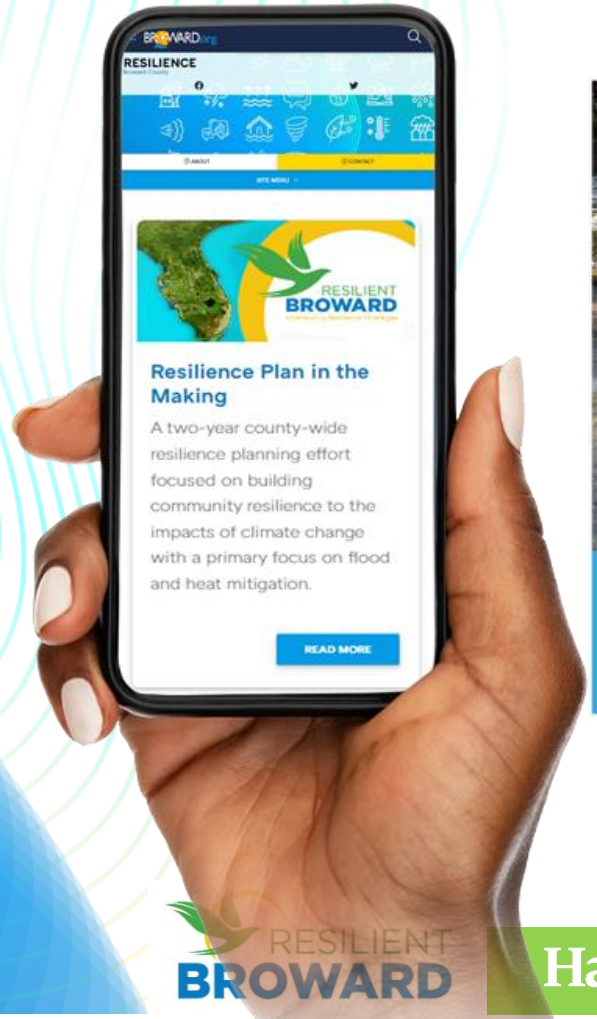
On the Path to Resilience:

The Broward County-wide Infrastructure Plan and Economic Analysis

Regional Economic Resilience Work Group

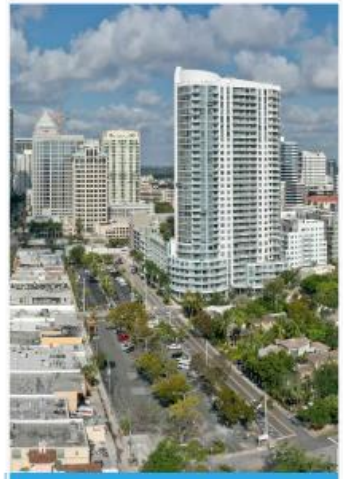
September 24, 2024

Development of a County-wide Resilience Plan



COMMUNITY OUTREACH

RISK ASSESSMENT

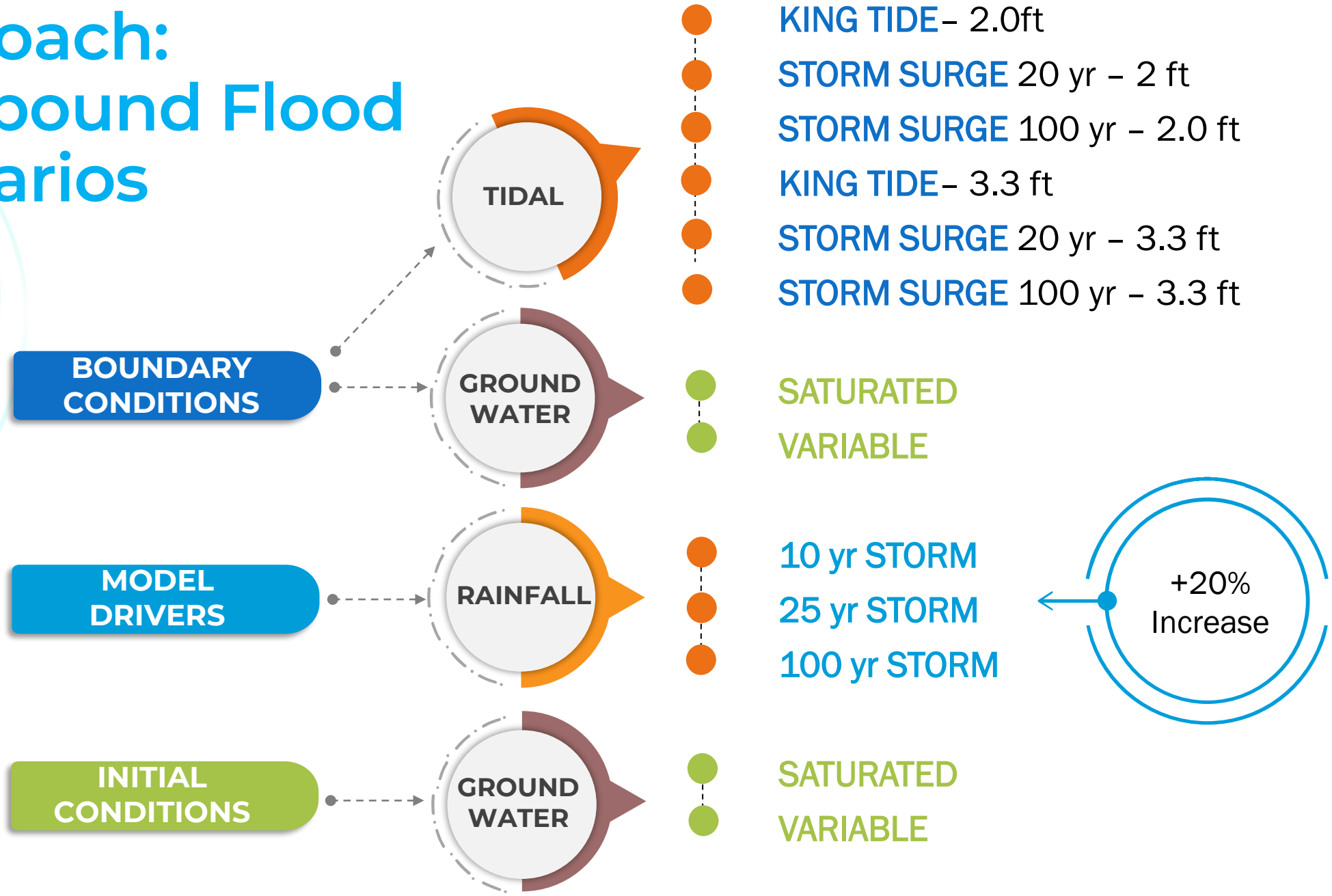


ECONOMIC MODELING

ADAPTION PLAN

ONLINE PLATFORM

Approach: Compound Flood Scenarios



Risk Assessment and Resilience Plan

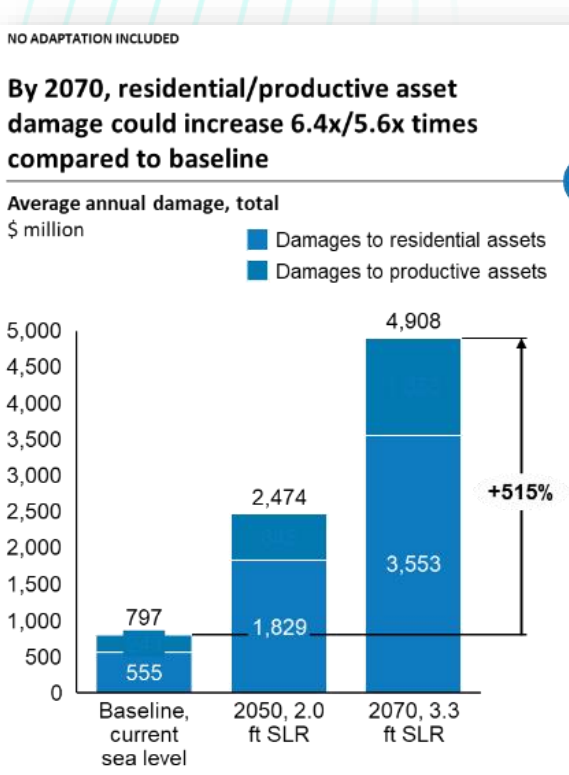
Economic Modeling

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

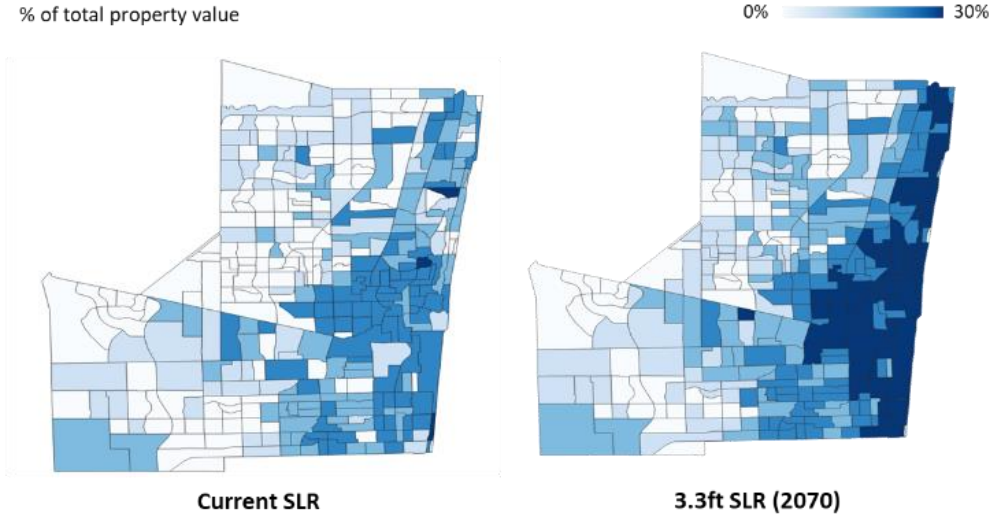
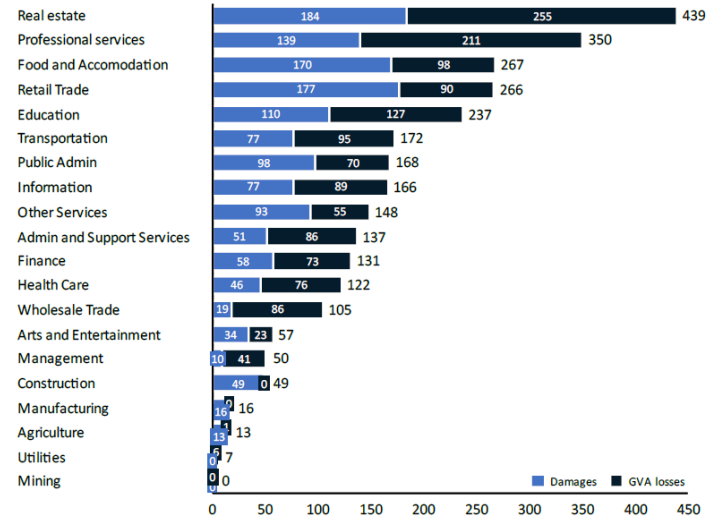


Exhibit 15: Damages and losses from flooding are unevenly distributed

Average annual damages and GVA losses by sector, $ million, 3.3ft SLR (2070)



1. Total losses represent the sum of damages to assets and GVA losses.
2. Excluding potential gains from reconstruction.

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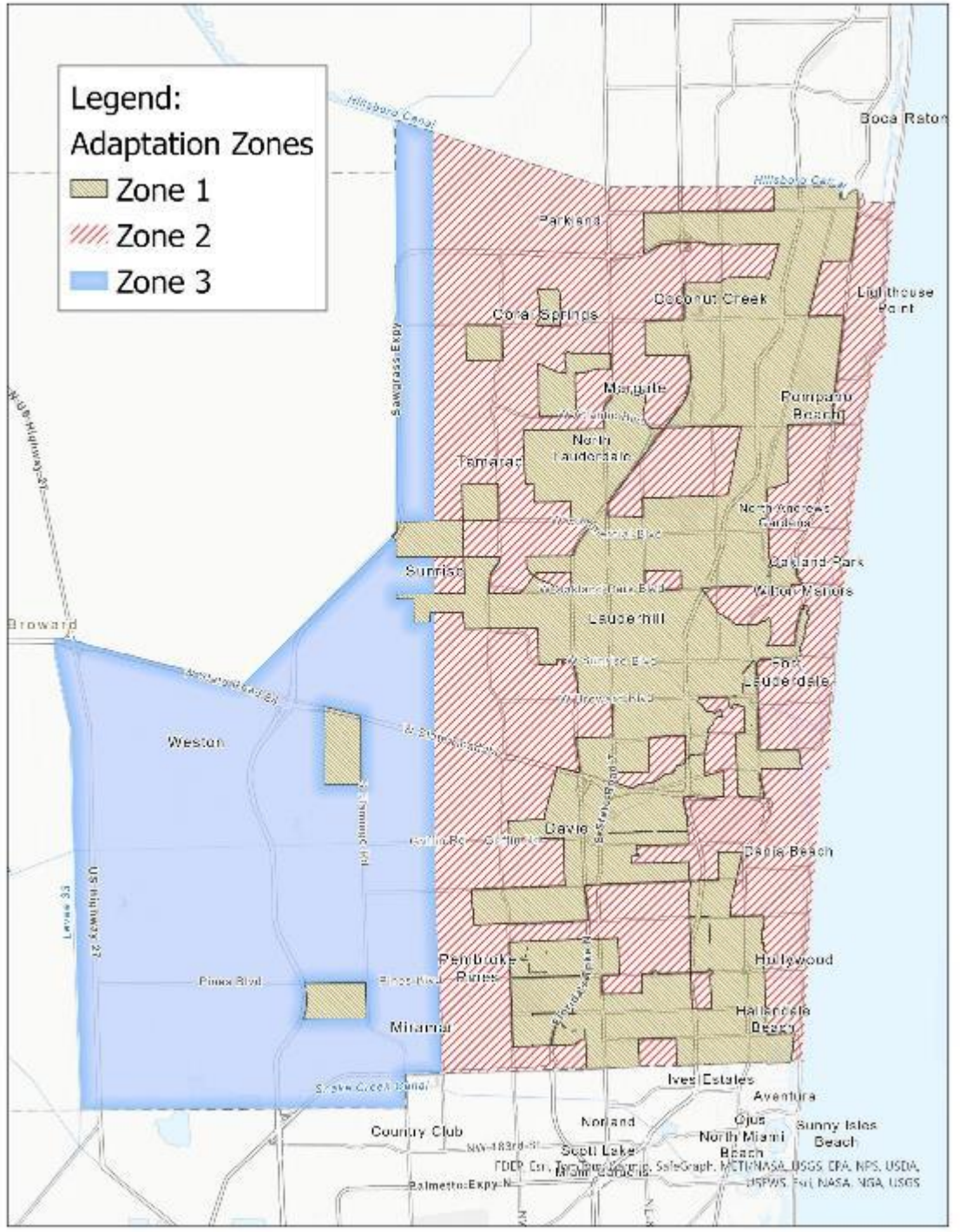
Suites of Adaptations were developed incorporating three adaptation zones

Zone 1 – Highest Vulnerability Areas
Zone 2 – Coastal
Zone 3 – Inland

Six Suites of Adaptations were evaluated using the Hydraulic & Hydrologic Model to define the adaptation plan components and sequence

A seventh suite was defined to address gaps in the simulation and after receiving feedback from stakeholders.



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Adaptation Strategies Evaluated

Storage
- Above ground storage (large)
- Recovering underground storage

Green Infrastructure

Reducing Impervious area
- Adding localized surface storage

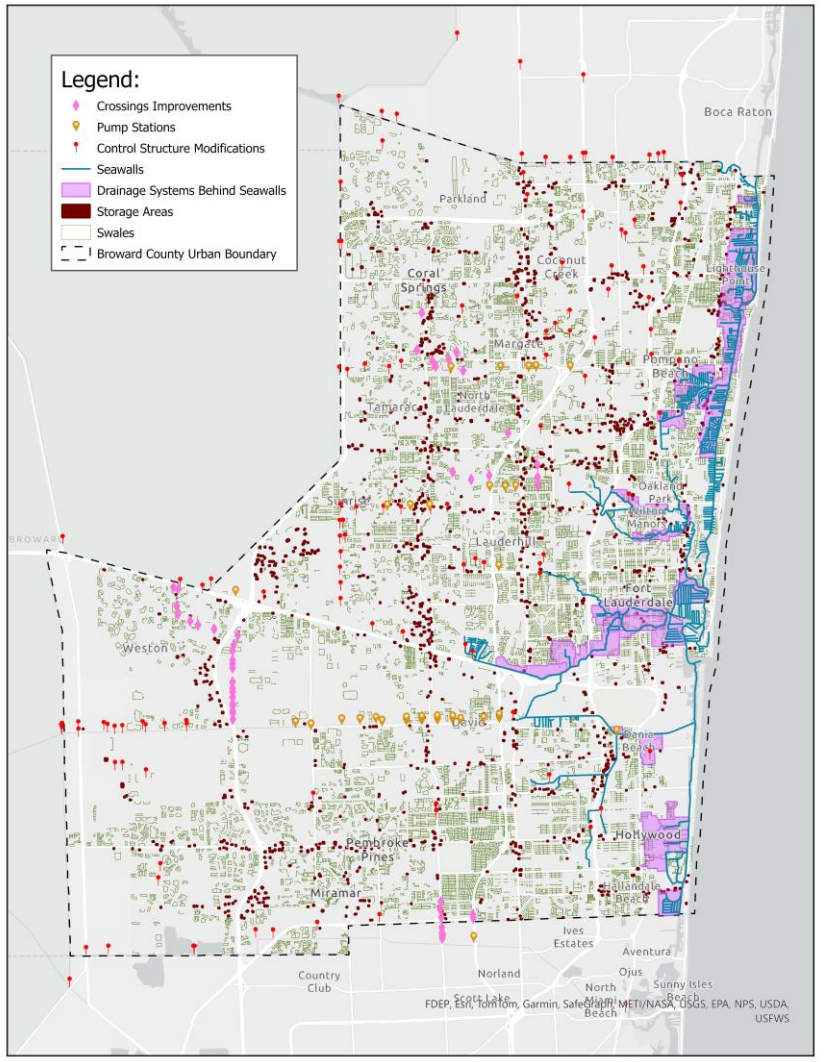
Conveyance
- Improving existing conveyance structures (canals, culverts, etc.)
- Additional Pumping

Barriers
- Property level seawalls
- Nature-based and/or engineered structures
- Large scale levees and other close out structures

This adaption strategy is linked to the development of Green Infrastructure. Most Green Infrastructure solutions are based on the idea of increasing infiltration by reducing impervious area. Infiltration can only be increased if there is available ground storage to receive rainwater.

