

An Integrated Approach to Coastal City Flood Resilience

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Overview

1. Increasing Coastal City Risks
 2. Need for an Integrated Approach
 3. Operationalizing Integrated Flood Resilience
 4. Delivering Flood Resilient places
 5. Take Aways
-

Coastal Cities are growing.
More people. More housing. More infrastructure.



66% of the global population will live in cities by 2050. UN, 2014



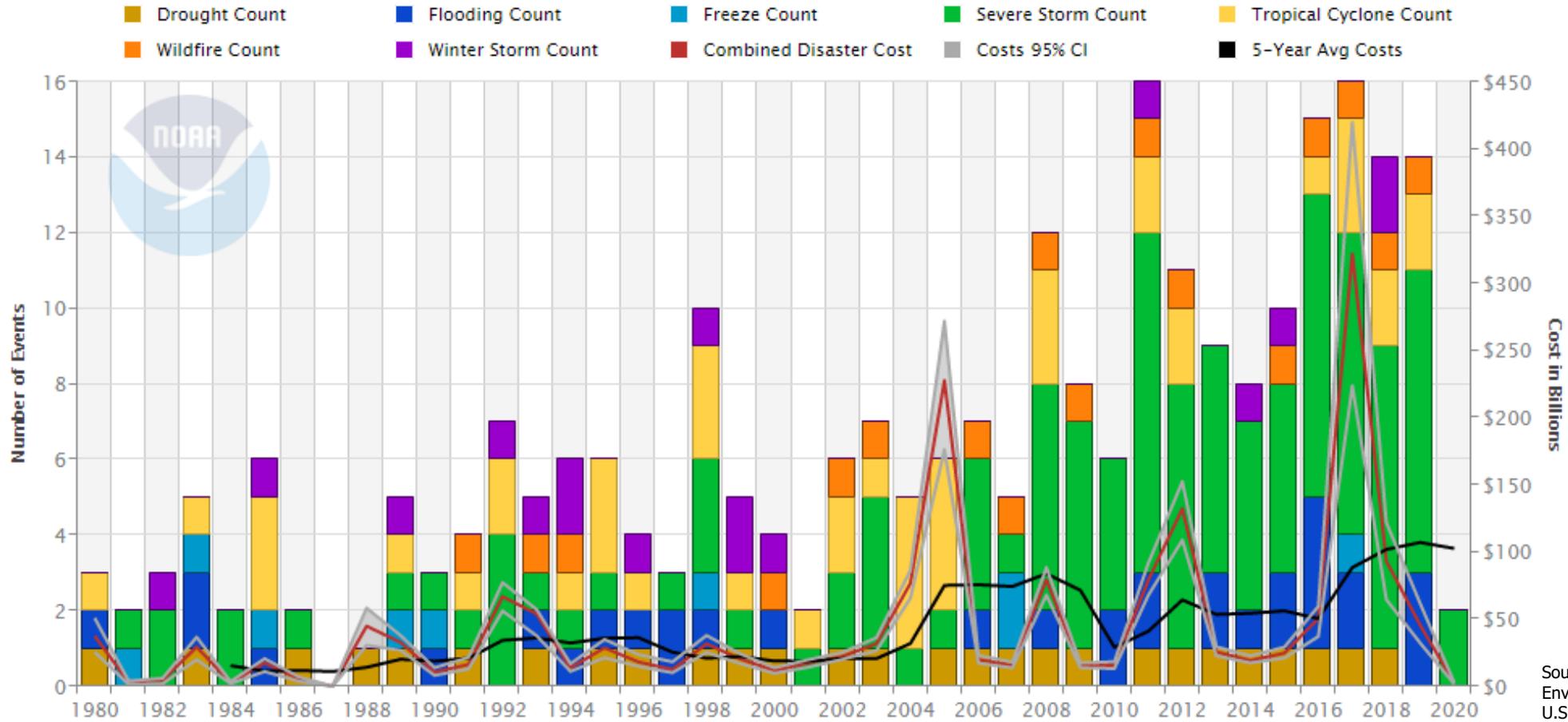
Our climate is
changing . . .

Jacobs

Challenging today.
Reinventing tomorrow.

Extreme Events Increasing in Frequency & Severity

United States Billion-Dollar Disaster Events 1980-2020 (CPI-Adjusted)



Number of events as of April 8, 2020

Source: NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters. <https://www.ncdc.noaa.gov/billions/>

Increasing flood risk

Coastal cities

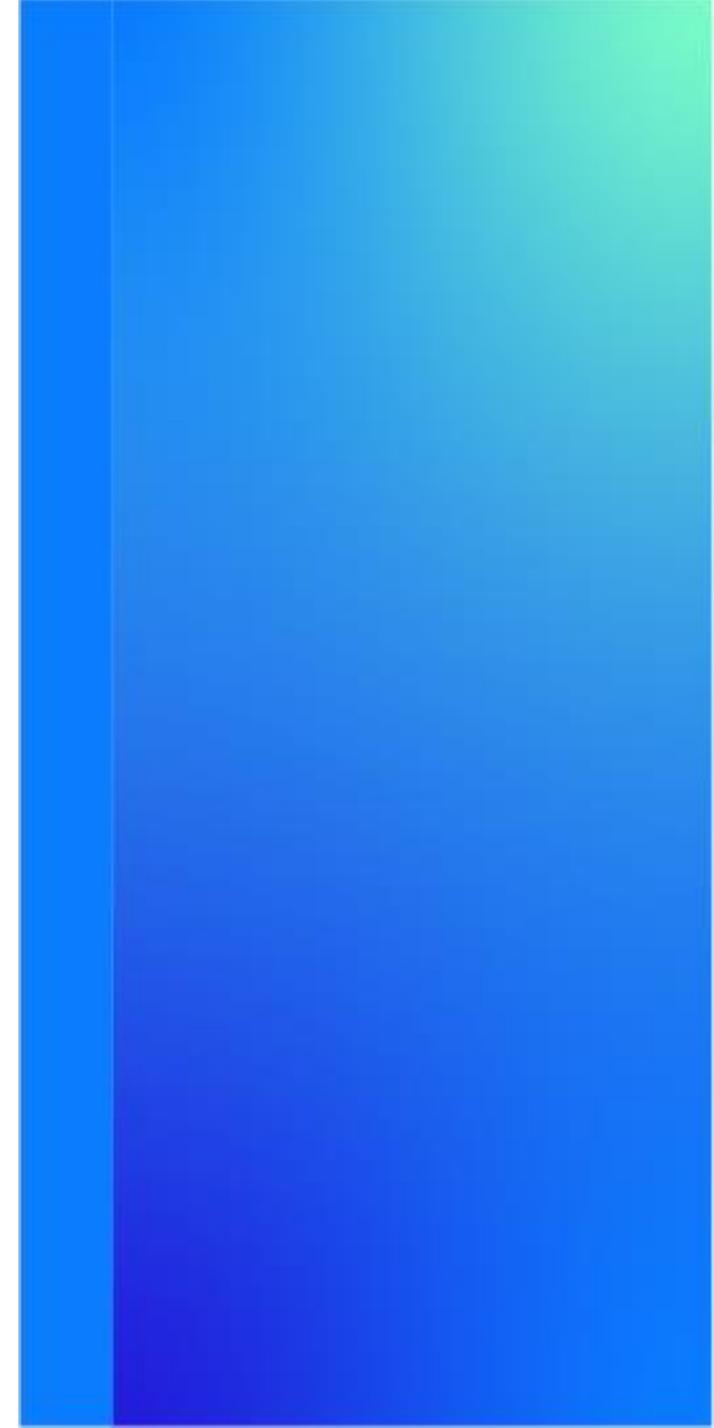


The OECD is predicting across 136 coastal cities globally there will be a five fold increase in population at risk

