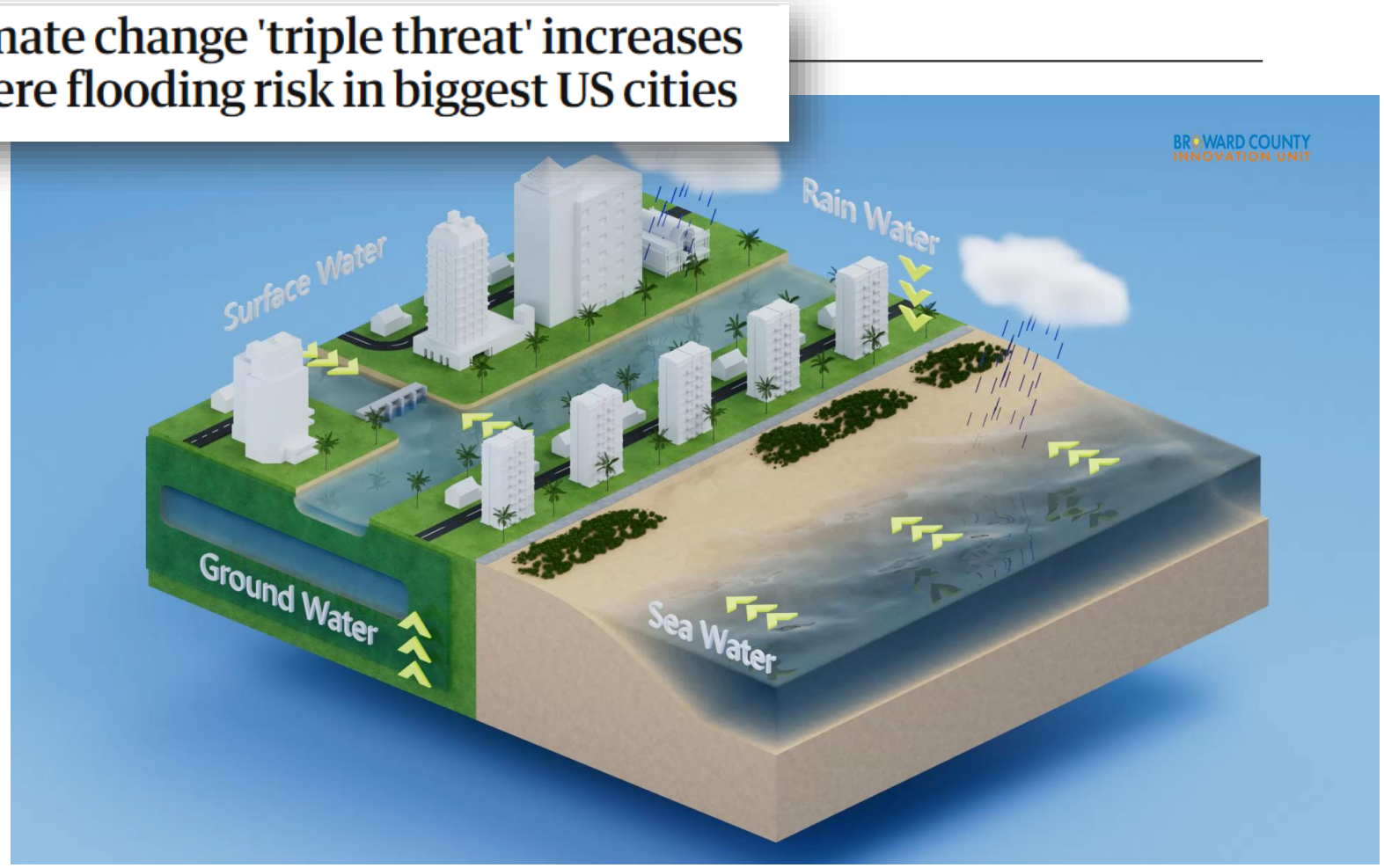
March 26, 2024

Community Resilience Challenges

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

Climate Change & Our Hydrologic System

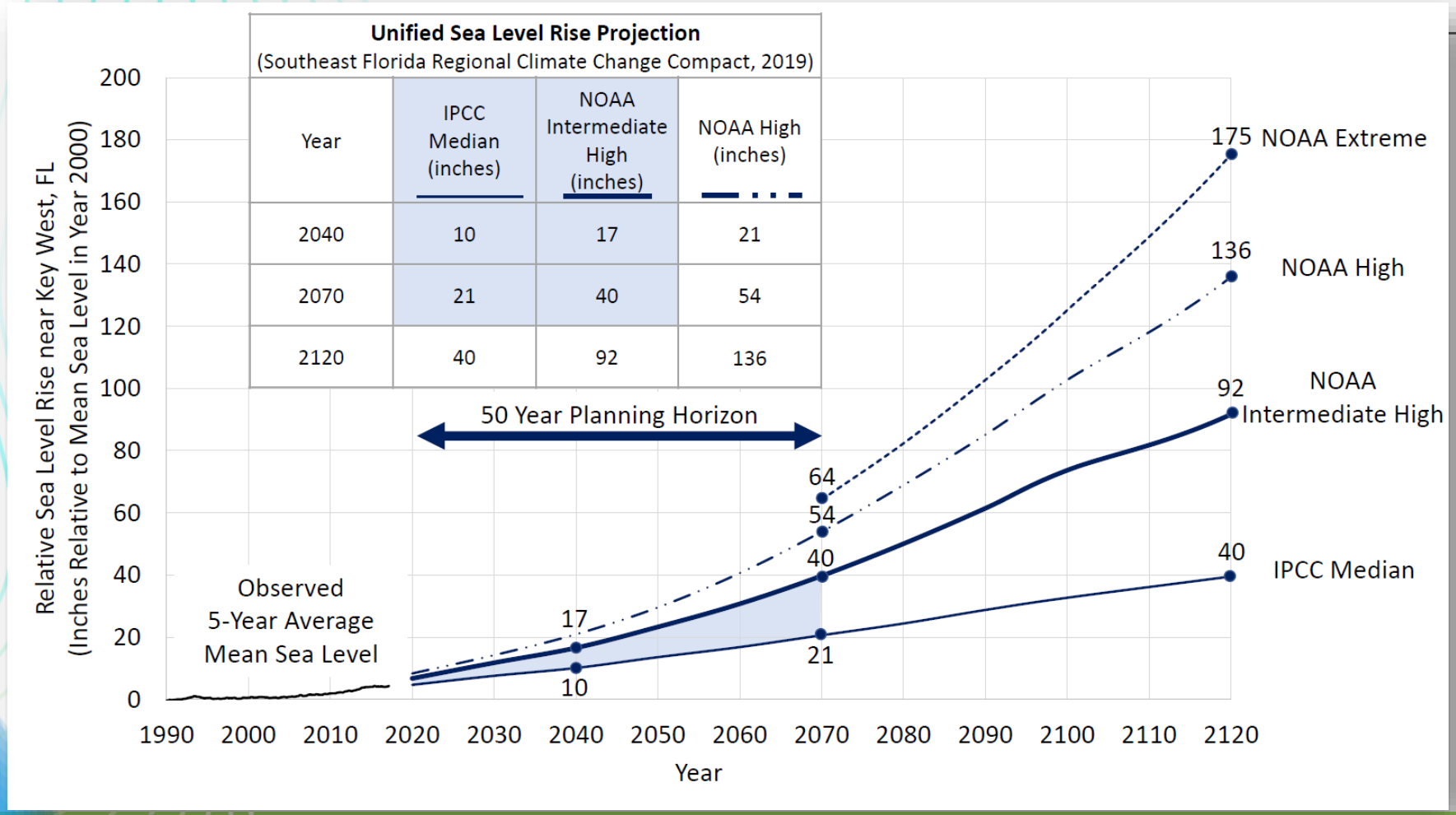
- Triple Threat
  - Rainfall and Storms
  - Storm Surge
  - Tidal Flooding
- Impacts
  - More frequent
  - More severe
  - More widespread
- Compounded Exposures
  - Value of Assets
  - Location of People