Full Suite of Adaptations – 2- and 3-feet Sea Level Rise, through 2070

- Tier 1
  - Pumping stations
  - Culvert improvements
  - Storage areas
  - Control structures
  - Two-way road conversions (swales)
  - 5-foot sea walls
- Tier 2
  - Drainage systems
  - Seawall elevated to 7 ft.



190+ Miles enhanced Seawalls

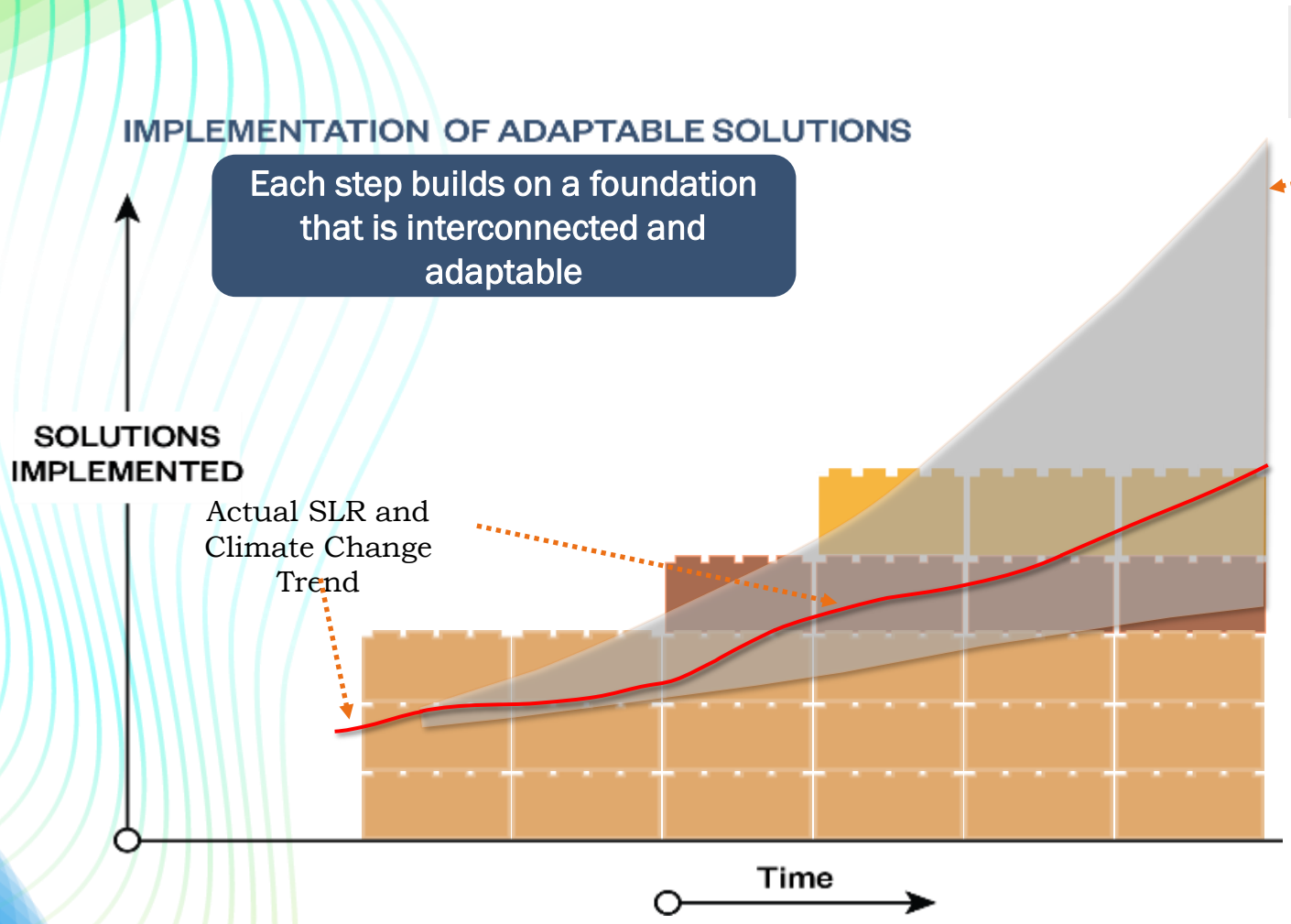
169 Controls Structures

28 New Pump Stations

50 Upgraded Crossings

1,247 Acres-ft of storage

Adaptations will be developed and constructed over time… and as opportunities to construct arise.



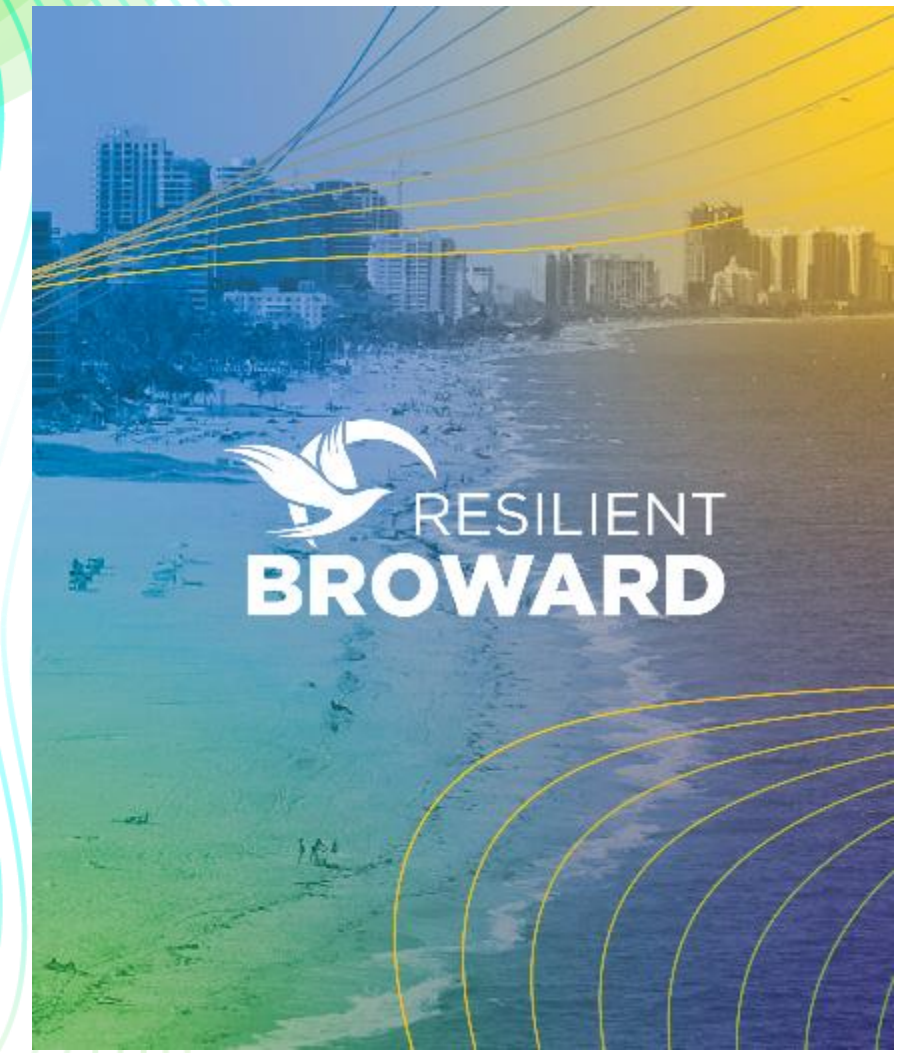
Uncertainty associated with SLR and Climate Change projections

Raising structures, flood walls, large surge barriers

Operational Changes - Conveyance Improvements – Continuation of Coastal Drainage

Green Infrastructure (Swales, Surface Storage, Pervious Areas) – Seawalls-Coastal Drainage

PLAN IMPLEMENTATION



Economic Analyses

Dollar value of five benefit categories

Property damage savings from avoided costs of repairing and replacing assets damaged by floods

Economic activity (Gross Value Added) benefits from avoided business and transport disruption

Increased Flood Insurance Coverage as risk and premia are lower due to flood mitigation