40 million people now will be
150 million people by 2070

\$3 trillion assets at risk now will be
\$35 trillion by 2070

The need for an integrated approach



Multiple sources of flooding

Precipitation - Driven

Stormwater/ Drainage



Localized flooding

Riverine



Regional flooding

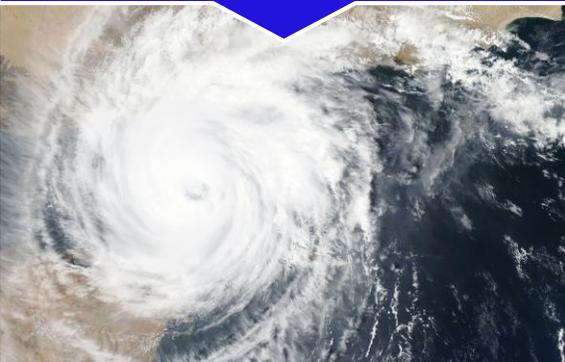
Coastal

Tidal/Groundwater



Recurrent flooding from increasing tide levels

Storm Surge



Coastal flooding

Multiple, interlinked receptors



Planet	ENVIRONMENTAL	ATMOSPHERE
		WATER
		ENERGY
		MATERIALS
		FOOD
		ECOSYSTEM
People	SOCIAL	COMMUNITY
		EDUCATION
		HEALTH + WELLNESS
		SHELTER
		TRANSPORT
		GOVERNANCE
		CULTURE + HERITAGE
		SAFETY + SECURITY
		Profit
VALUE		
JOBS		



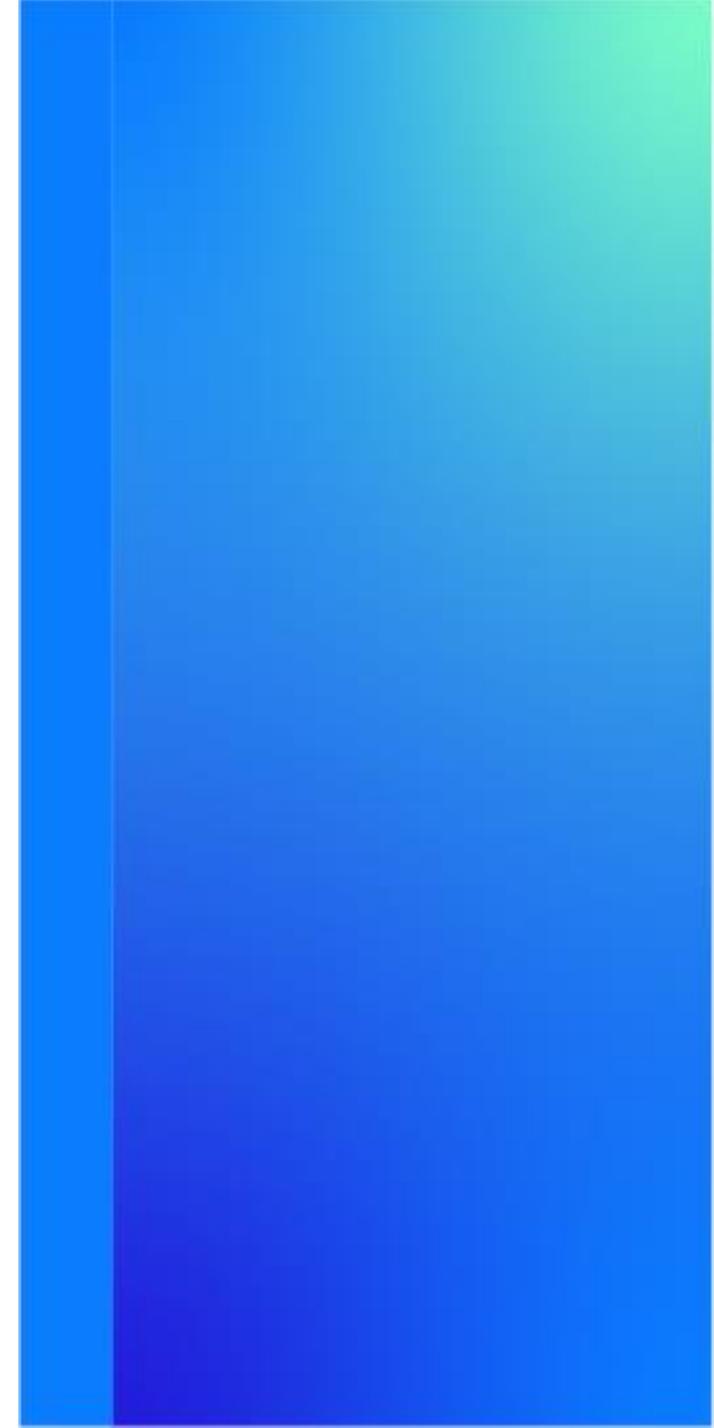
INFLUENCERS - Technology + Policy

The need for integration

- Siloed responses won't meet needs
- Shift from sectoral to 'place-based'
- Considering all interests and challenges facing an area
- Opportunities to deliver co-benefits, meet funding challenges
- Partnership with communities