2019 Regional Sea Level Rise Projection

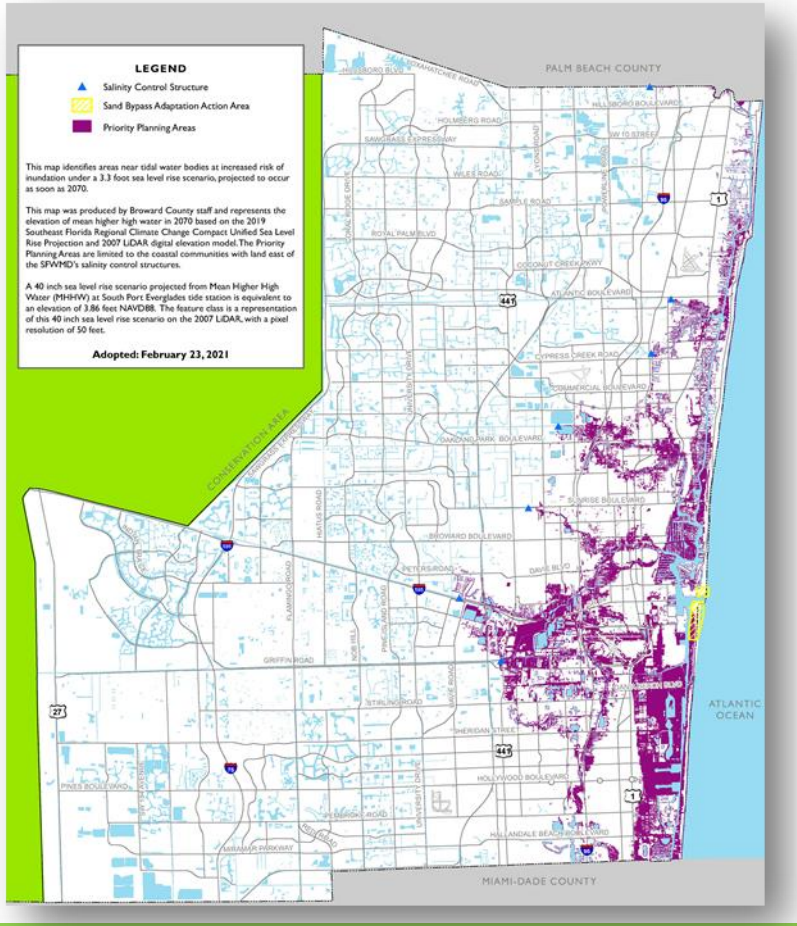
Unified Sea Level Rise Projection
(Southeast Florida Regional Climate Change Compact, 2019)

Year	IPCC Median (inches)	NOAA Intermediate High (inches)	NOAA High (inches)
2040	10	17	21
2070	21	40	54
2120	40	92	136



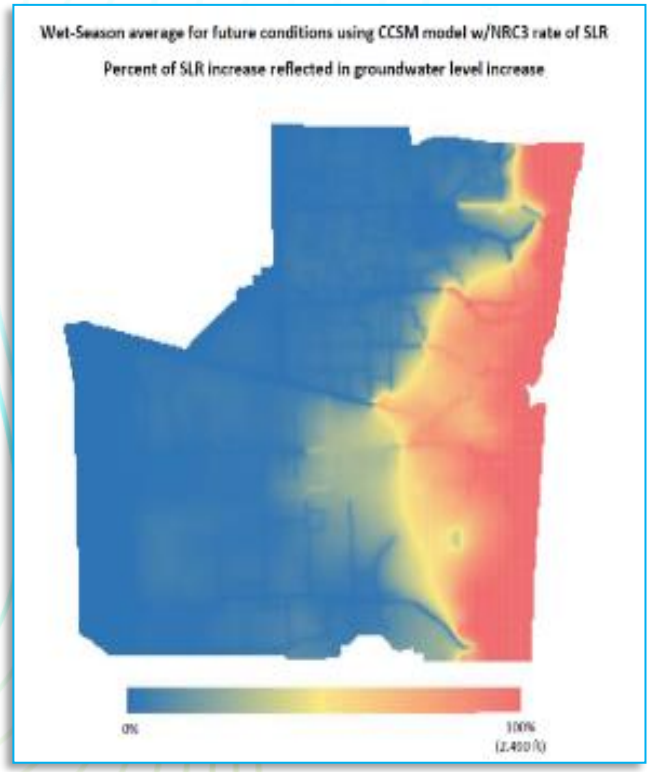
State of Resilience Standards

- Resilience Standards
  - Sea Level Rise Projection – 2012, 2015, 2020
  - Drainage infrastructure – 2017, 2024*
  - Tidal flood barriers - 2020
  - 100-Yr Flood elevations – 2021, 2024**
  - Design storms–2021, 2024**