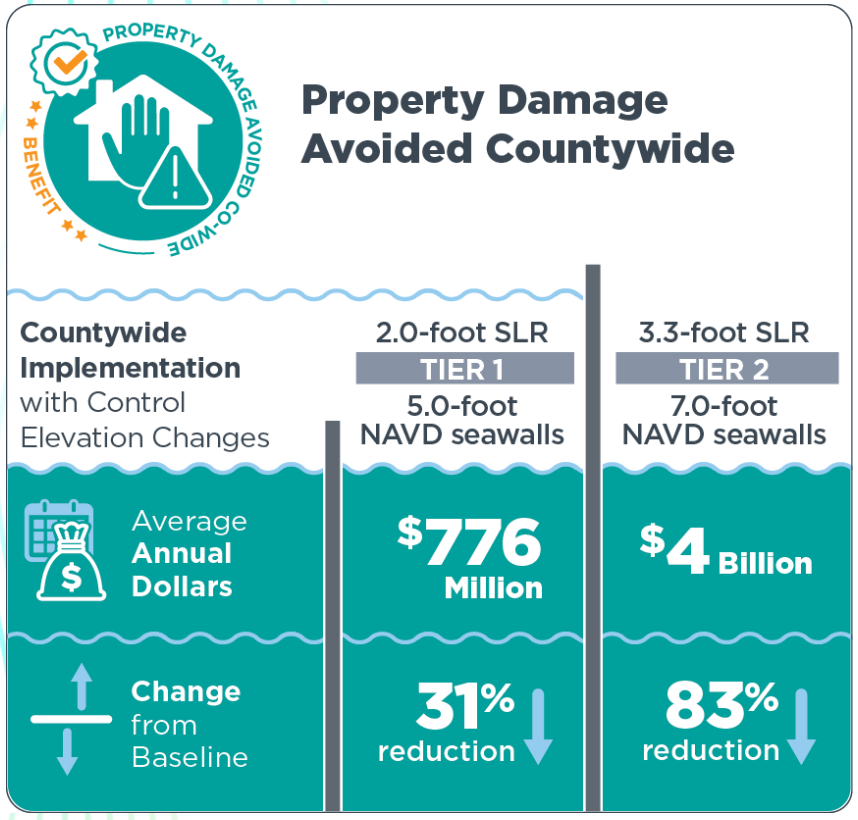
Increased Real Estate Value resulting from lower flood damage costs, insurance premia savings, and rental income losses

Increased Property Tax collections to County and cities because of higher property values

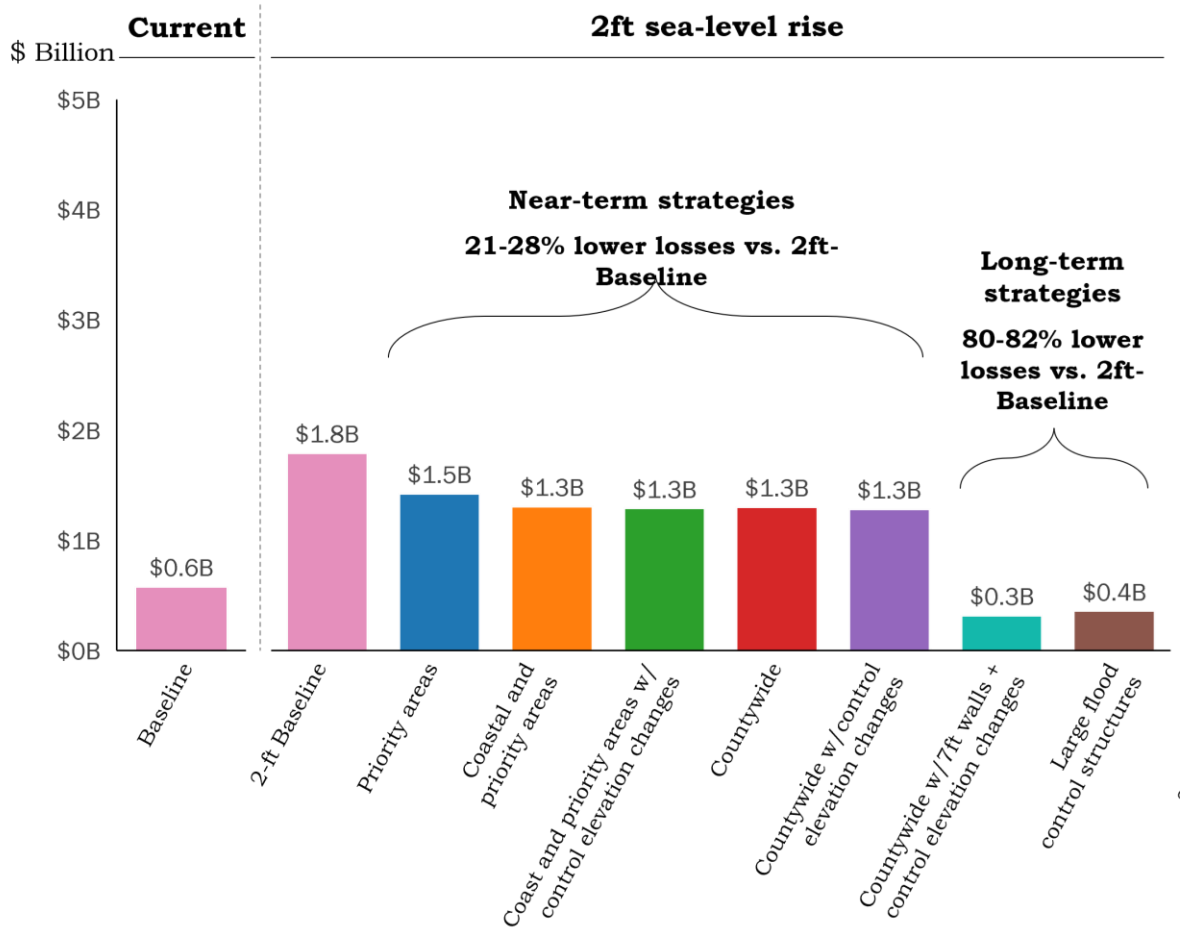
All dollar values are in 2024 (today's) dollars.