Essential if we are to make our coastal cities truly resilient to flooding

Operationalizing Integrated Flood Resilience



MIAMI BEACH SEA LEVEL RISE ADAPTATION CHALLENGES

1. Topography & Geology
2. Aging Infrastructure
3. High groundwater



Courtesy of City of Miami Beach



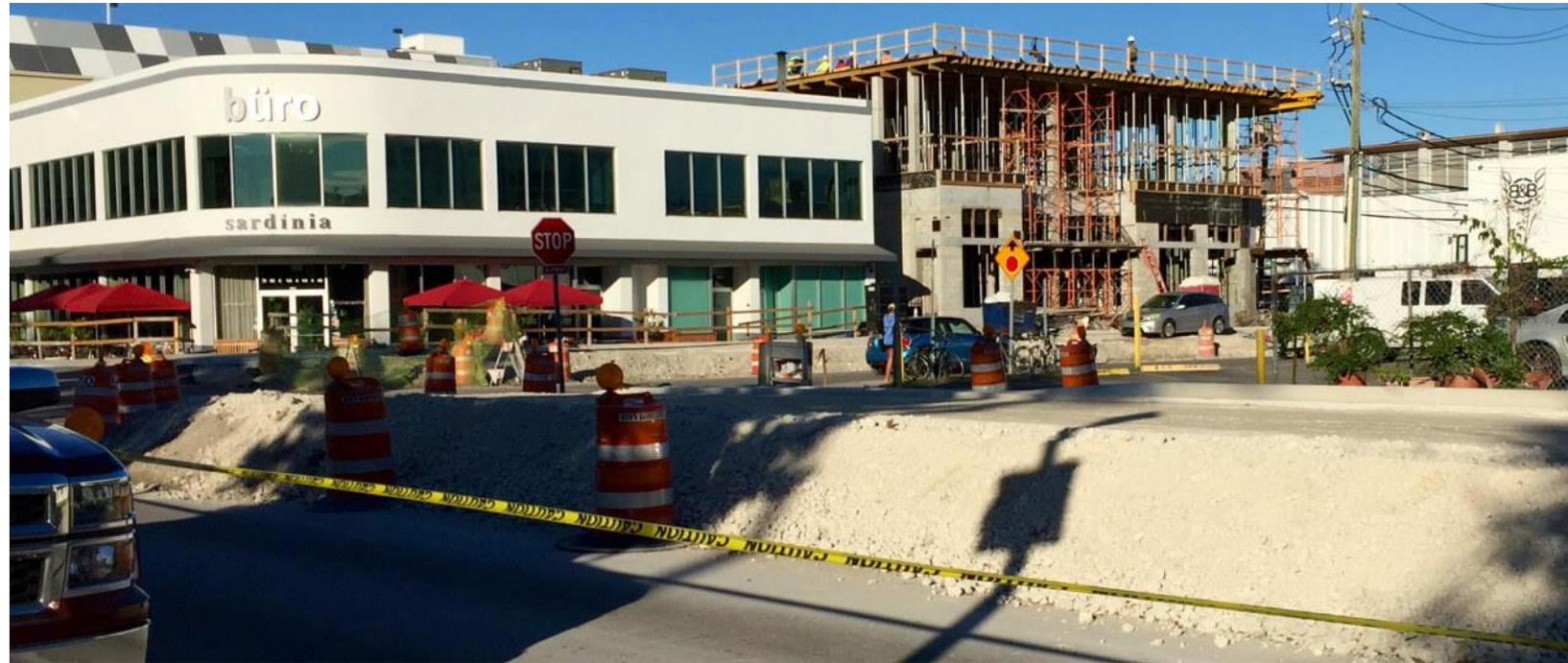


Courtesy of City of Miami Beach



“Fix the streets; Stop flooding”

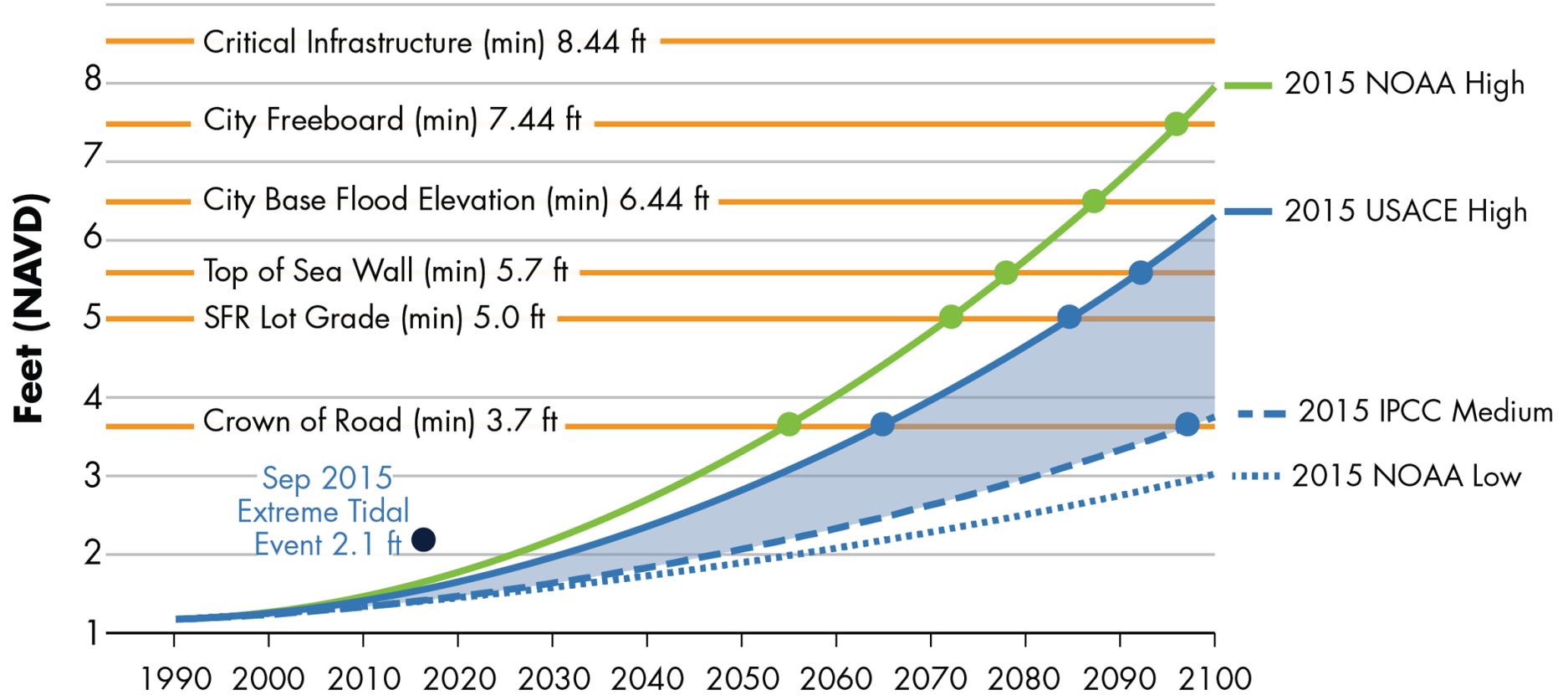
Courtesy of City of Miami Beach



Courtesy of City of Miami Beach

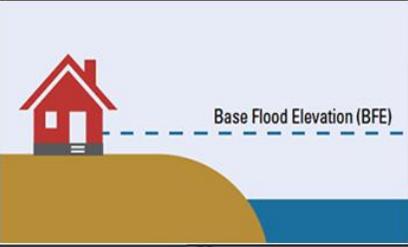
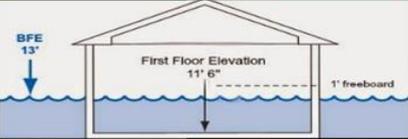
Designing for Sea Level Rise

SE FL Regional Climate Compact - SLR Projections (2015)
+ 1.2 ft NAVD (High Astronomical Tide)



Courtesy of City of Miami Beach

Private Property Adaptation: Land Development Regulations Updates

	Old Requirements	New Requirements	
Base Flood Elevation (BFE)	5.44 Feet NAVD (7 Feet NGVD)	6.44 Feet NAVD (8 Feet NGVD)	
Freeboard	0 feet above BFE	+1 to +5 feet above BFE	
Seawall Elevation (Private)	3.2 FT NAVD 4.76 FT NGVD	4 to 5.7 FT NAVD 5.56 to 7.26 FT NGVD	
Seawall Elevation (Public)	3.2 FT NAVD 4.76 FT NGVD	5.7 FT NAVD 7.26 FT NGVD	
Minimum required yard elevation	No minimum required	5.0 Feet NAVD (6.56 Feet NGVD)	

Courtesy of City of Miami Beach

Private Property Adaptation: Land Use Board Review Criteria



The photo shows the front of the property elevated 5 feet above BFE (13 feet NGVD and 11.44 feet NAVD).

Red line shows the lowest living floor elevation of the house.