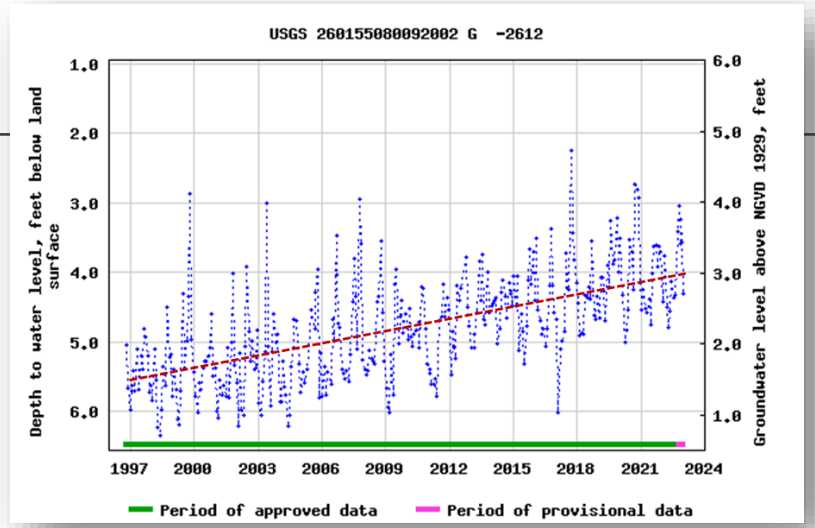


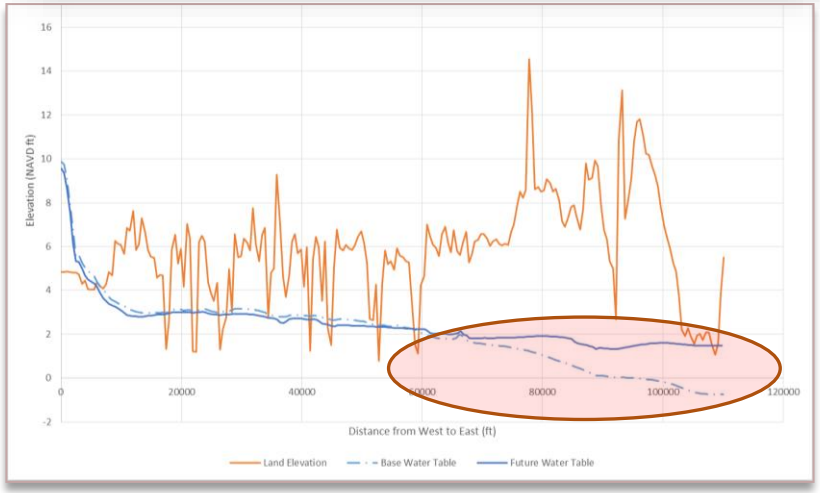
3.3 ft SLR = 17.6 mi^2

Future Conditions Groundwater Table Map

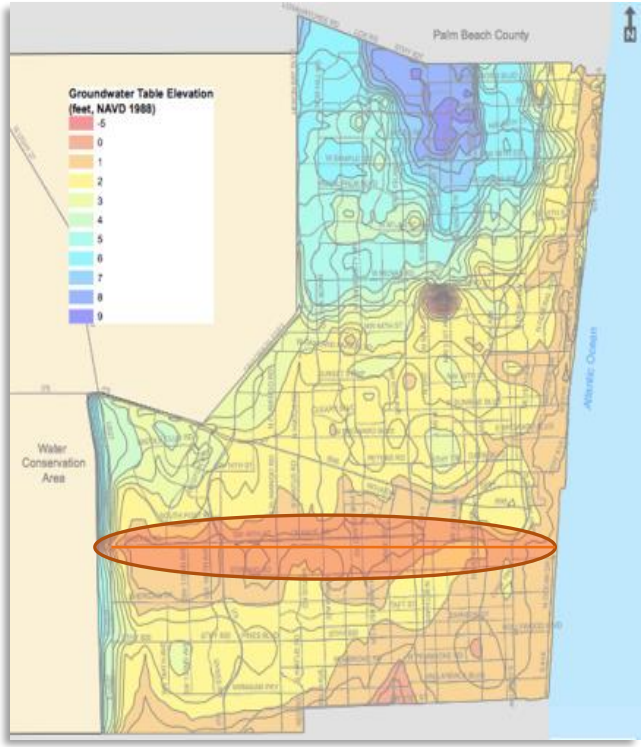


Modeled Change





Modeled W-E Cross Section



Future Conditions Groundwater Table Map

Tidal Flood Barriers

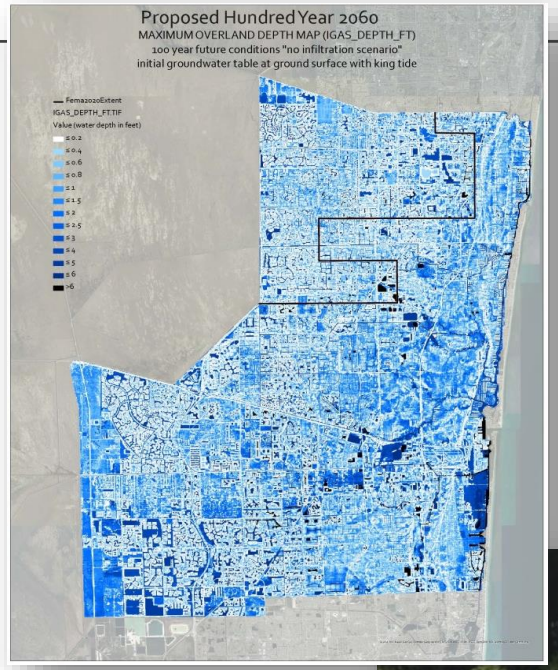
- Modeled water levels:
  - 2 feet sea level rise
  - High tides
  - 25-yr storm surge
- Requires 5 feet NAVD by 2050, allows 4 feet NAVD until 2035
- Applies to new construction, major redevelopment, and sites w/ tidal water trespass
- Requires municipal adoption and real estate disclosure.

HOLLYWOOD MARINA

100-year Future Conditions Flood Map

Incorporates:

- 2 Feet SLR
- King tides
- Increase rainfall (13%)
- Ground saturation
- 368 flood areas



What about the Existing Landscape?

