TOWN OF MARSHFIELD

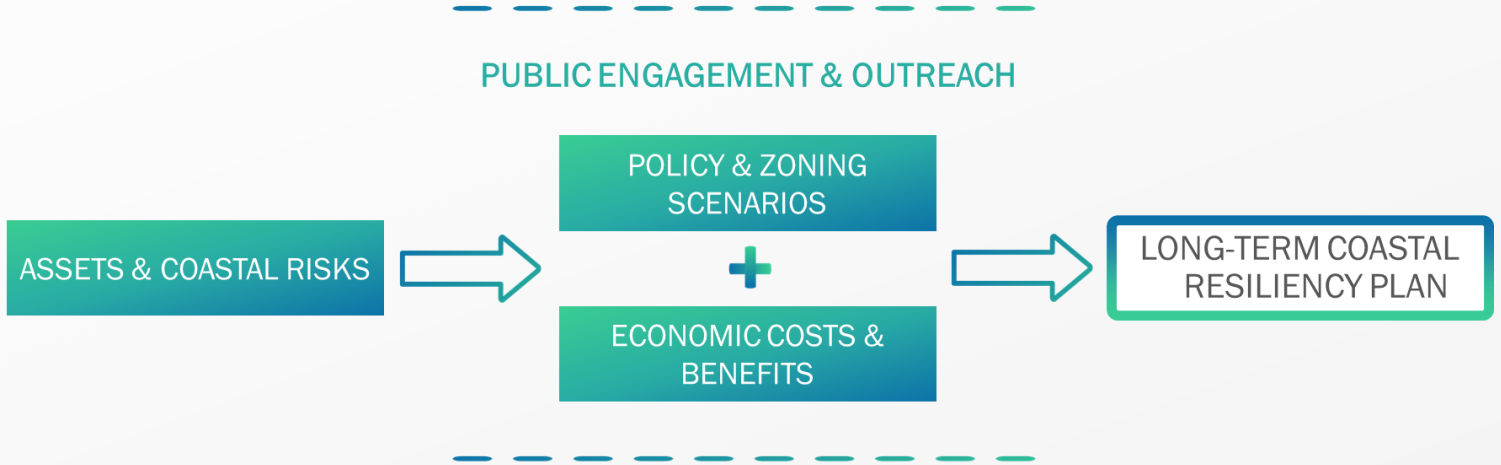
Long-term Coastal Resilience Plan

Public Meeting

May 26, 2022

Project Overview

The goal of the Marshfield Long-Term Coastal Resilience Plan is to develop guiding principles and recommended policies and zoning to proactively reduce future coastal flooding and erosion vulnerabilities and, if necessary, rebuild in a more resilient way after a future catastrophic event.



The project will NOT focus on engineering strategies like seawalls or beach nourishment.

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Roadmap

Community Workshop and online survey

62 people participated in each

Estimate costs and benefits of "no action"

Develop policy alternatives based on risks, workshop and survey results

Estimate costs and benefits of policy alternatives

Additional public outreach and engagement

(May 2022)

WE ARE HERE

(May 2022)

Develop draft recommendations

Finalize plan

(June 2022)

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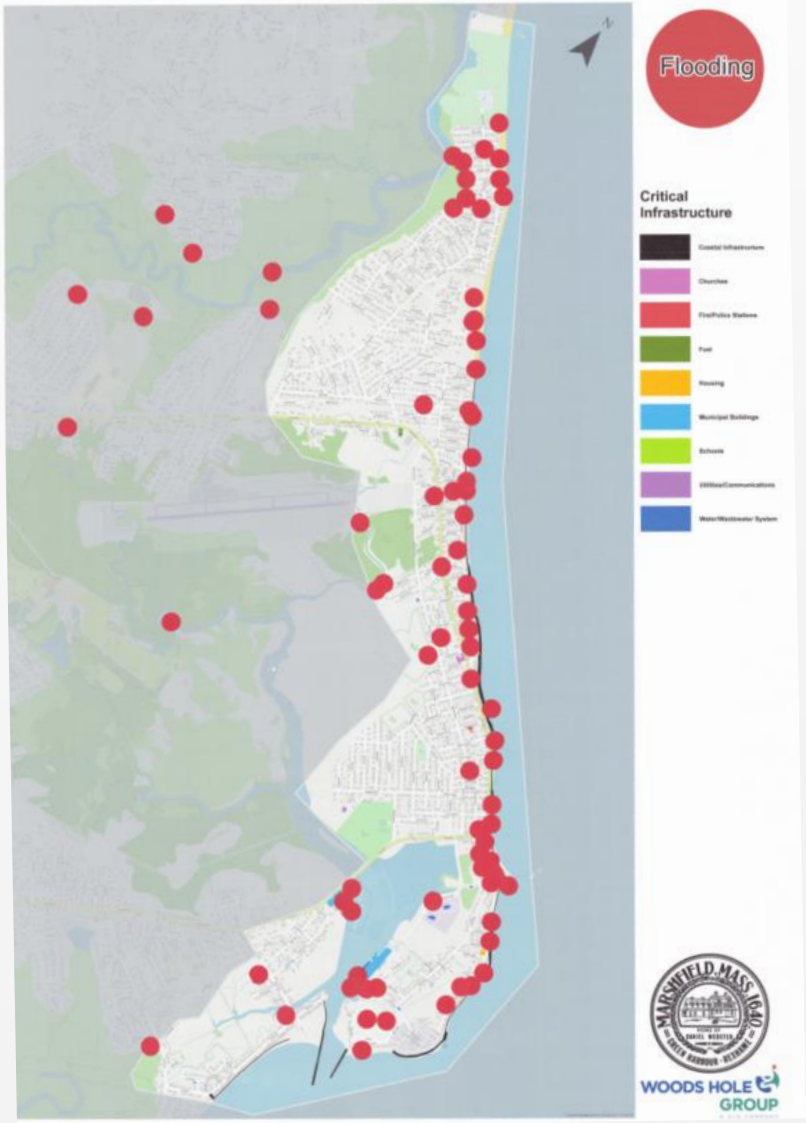
COMMUNITY WORKSHOP & SURVEY SUMMARY

Different types of coastal flooding affect the planning area

- Tidal (e.g., King Tide)
- Storm drain backflow
- Wave runup and overtopping
- Storm surge

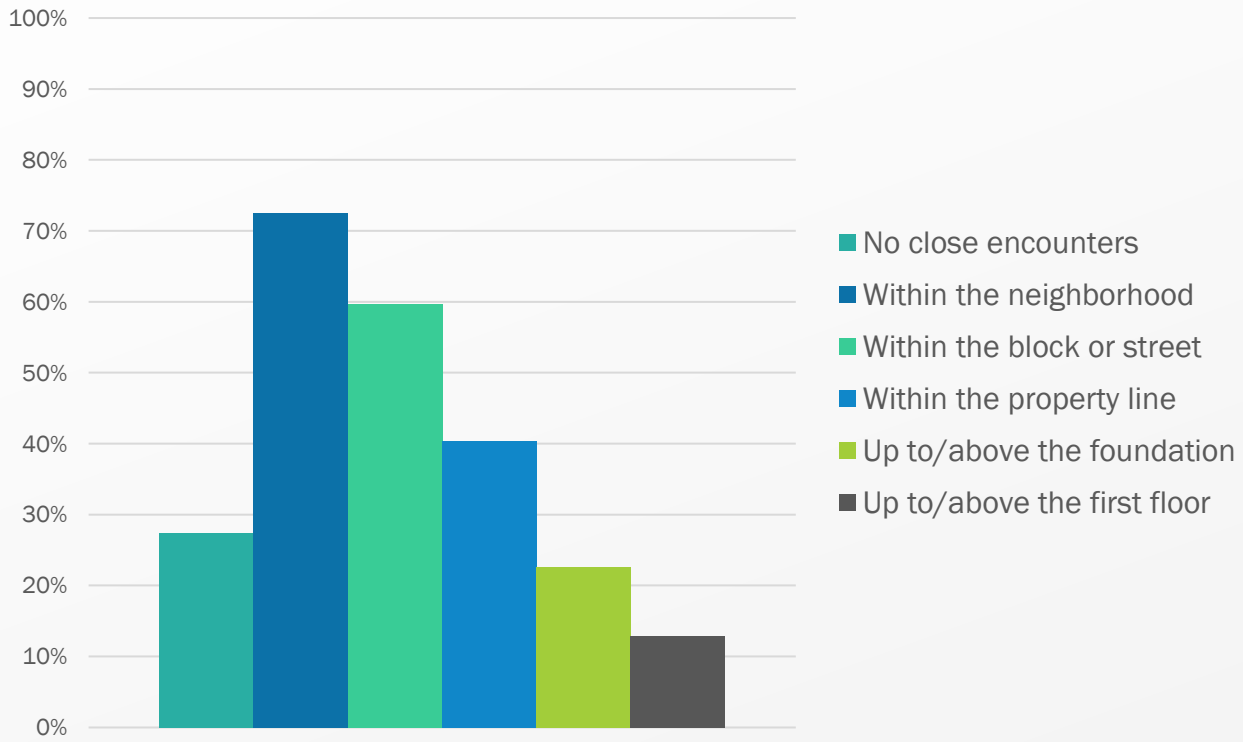
Credits: Wicked Local/Alyssa Stone, MyCoast,