Miami Beach approach to climate adaptation



PUBLIC INFRASTRUCTURE
POLICY AND UPGRADES



DESIGN GUIDELINES FOR
HISTORIC PROPERTIES



PRIVATE DEVELOPMENT STANDARDS
IN LAND USE CODE



Courtesy of City of Miami Beach



VISION

- *Integrate stormwater management into the larger resilience strategy*
- *Enhance trust, trust the public, increase transparency*
- *Elevate aesthetics and function to perpetuate city's cultural relevance*
- *Actively use green and open spaces for sponge function*
- *Increase long term financial and comprehensive protection*
- *Go big on the resilience brand – distinguish yourself from your coastal competitors*



- *Maintain urgency,*
- *incrementalism & evaluation,*
- *transparency,*
- *ecological health,*
- *financial pragmatism,*
- *co-benefits,*
- *social equity,*
- *cultural identity,*
- *living with water,*
- *long-term and regional perspective*



Courtesy of City of Miami Beach



RESIL
GREATER
& THE BE



PLACES

OBJECTIVES

- ◆ Safeguard vital ecosystems
- ◆ Create mobility solutions
- ◆ Increase energy efficiencies
- ◆ Leverage planning opportunities
- ◆ Enhance housing options

19 actions | 6 spotlights
15 case studies



PEOPLE

OBJECTIVES

- ◆ Cultivate financial stability
- ◆ Advance public health priorities
- ◆ Strengthen community response
- ◆ Communicate resilience

22 actions | 13 spotlights
5 case studies



PATHWAYS

OBJECTIVES

- ◆ Pre-plan for post recovery
- ◆ Cultivate resilience expertise
- ◆ Develop shared resources
- ◆ Leverage our dollars
- ◆ Implement our Strategy

18 actions | 6 spotlights
9 case studies

Scaling our Work





Institutionalizing Resilience into the Decision-Making Process

Leadership & Commitment

Structure

Integration

Staff

Training

Community Capacity

Outreach & Education

Implementation

Relationships

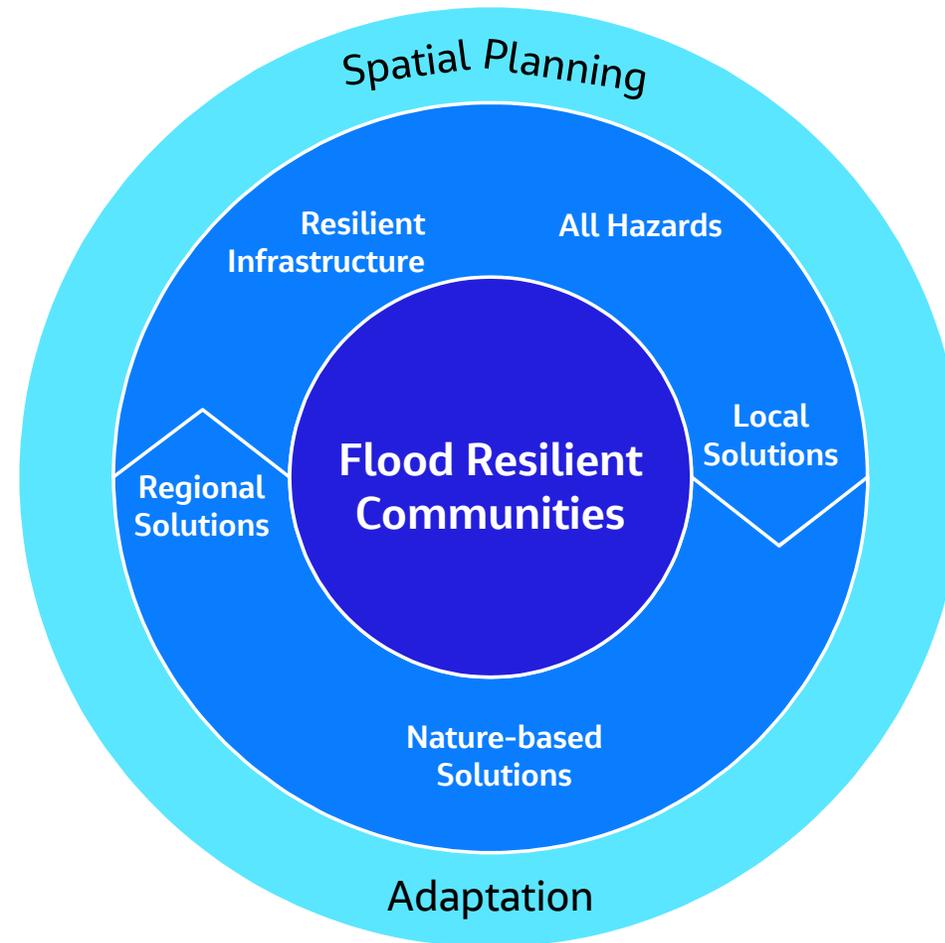
Repeat !

Delivering Flood Resilient Places



Solutions to fit the space

- Differing challenges require differing solutions
- Hazards, uses, community needs differ



All Hazards

- As well as multiple sources of flooding, coastal cities face other natural, and man-made, hazards
- Integration considers multiple sources, to deliver a consistent level of resilience

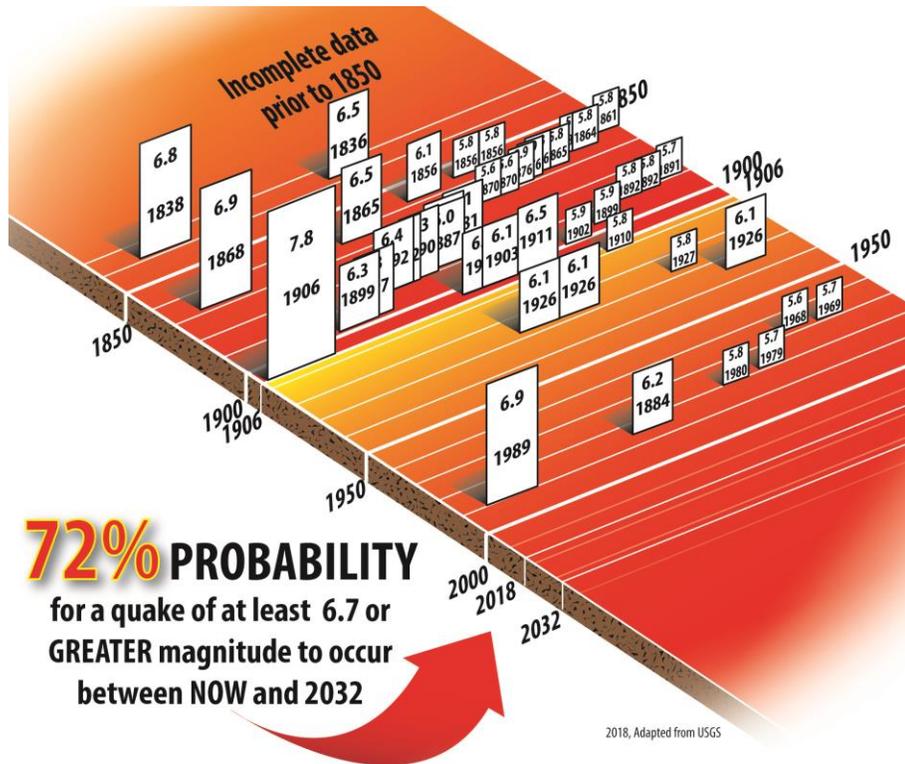


Christchurch, NZ - "Is it worth protecting the city from flooding if another hazard will significantly increase flood risk or cause worse damage"

