CWC

SMART VENT
Foundation Flood Vents

COASTAL
engineering co.

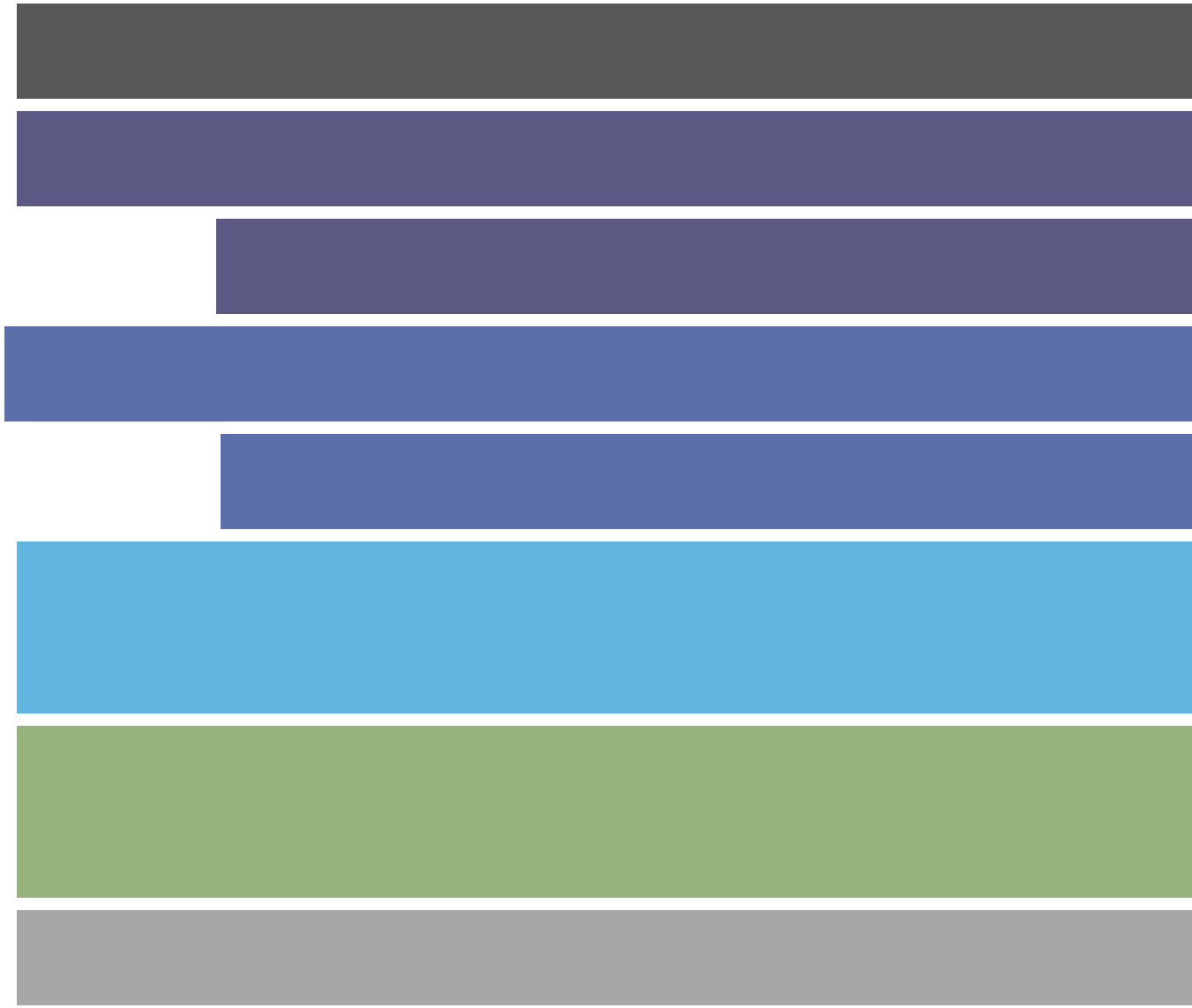
offshoots
PRODUCTIVE LANDSCAPES

OFFSHOOTS- 30 MIN

COASTAL ENG. GROUP- 20 MIN