Workshop – Areas of reported flooding

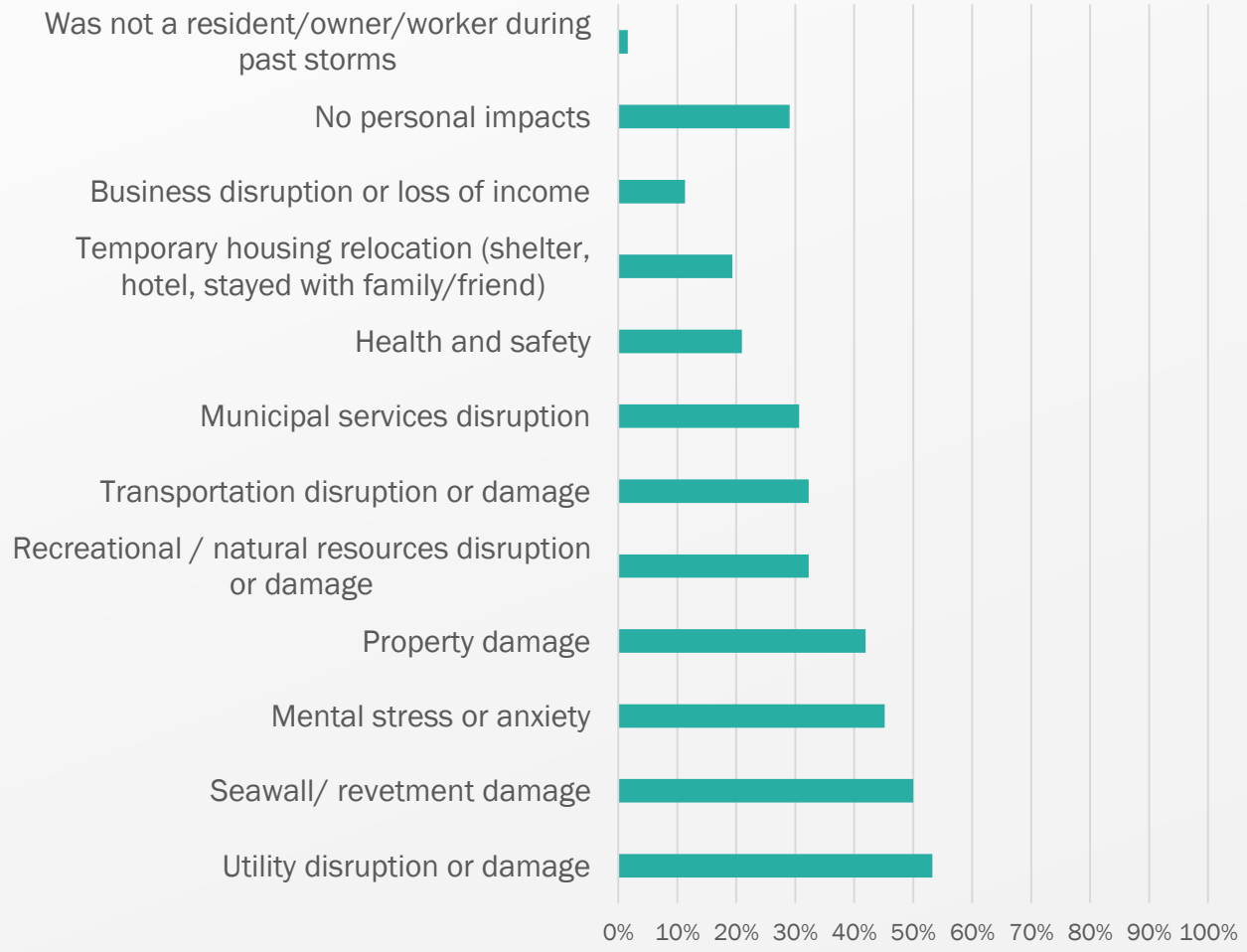


Community members have experienced flooding differently

- Some from afar
- Many up close
- Some deeply personal



Neighborhood and personal impacts reported

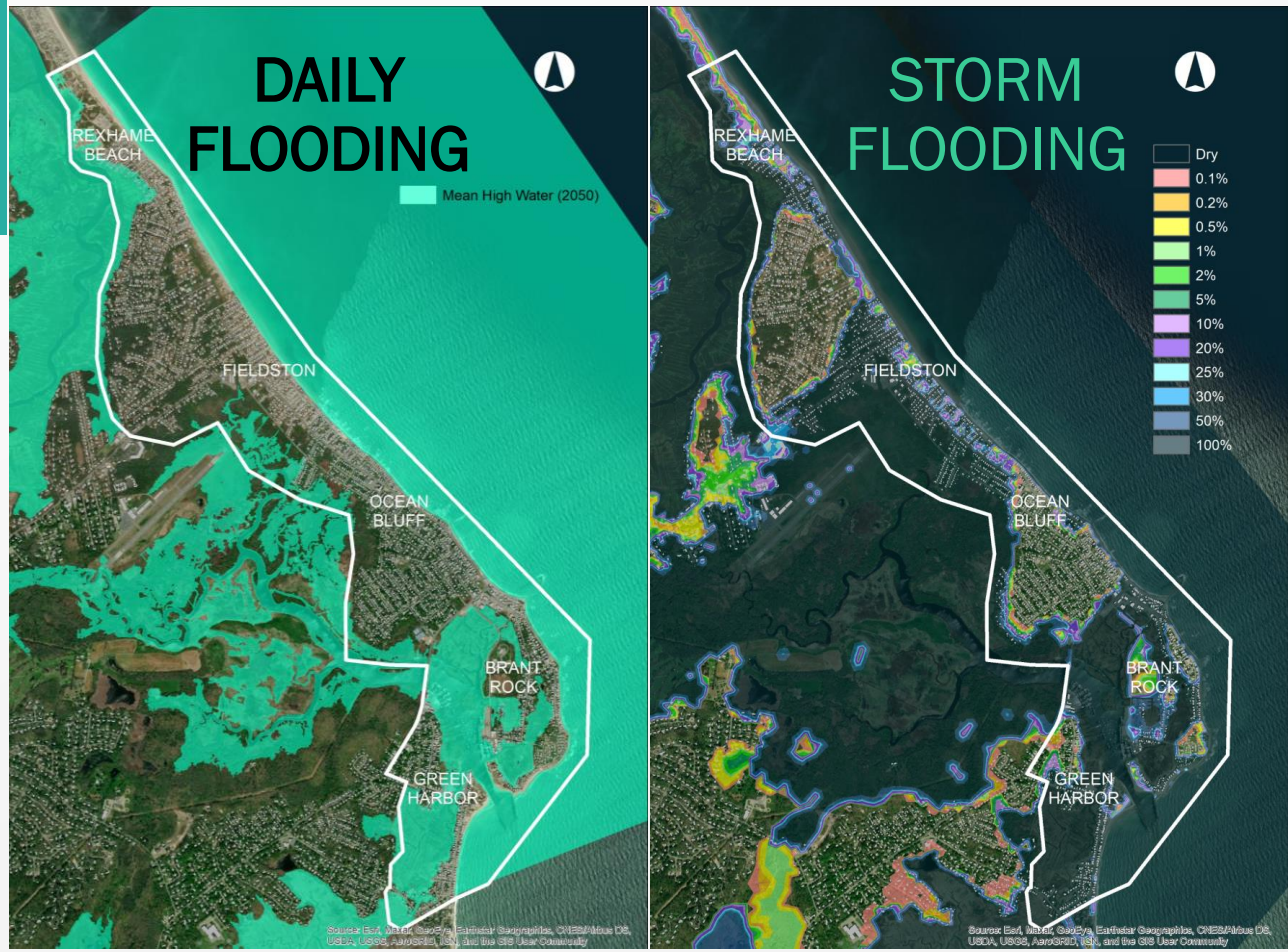


The community needs a long-term coastal resilience plan because of…

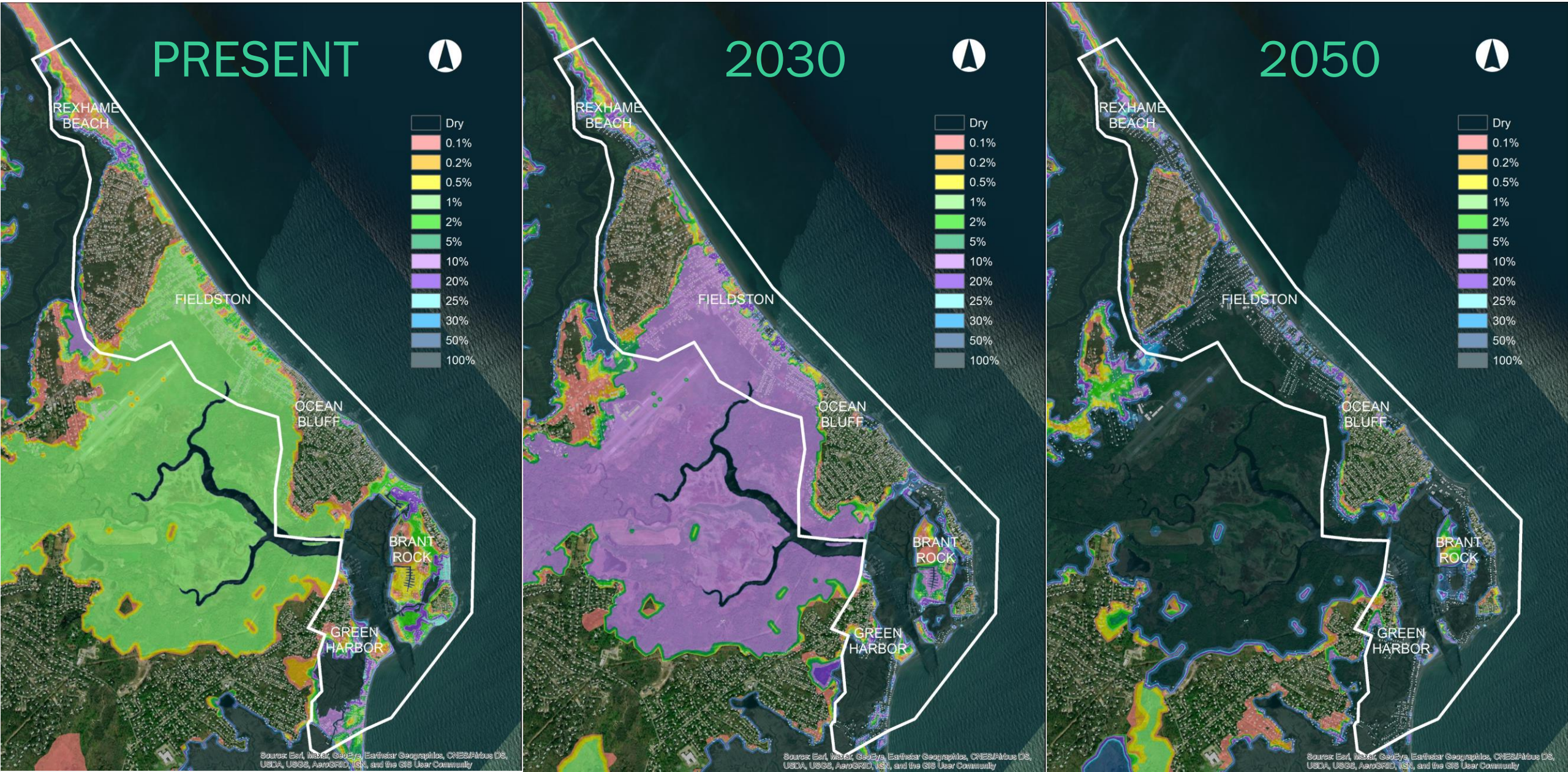
- Dangers to residents, workers, and visitors
- Dangers to first responders
- High Town, State, Federal costs (your taxes)
- High personal costs
- Damages to natural resources
- **Sea level rise - more tidal and storm flooding**

Credits: Wicked Local/Alyssa Stone, Patriot Ledger/Greg Derr, MyCoast,

Long-term planning scenarios (2050)

