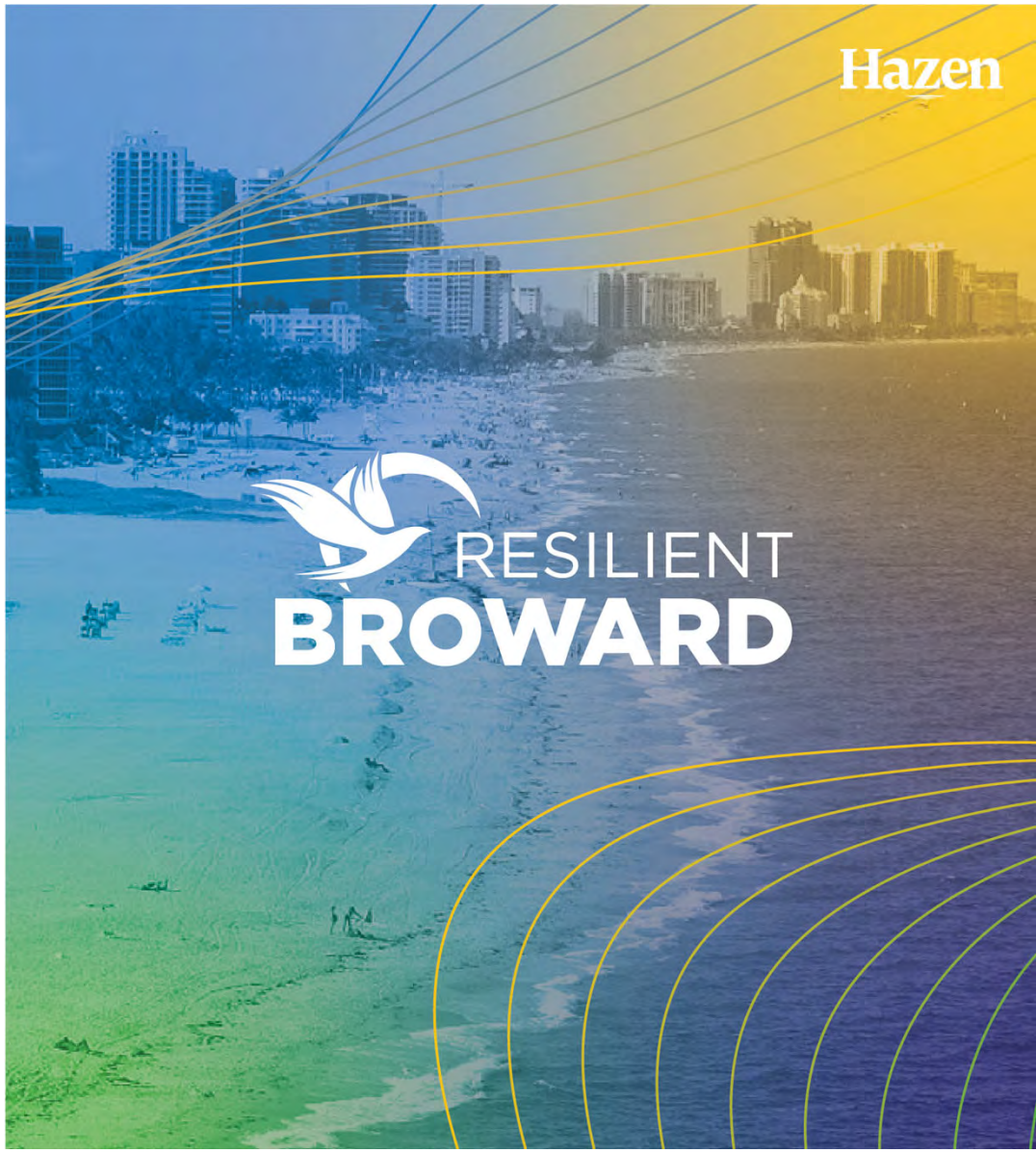
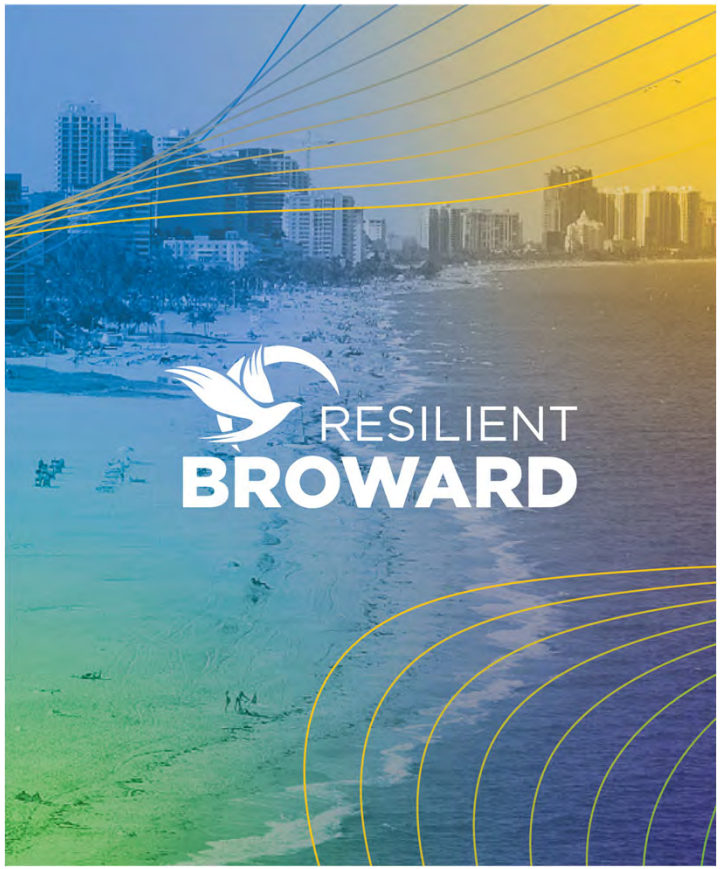
Resilience Steering Committee
Countywide Risk Assessment and Resilience Plan

October 12, 2022



Outline

1. Reflection on Hurricane Ian
2. Update on data collection from stakeholders
3. Incorporation/use of data for hydrologic model
4. Update on economic modeling/follow-up from prior discussion
5. Review of progress and impacts on schedule
6. Introduction to “the Platform”
7. Next Steps/Upcoming Activities



1

Reflection on Hurricane Ian

Hazen

NEWS

HOME > SUSTAINABILITY

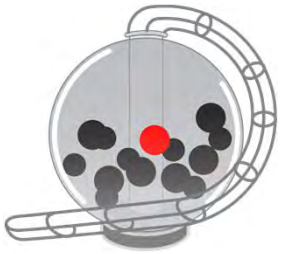
Hurricane Ian hit southwest Florida just as the state put historic amounts of money into climate resilience. Now officials have to move faster.

Hurricane Ian flooded neighborhoods like this one in Fort Myers, Florida. Photo by Ricardo Arduengo/AFP via Getty Images

Frequency, Return Period, and Compound Probability

Return Period (symbolized as **Tr**) **provides an estimate of the probability that the magnitude of a given event be exceeded**. For example, if the 100-year return period flow value for a river is 5,000 cfs, it means that there is a 1 in a 100 or 1% chance that this flow will be exceeded in the river in a given year.

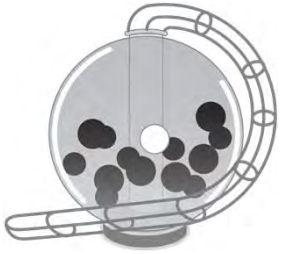
Tr = 1/ P



If there are 99 black balls in a lottery hopper, along with one red ball (100 ball total), and a person randomly picks one ball from the hopper. The probability of that ball being red is:

P = 1/100 = 1%.

If the red ball is put back in the hopper, the probability of the next ball being picked from the hopper being red again is also 1% (independent events).



If the same experiment is done in parallel with 99 black balls and one white ball.
The probability that a red ball is picked in the hopper and a white ball is picked in the other hopper at the same time is:

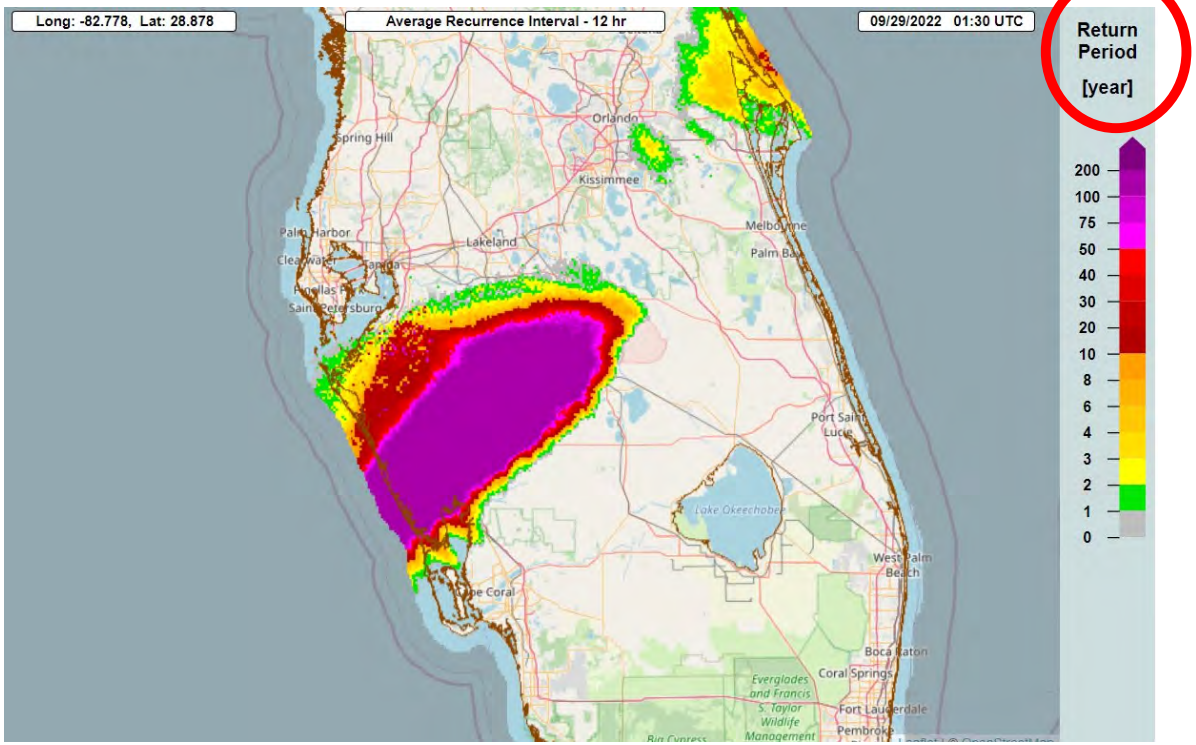
$P_T = P_1 \times P_2$. (If event 1 and event 2 are independent)

This is called the **compound probability.**

Flooding is caused by the combination of several drivers (e.g. tidal surge + rainfall). Each one of these drivers might have their respective probability of exceedance. Compound Probability is the combination of these probabilities. Since these events are not always independent, the computation of the compound probability of a combined event is more complex.