Source: Hazen, FEMA

Reduces Direct Property Losses & Protects Property Value

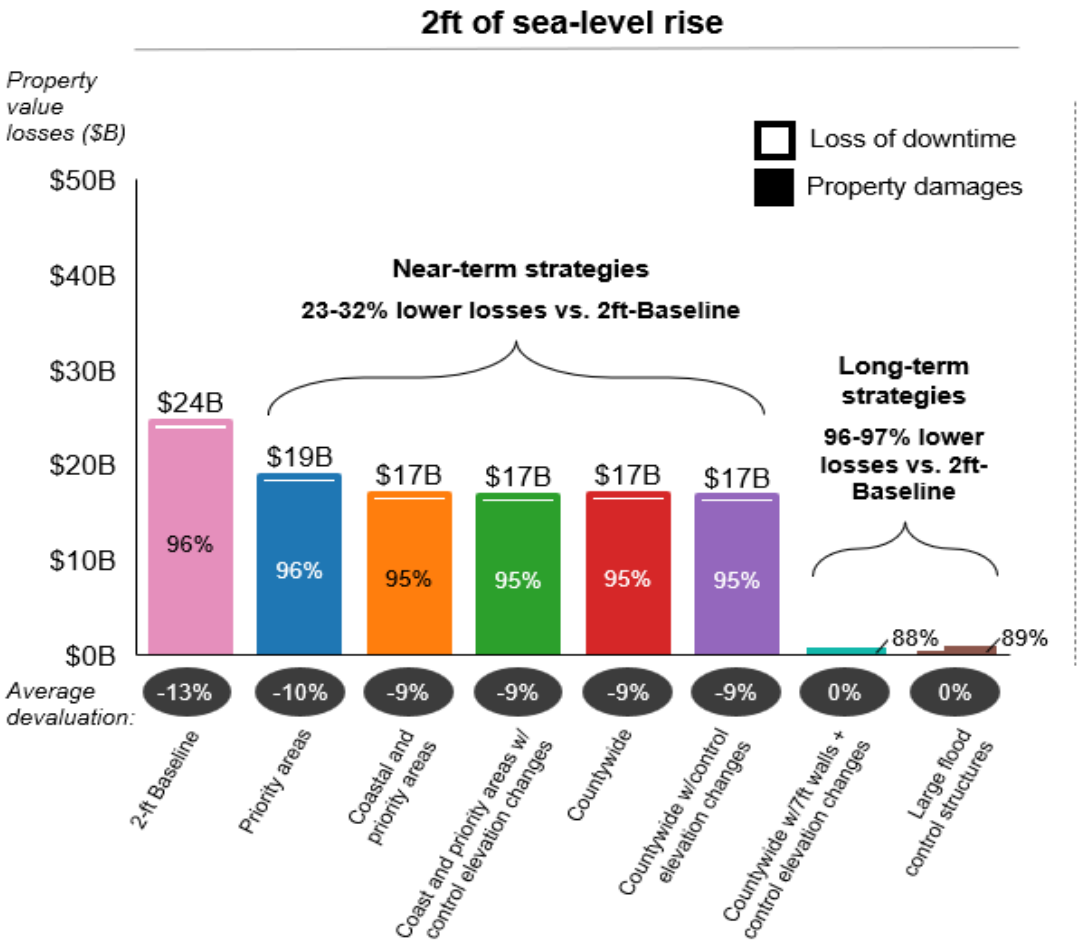


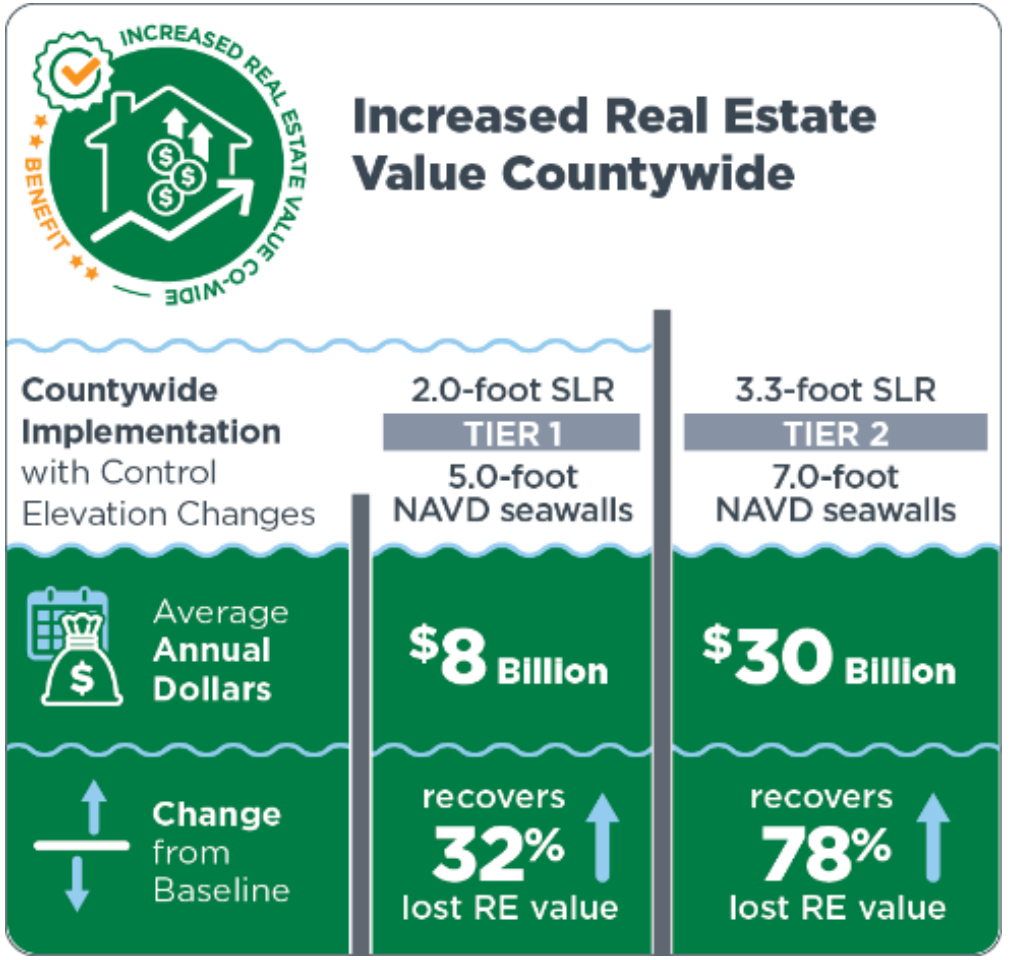
Avoided residential damages relative to baseline ($M)



Preserves residential property value - $8B near-term to $30B long-term

Residential Real Estate Devaluation

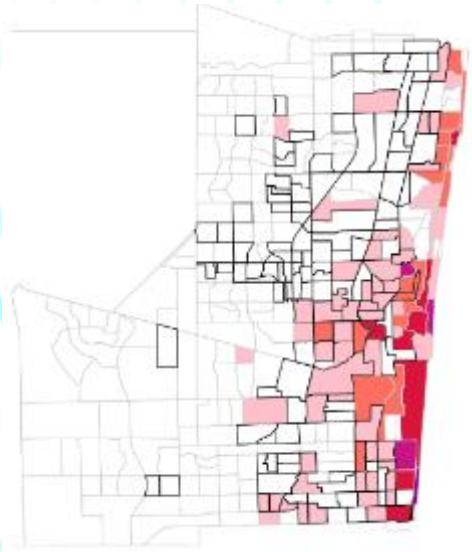




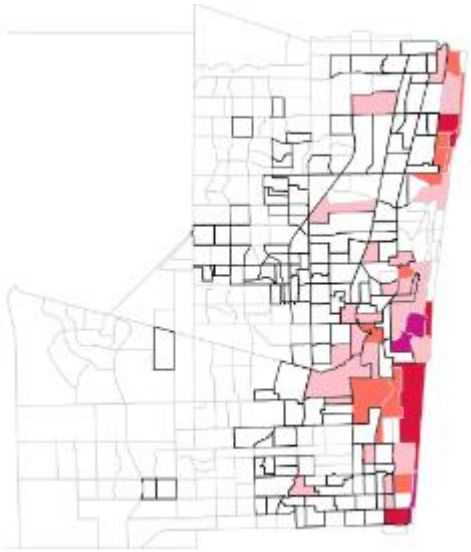
Tier 1 and Tier 2 reduce property damage across much of Broward County with significant countywide benefits realized under Tier 2

Annual average damages to residential assets as share of property value across the county

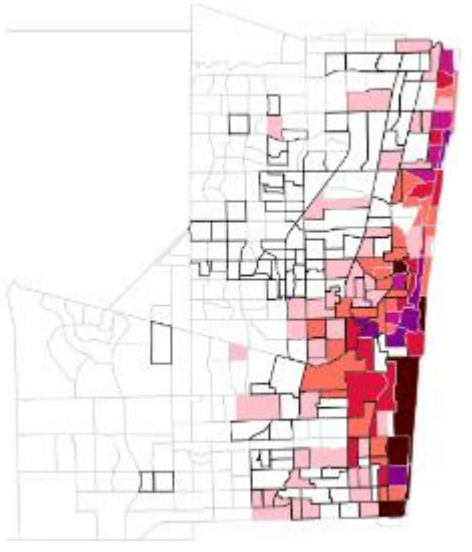
Baseline – 2ft



Countywide adaptations w/ control elevation changes – 2ft



Baseline – 3.3ft



Countywide adaptations w/ control elevation & 7ft seawalls- 3.3ft

Damages as share of property value:

- 15-18%
- 12-15%
- 9-12%
- 6-9%
- 3-6%
- 1-3%
- <1%

Areas outlined in black relate to zone 1

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Source: Hazen, FEMA

Benefits of higher property values across the County are evident under both Tiers

Real estate value losses across the County ($M losses)

Baseline – 2ft

Countywide adaptations w/ control elevation changes – 2ft

Baseline – 3.3ft

Countywide adaptations w/ control elevation & 7ft seawalls- 3.3ft

Property value loss as share of total building value, %

- 80-100%
- 40-80%
- 10-40%
- 1-10%
- <1%

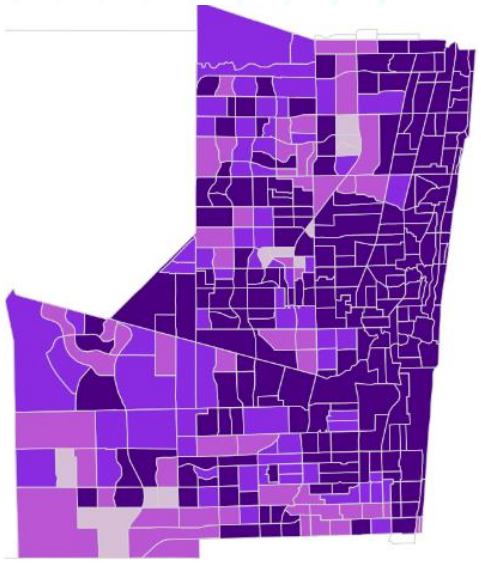
Areas outlined in black relate to zone 1

Source: Hazen, FEMA

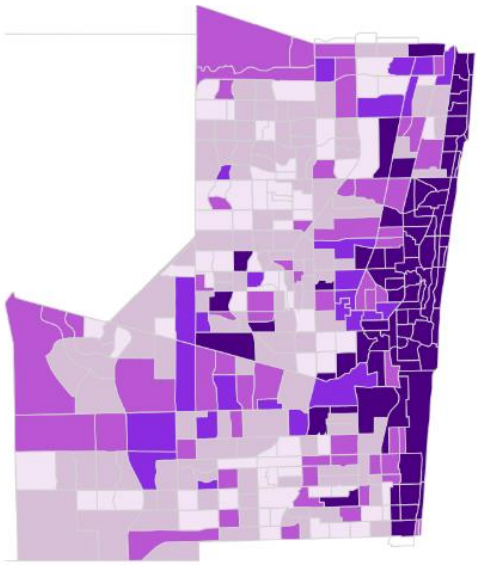
Benefits of reduced flood insurance premia across the County are evident under both Tiers, including in vulnerable areas (assumes all policies remain in place, despite pricing)