Southeast Florida Resilience Business Case

Community-wide Adaptation

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

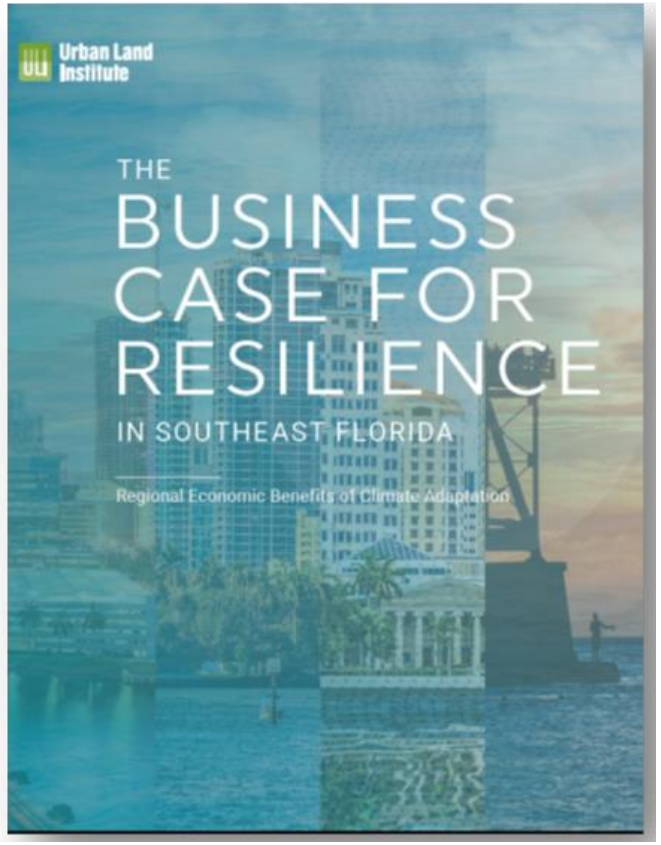
2:1

Building-level Adaptation

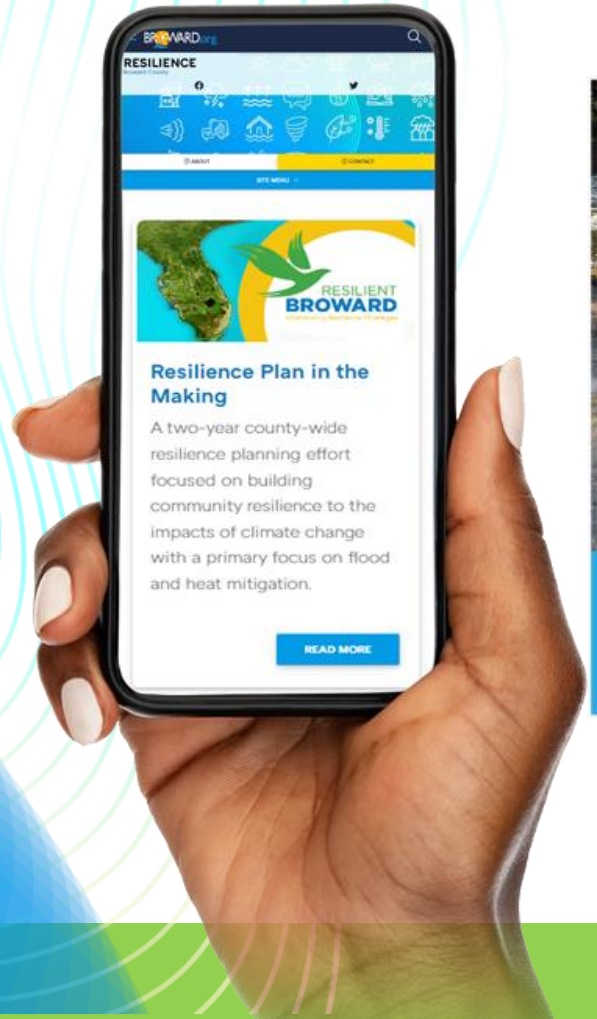
- A combination of structural improvements to property itself.