Hurricane Ian Related Rainfall Depths

Radar rainfall estimates midway through Ian

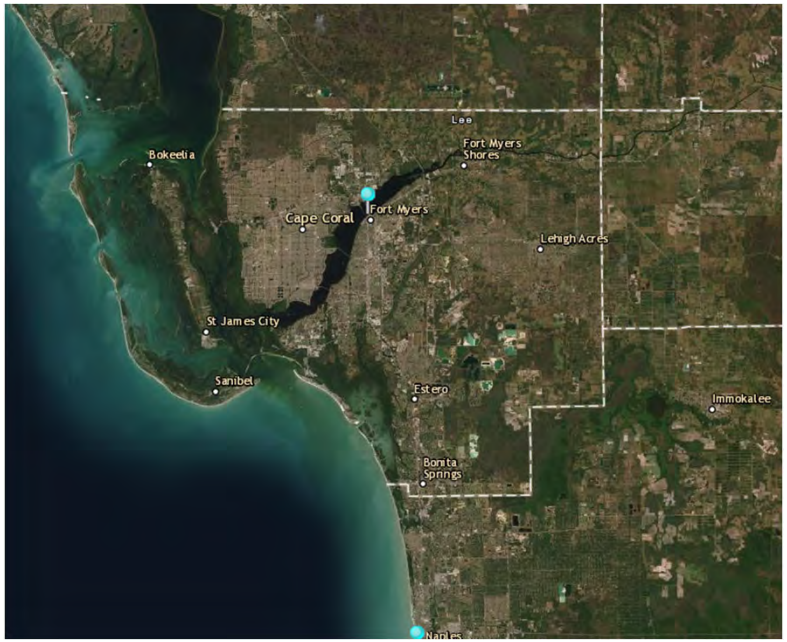


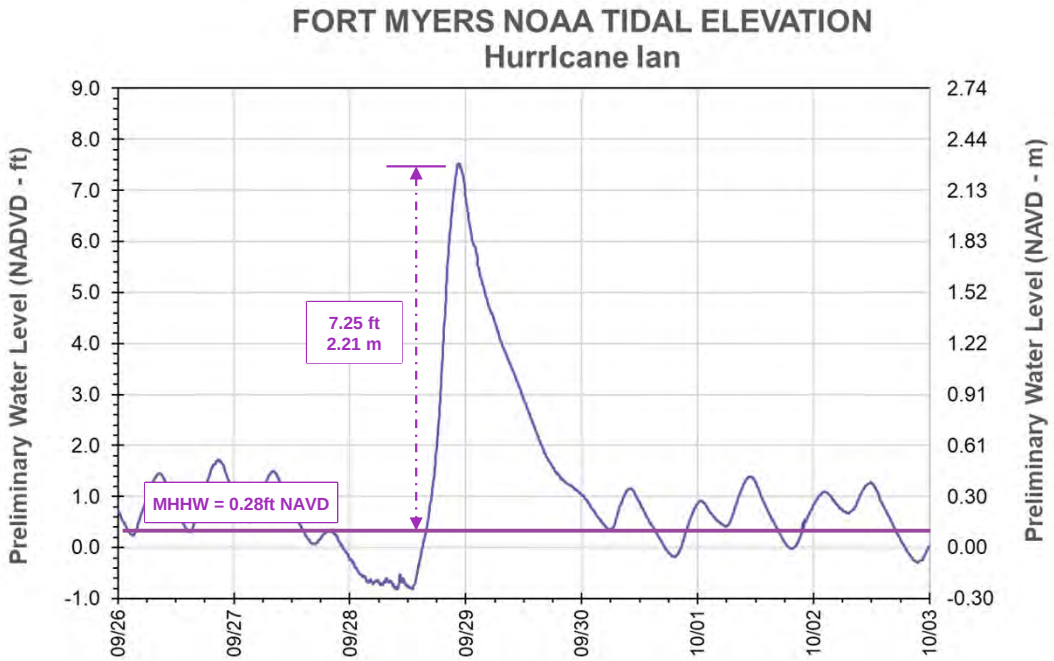
… from other sources

Resilience Plan uses scenarios that include the 10-, 25-, and 100-year event, Countywide

Hurricane Ian Surge in Fort Myers

Coastal Inundation Dashboard





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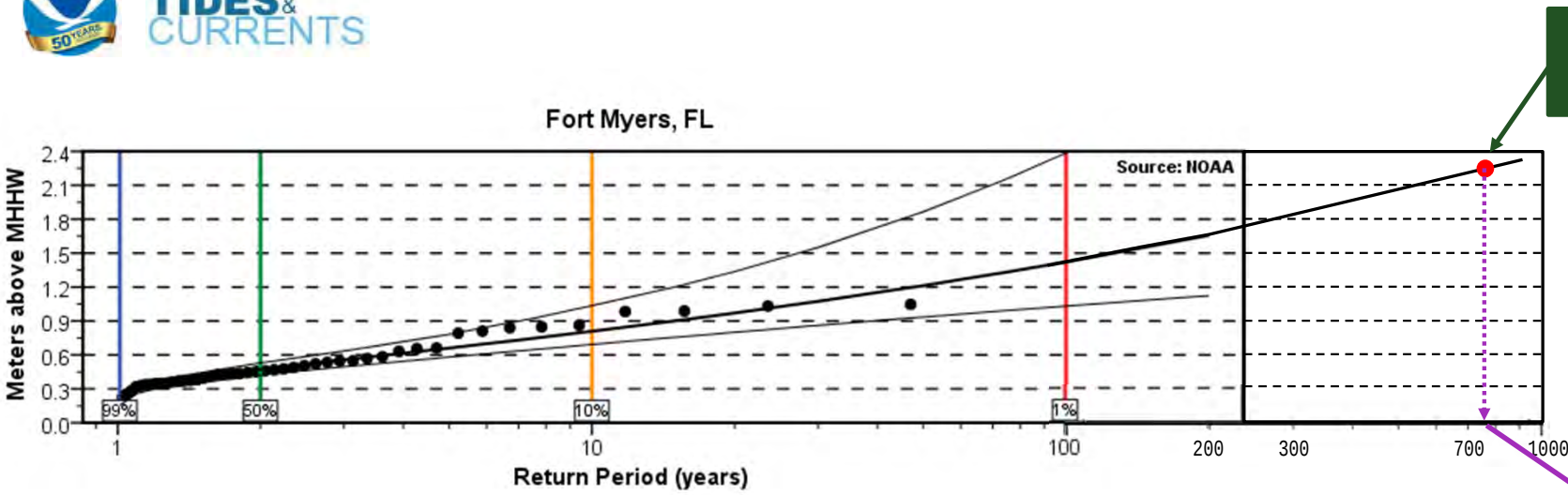
Hurricane Ian Surge in Fort Myers



2.21 meters above the MHHW

Return Period = 700-800 years

https://tidesandcurrents.noaa.gov/est/curves.shtml?stnid=8725520

Hurricane Ian Surge in Fort Myers

Water Level Data | Meteorological Data | High Tide Flooding Events | Top-10 Water Levels | Sea Level Trend | Exceedance Probabilities

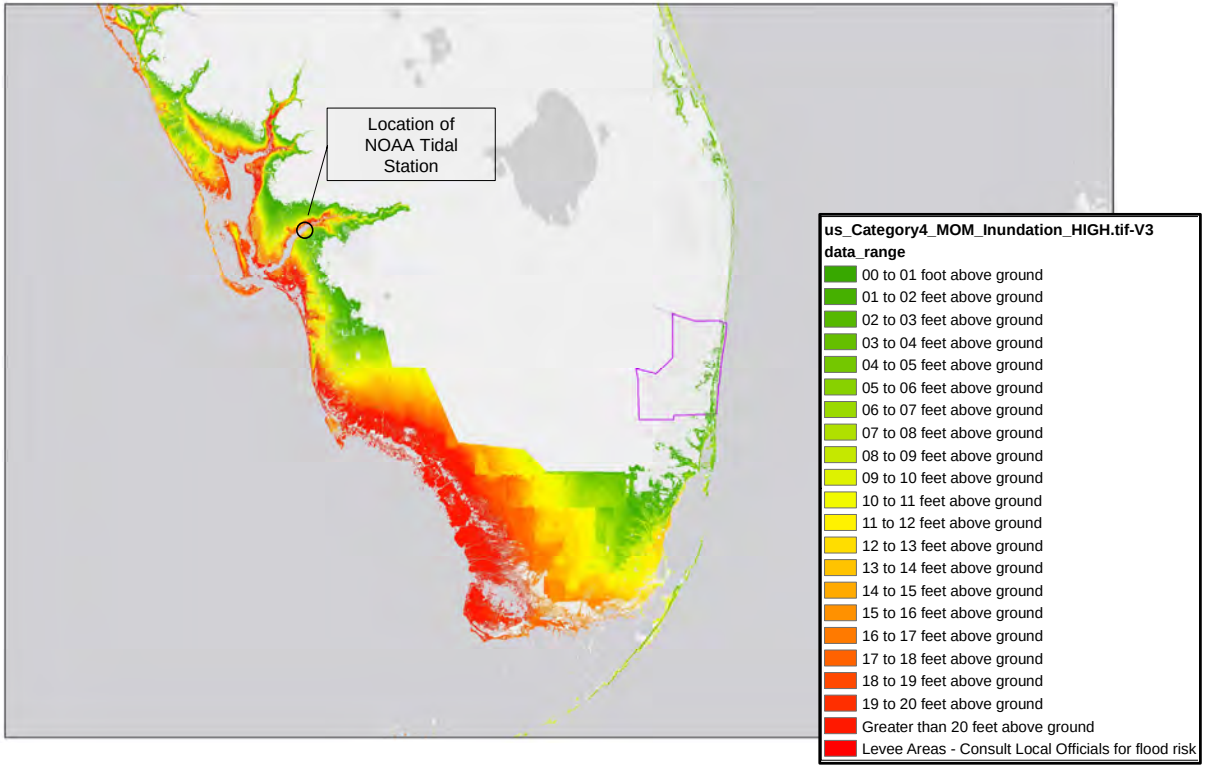
NOS/NOAA/CO-OPS
Top-10 Highest Water Levels
8725520, Fort Myers FL