San Francisco Seawall Program

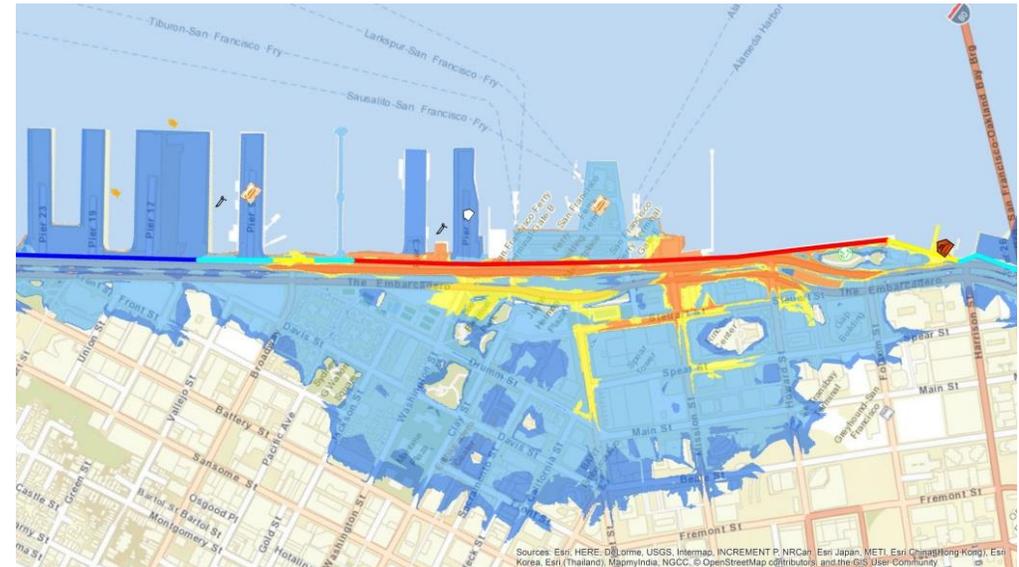
Seismic Hazards

Immediate and increasing hazard



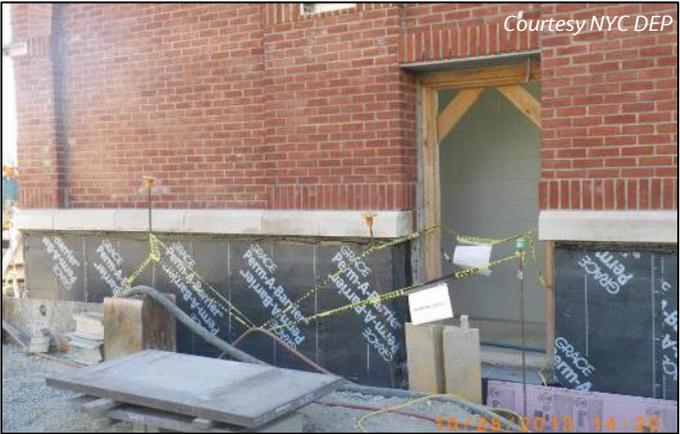
Flood and Sea Level Rise Hazards

Localized hazard currently, with increasing urgency over the coming decades



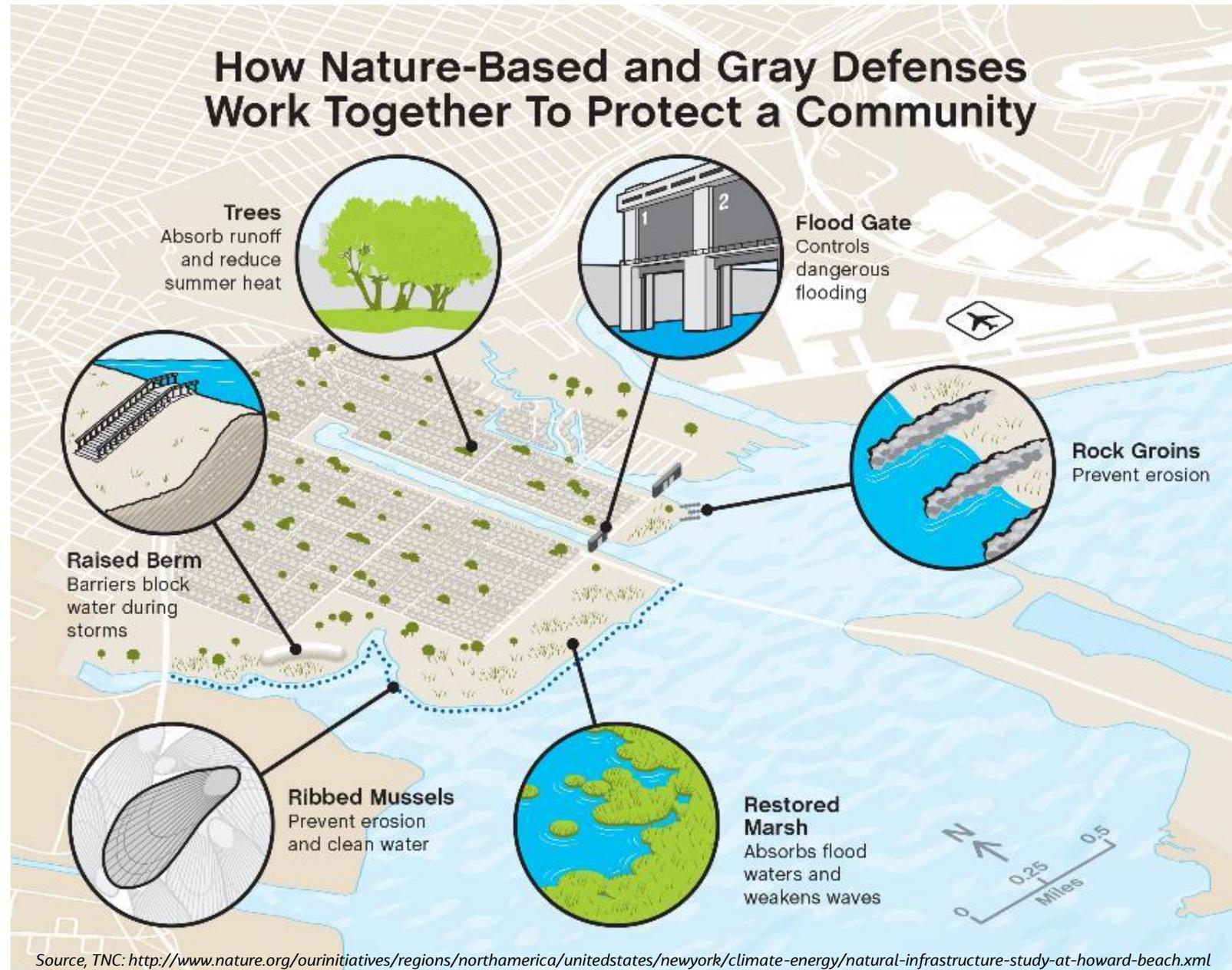
Courtesy of Port of San Francisco

Scalable solutions



Green Solutions

- Natural and nature-based approaches
- Deliver adaptive flood resilience alongside wider benefits
- Delivered at the coastal edge to mitigate rising sea levels, or
- Within the urban fabric to manage stormwater



Source, TNC: <http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/newyork/climate-energy/natural-infrastructure-study-at-howard-beach.xml>