SMART VENT- 20 MIN

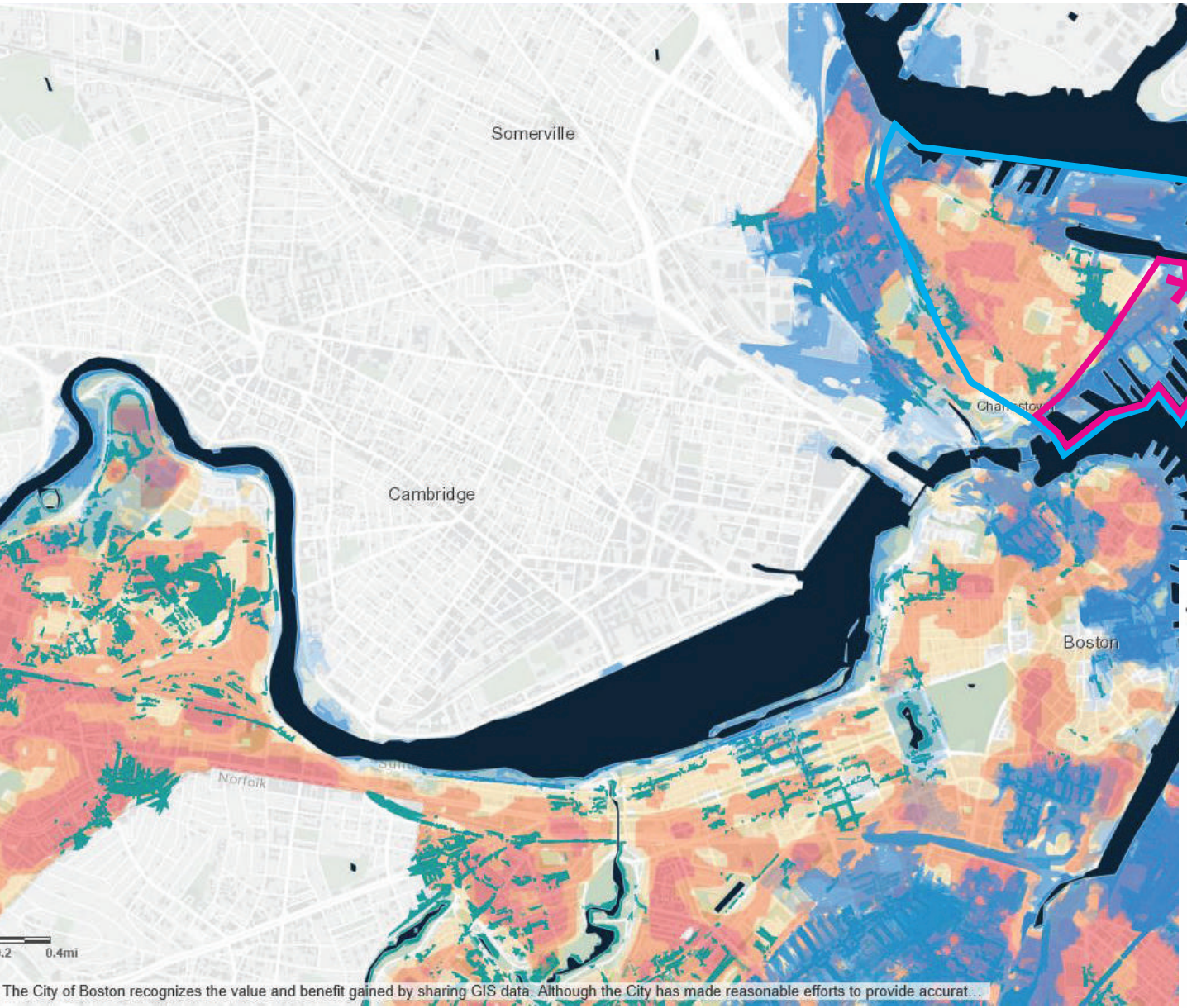
QUESTIONS & DISCUSSION- 30 MIN

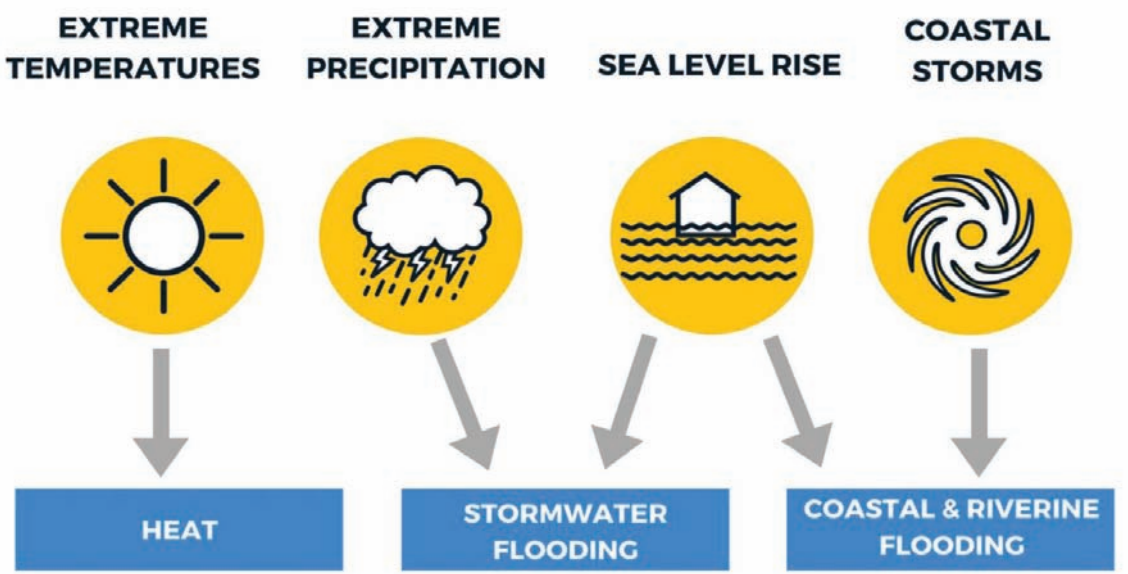


CONTEXT: CLIMATE CHANGE IN BOSTON

BOSTON 2070