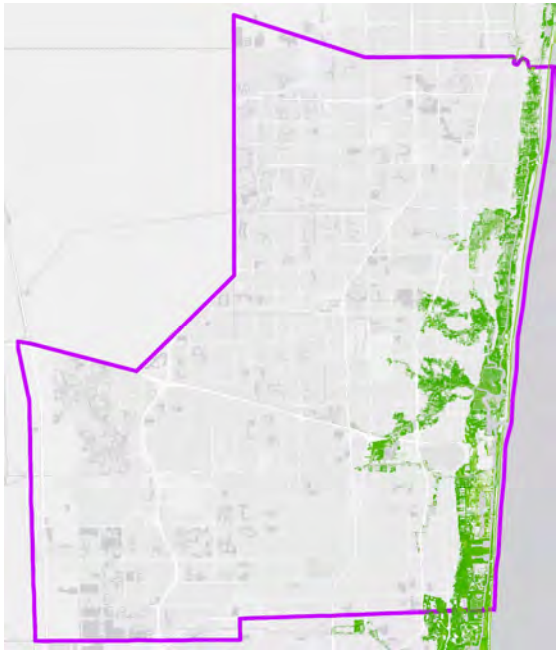
Date	Height (Feet above MHHW)	Event Category	Event	Source
September 28, 2022	7.25	Tropical	Hurricane Ian	
September 14, 2001	3.36	Tropical	Hurricane Gabrielle	Observed Peak Water Level
November 23, 1988	3.33	Tropical	Tropical Storm Keith	Observed Peak Water Level
June 18, 1982	3.29	Tropical	Subtropical Storm One	Observed Peak Water Level
September 11, 2017	3.06	Tropical	Hurricane Irma	Observed Peak Water Level
June 25, 1974	3.06	Tropical	Subtropical Storm One	Observed Peak Water Level
August 13, 2004	2.98	Tropical	Hurricane Charley	Observed Peak Water Level
August 31, 1985	2.77	Tropical	Hurricane Elena	Observed Peak Water Level
November 11, 2020	2.74	Tropical	Tropical Storm Eta	Observed Peak Water Level
October 8, 1996	2.69	Tropical	Tropical Storm Josephine	Observed Peak Water Level
September 6, 2004	2.69	Tropical	Hurricane Frances	Observed Peak Water Level

Listing of the top historical water levels, along with the associated weather event. Most values are based on the peak water level observed at the tide gauge. At times where observed water levels are unavailable, values may be taken from high water marks. For additional information or data, please visit the Extreme Water Levels website.

NOAA Estimates for the Surge Produced by a Category 4 Hurricane

NOAA Sea, Lakes and Overland Surges for Hurricanes (SLOSH)
Category 4, Max of Max, V3 Model Results





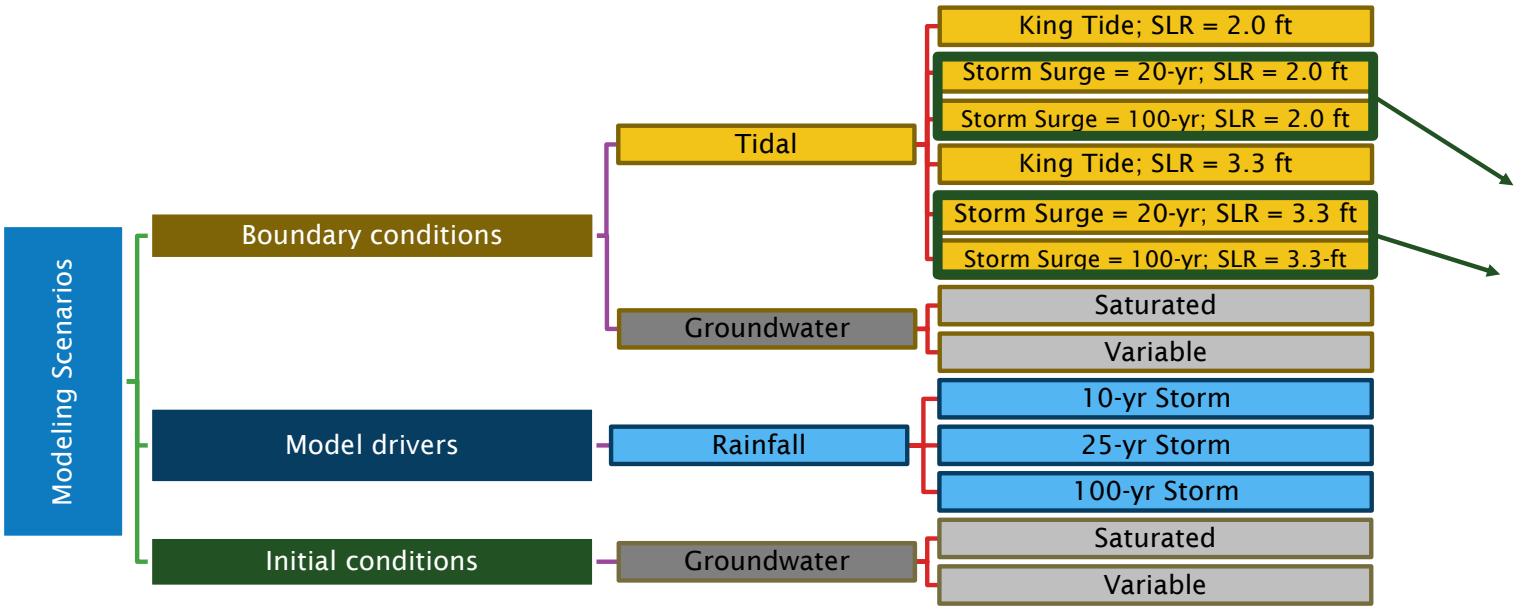
SLOSH results for Hurricane Ian affected area are similar to what was observed. Same set of results indicate much lower effects on Broward County for same Category.

Broward County Resilience Plan modeling will consider multiple elements, including the critical impact of storm surge

	Rainfall				Sea Level Rise Scenario		Antecedent Condition		Tidal Condition		
	25-yr	50-yr	100-yr	3-day 10-yr + 20%	2.0 ft	3.3 ft	Variable GW	Saturated GW	King Tide	20-yr Storm Surge	100-yr Storm Surge
RP-1	X				X		X		X		
RP-2		X			X		X		X		
RP-3			X		X			X	X		
RP-4	X				X		X			X	
RP-5		X			X		X			X	
RP-6			X		X			X		X	
RP-7	X				X		X				X
RP-8		X			X		X				X
RP-9			X		X			X			X
RP-10	X					X	X		X		
RP-11		X				X	X		X		
RP-12			X			X		X	X		
RP-13	X					X	X			X	
RP-14		X				X	X			X	
RP-15			X			X		X		X	
RP-16	X					X	X				X
RP-17											
RP-18			X	+		X	+	X		+	X
RP-19											
RP-20				X	X		X			X	
RP-21				X	X		X				X
RP-22				X		X	X		X		
RP-23				X		X	X			X	
RP-24				X		X	X				X

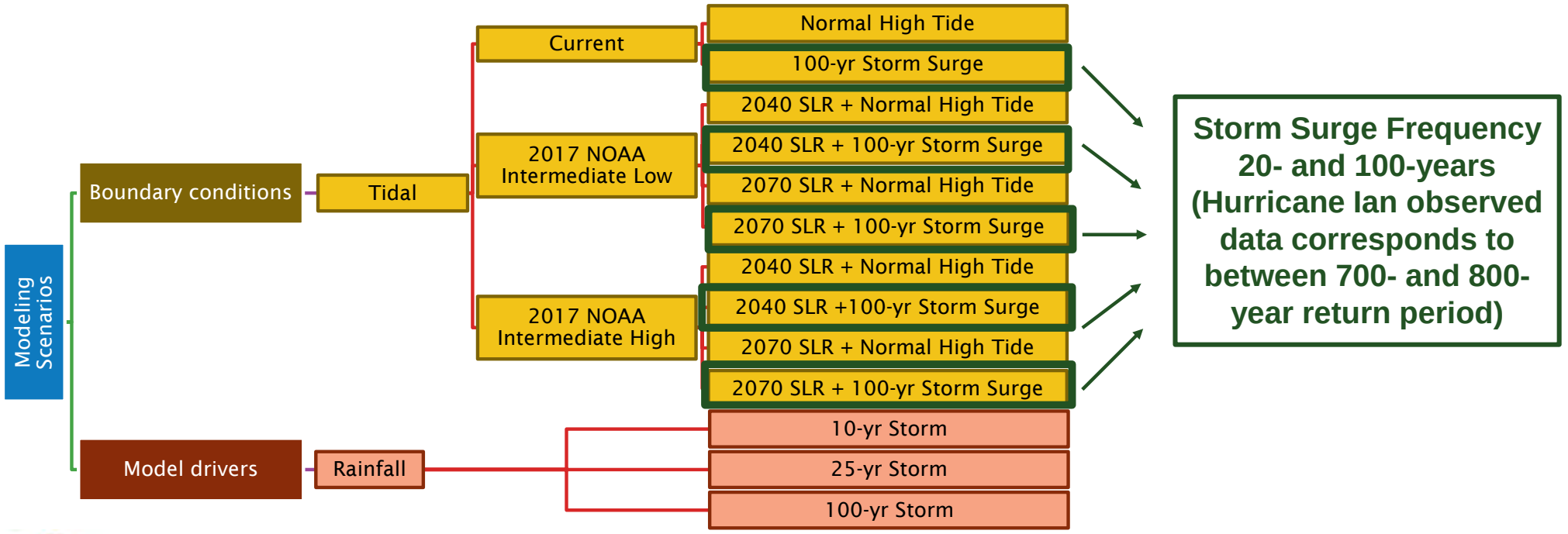
The combination of the probability of each one of these parameters will produce the "Compound Probability" of the Scenario. This probability will be associated to the flooding extent obtained from the models.