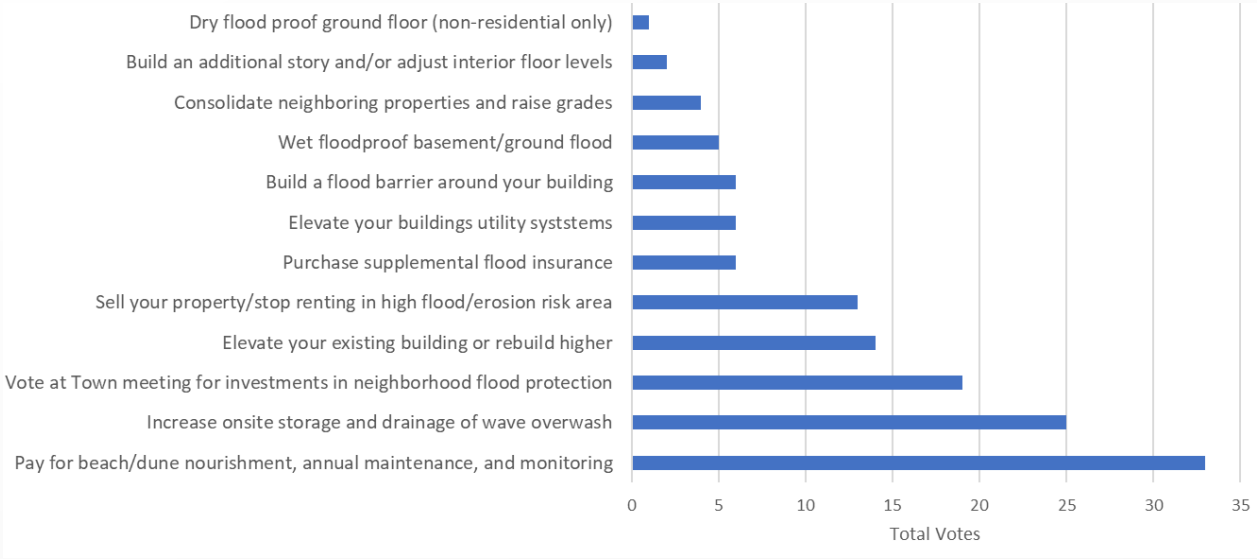


Annual probability of coastal flooding

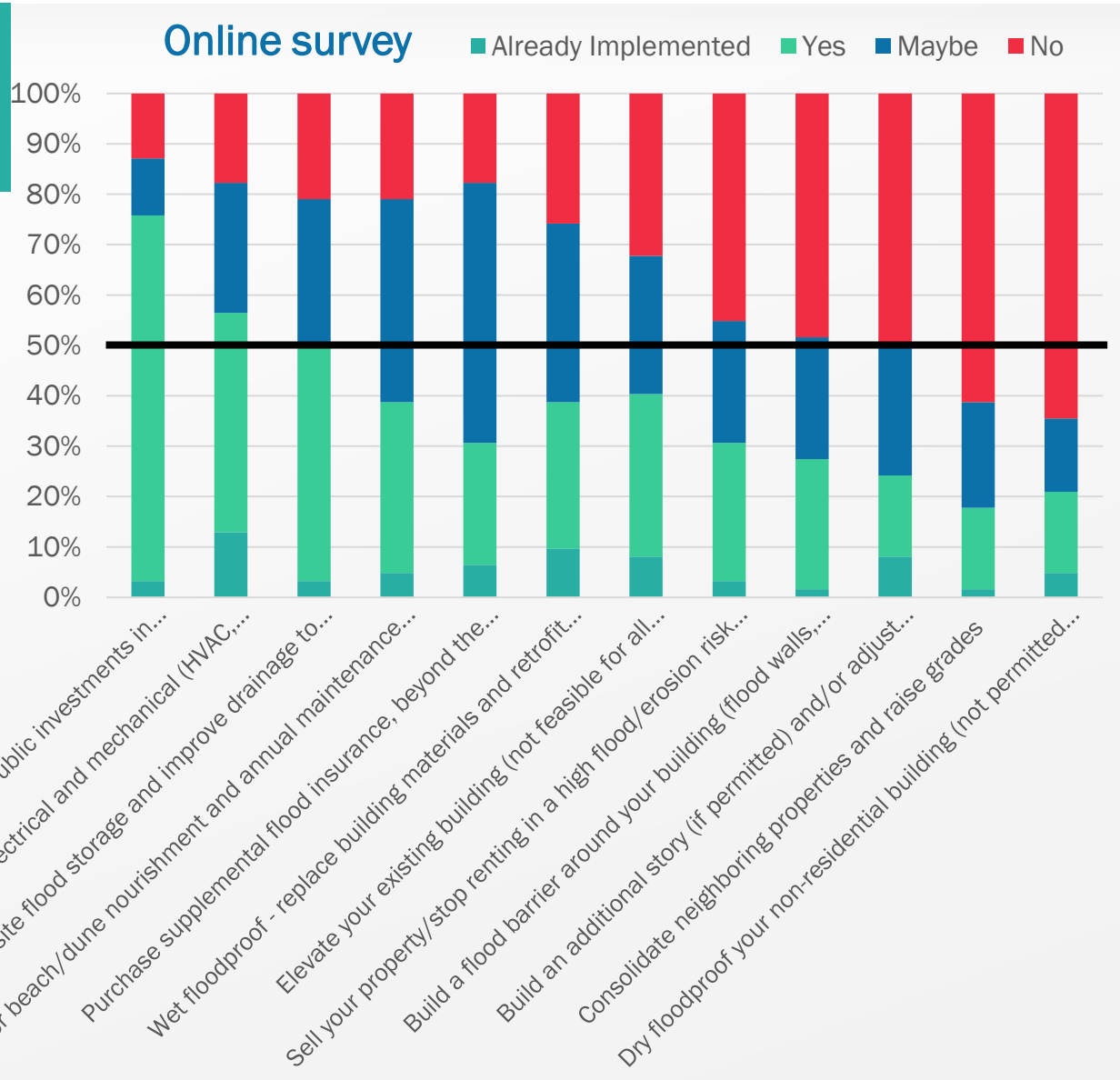


Community members are generally open to considering a range of…

- Flood risk reduction strategies
- Especially public flood protection infrastructure
- Various actions on their own properties



Workshop results

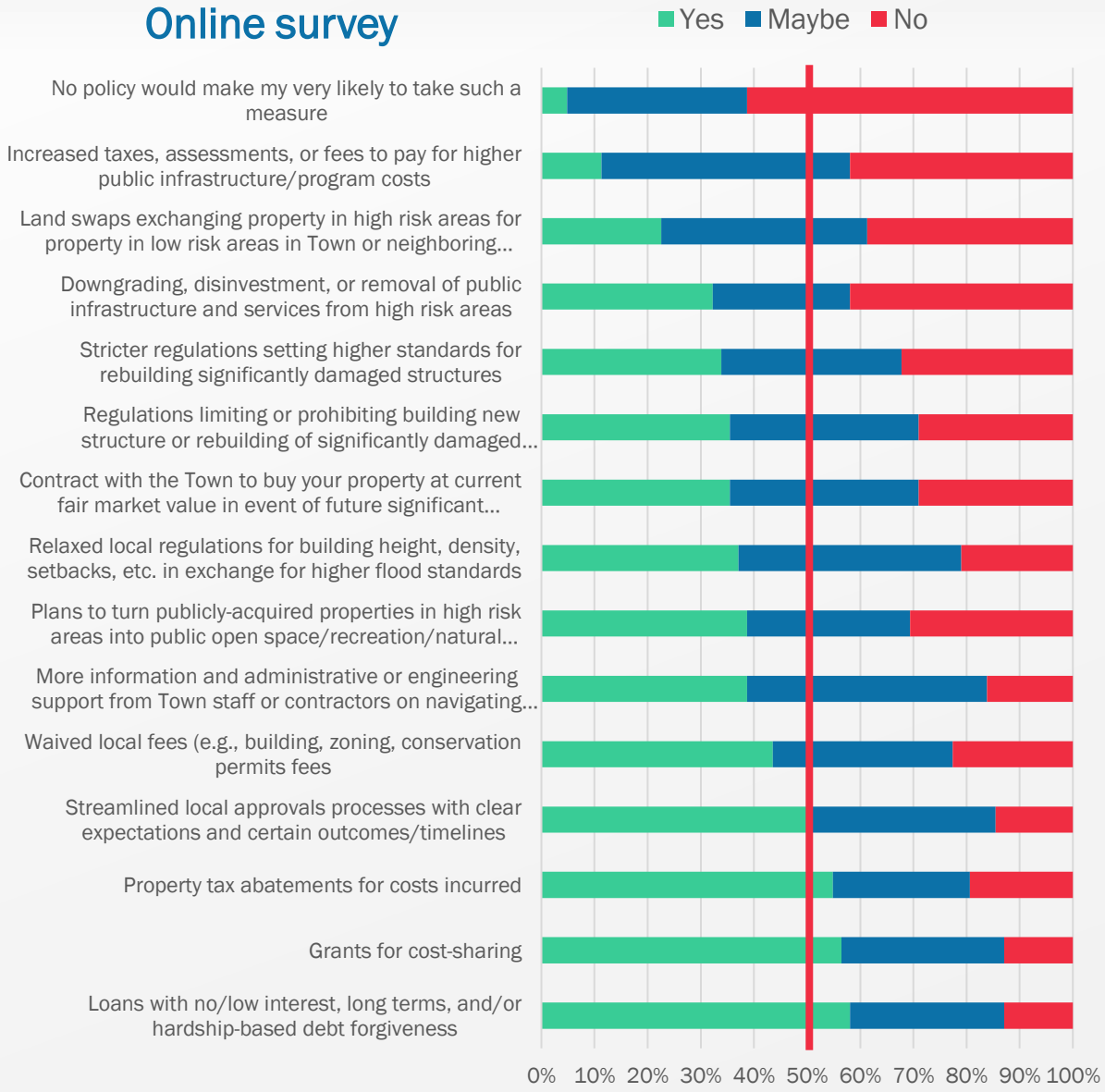


Community members are generally open to influence by a range of…

- Policies to incentivize flood risk reduction actions
- Especially financial support