Stormwater Flooding, Coastal Flooding, Extreme Heat

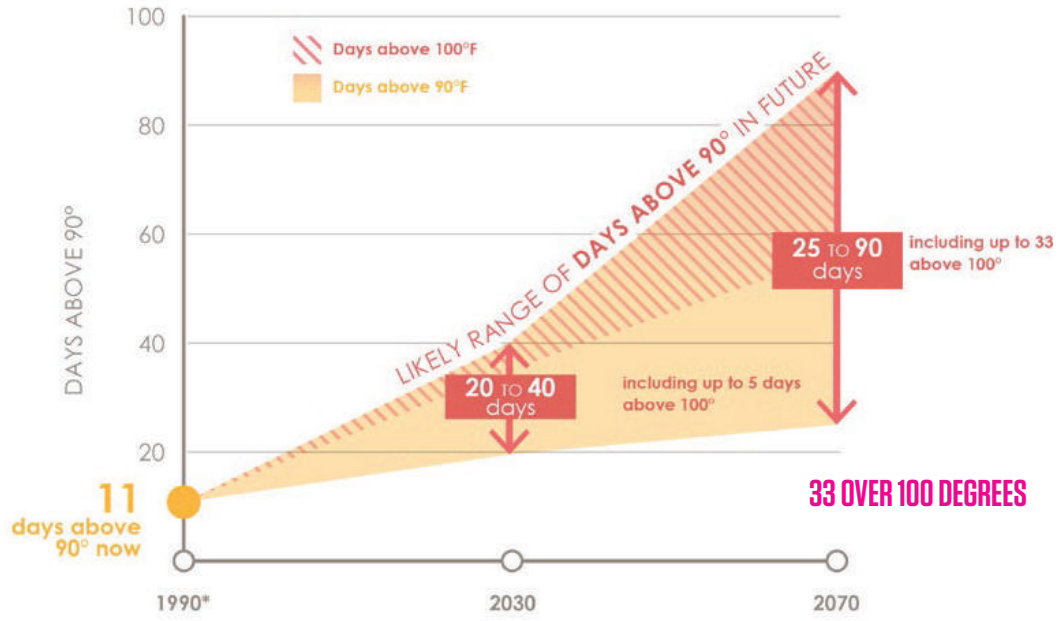




Source: Climate Ready Boston Map Explorer, City of Boston, 2018, boston.maps.arcgis.com/.