Delridge Natural Drainage System - Seattle, WA

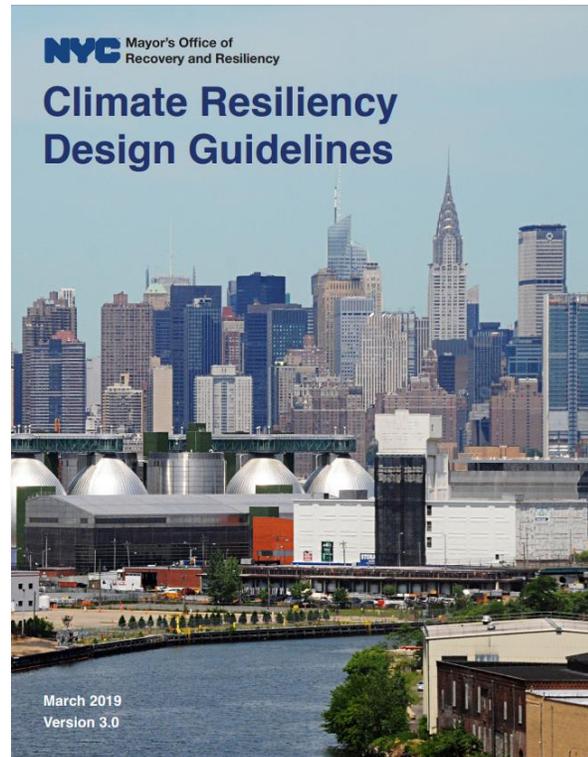
Stay Healthy Streets

Closed to thru-traffic – but not residents or deliveries – 24 hours a day, seven days a week.
Program extended due to COVID-19.



Resilient Infrastructure

- Understanding the hazard exposure and consequence
- Consider criticality and inter-dependencies



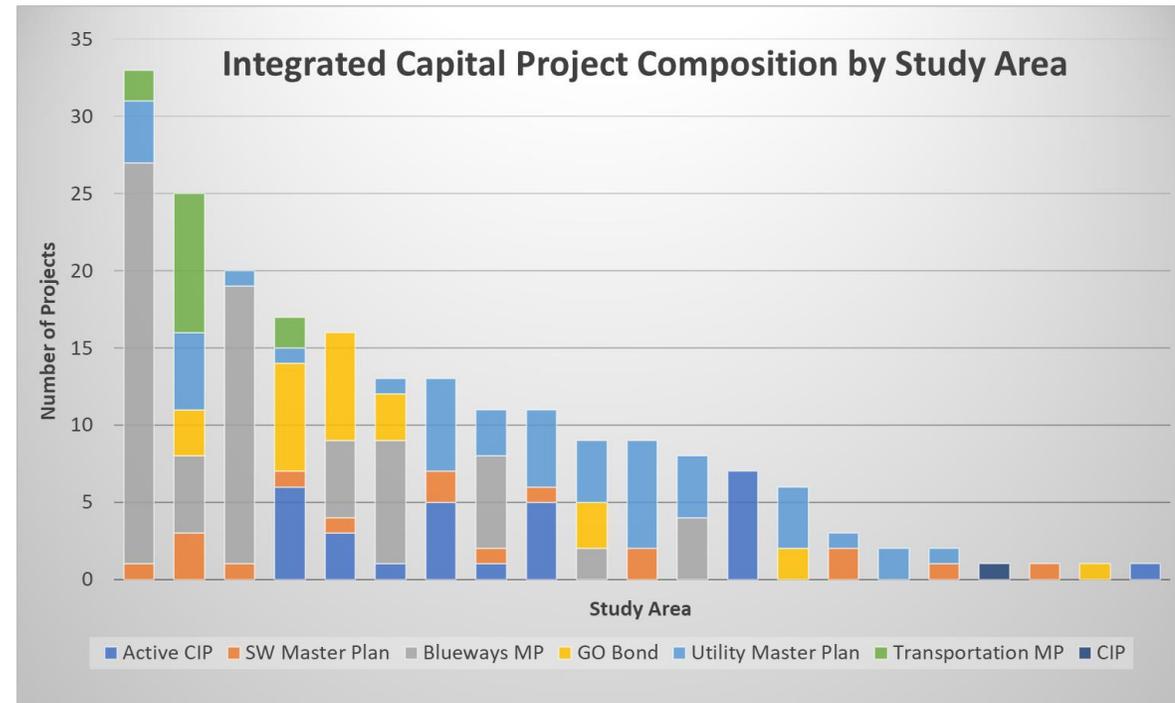
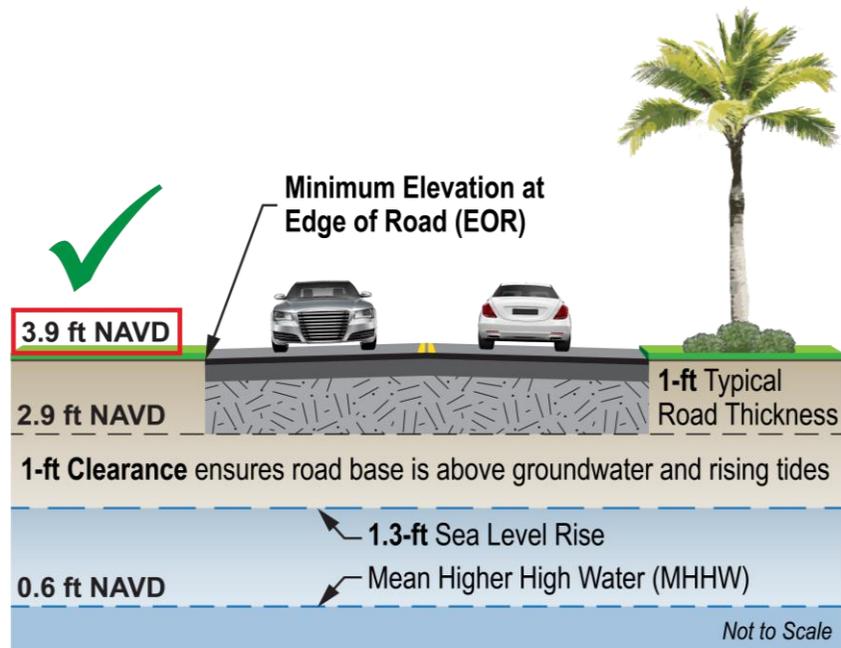
https://www1.nyc.gov/assets/orr/pdf/NYC_Climate_Resiliency_Design_Guidelines_v3-0.pdf

Adaptation Strategy	Resiliency/Effectiveness	Cost
 <p>Elevate Equipment on pads or platforms, to a higher floor, to the roof, or to a new elevated building.</p>		<p>\$\$\$\$</p>
 <p>Flood-Proof Equipment by replacing pumps with submersible pumps and installing watertight boxes around electrical equipment.</p>		<p>\$\$\$</p>
 <p>Install Static Barrier across critical flood pathways or around critical areas.</p>		<p>\$\$\$</p>
 <p>Seal Building with water-tight doors and windows, elevating vents and secondary entrances for access during a flood event.</p>		<p>\$\$</p>
 <p>Sandbag Temporarily around doorways, vents, and windows before a surge event.</p>		<p>\$</p>
 <p>Install Backup Power via generators nearby or a plug for a portable generator.</p>	<p><i>Does not protect equipment but facilitates rapid service recovery.</i></p>	<p>\$\$\$</p>