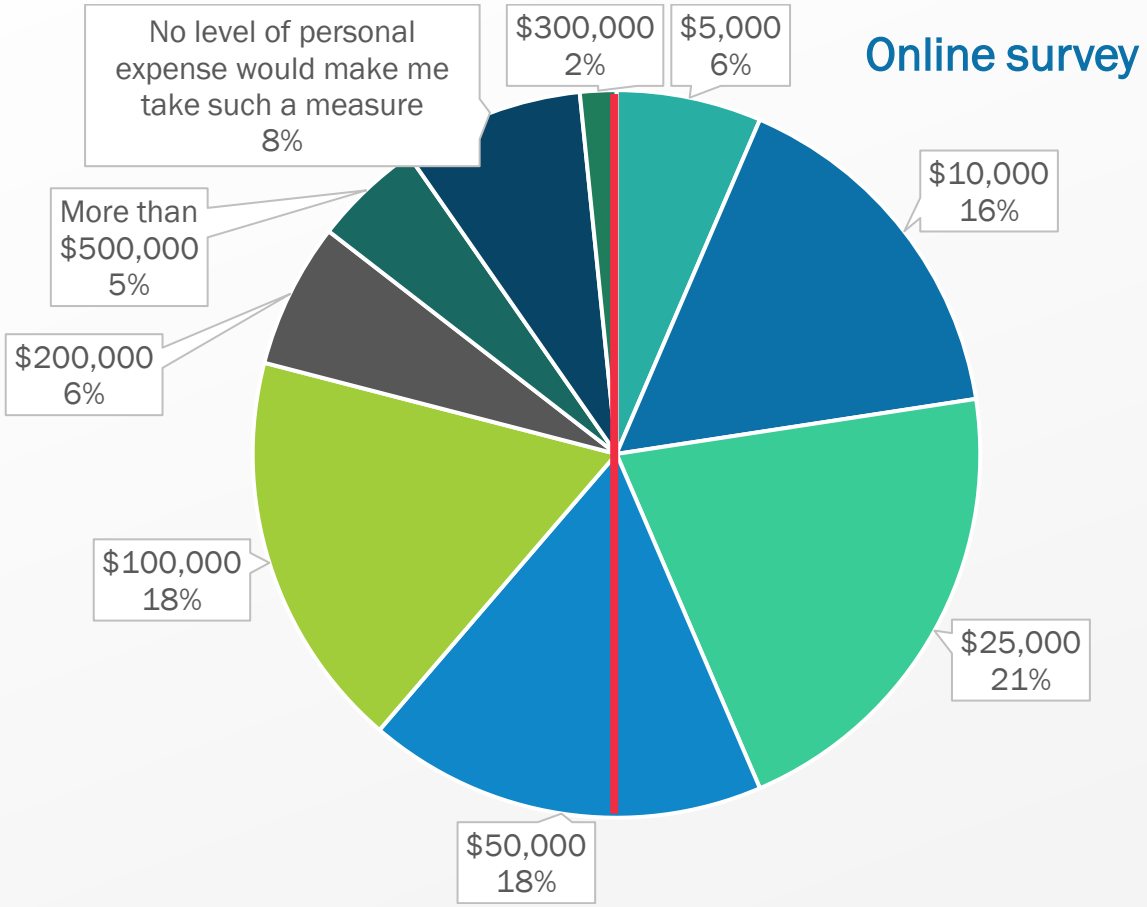
Workshop results

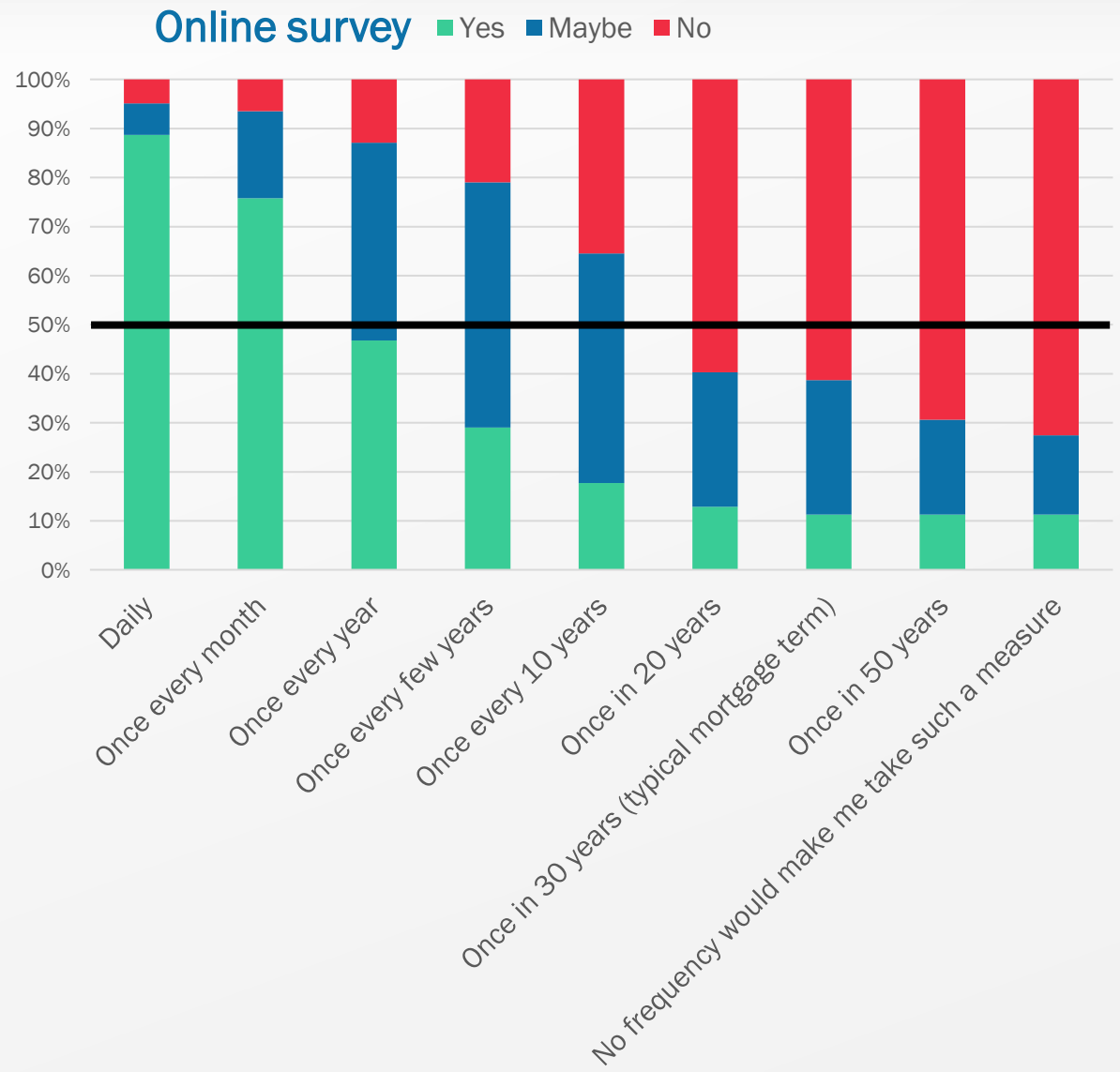
Online survey



Community members are likely to take substantial actions if they…

- Incur a high personal expense from flooding
- Experience frequent flood damages/losses





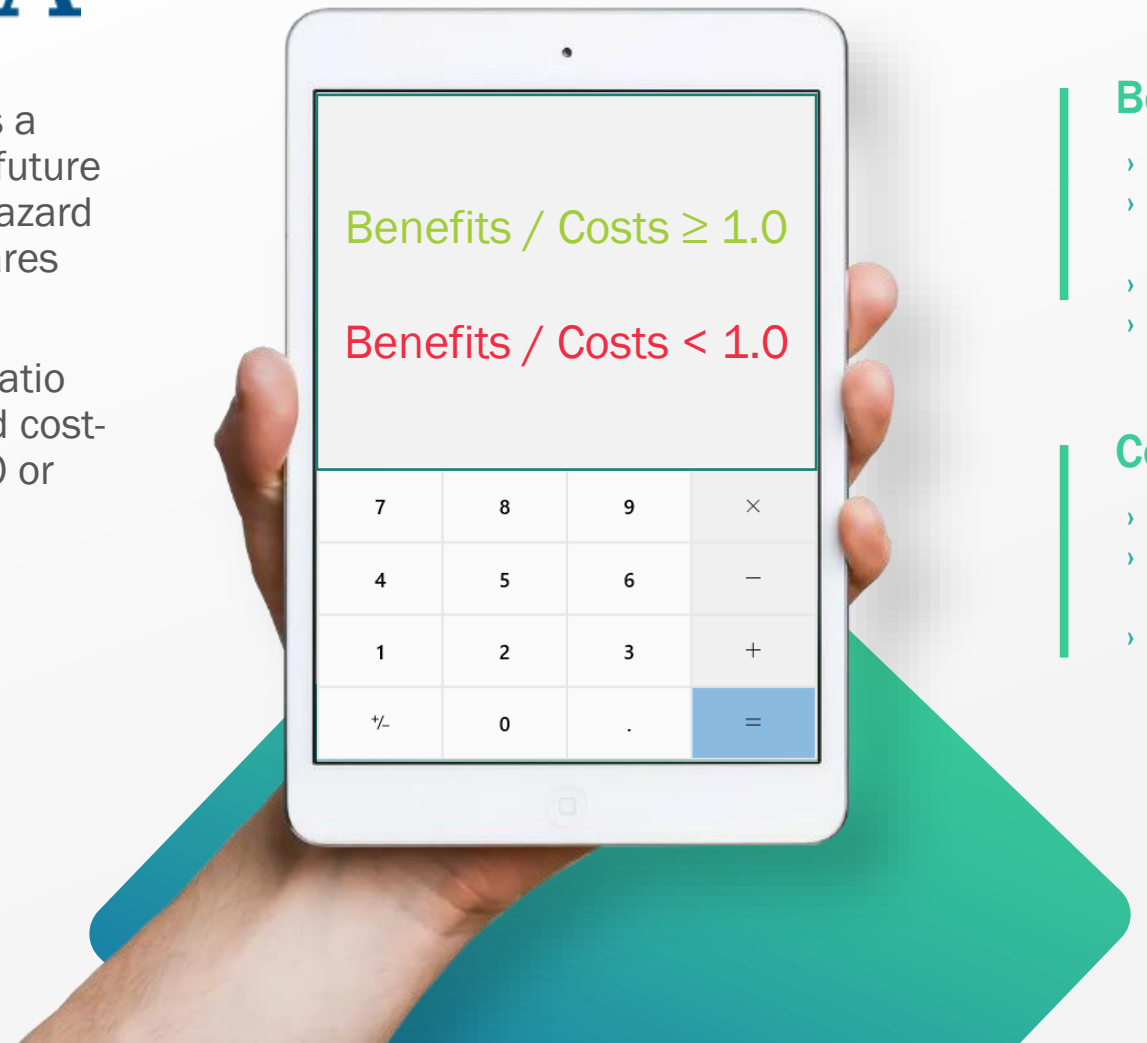
BENEFIT COST ANALYSIS BASICS

Benefit-Cost Analysis

FEMA

Benefit-Cost Analysis (BCA) is a method that determines the future risk reduction benefits of a hazard mitigation project and compares those benefits to its costs.

The result is a Benefit-Cost Ratio (BCR). A project is considered cost-effective when the BCR is 1.0 or greater.



Benefits

- Avoided damage/loss
- Avoided emergency response, cleanup costs
- Environmental benefits
- Insurance costs

Costs

- Construction costs
- Engineering, real estate, legal, management costs
- Loss of tax revenue

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BCAs are useful for different purposes

Individual structure:

- Evaluate relative cost-effectiveness of different mitigation strategies

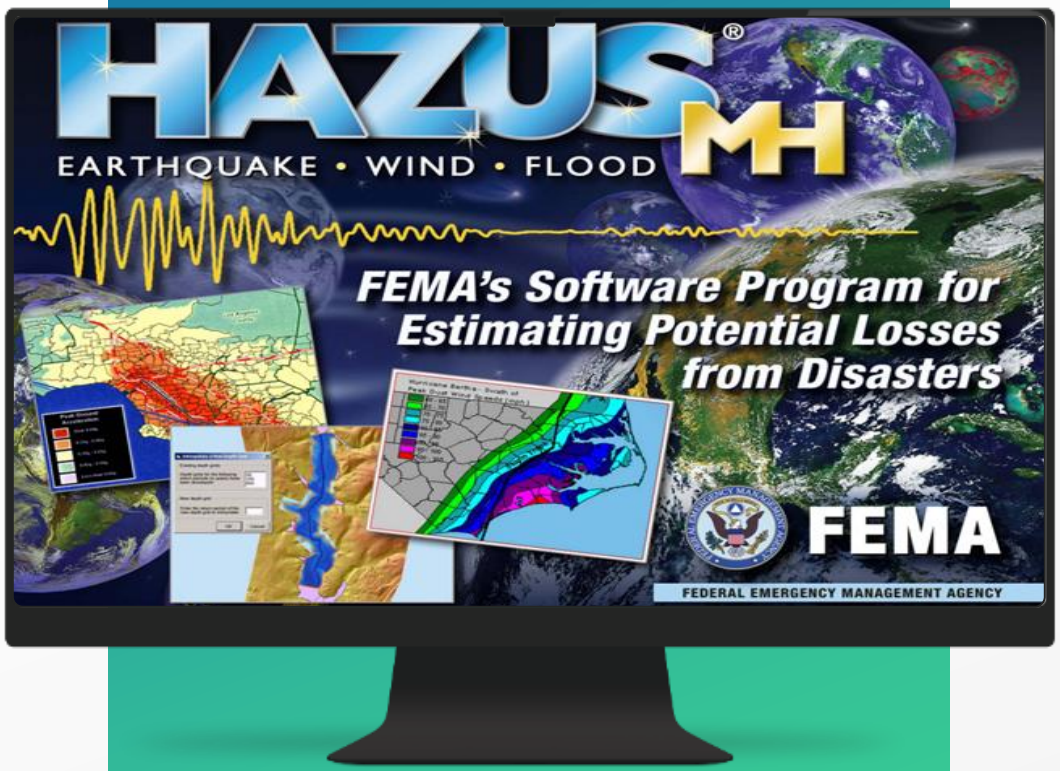
Multiple structures:

- Prioritize where to invest limited mitigation resources

Community:

- Evaluate overall social/economic outcomes of a mitigation program
- Identify a portfolio of projects that is cost-effective overall

Estimating damage/loss with Hazus



FEMA's Hazus Program provides standardized tools and data for estimating risk from floods and other hazards.

Hazus models combine expertise from many disciplines to create actionable risk information that increases community resilience.