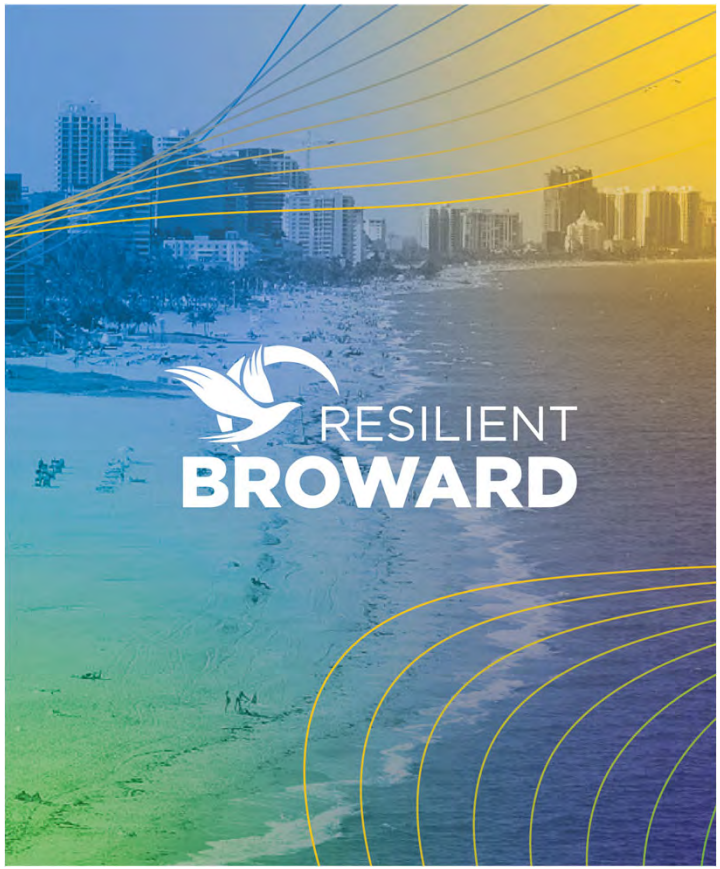
Broward County Resilience Plan modeling will consider multiple elements, including the critical impact of storm surge



Storm Surge Frequency 20- and 100-years (Hurricane Ian observed data corresponds to between 700- and 800-year return period)

Broward County Vulnerability Assessment modeling will also consider multiple elements, including the critical impact of storm surge



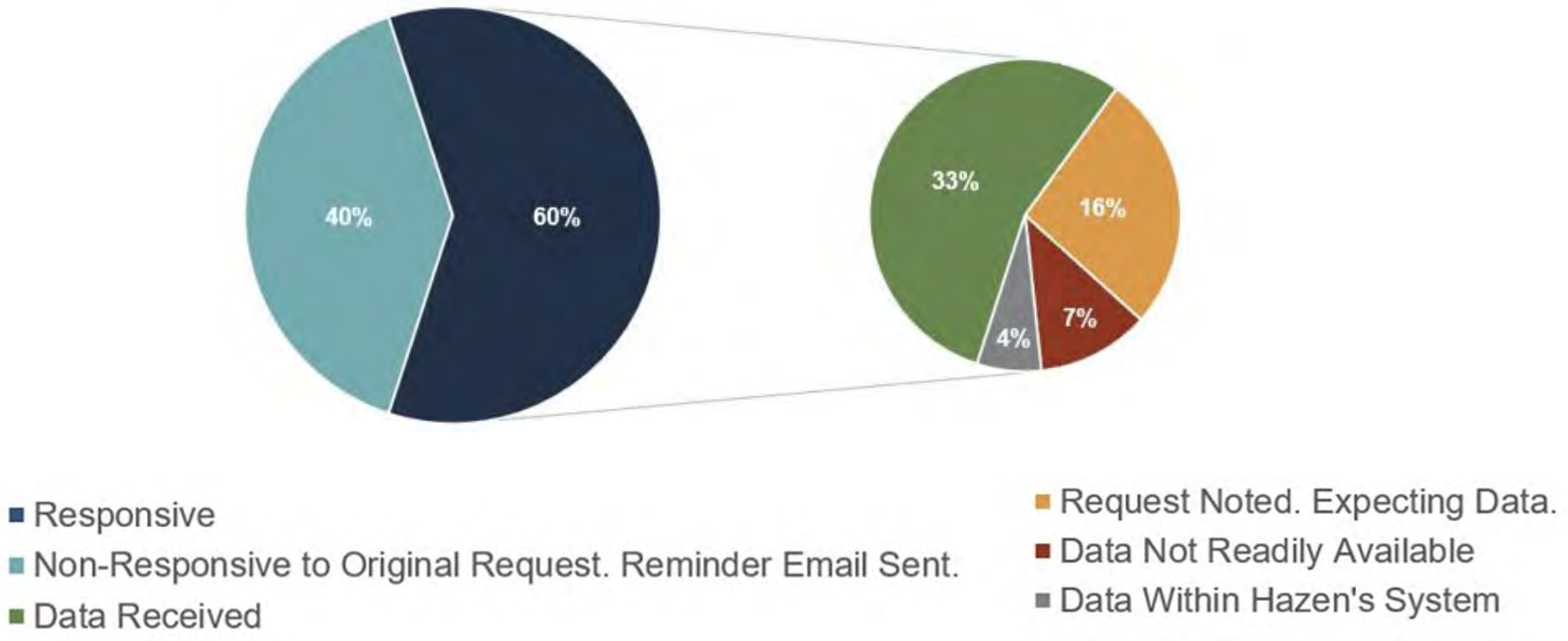


2

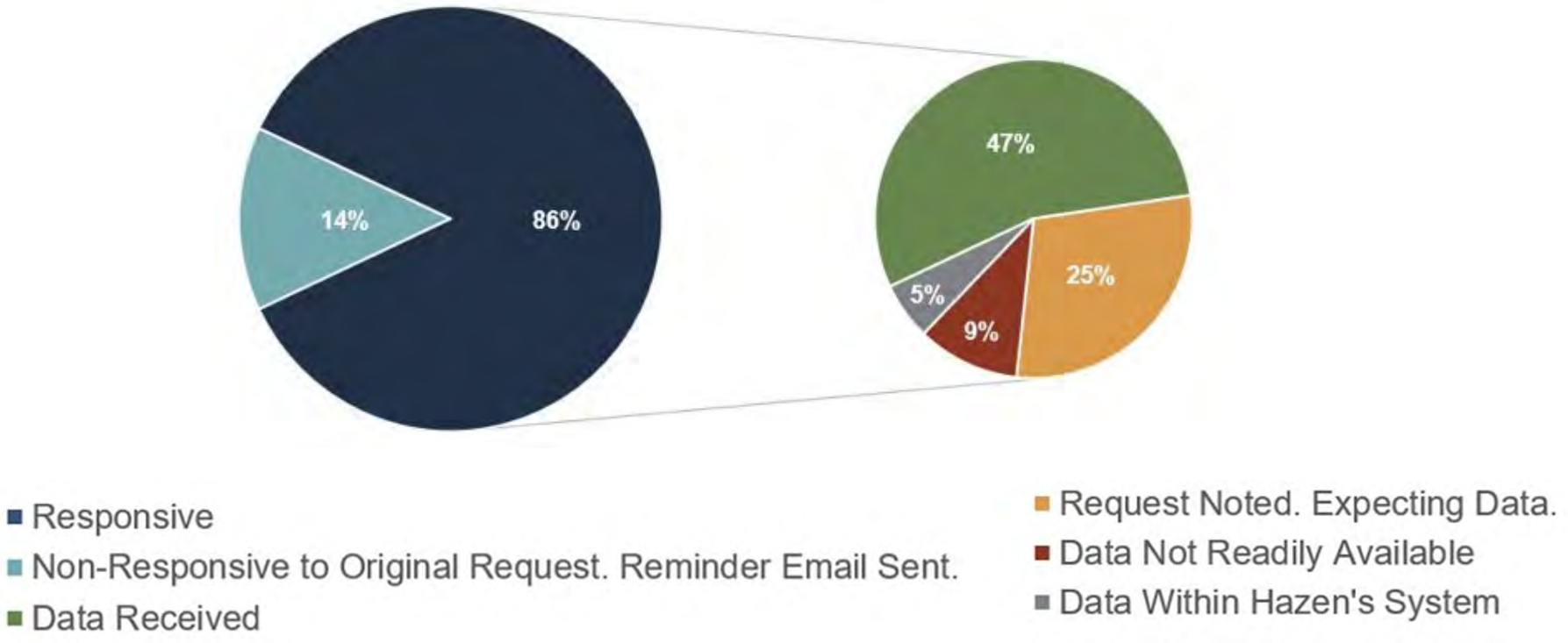
Update on Data Collection from Stakeholders

Hazen

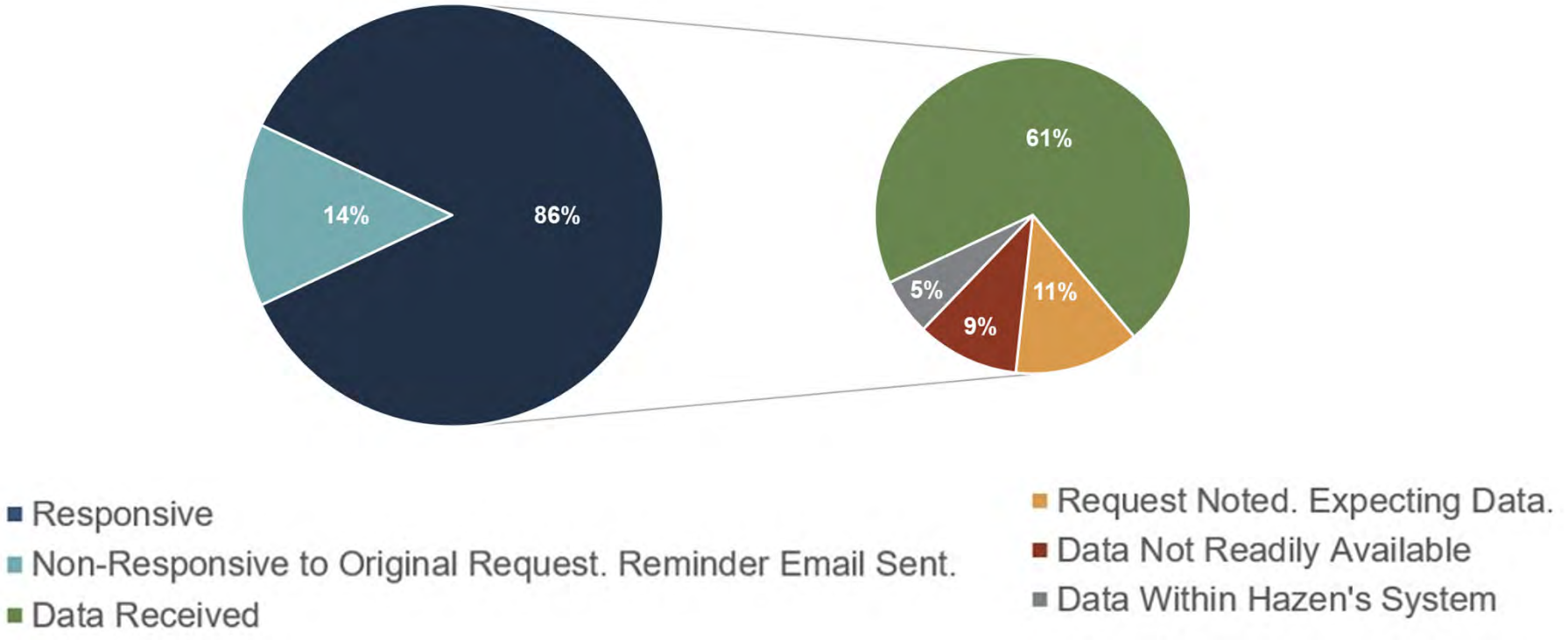
Where we were on August 10th when we last met