Images courtesy of NYCDEP

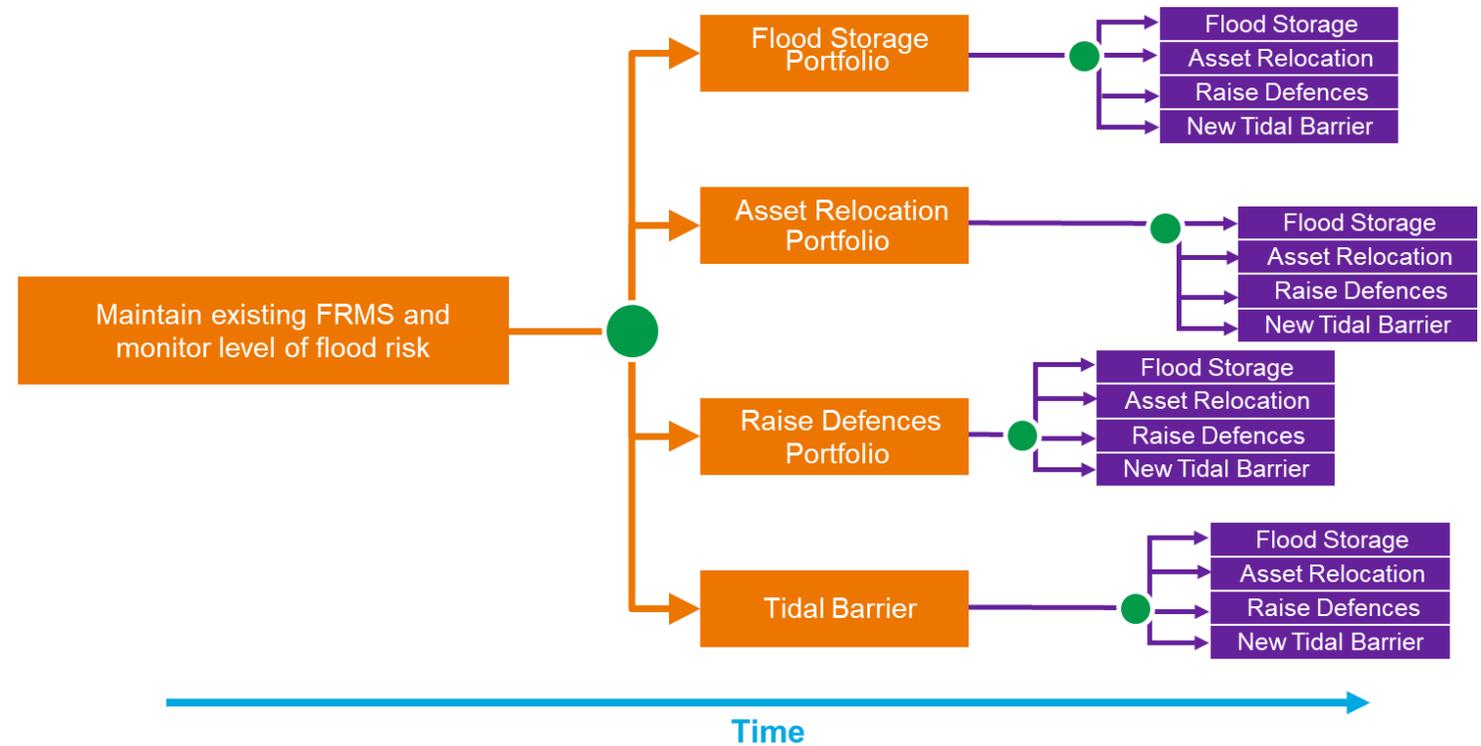
Miami Beach, FL Integrated Water Management Plan

- Incorporation of Blue Green Infrastructure in all capital projects
- Enhanced risk based policies and minimum design criteria
- Multi-departmental approach to project development
- Integrated approach to project implementation to maximize community benefit



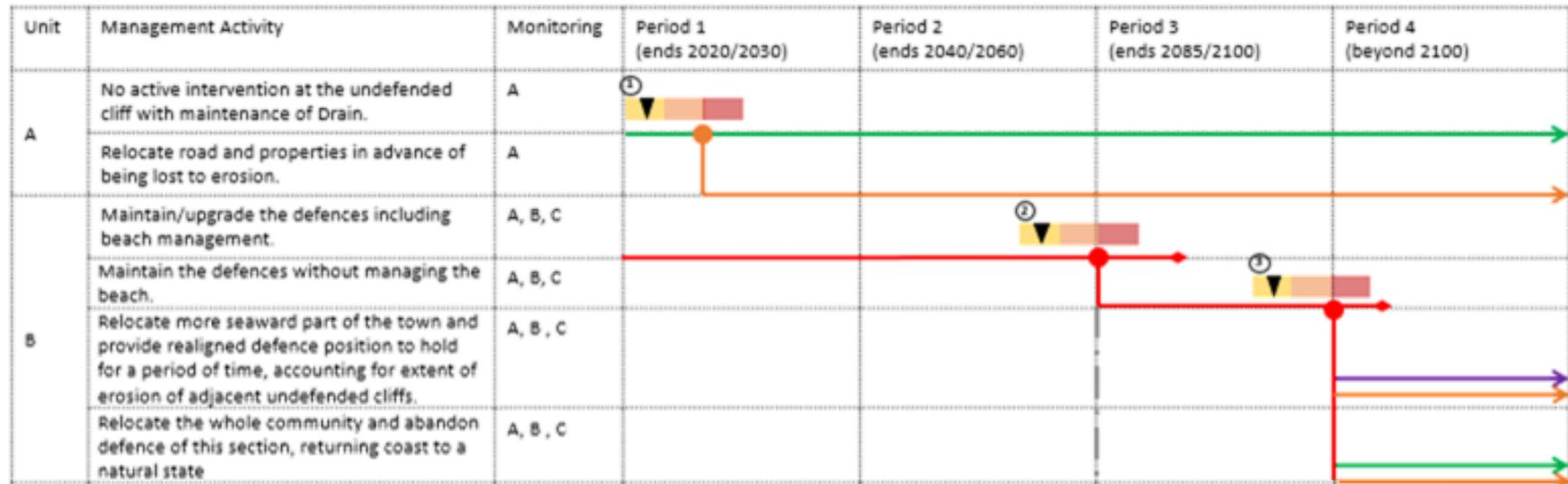
Adaptable Approaches

- Risks are non-stationary
- Inherent uncertainty
- Solutions able to maintain their performance standards
- Adaptive management, and adaptation pathways
- Pro-active monitoring of change and triggers for action



Adapted from Thames Estuary 2100 Strategy, UK

Coastal adaptation pathway



Monitoring	
A	Erosion/accretion/ morphological change
B	Flooding (frequency/severity)
C	Asset condition

Key	
	Option pathway
	Continuation
	Decision point
	Option deemed unsustainable past this point
	Planning pathway
	No works
	Protection works
	Managed Realignment
	Relocation

Engagement activity

- Raise public awareness
- Consultation with the public and stakeholders

Spatial planning activity

- Plan defence/protection of critical assets
- Impose land use restrictions in risk areas
- Preparation to relocate community/assets at risk



Spatial Planning

Visualize solutions at the neighborhood scale

Integrating ...