4:1

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

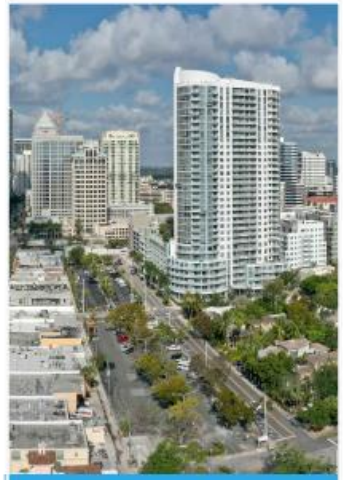


Community Resilience Requires Coordinated Plans and Investments



COMMUNITY OUTREACH

RISK ASSESSMENT

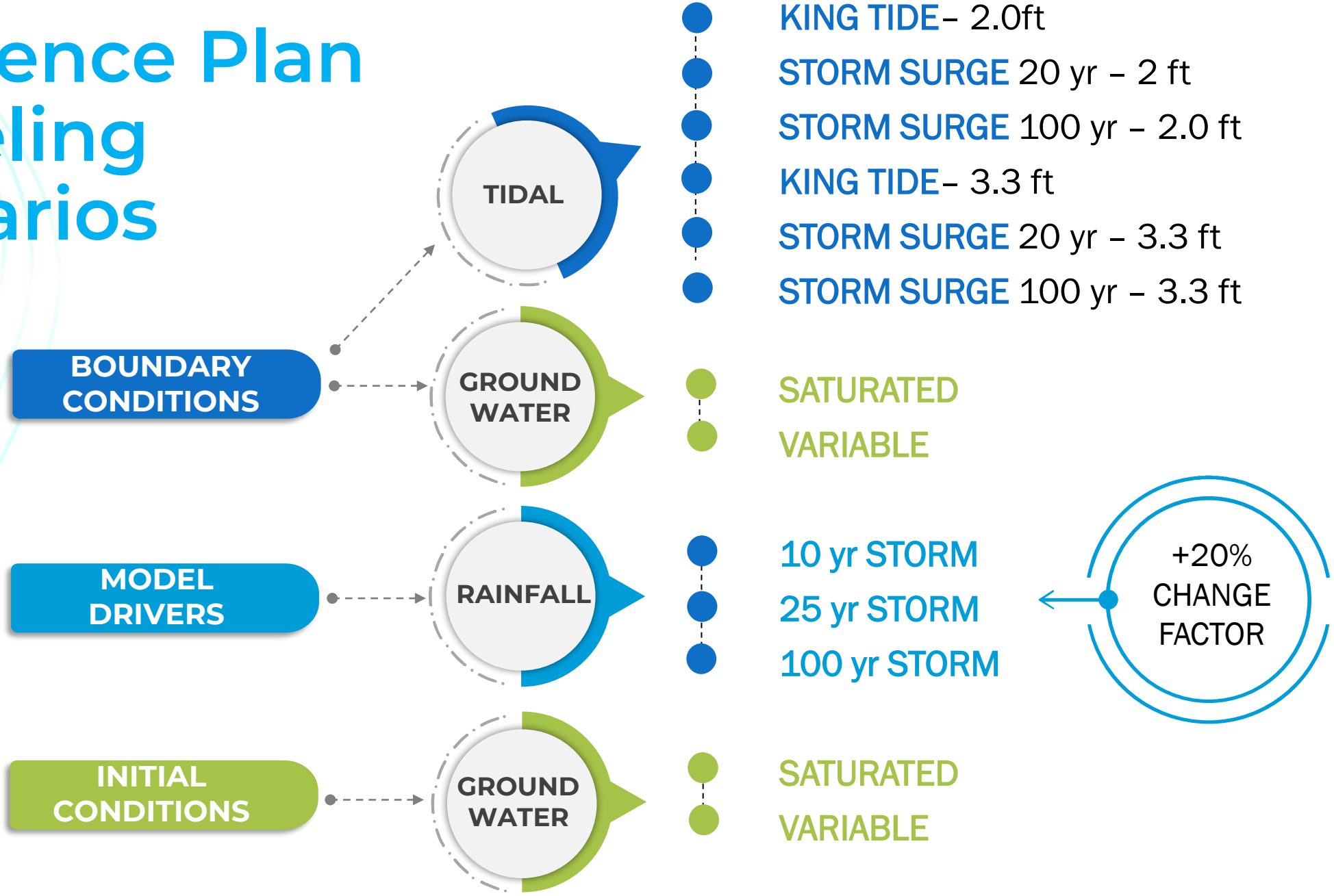


ECONOMIC MODELING

ADAPTION PLAN

ONLINE PLATFORM

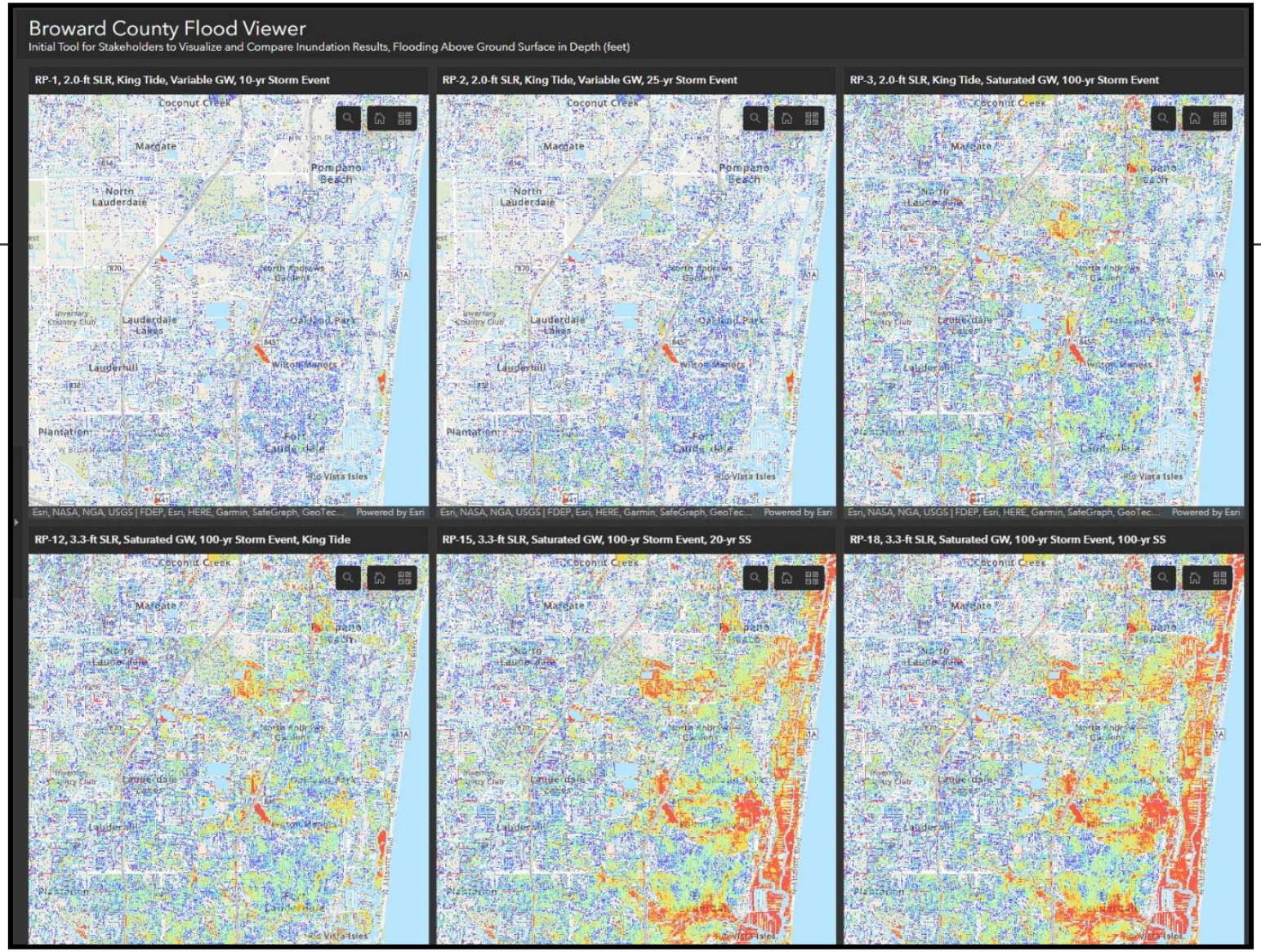
Resilience Plan Modeling Scenarios



Comparative Flood Risk Analysis

bit.ly/RiskAnalyses

3 feet/100-yr
+ high tide



2 feet/100-yr
+ High tide

3 feet/100-yr
+ High tide
+ surge

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

Risk Assessment and Resilience Plan

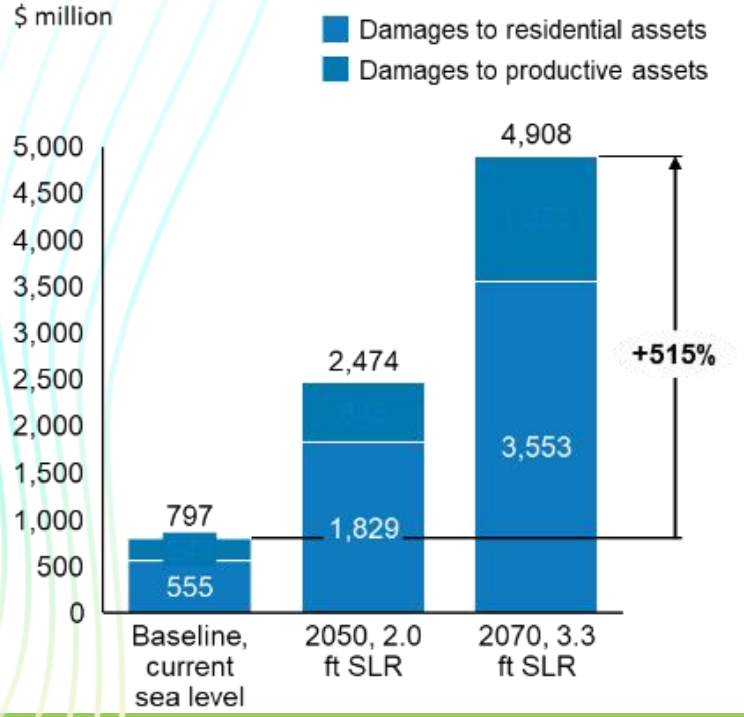
Economic Modeling

NO ADAPTATION INCLUDED

By 2070, residential/productive asset damage could increase 6.4x/5.6x times compared to baseline