Single-family home premiums ($ premium cost) adjusted for risk

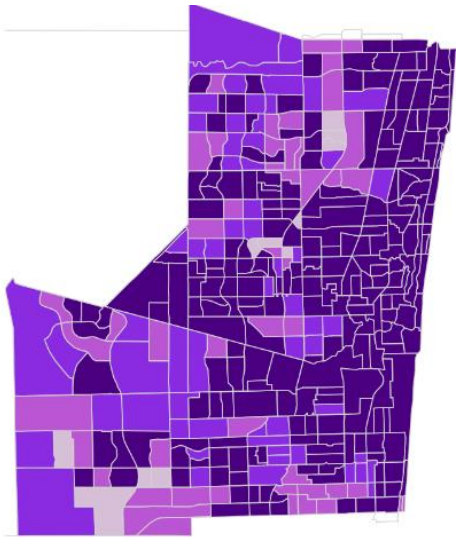
Baseline – 2ft



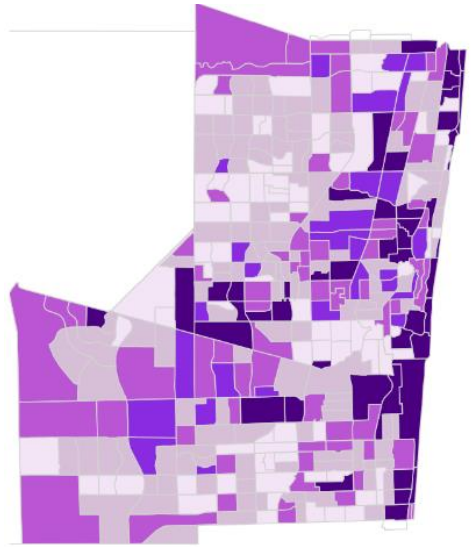
Countywide adaptations w/ control elevation changes – 2ft



Baseline – 3.3ft



Countywide adaptations w/ control elevation & 7ft seawalls-3.3ft



Average premium for single-family home:

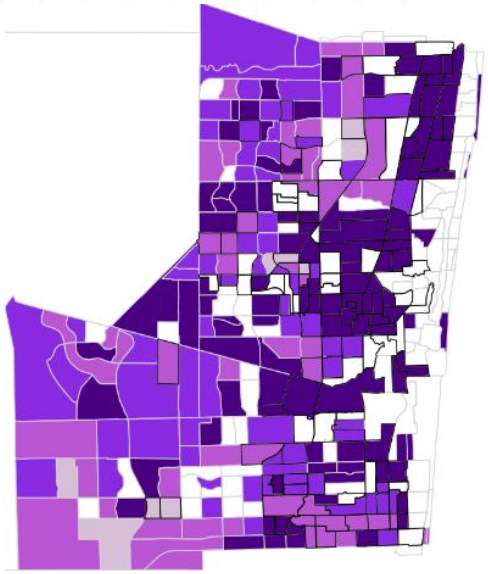
- >$1,600
- $1,200-$1,600
- $800-$1,200
- $400-$800
- Up to $400

Source: Hazen, FEMA

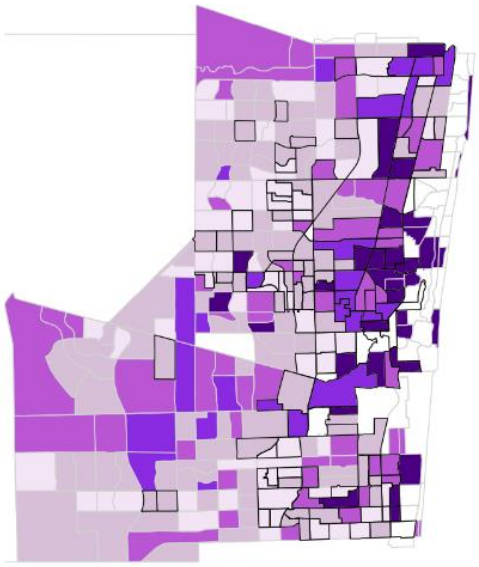
Benefits of reduced flood insurance premia across the County are evident under both Tiers, including in vulnerable areas (reflects uptake changes due to pricing)

Single-family home premiums ($ premium cost) across the County

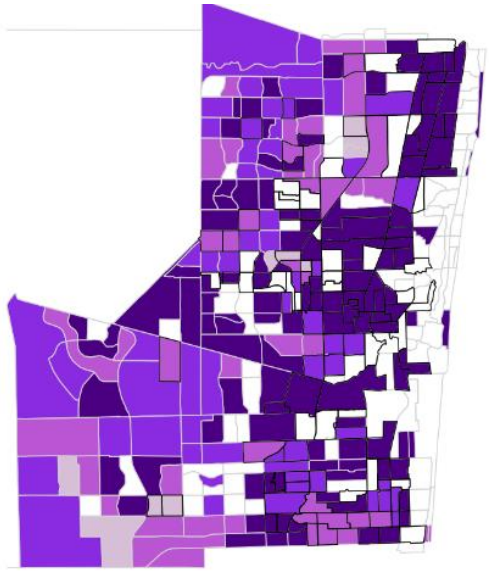
Baseline – 2ft



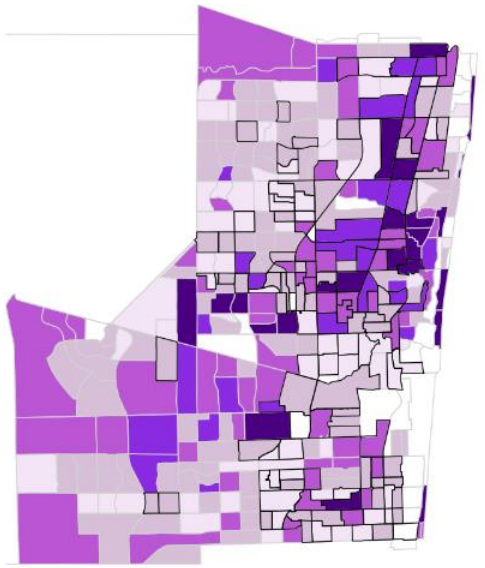
Countywide adaptations w/ control elevation changes – 2ft



Baseline – 3.3ft



Countywide adaptations w/ control elevation & 7ft seawalls-3.3ft

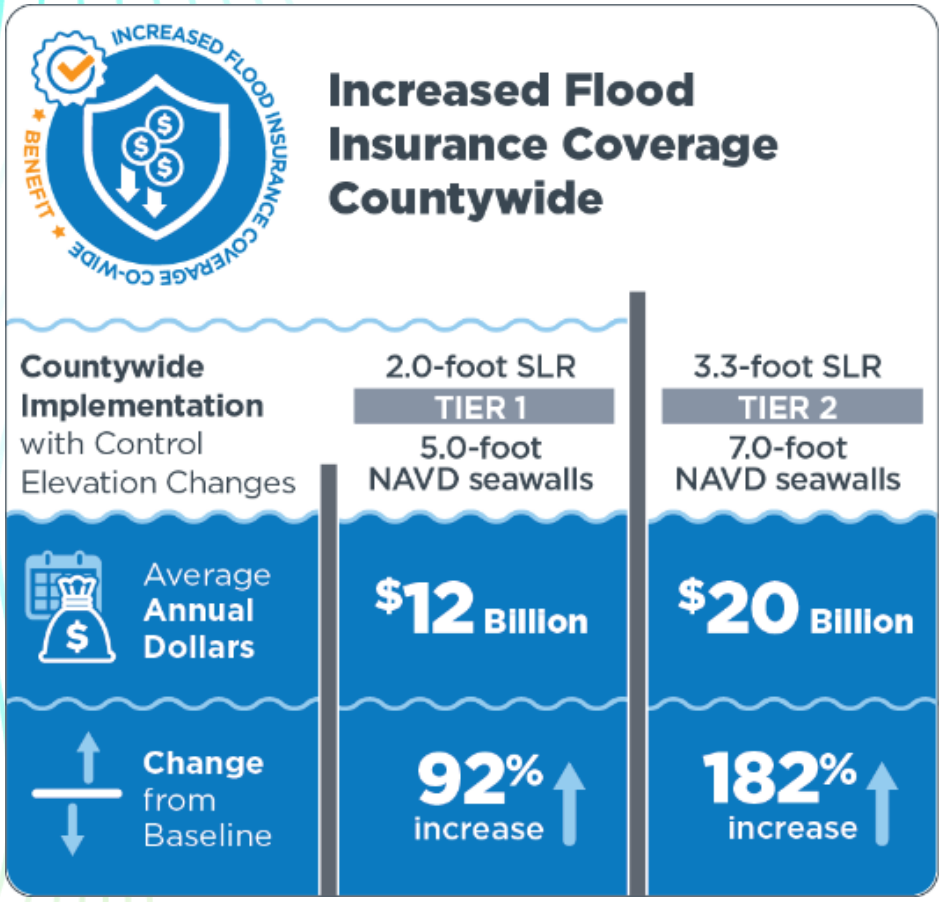


Average premium for single-family home:

- No policies due to high costs
- >$1,600
- $1,200-$1,600
- $800-$1,200
- $400-$800
- Up to $400

Source: Hazen, FEMA

Tier 1 and Tier 2 Adaptation Strategies could increase flood insurance coverage countywide