Scaled Solutions

Green Infrastructure

Relocation

Policy

Outreach & Education

Financial Assistance

Inclusive design, multi-faceted solutions



East Side Coastal Resilience, NYC



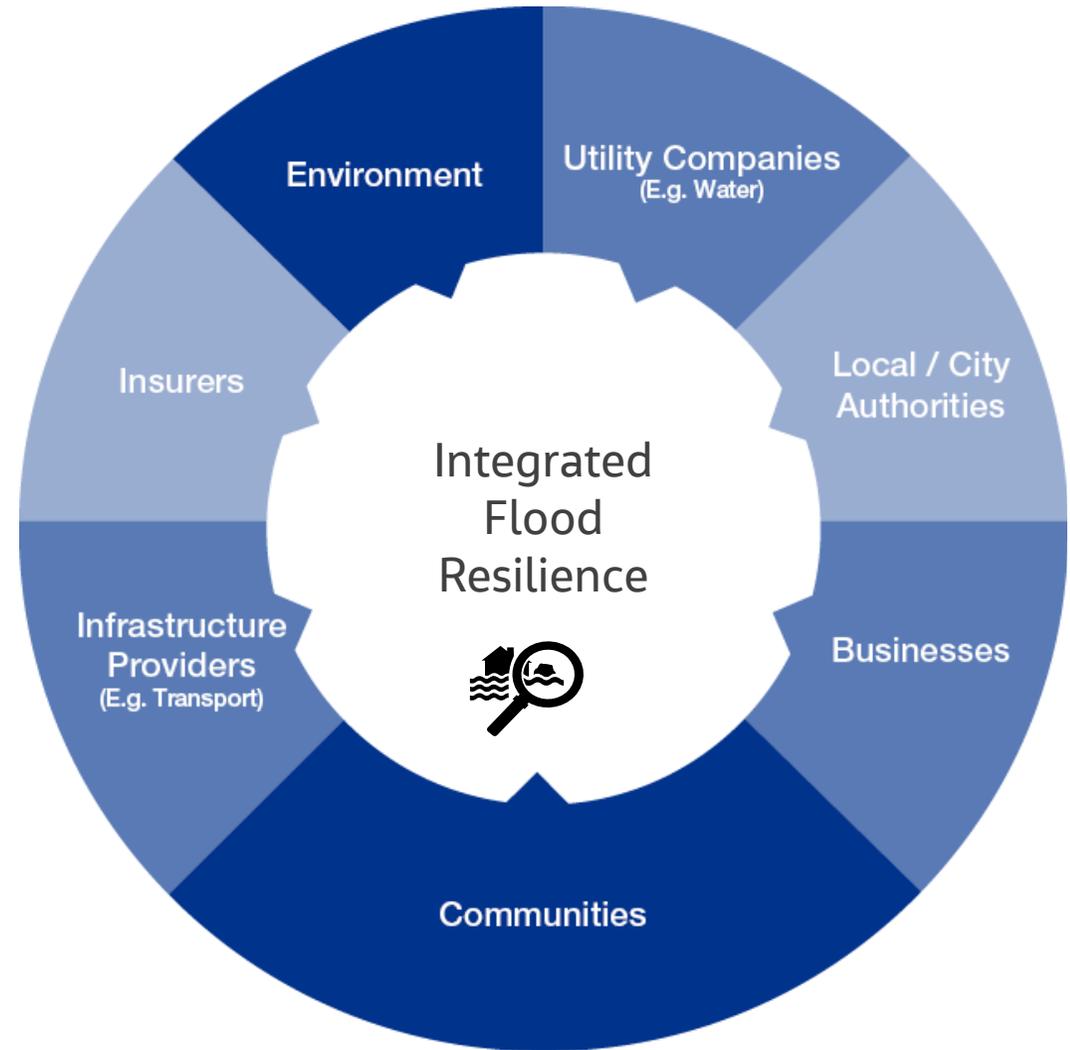
Images courtesy of One Architecture and Urbanism

Take Away

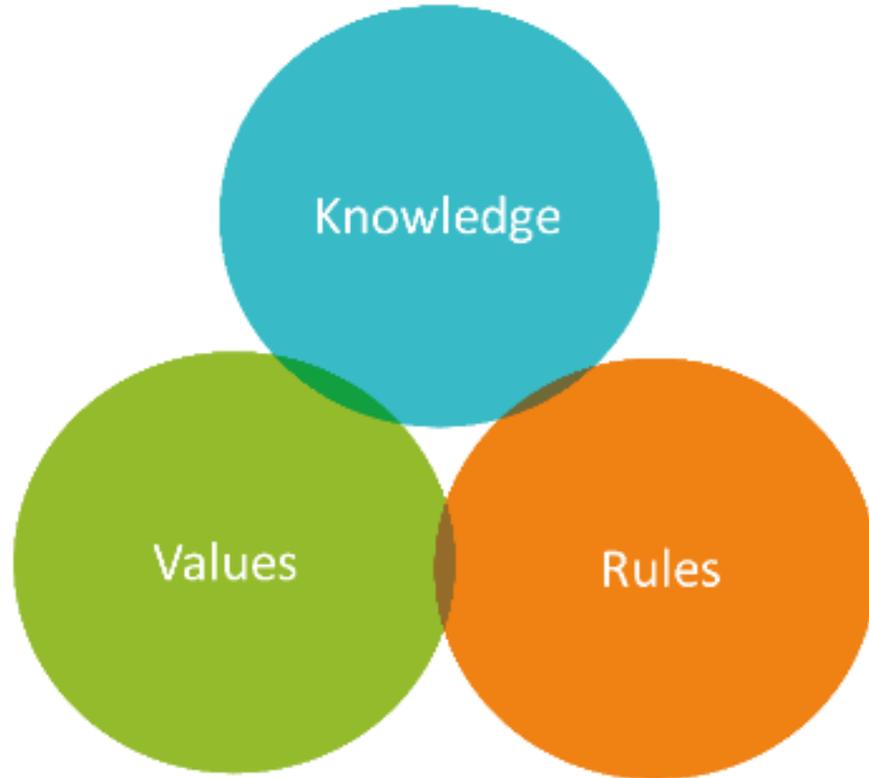


We all have a part to play

- A shared ownership and understanding
- Look for the opportunities
- Take a 'spatial' approach to resilience and equity

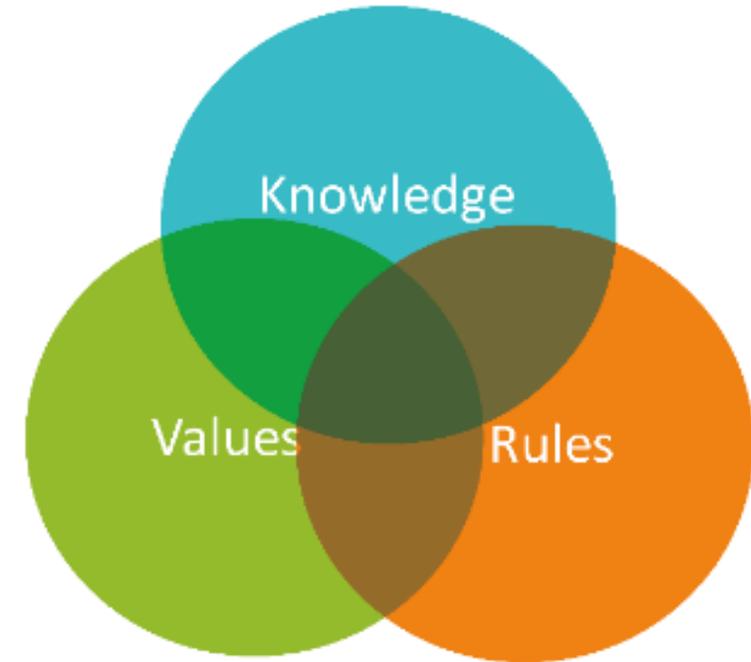


Integration for Resilience



Low resilience, non-adaptive

Little overlap between knowledge, values and rules



Resilient and highly adaptive

knowledge, values and rules intersect



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An Integrated Approach to Coastal Flood Resilience

Thank you and Stay Safe!



Challenging today.
Reinventing tomorrow.



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