Where we were on September 6th

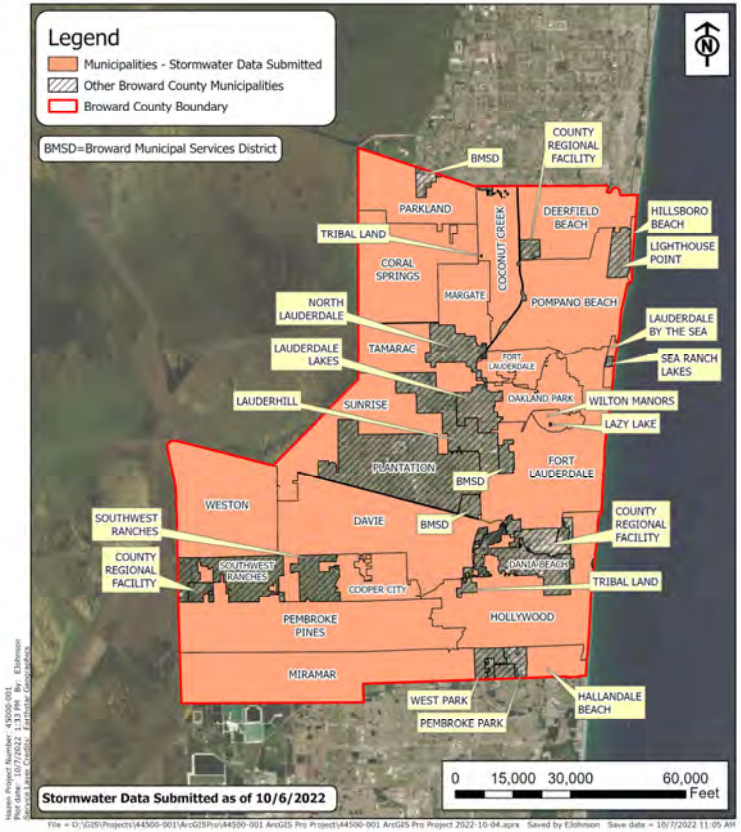


Where we are now in October (October 6th)



Submitted Stormwater Data

Municipalities



Water Control Districts

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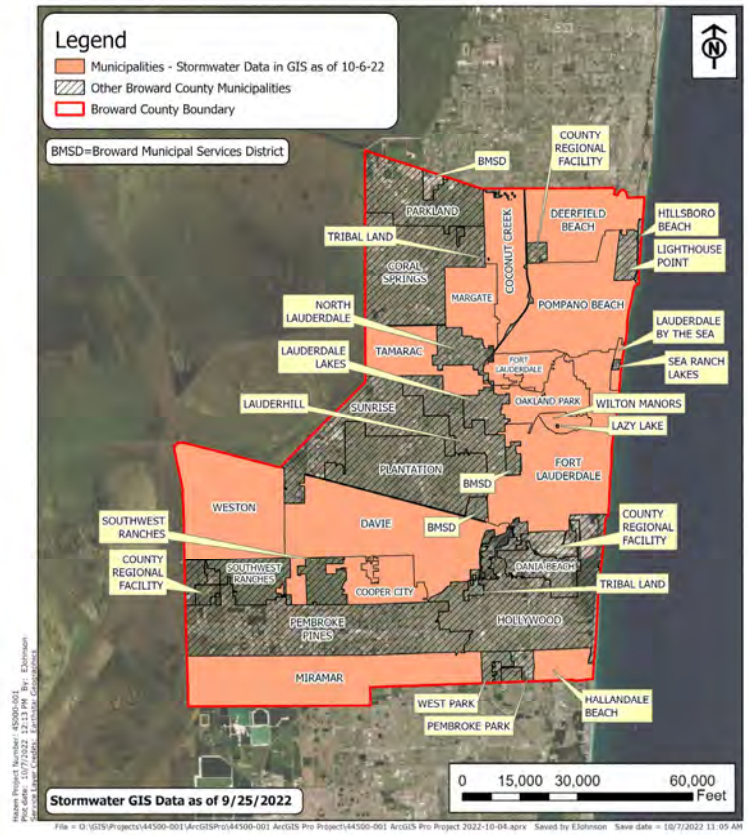
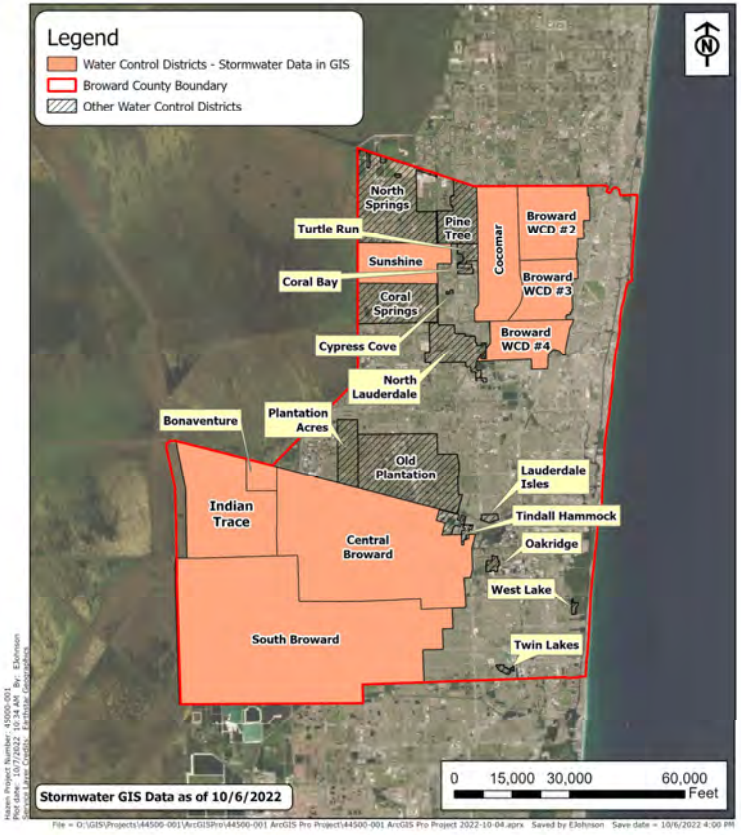
Submitted Stormwater GIS Data