USER INPUTS

Building Inventory

- Area, stories, foundation type, basement, first floor height above ground, replacement value

Flood Depth Maps

- Time horizons: 2030, 2050
- Return periods: 10-, 20-, 50-, 100-, 500-year

HAZUS OUTPUTS

Direct Damages

- Cost to repair/replace damaged buildings, contents, and inventories

Time-Dependent Losses

- Temporary relocation expenses
- Rental income loss
- Capital related loss
- Income loss
- Business interruption

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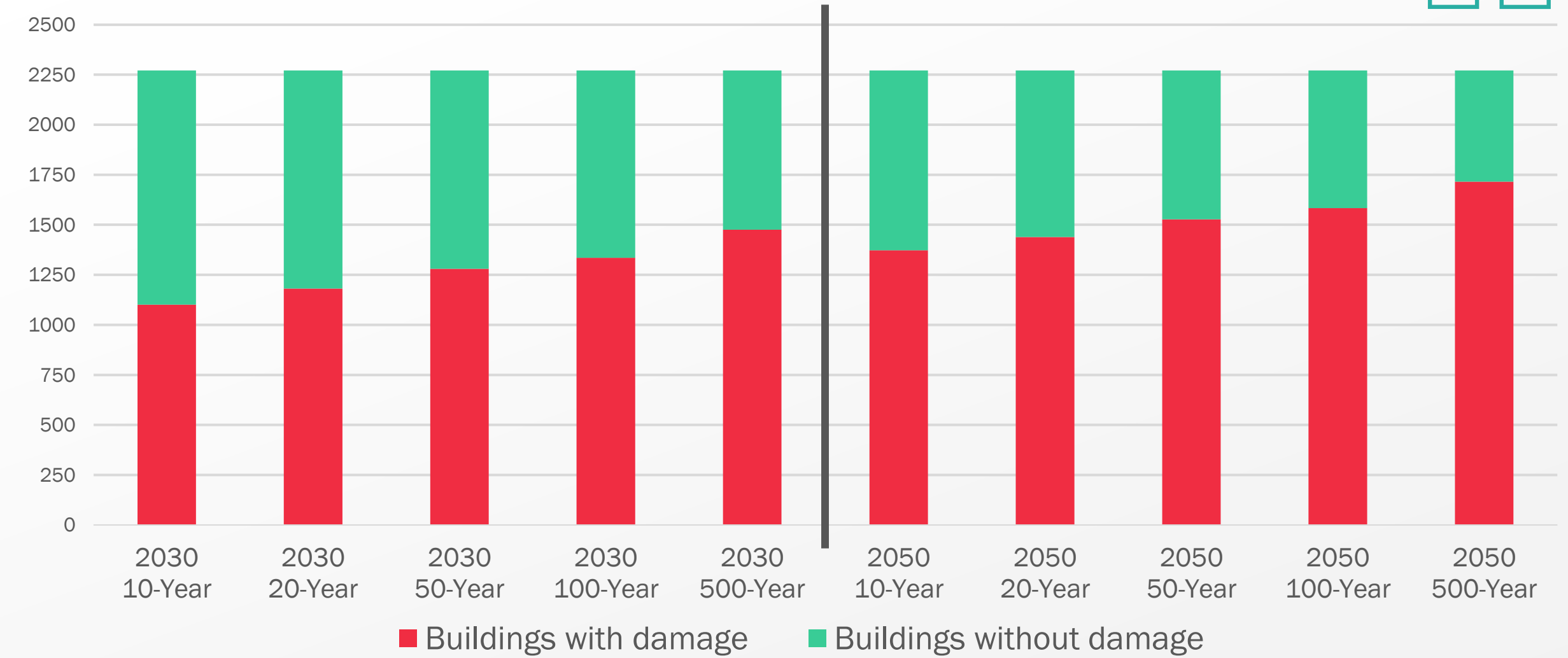
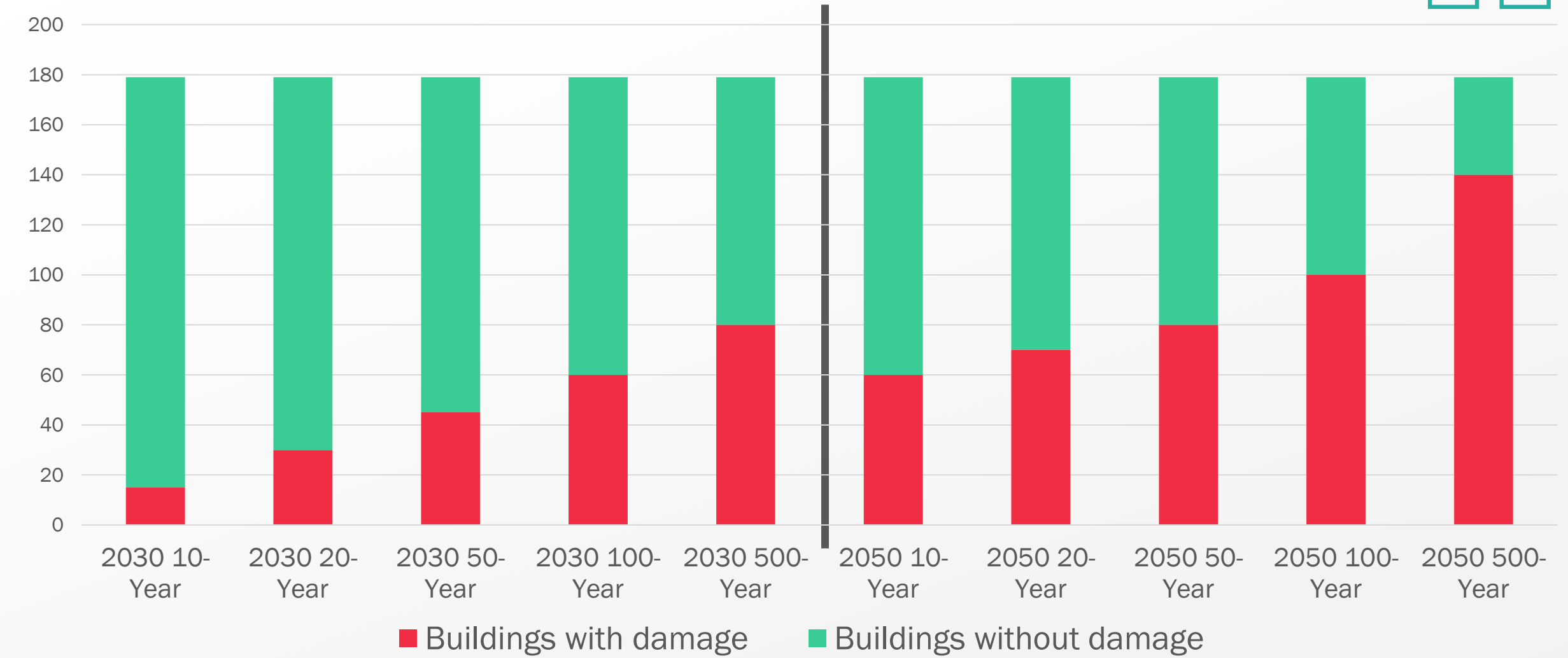
COSTS OF “NO ACTION”

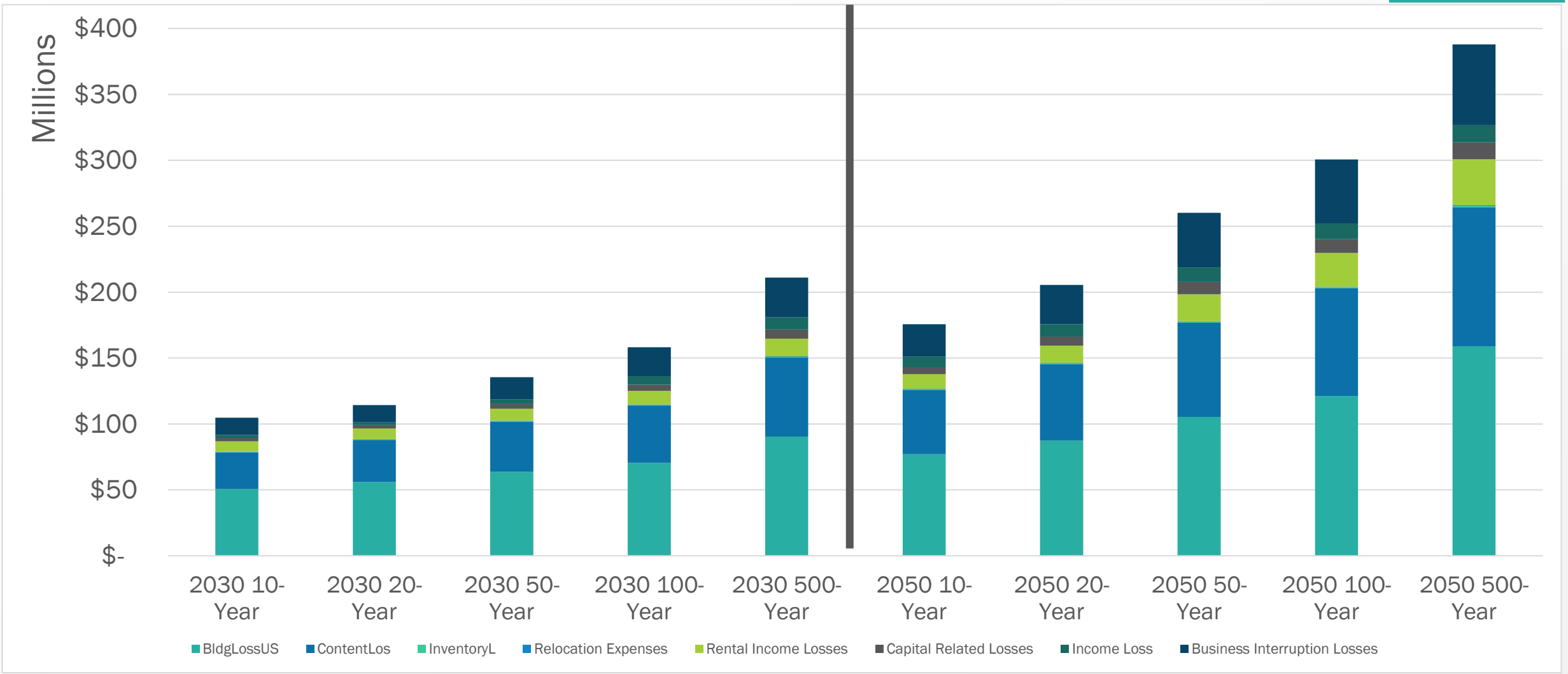
Number of buildings with/out flood damage/loss - surge (total = 2,271)