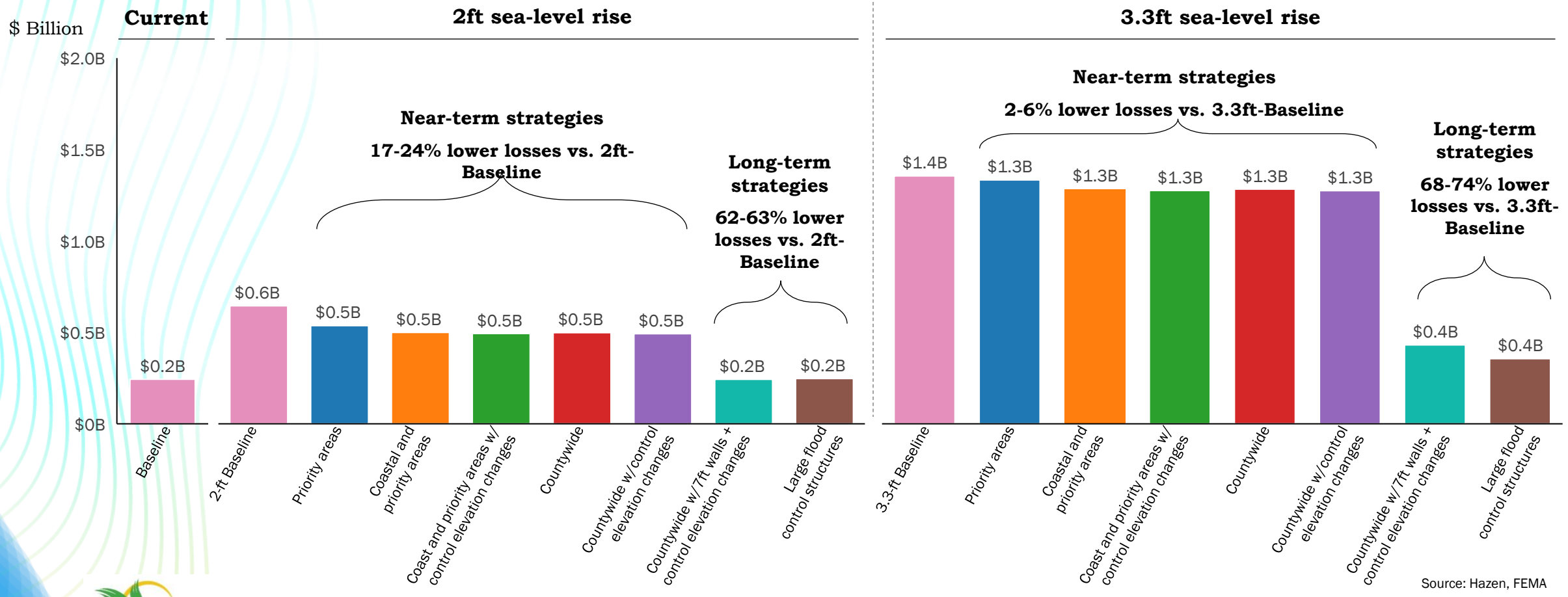
Avoided flood damages could have several benefits for insurance markets including:

- **Higher number of homes maintaining flood insurance policies** (assuming pricing is risk-based)
- As a result, **higher continued flood insurance coverage** (and less uninsured costs to households)
- **Lower average premiums** for those that maintain insurance

Source: Hazen, FEMA

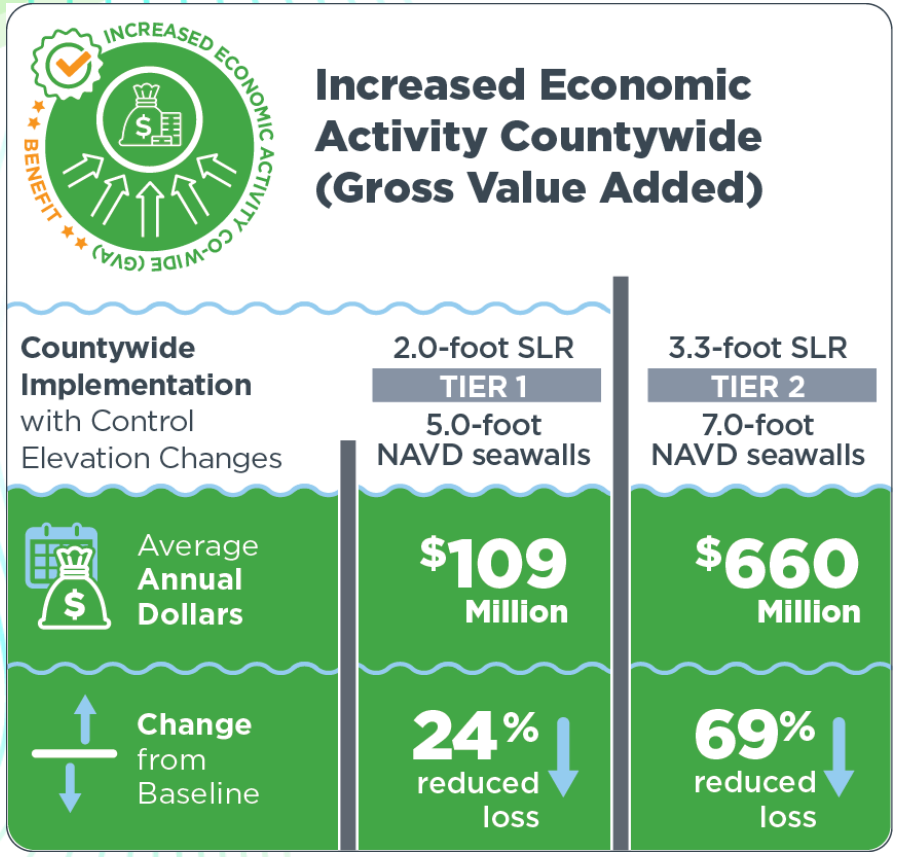
Adaptations reduce damage to productive assets by at least 17% under 2ft sea-level rise. Under 3.3ft sea-level rise, only the larger investment strategies provide significant damage reduction.

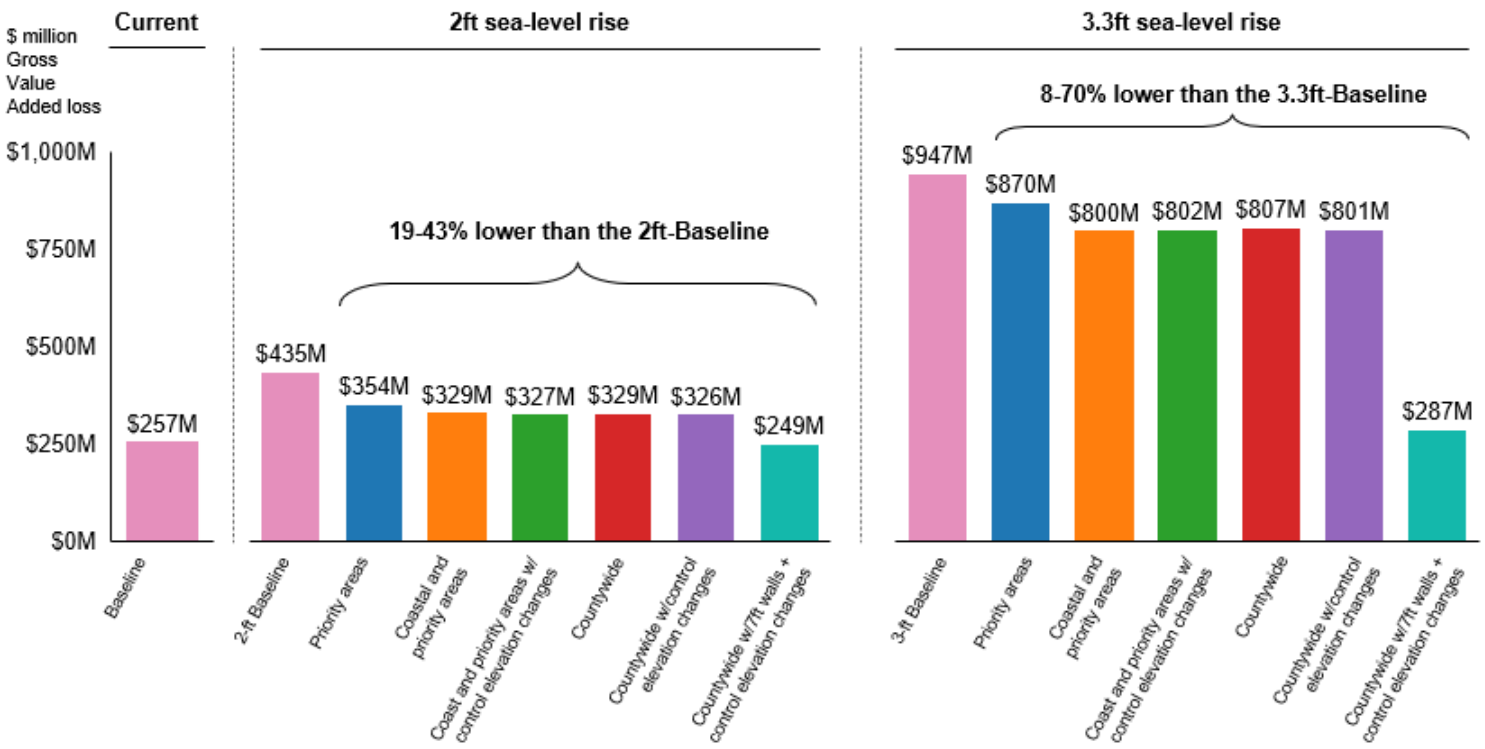
Annual average damages to productive assets ($B damages)