Municipalities



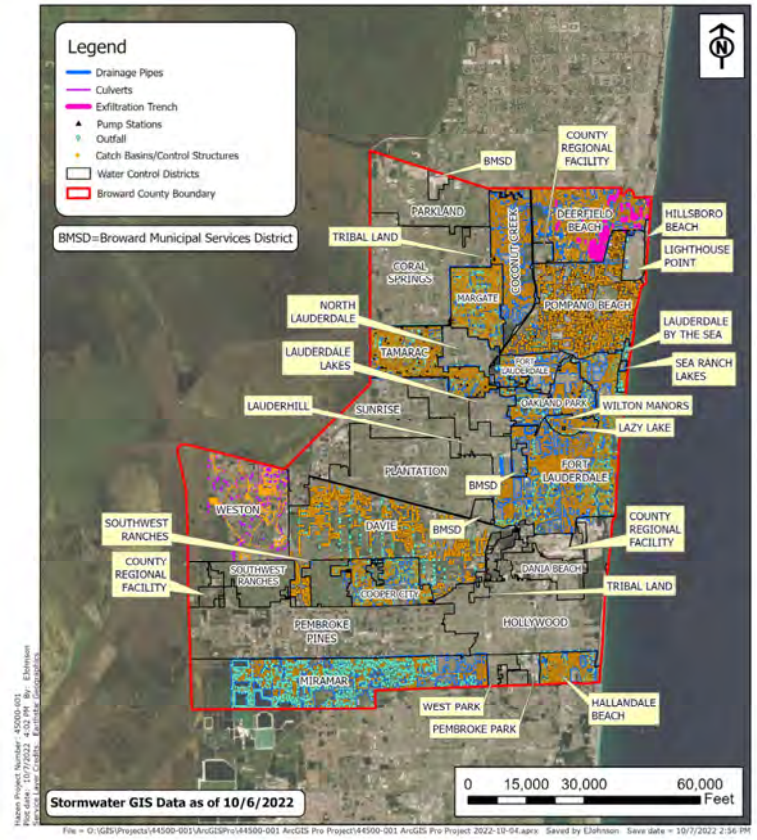
Water Control Districts



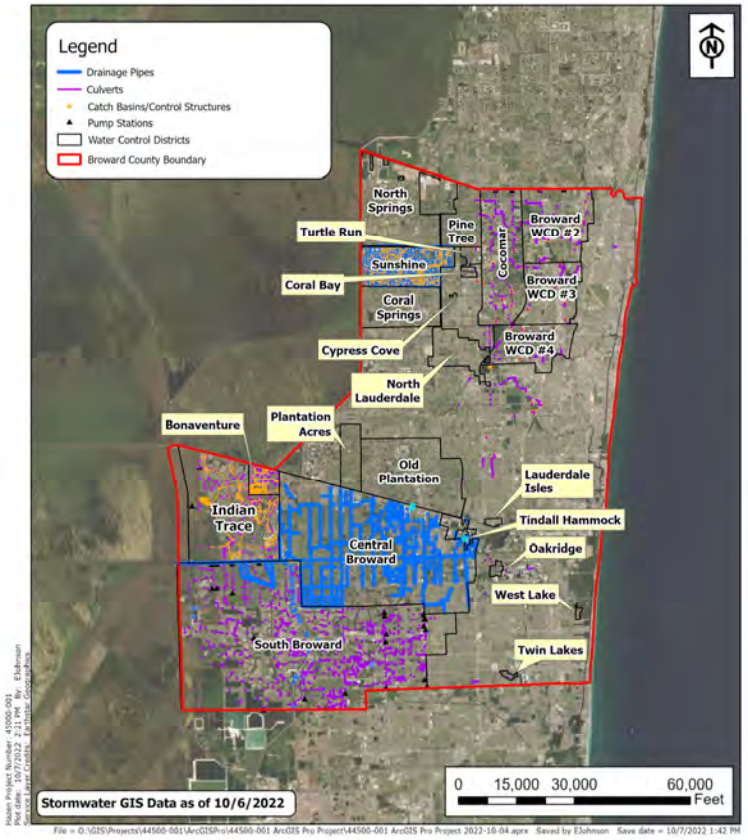
RESILIENT BROWARD

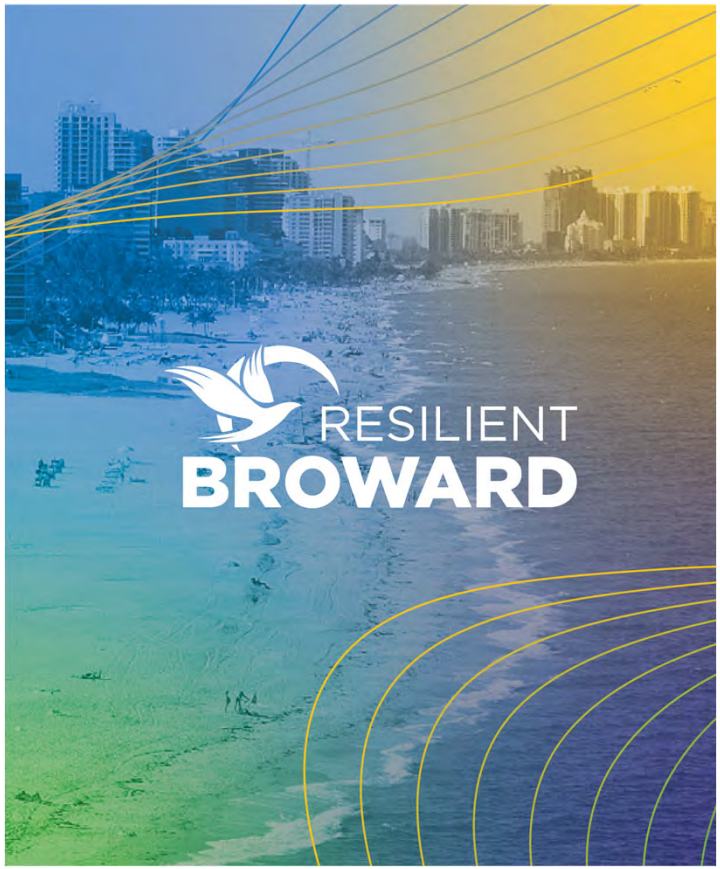
Submitted Stormwater GIS Data – Continued

Municipalities



Water Control Districts





3

Incorporation/use of data for hydrologic model

Hazen

Summary of Model Refinement

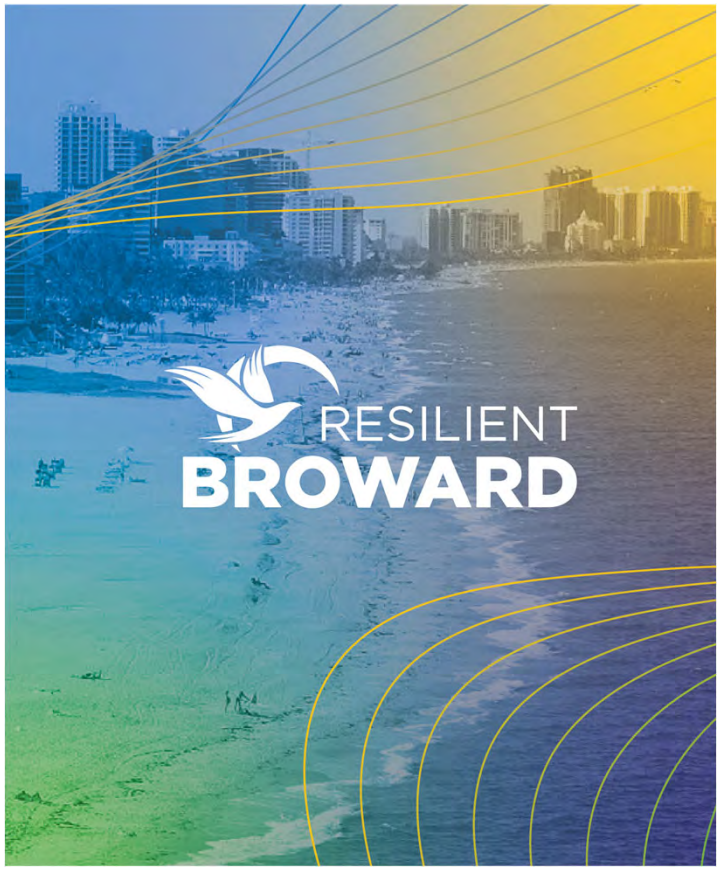
Model eastern boundary extension
- Include the Intracoastal Waterway in MIKE HYDRO
- MIKE SHE boundary extended to the coast

Addition of canals
- Used SFWMD AHED dataset to fill in areas without canals in MIKE HYDRO

Impervious areas
- Image training process
- Cell by cell impervious fraction

Drainage routing revision
- *Guided by collected stormwater data*
- Include flow controlling structures and storage

Groundwater layering reduction for efficiency
- Use internal boundary condition to simulate vertical fluxes



4

Update on economic modeling/follow-up from prior discussions

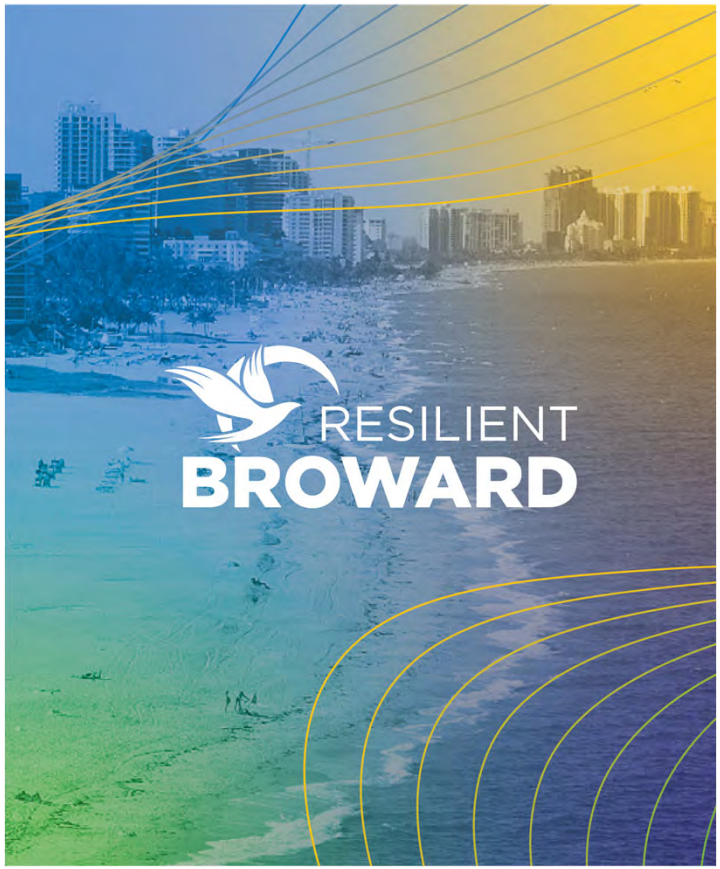
Hazen

Types of benefits to be measured in dollars by location (metrics are non-exhaustive and preliminary)

Avoided Loss in:	Avoided Cost of:	Avoided Reduction in:
Resident and Business income	Emergency services	Property values
Neighborhood amenities (access to public services)	Increases in property insurance premiums	Value of Recreation days (willingness-to-pay)
	Increases in 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

Economic modeling methodology was outlined during August 10, 2022 RSC Meeting and is in development

- Dr. Johns sent follow up email on August 15, 2022
  - **Still glad to receive follow up questions/comments**
  - **Particular areas of helpful input may include:**
    - *Key Sectors to Emphasize*
    - *Identification of Vulnerable Groups*
    - *Data Sources*
    - *Relevant Measurement Metrics*
- Methodology review meeting with Vivid Economics on September 22, 2022
- Economic modeling update planned for December 2022 RSC meeting