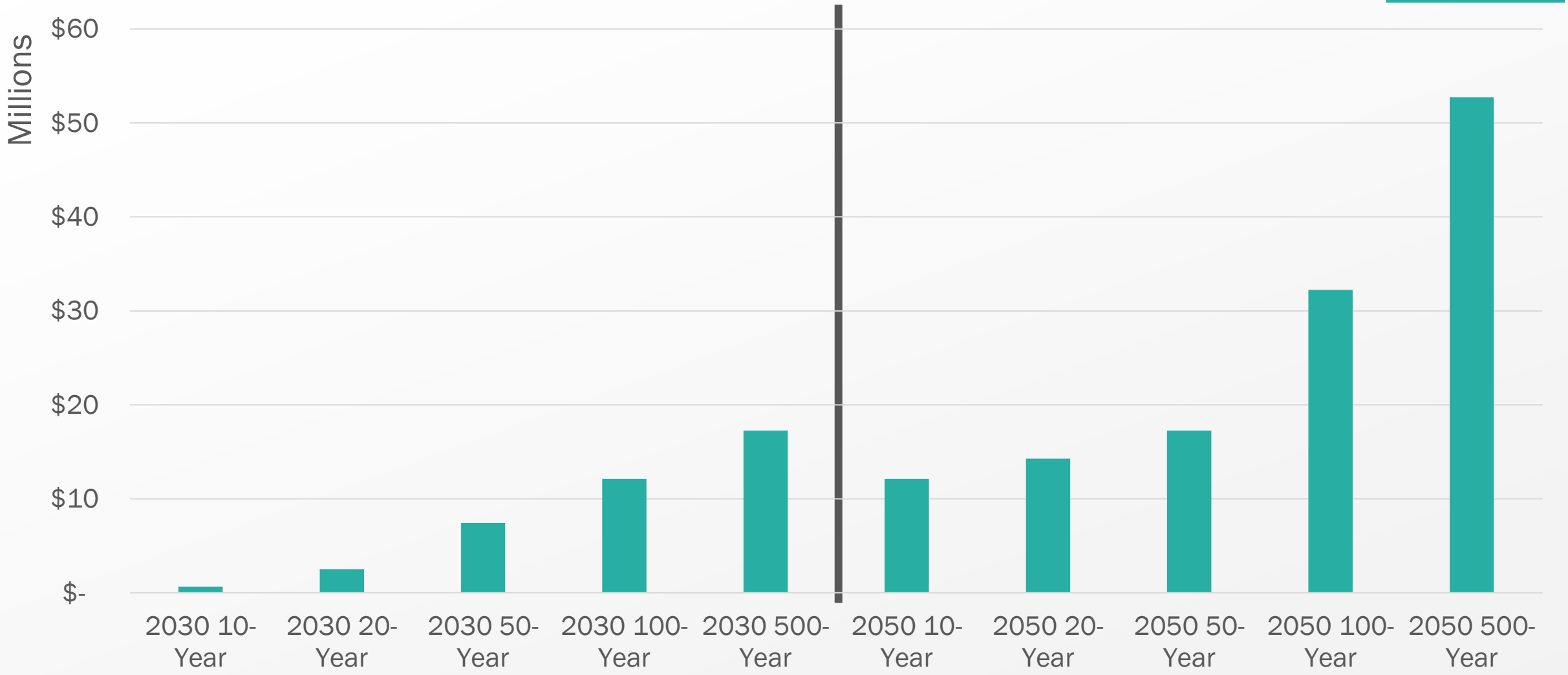
Number of buildings with/out flood damage/loss - waves (total = 180)



Value of flood damage/loss - surge



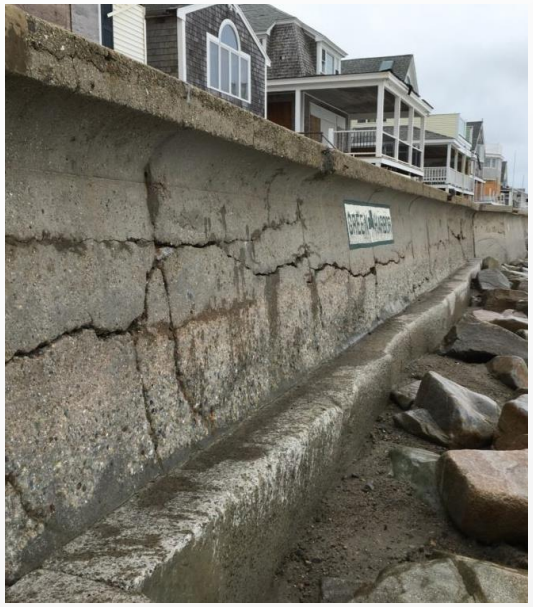
Value of flood damage/loss - waves



Other impacts

Seawall Failures/ Replacements:

- $30-40 million



Emergency Response

- $20+ million

Single event versus annualized damages

Risk = Probability x Consequence

Example:

Average annual loss for 1% storm that causes $100,000 loss = $1,000

We add the annualized damages for each building from the 5 storms in each time horizon to get a total average annual loss for 2030 and 2050

Calculating avoided losses (aka benefits) of mitigation

We add up all the annualized damages that are avoided for each year that a mitigation strategy is effective (e.g., 50 years)

Because people value future money less than money right now, we apply a "discount rate" to future avoided damages (kind of like depreciation):

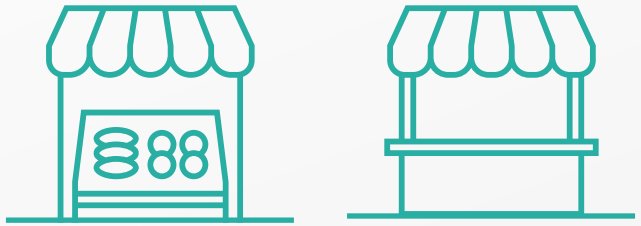
7% is the regulatory standard: $100 dollars in 2023 = $93 today
BUT 3% is also used as a "social discount rate": $100 in 2023 = $97 today
Which one is chosen can have big impacts on results

The result is the "net present value" of avoided future losses which we can compare to the cost of implementing the mitigation measure today.

Present Mitigation Costs  **to**  Avoid Future Damages

MITIGATION STRATEGIES

Mitigation strategies included in Hazus analysis



Elevation (Residential)

- First floor raised to 2050 100-year flood elevation + 1 foot freeboard
- Cost per structure based on building characteristics

Voluntary Acquisition

- Property purchased for fair market value and buildings demolished and turned to open space
- Cost per structure based on total assessed value plus flat demolition cost
- Cost of lost tax revenue

Dry Floodproofing (Non-Residential)

- Structure modified to be substantially impermeable to water up to the 2050 100-year flood elevation + 1 foot freeboard
- Cost per structure based on first floor area

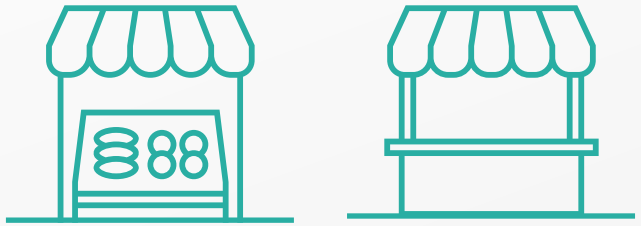
All costs include:

- Base cost
- Markups (% of base cost) for technical/administration
- 30% contingency

Regulatory Taking/Eminent Domain

- Property cannot be rebuilt/redeveloped or property is taken for proper public purpose, owner entitled to compensation
- Cost per structure based on total assessed value plus flat demolition cost plus flat legal cost
- Cost of lost tax revenue

Policy and zoning strategies to incentivize mitigation



Elevation (Residential)

- Federal grant programs (FEMA, US Army Corps)
- Promote and offer counseling on flood insurance
- Limit allowable uses below future flood elevation to parking/storage within existing Flood Overlay or new one with wider boundary, equivalent increase building heights
- Strengthen wetlands and building regulations, education, and enforcement

Voluntary Acquisition

- Federal, State, and non-profit grant programs (MassEEA, FEMA, US Army Corps)
- Add to Open Space Plan priority acquisition list
- Leaseback agreements (case-by-case)

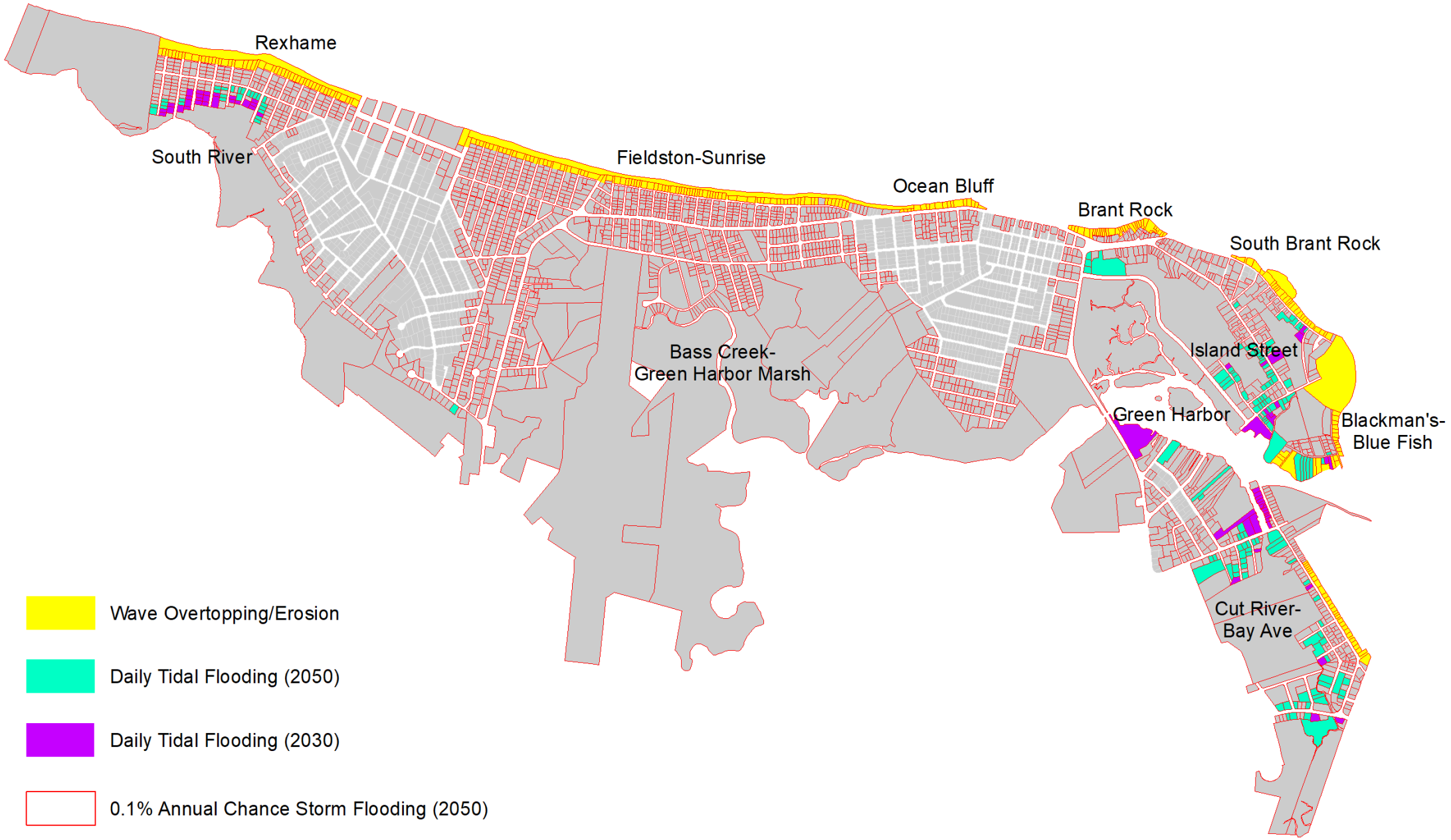
Regulatory Taking/Eminent Domain

- Strengthen zoning setbacks
- Strengthen wetlands buffers
- Prepare resilient shoreline infrastructure plans

Dry Floodproofing (Non-Residential)

- Federal grant programs (FEMA, US Army Corps)
- Promote and offer counseling on flood insurance
- Limit allowable uses below future flood elevation to parking/storage within existing Flood Overlay or new one with wider boundary unless dry floodproofed

Impact zones considered



Sources of uncertainty, assumptions, limitations

Sources of uncertainty:

- Sea level rise projections and timing
- Flood model
- Building inventory
- Depth-damage functions
- Discount rate

Costs/benefits not included:

- Daily or annual recurrence flood damages
- Damage to roads, seawalls, other infrastructure
- Wave overtopping damages
- Erosion of beaches
- Flooding from rainstorms
- Human life and well-being
- Broader economic and productivity impacts

While the large damage/loss values presented may seem high, it is much more likely that they are underestimates

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POLICY & ZONING SCENARIOS

How might the community rebuild in a more resilient way after a future catastrophic event

1. A 100-year flood occurs in 2030
2. Policies and zoning kick-in – limited, moderate, maximum
   - Buildings that are substantially damaged (≥50% of building replacement value) must elevate or floodproof to a higher level
   - Incentives and other support may be provided to help people take voluntary actions
   - Some properties are acquired or not allowed to rebuild due to tidal flooding exposure
3. Estimate immediate costs of mitigation
4. Estimate benefits over next 50 years of mitigation
5. Estimate cost-effectiveness of different mitigation policies and zoning
6. Estimate the unmitigated risks left over

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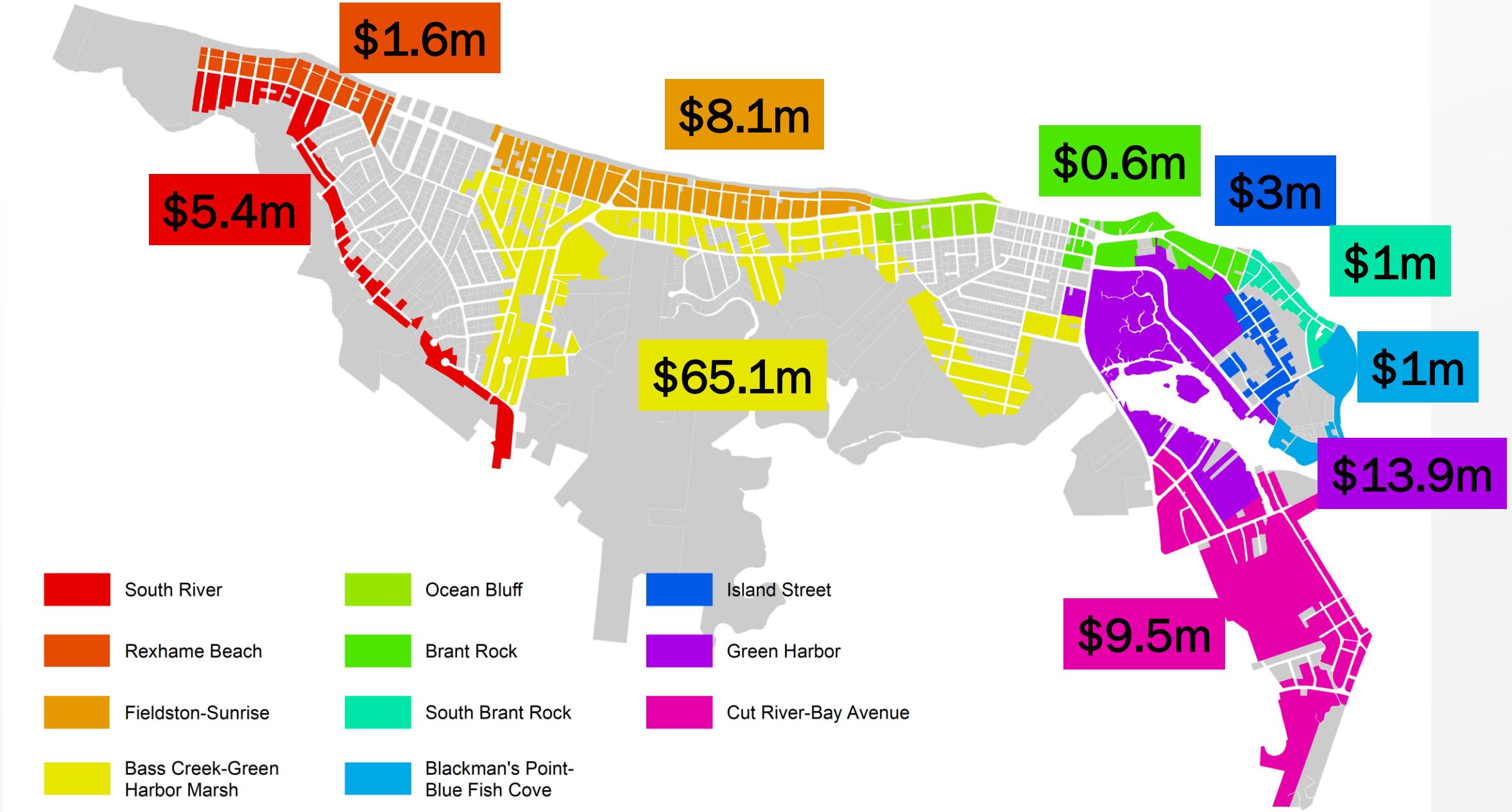
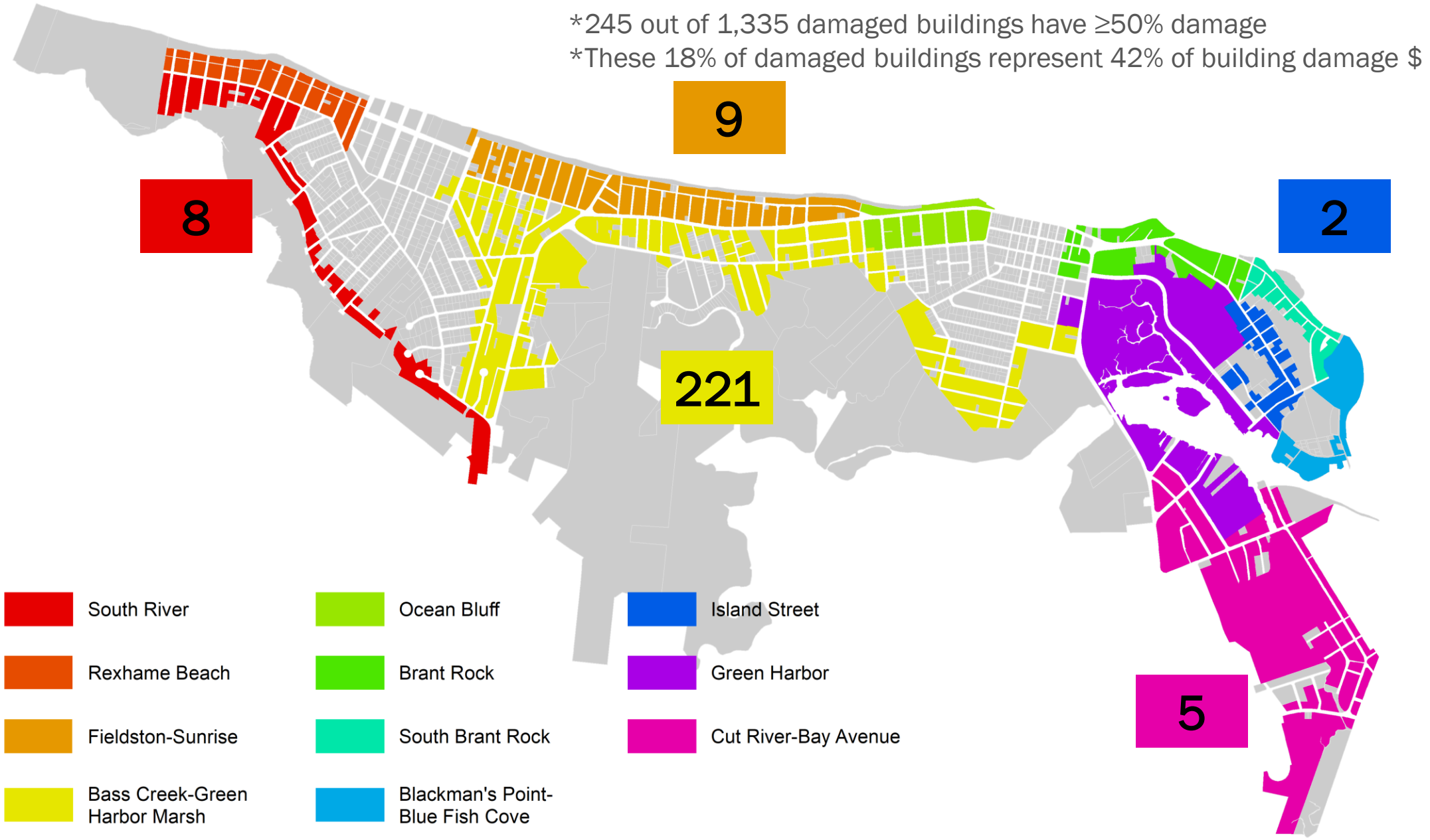
Total damage and loss in 2030 1% storm - surge