Average annual damage, total

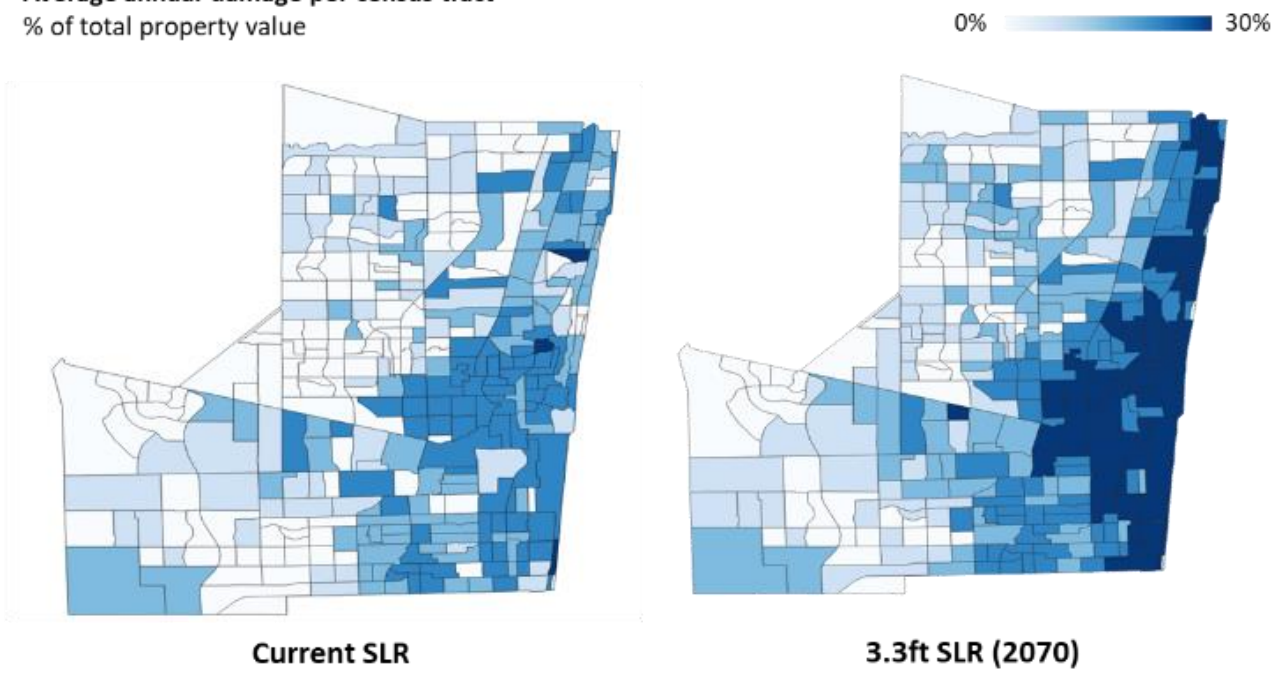
$ million



Most flood damage is concentrated along the coast

Average annual damage per census tract

% of total property value



Current SLR

3.3ft SLR (2070)

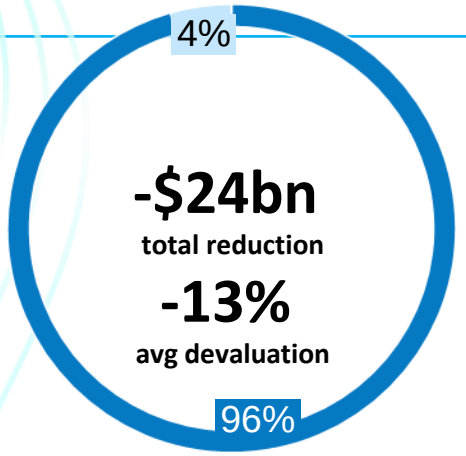
Increased damages could reduce property values by ~13% Countywide in 2.0ft SLR scenario

NO ADAPTATION OR INFLATION INCLUDED

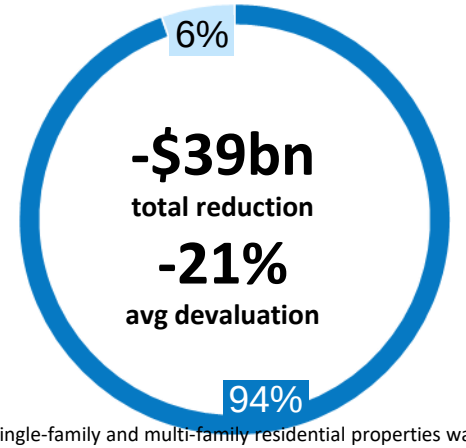
Total reduction in residential property value[1,2]

Drivers: Asset damages Loss of use

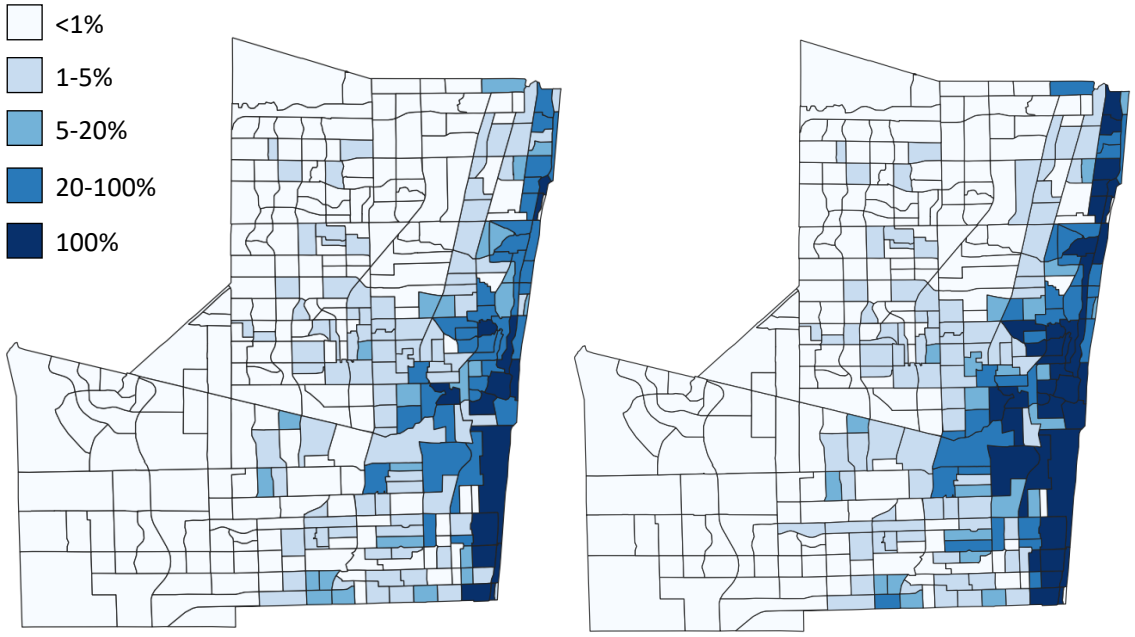
2.0ft SLR (2050) vs current



3.3ft SLR (2070) vs current



Distribution of census tracts by average residential building devaluation (%)



2.0ft SLR (2050) **3.3ft SLR (2070)**

Interim Results (Baseline/No adaptation actions considered)

1. Capitalization rate used for both single-family and multi-family residential properties was the average capitalization rate for multi-family residential properties in 4 Florida cities as per CBRE 2023 1H
2. The analysis does not consider impact from loss of local amenities and services as well as second-order impact from reduced economic activities
3. Downtime-related losses assumes owners do not derive value for the property while it is uninhabitable
4. A census tract is considered to experience complete loss in property value if the average annual flood-related loss increase (vs current) is greater than current net operating income (i.e., around $23k, which is 4.94% of average property value).