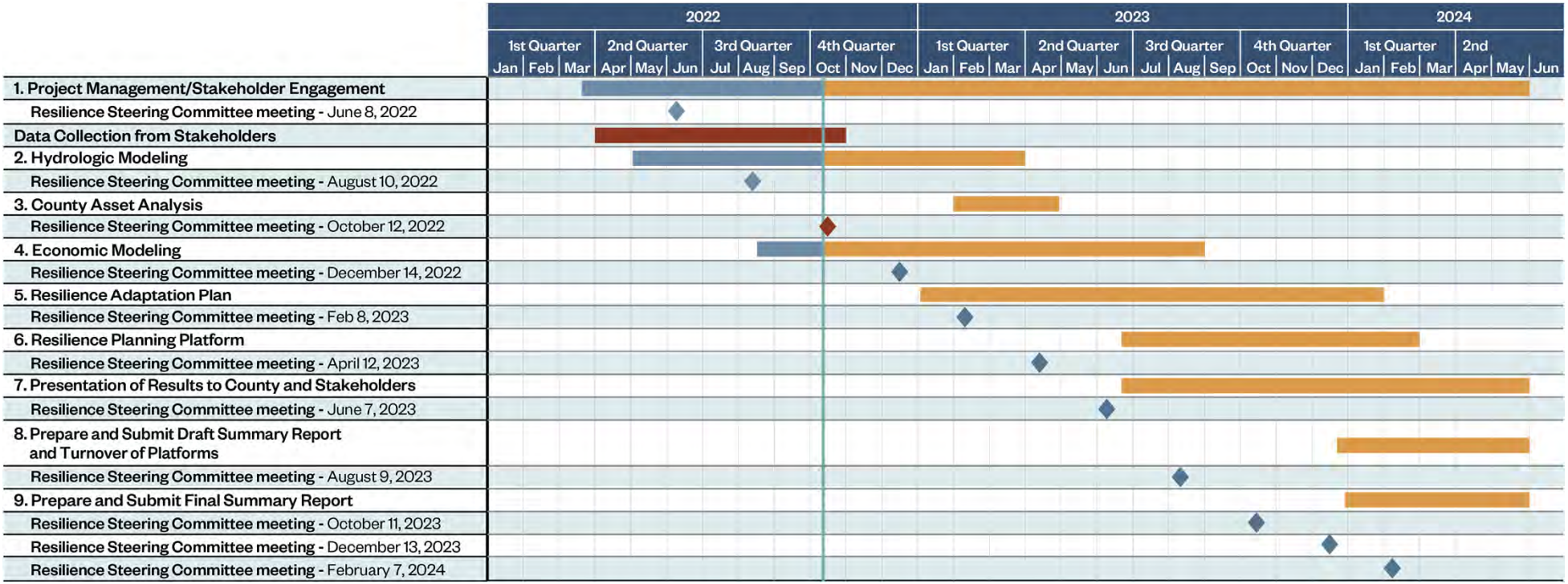


5

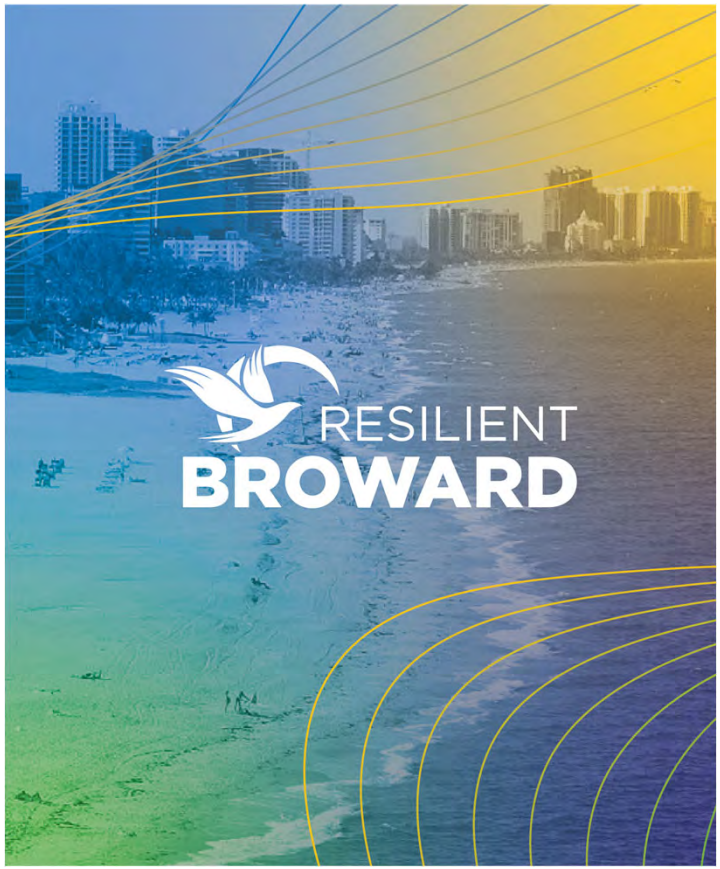
Review of progress and impacts on schedule

Hazen

Collection of stakeholder data consumed more time than anticipated…



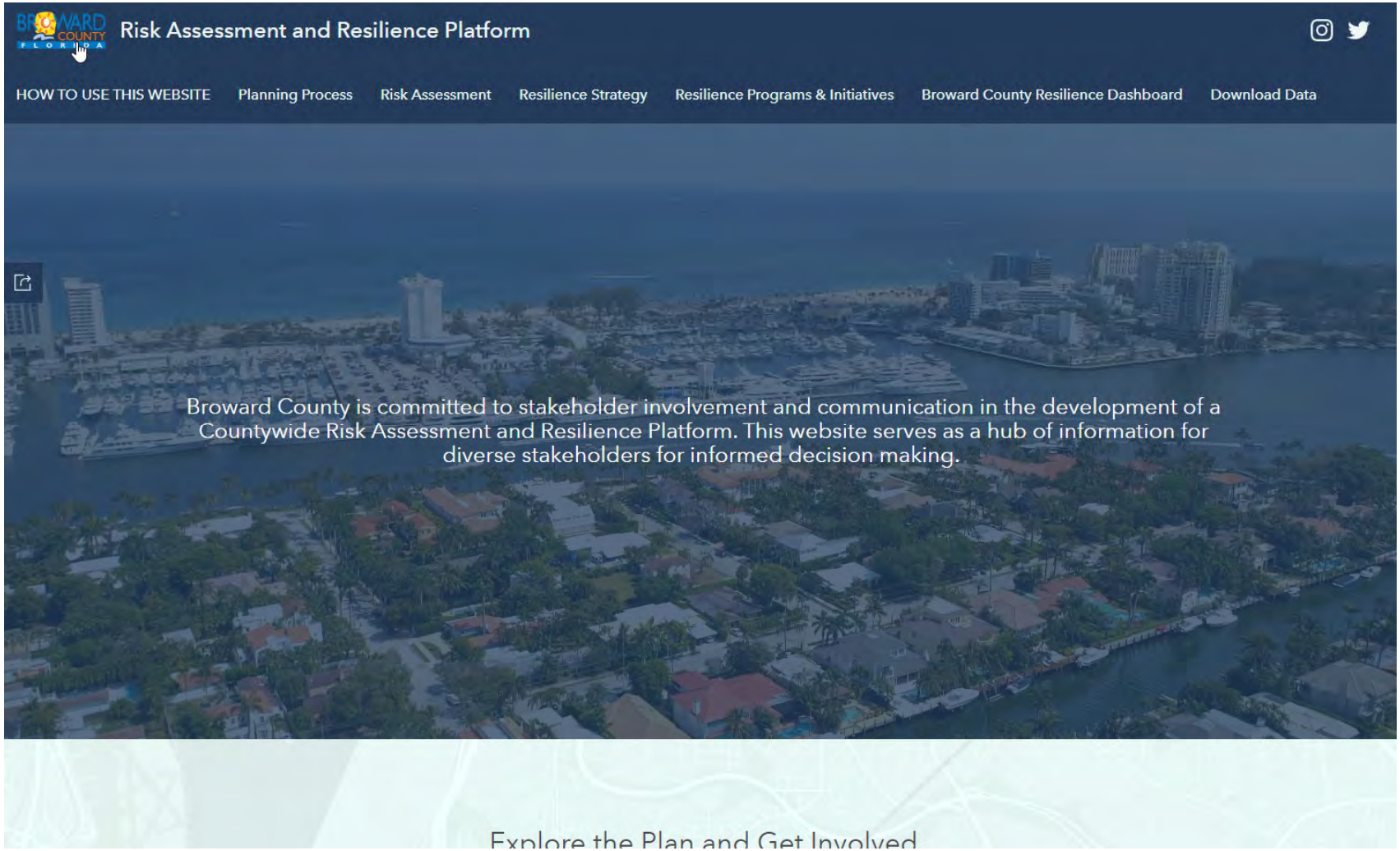
… but tasks are on-track for completion in 2024.

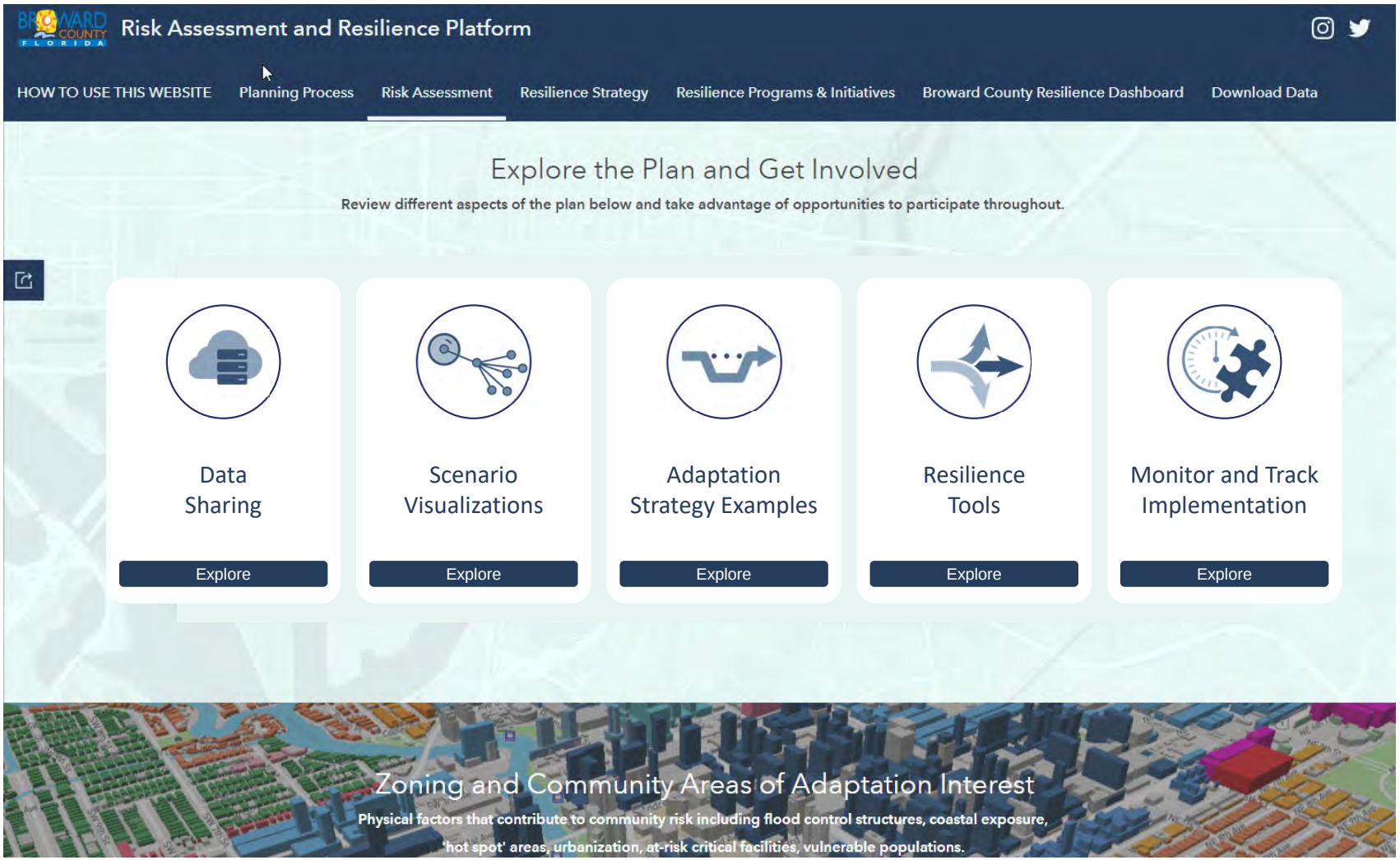


6

Introduction to “the Platform”

Hazen


Risk Assessment and Resilience Platform
HOW TO USE THIS WEBSITE
Planning Process
Risk Assessment
Resilience Strategy
Resilience Programs & Initiatives
Broward County Resilience Dashboard
Download Data
Broward County is committed to stakeholder involvement and communication in the development of a Countywide Risk Assessment and Resilience Platform. This website serves as a hub of information for diverse stakeholders for informed decision making.
Explore the Plan and Get Involved