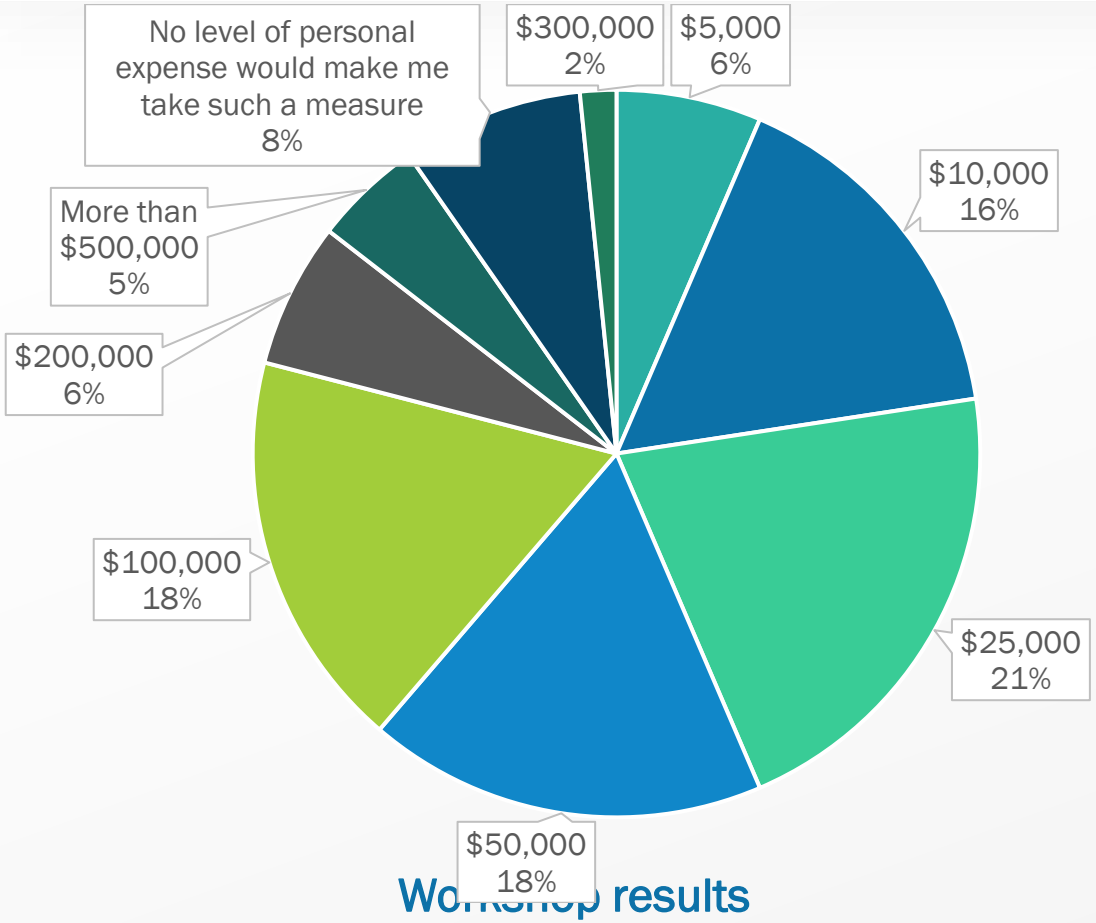


Substantially damaged buildings in 2030 1% storm - surge

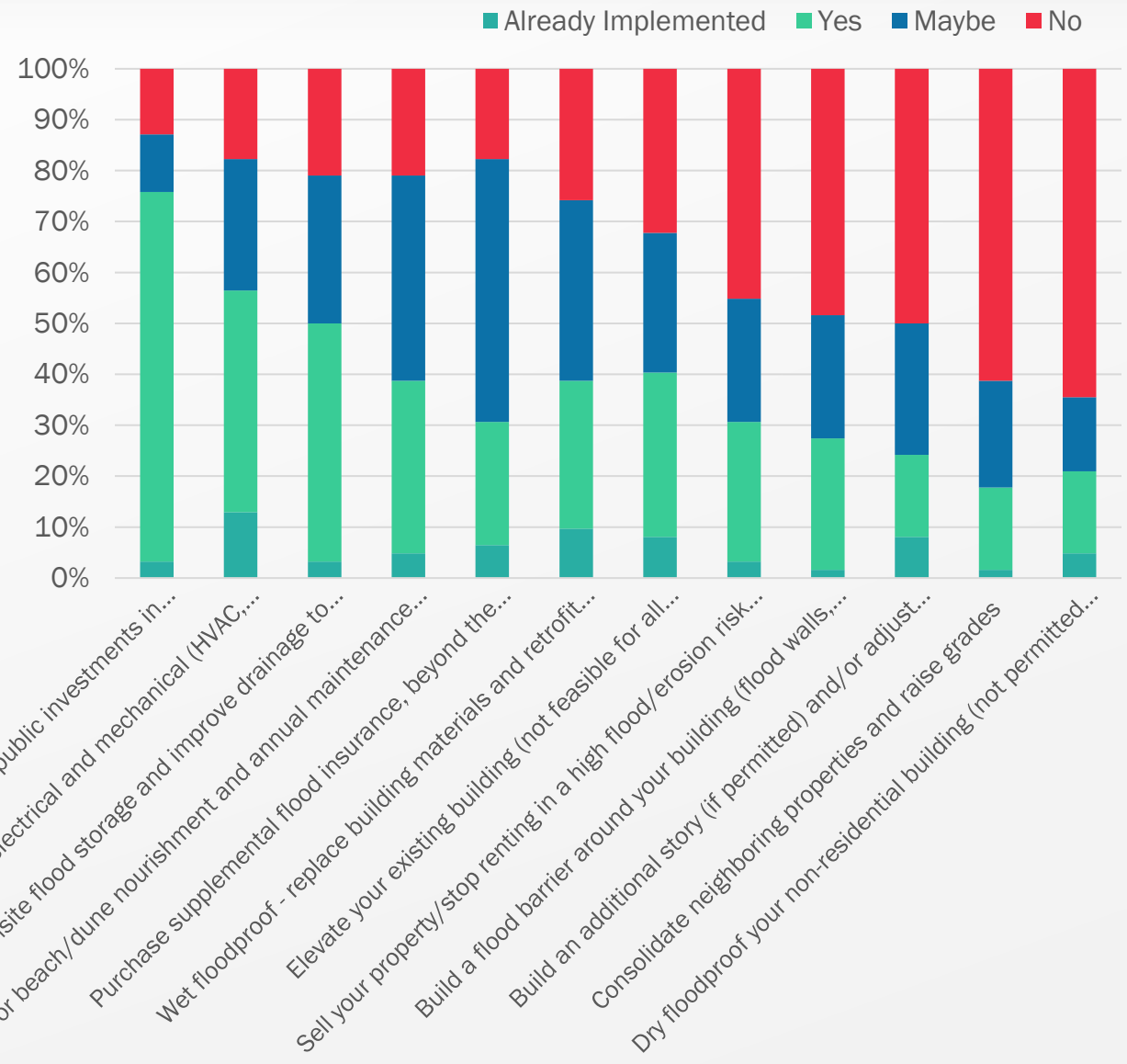
*245 out of 1,335 damaged buildings have ≥50% damage
*These 18% of damaged buildings represent 42% of building damage $



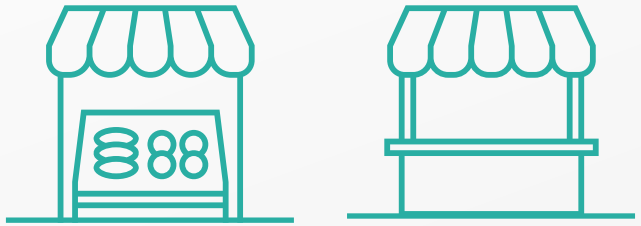
Voluntary mitigation participation levels are based on survey results



Workshop results



1: Higher Standards + Limited Acquisition



Elevation (Residential)

- 241 buildings with ≥50% damage (required)

Cost	Benefit
$50,007,680	$51,783,547

Key Finding: Higher standards makes good economic and societal sense

Voluntary Acquisition

- 4 properties with ≥50% damaged buildings
- AND exposed to daily flooding in 2050

	Lost Tax Revenue	Ecosystem Services
$2,534,016	$240,950	$293,521

Dry Floodproofing (Non-Residential)

- 0 buildings with ≥50% damage

$0		$0
$52,782,646		$52,535,592

Key Finding: Doing just the minimum leaves 2/3 of damage/loss unmitigated

Benefit-Cost Ratio = 0.995

Unmitigated Damage/Loss over 50 years ~91.5 million

2: Higher Standards + Moderate Acquisition/Taking + Moderate Voluntary Mitigation

Elevation (Residential)

- 232 buildings with ≥50%+ damage (required)
- 101 buildings with <50% damage (voluntary)
  - 67 with $25-50k in building damage
  - 29 with $50-100k in building damage
  - 5 with $100k+ in building damage

Voluntary Acquisition

- 6 properties with <50% building damage:
  - 2 with $25-50k in building damage
  - 2 with $50-100k in building damage
  - 2 with $100k+ in building damage
- AND exposed to daily flooding in 2030

Regulatory Taking

- 13 properties with ≥50% damaged buildings
- AND exposed to daily flooding in 2050

Dry Floodproofing (Non-Residential)

- 0 buildings with ≥50% damage
- 13 buildings with <50% damage (voluntary)
  - 6 buildings with $25-50k in damage
  - 2 buildings with $50-100k in damage
  - 5 buildings with $100k+ in damage

	Cost	Benefit
	$67,668,037	$54,381,662
	$13,596,745	$1,610,128
	Lost Tax Revenue $1,313,643	Ecosystem Services $603,094
	$11,783,290	$13,400,681
	$94,361,715	$69,995,566

Key Finding: To support voluntary mitigation in a cost-effective way, upfront portfolio planning and eligibility criteria are required

Benefit-Cost Ratio = 0.74

Unmitigated Damage/Loss over 50 years ~74.3 million

3: Higher Standards + Moderate Acquisition/Taking + Maximum Voluntary Mitigation

Elevation (Residential)

- 232 buildings with ≥50%+ damage (required)
- 195 buildings with <50% damage (voluntary)
  - 127 with $25-50k in building damage
  - 55 with $50-100k in building damage
  - 13 with $100k+ in building damage

Voluntary Acquisition

- 10 properties with <50% building damage:
  - 4 with $25-50k in building damage
  - 3 with $50-100k in building damage
  - 3 with $100k+ in building damage
- AND exposed to daily flooding in 2030

Regulatory Taking

- 13 properties with ≥50% damaged buildings
- AND exposed to daily flooding in 2050

Dry Floodproofing (Non-Residential)

- 0 buildings with ≥50% damage
- 16 buildings with <50% damage (voluntary)
  - 7 buildings with $25-50k in damage
  - 3 buildings with $50-100k in damage
  - 6 buildings with $100k+ in damage

Cost	Benefit
$84,787,111	$57,898,953

Key Finding: Acquisition and regulatory takings do not generally offer sufficient benefits to outweigh the high costs

$16,561,262	$1,780,006
Lost Tax Revenue $1,607,673	Ecosystem Services $653,543
$14,691,174	$13,651,780
$117,647,219	$73,984,281

Benefit-Cost Ratio = 0.63

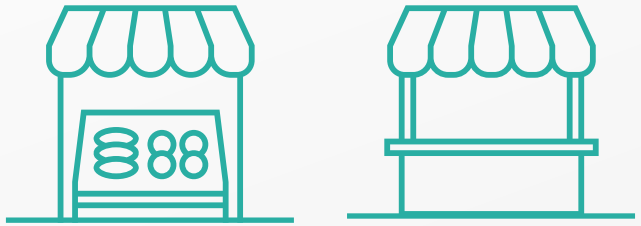
Unmitigated Damage/Loss over 50 years ~70.4 million

Benefit-cost analysis summary

	Scenario 1 (Limited)	Scenario 2 (Moderate)	Scenario 3 (Maximum)
Buildings Mitigated	245	365	466
Total Cost	$52,782,646	$94,361,715	$117,647,219
Total Benefit @ 7% Discount Rate	$52,535,592	$69,995,566	$73,984,281
Benefit Cost Ratio @ 7%	0.995	0.74	0.63
Buildings Unmitigated	1,493	1,373	1272
Damage/Loss Unmitigated @ 7%	$91,480,755	$74,330,354	$74,330,354
Total Benefit @ 3% Discount Rate	$103,311,033	$139,059,442	$147,372,644
Benefit Cost Ratio @ 3%	1.95	1.46	1.24
Damage/Loss Unmitigated @ 3%	$188,210,132	$153,038,883	$144,819,738

Key Finding: When using a “social discount rate” versus regulatory rate, even maximum intervention scenarios are positive

Cost-effective mitigation programs can be built

	FEMA Pre-Calculated Benefits	Benefit-Cost Ratio ≥ 1.0
Elevation (Residential) 	954 buildings cost ≤ $227,550	111 buildings have BCR ≥ 1.0
Voluntary Acquisition 	18 properties cost ≤ $358,530	18 properties have BCR ≥ 1.0
Dry Floodproofing (Non-Residential) 	Federal support for mitigation programs may require BCR ≥ 1.0 at the portfolio level rather than individual structure/property level. Over 300 properties with a range of BCRs (even lower than 0.5) can potentially be packaged together and still be considered cost-effective at 1.0	20 buildings have BCR ≥ 1.0

High-level recommendations – your feedback needed!

1. Outreach: Insurance, insurance, insurance
2. Zoning: Incorporate limitations on allowable uses below higher flood elevation and dry floodproofing – provide building height flexibility
3. Zoning: Consider a 30-50 ft (splash zone) setback from public seawalls
4. Mitigation Programs: Restart FEMA home elevation programs
5. Mitigation Programs: Consider requesting US Army Corps to conduct an area-wide non-structural measures feasibility study
6. Mitigation Programs: Consider creating a pre-disaster administrative or engineering assistance program to help residents develop documentation required for post-disaster mitigation
7. Mitigation Project: Consider developing a BRIC or other grant application for Dyke Road

ANY RECOMMENDATIONS WOULD GO THROUGH ADDITIONAL PUBLIC PROCESS

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Thank you

Questions & Discussion

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