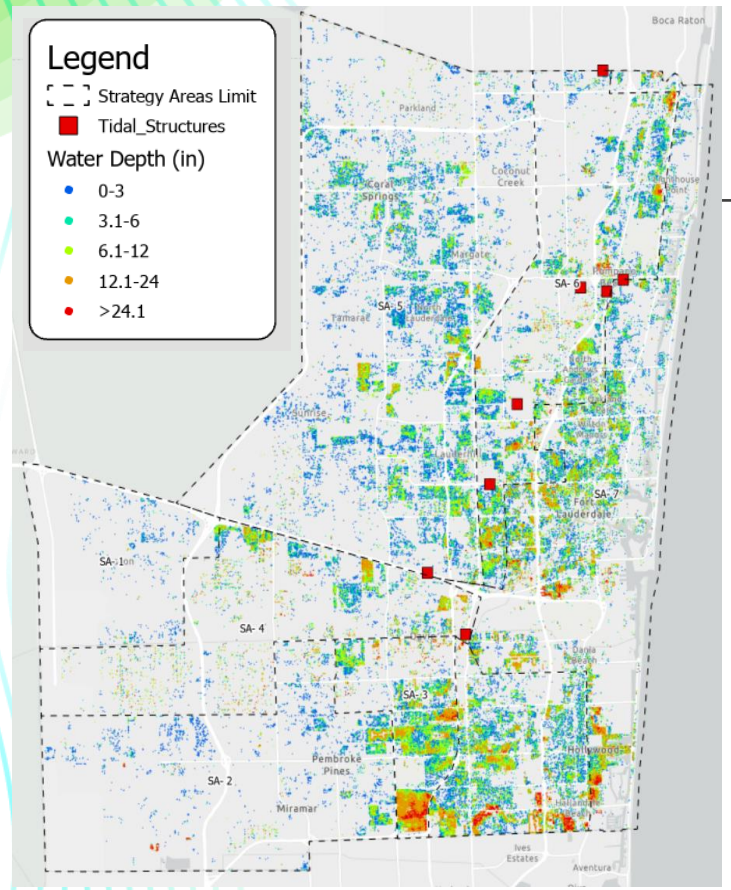
Source: Flood modeling and damages from Hazen and Sawyer

Adaptation Strategies Evaluated

- Storage - Above and below ground
- Reducing Impervious area
- Conveyance
  - Improving structures (canals, culverts, etc.)
  - Additional Pumping
- Barriers
  - Seawalls
  - Nature-based and/or engineered structures
  - Large scale levees and other close out structures

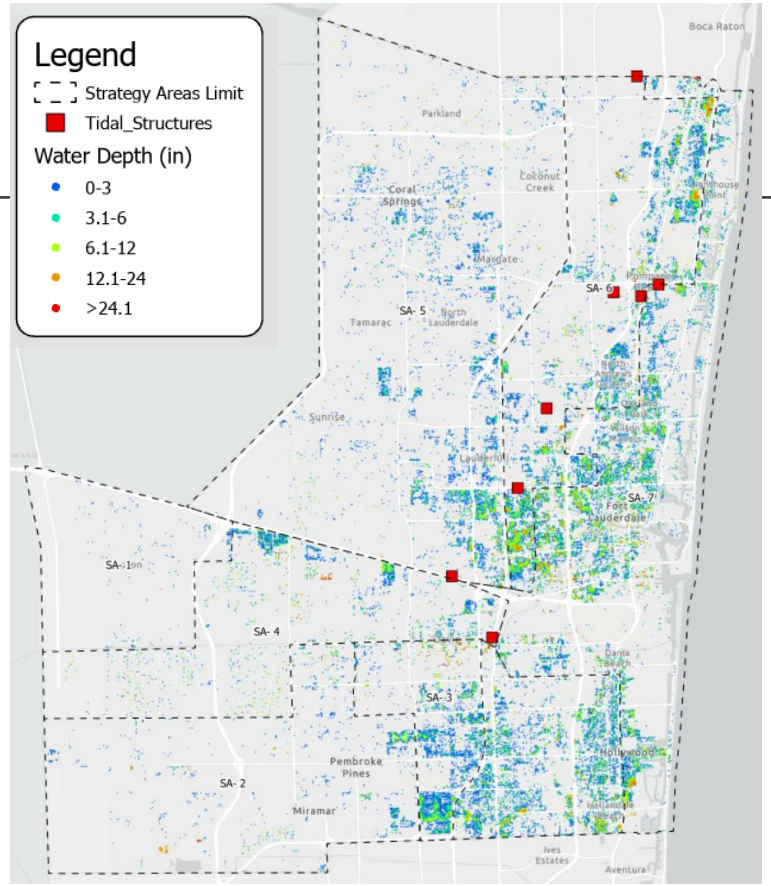
Green Infrastructure

All Adaptation Strategies Working in Combination



Base Scenario Water Depth

Rain	SLR	Tidal
100-yr 3-day	2 ft	King Tide



Adaptation Strategy Water Depth

All secondary structures have the control elevation (CE) reduced by 1'.
Includes also: Pumps, Crossings, Seawalls.

Water Depth Reduction (148,045 Prop)

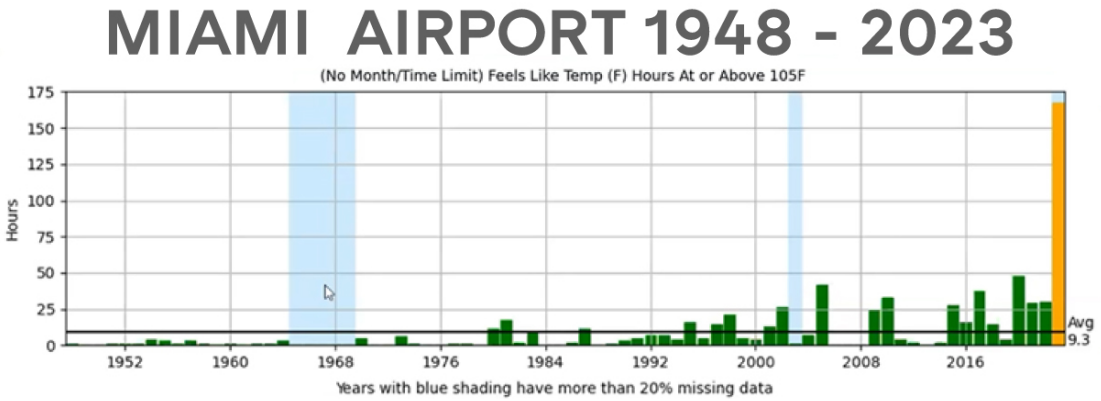
Delta Flood Depth (inches)		%
from 12	to 24	14.0
from 9	to 12	14.0
from 6	to 9	20.5
from 3	to 6	22.7
from 0	to 3	28.8