Risk Assessment and Resilience Platform
HOW TO USE THIS WEBSITE
Planning Process
Risk Assessment
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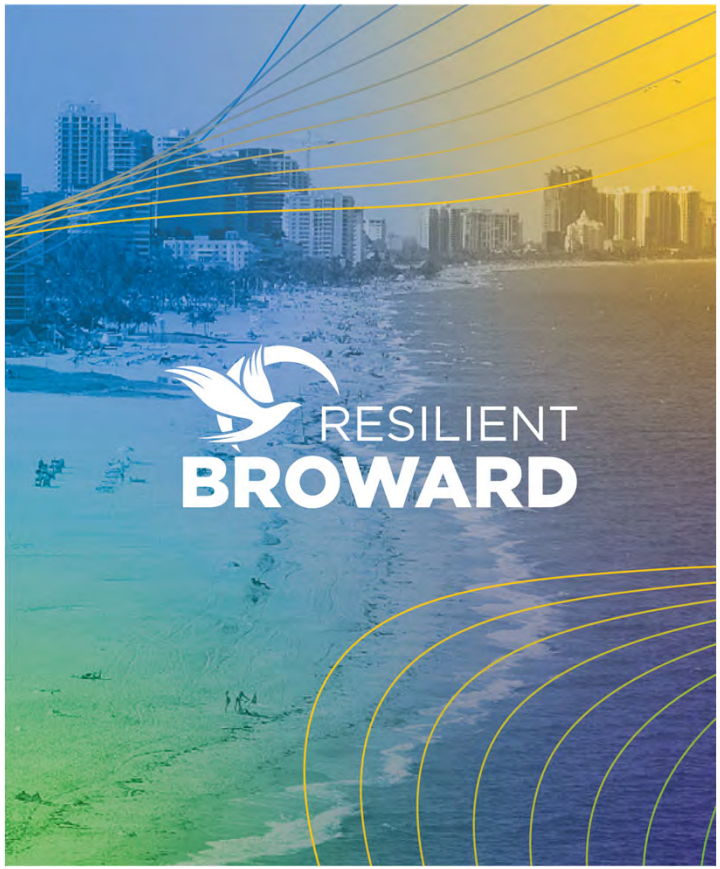
Resilience Programs & Initiatives
Broward County Resilience Dashboard
Download Data
Explore the Plan and Get Involved
Review different aspects of the plan below and take advantage of opportunities to participate throughout.
Data Sharing
Explore
Scenario Visualizations
Explore
Adaptation Strategy Examples
Explore
Resilience Tools
Explore
Monitor and Track Implementation
Explore
Zoning and Community Areas of Adaptation Interest
Physical factors that contribute to community risk including flood control structures, coastal exposure, 'hot spot' areas, urbanization, at-risk critical facilities, vulnerable populations.

Boston Inundation Model Viewer



7

Next Steps/Upcoming Activities

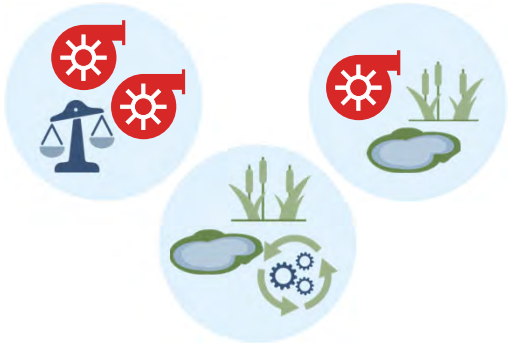
Hazen

The Resilience Adaptation Plan will include actionable Countywide adaptation and mitigation strategies…

Sample Types of Adaptation / Mitigation Strategies:

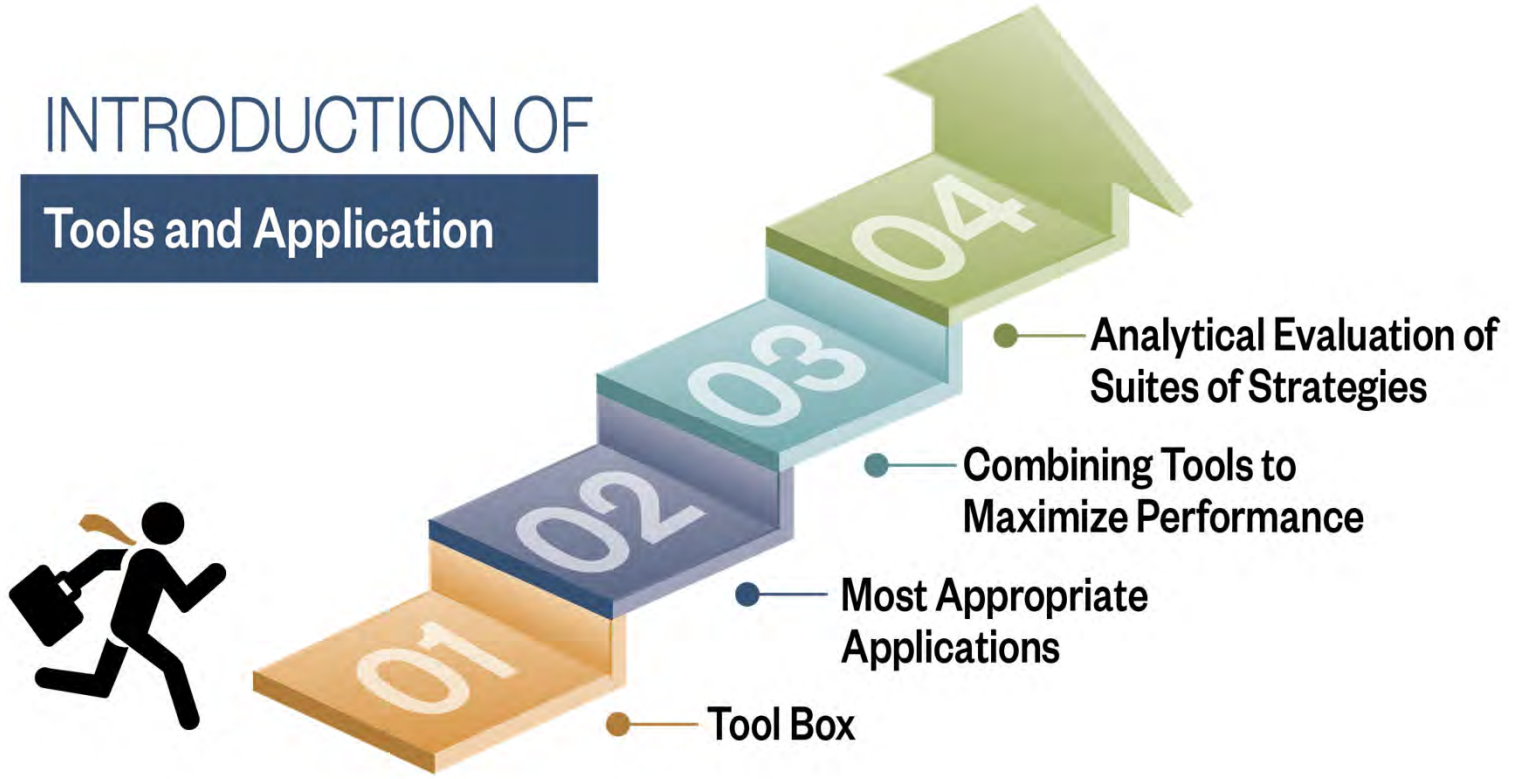
- Pump Stations
- Natural Barriers
- Storage/Impoundments
- Regulation Changes
- Operation Changes
- Et cetera

Sets of Strategies
are combinations of different types of mitigation strategies in different parts of the County.



The evaluations need to consider the effects of the sets of strategies on the entire County. Stakeholder feedback is necessary regarding applicability of various strategies in stakeholders' respective locales.

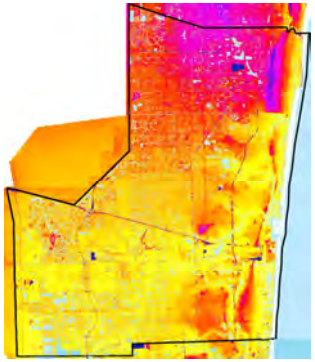
Adaptation strategies are being developed concurrent with “No Action” scenario modeling



We are driving toward further stakeholder engagement

Stakeholder Roundtable (over 90 attendees)

2022
September 25

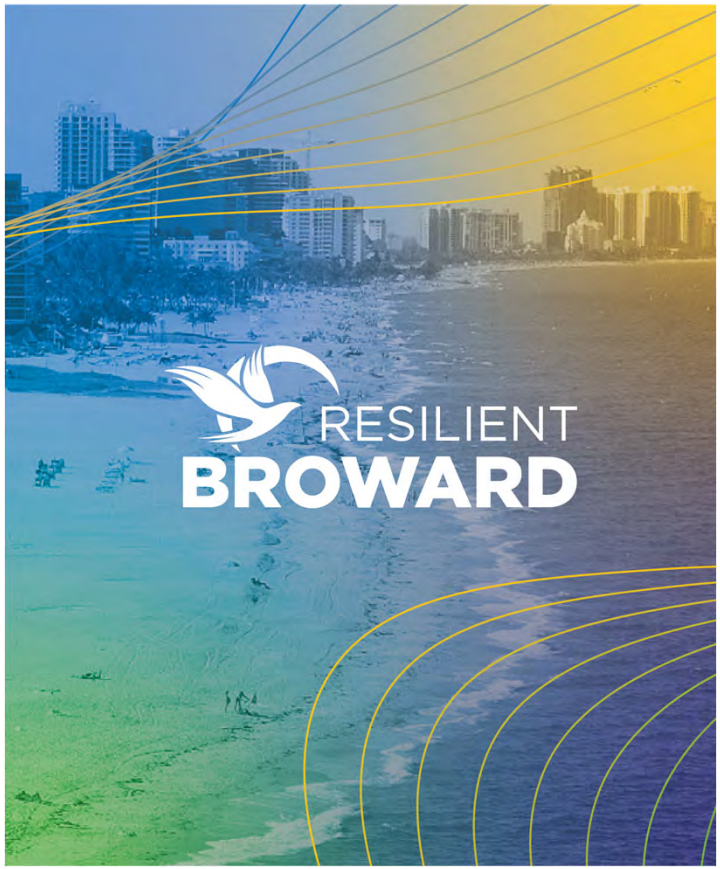


"No Action Scenario"
Results – Virtual Workshop (Jan '23)

Stakeholder Review

Feedback

Small Group
Follow Up (2-4 weeks later)



Questions

Hazen