Source: Hazen, FEMA

Delivers Increased Economic Activity - Gross Value Added
Saves $109 – $660M Annually in Economic Production





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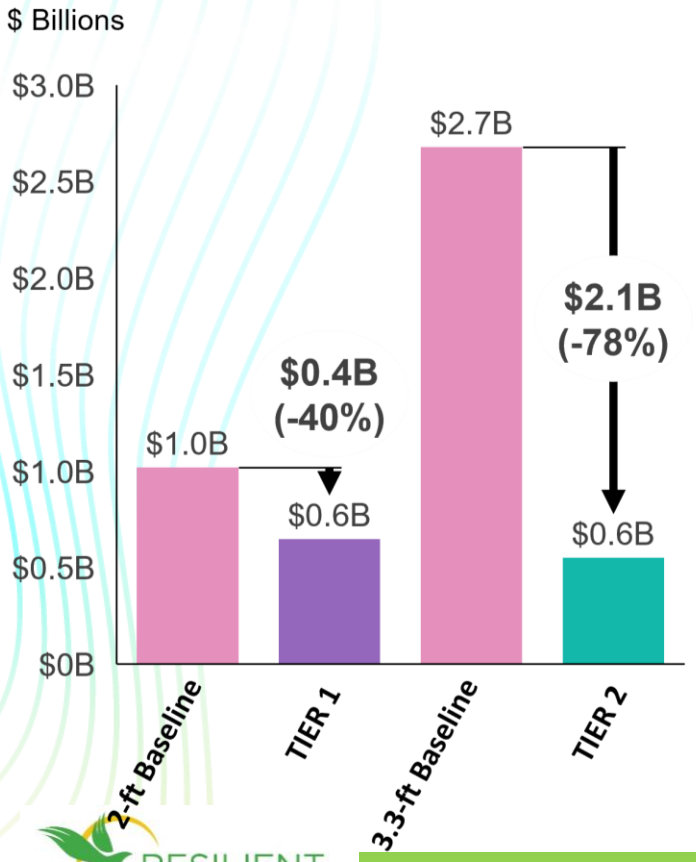
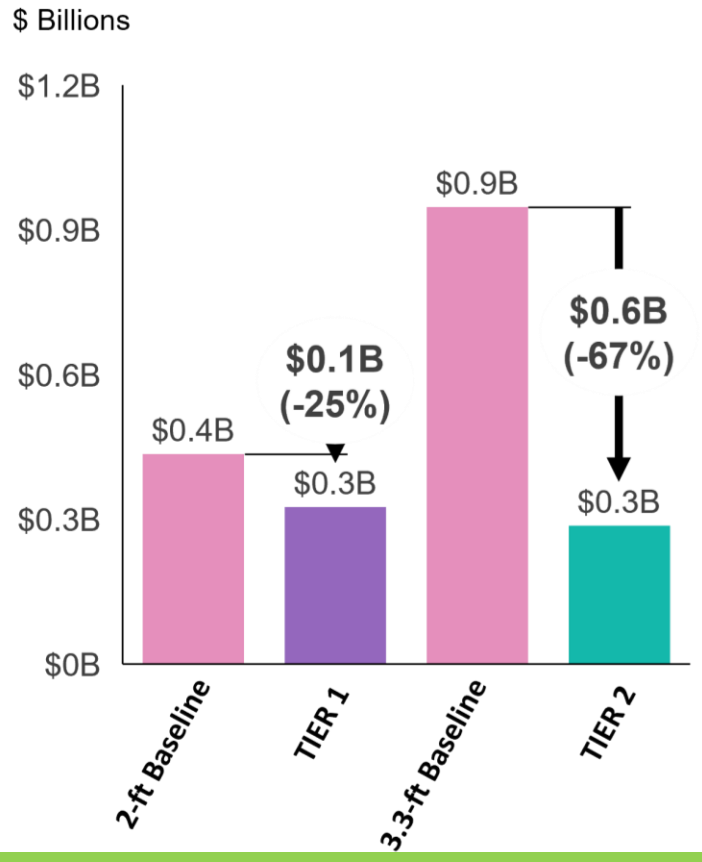
Adaption reduces revenue losses ($0.4B to $2.1B), preserves Gross Value Added ($0.1B – $0.7B) and protects jobs

Economic benefits under Tier 1 and Tier 2

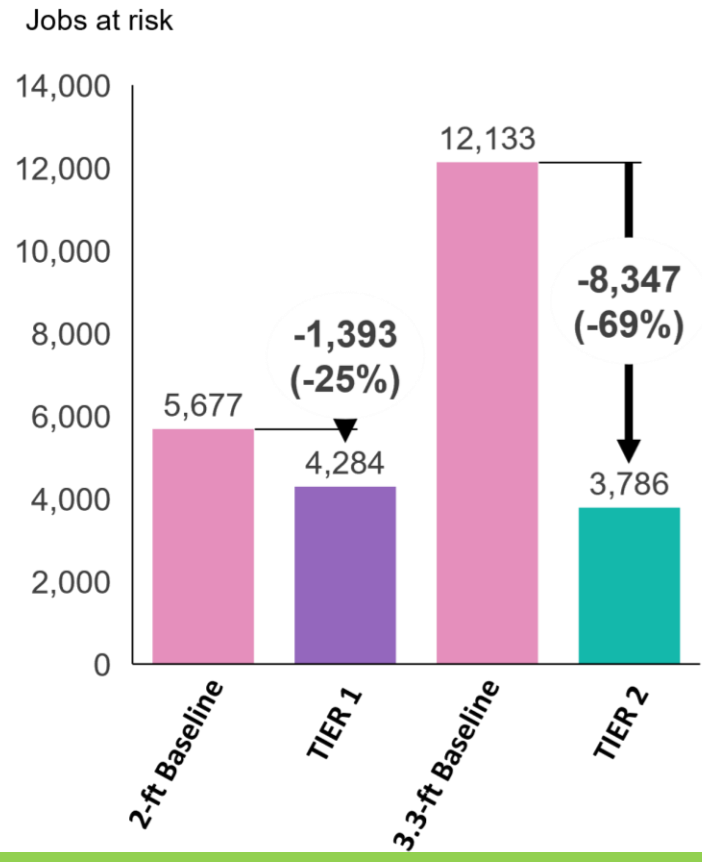
Max sales revenue losses from disruption



Average annual gross value added losses



Average annual jobs at risk



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Summary of Tier 1 and Tier 2 Benefit Value Estimates

Summary of Tier 1 and Tier 2 Benefit Value Estimates		
Benefit Category	**Tier 1 Adaptation Strategy to Mitigate 2-foot SLR**	**Tier 2 Adaptation Strategy to Mitigate 3.3-foot SLR**
Property Damage Avoided, average annual	$776,000,000	$4,000,000,000
Increased Short-term Economic Activity, average annual	$109,000,000	$660,000,000
Increased Property Tax Collected, average annual	$211,000,000	$962,000,000
Increased Flood Insurance Coverage	$12,000,000,000	$20,000,000,000
Increased Real Estate Value	$8,000,000,000	$30,000,000,000

Resilience Strategies - Planning Level Cost Summary

Estimated Costs of the Tier 1 and Tier 2 Adaptation Strategies, 2024 dollars			
Item	Tier 1	Tier 2	Additional Cost of Tier 2 Once Tier 1 is Constructed
	Countywide - 5ft NAVD seawalls	Countywide - 7ft NAVD seawalls	
(1)	(2)	(3)	(4) = (3) – (2)
Capital Cost	$21,400,000,000	$30,300,000,000	$8,900,000,000
Annual O&M and R&R Cost	$214,000,000	$303,000,000	$89,000,000

* Accounts for design, permitting, and construction with 30% contingency

Resilience Plan Performance – Positive Return on Investment

Economic Metric	Tier 1 and Tier 2	Tier 1 Only
	SLR is 2ft by 2050 and 3.3ft by 2070	**SLR is 2ft by 2050 and no additional SLR after**
Rate of Return on Investment, nominal annual	At least 10%	At least 7%
Benefit to Cost Ratio at 5% annual nominal discount rate	At least 3.4	At least 1.4

Tier 1 and Tier 2 to mitigate flood risk are economically feasible when compared to County's 5% annual opportunity cost of money

Benefit categories included are estimated avoided property damage, increased short term economic activity, and increased real estate value.

Summary

- Economic analysis provides solid demonstration of positive benefits to be realized with organized resilience investments implemented county-wide.
- Tier 1 strategies provide 19 municipalities with a 40% reduction in flood damage (or greater), increasing to 24 municipalities with tier 2, when overall damages are reduced 83% county-wide.
- Economic findings show positive results for all metrics assessed, including at least $776 Million in preserved economic activity.
- Proposed strategies deliver $8 to $30 Billion in residential property value preservation, avoid up to $4 Billion in asset damages, and preserve $20 Billion in flood insurance coverage.

Questions ?

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