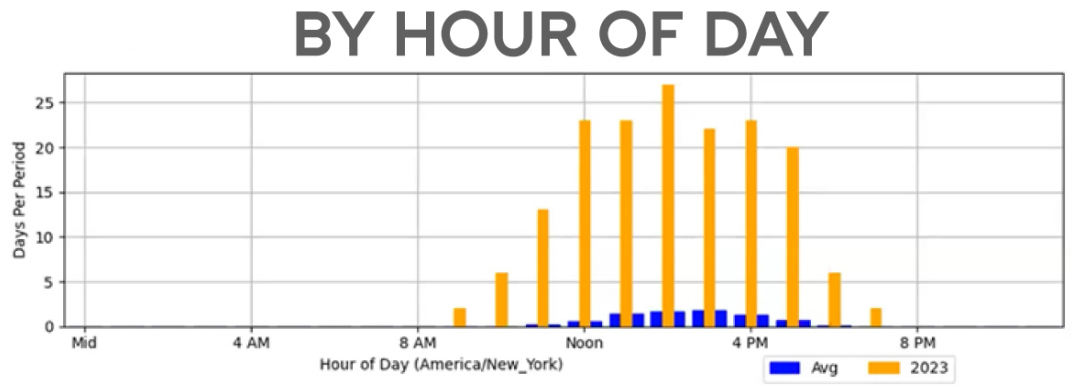
+190

Miles of Seawall and Enhanced Natural Barriers

Greater Context: IPCC's 6th Assessment Report

- With every increment of global warming, regional changes in mean climate and extremes become more widespread and pronounced.

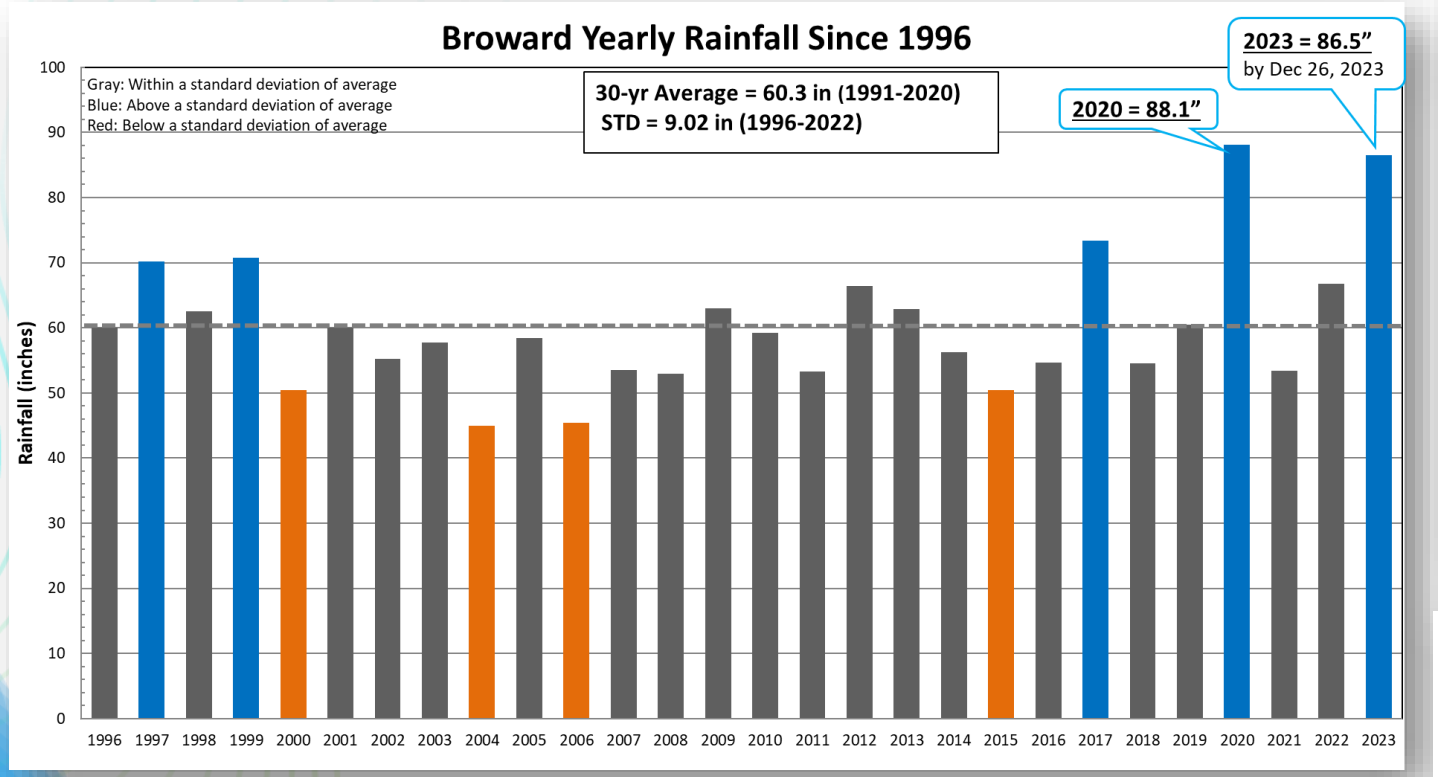




RECORD HEAT IN 2023

Fort Lauderdale eclipses 100 inches of rain in 2023, as Florida braces for more flooding

Historic downpour in Fort Lauderdale dropped 88 billion gallons of rain



NATIONAL

Fort Lauderdale was inundated with a third of its annual rainfall within hours

By Tim Craig, Scott Dance, Andrew Jeong and Matthew Cappucci

Updated April 13, 2023 at 3:04 p.m. EDT | Published April 12, 2023 at 10:57 p.m. EDT

How we Intend to Quantify Plan 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

Summary

- Evolving and compound flood risk is one of South Florida's most pressing climate-related challenges (in addition to extreme heat).
- Update of design standards is already delivering benefits.
- Current efforts focus on development of a coordinated, community-wide resilience plan.
- Community and economic resilience is a central theme, addressing livability, affordability and opportunity.
- Large scale adaptation is on horizon, but must be combined with state and federal investments, along with aggressive emissions reductions, community-wide.

Questions ?

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