CONTEXT: CLIMATE CHANGE IN BOSTON

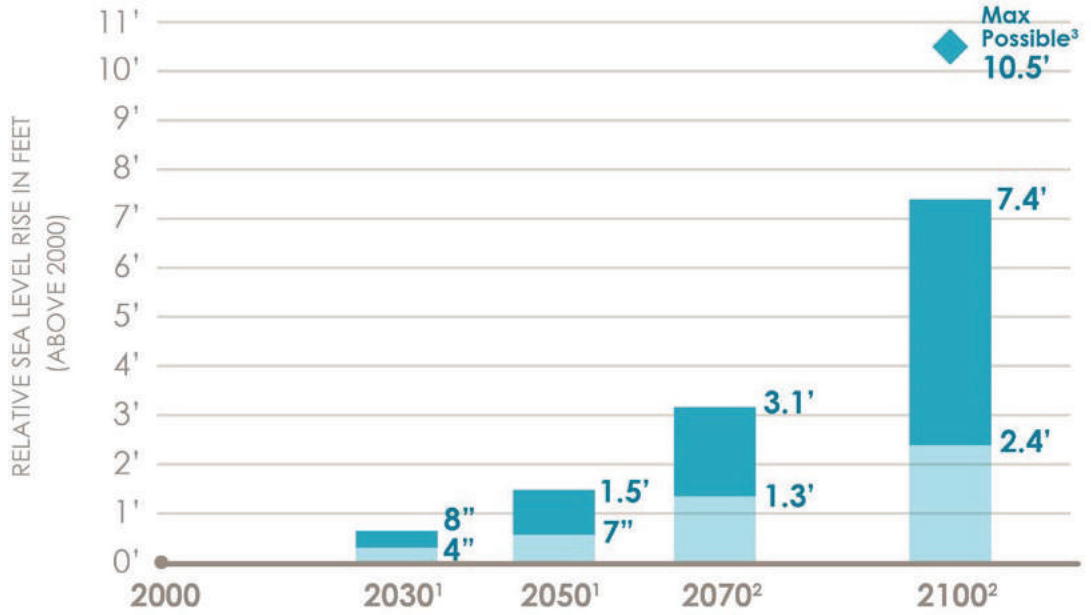
THE NUMBER OF VERY HOT DAYS WILL INCREASE



Data source: Rossi et al. 2015

* Baseline represents historical average from 1971-2000
Upper values from high emissions scenario. Lower values from low emissions scenario.

SEA LEVELS IN BOSTON WILL CONTINUE TO RISE



Data Source:
BRAG Report, 2016

1 - Likely under all emission scenarios
2 - Likely under moderate to high emission scenarios
3 - Low probability under high emission scenario

16 OF THE 17 HOTTEST YEARS IN RECORDED HISTORY HAVE OCCURED SINCE 2001 2016= HOTTEST 2017 = 3RD HOTTEST

Source: Climate Ready Boston Executive Summary, City of Boston, 2016, boston.gov/departments/environment/climate-ready-boston/.

WHAT'S AT STAKE?

People and Buildings Exposed to a 1% Flood Risk

2030+

18,000 PEOPLE

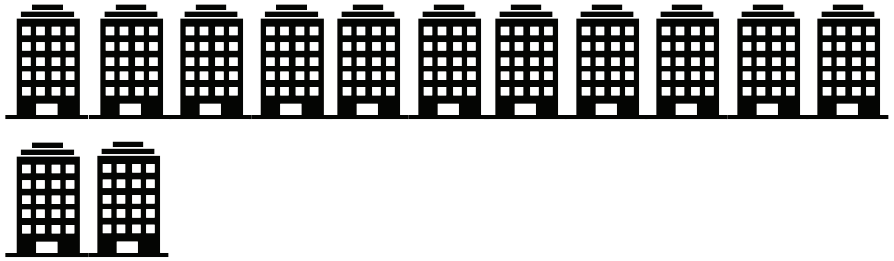
2,000 BUILDINGS

$20B

2070+

85,000 PEOPLE

12,000 BUILDINGS



$85B

Source: Climate Ready Boston, City of Boston, 2016, boston.gov/departments/environment/climate-ready-boston/.

CONTEXT: CLIMATE CHANGE IN BOSTON

Cities Most Vulnerable to Coastal Flooding by 2050

Top 25 cities and their populations at risk (thousands) within FEMA's 100-year coastal floodplain as augmented by projected sea level rise

1.	New York	426
2.	Hialeah, Fla.	204
3.	Miami	154
4.	Fort Lauderdale, Fla.	127
5.	Pembroke Pines, Fla.	120
6.	Coral Springs, Fla.	119
7.	Miramar, Fla.	100
8.	St. Petersburg, Fla.	91
9.	Davie, Fla.	90
10.	Miami Beach, Fla.	87
11.	Charleston, S.C.	83
12.	Pompano Beach, Fla.	80
13.	Sunrise, Fla.	79
14.	Hollywood, Fla.	76
15.	Miami Gardens, Fla.	72
16.	Norfolk, Va.	66
17.	Lauderhill, Fla.	66
18.	Cape Coral, Fla.	66
19.	Boston	62
20.	Tamarac, Fla.	60
21.	Virginia Beach, Va.	58
22.	Tampa, Fla.	57
23.	Fountainebleau, Fla.	56
24.	Margate, Fla.	53
25.	Kendale Lakes, Fla.	51

CLIMATE CENTRAL

"These U.S. Cities are Most Vulnerable to Major Coastal Flooding and Sea Level Rise,"Climate Central, 2017, climatecentral.org/news/.

CONTEXT: CLIMATE CHANGE IN BOSTON

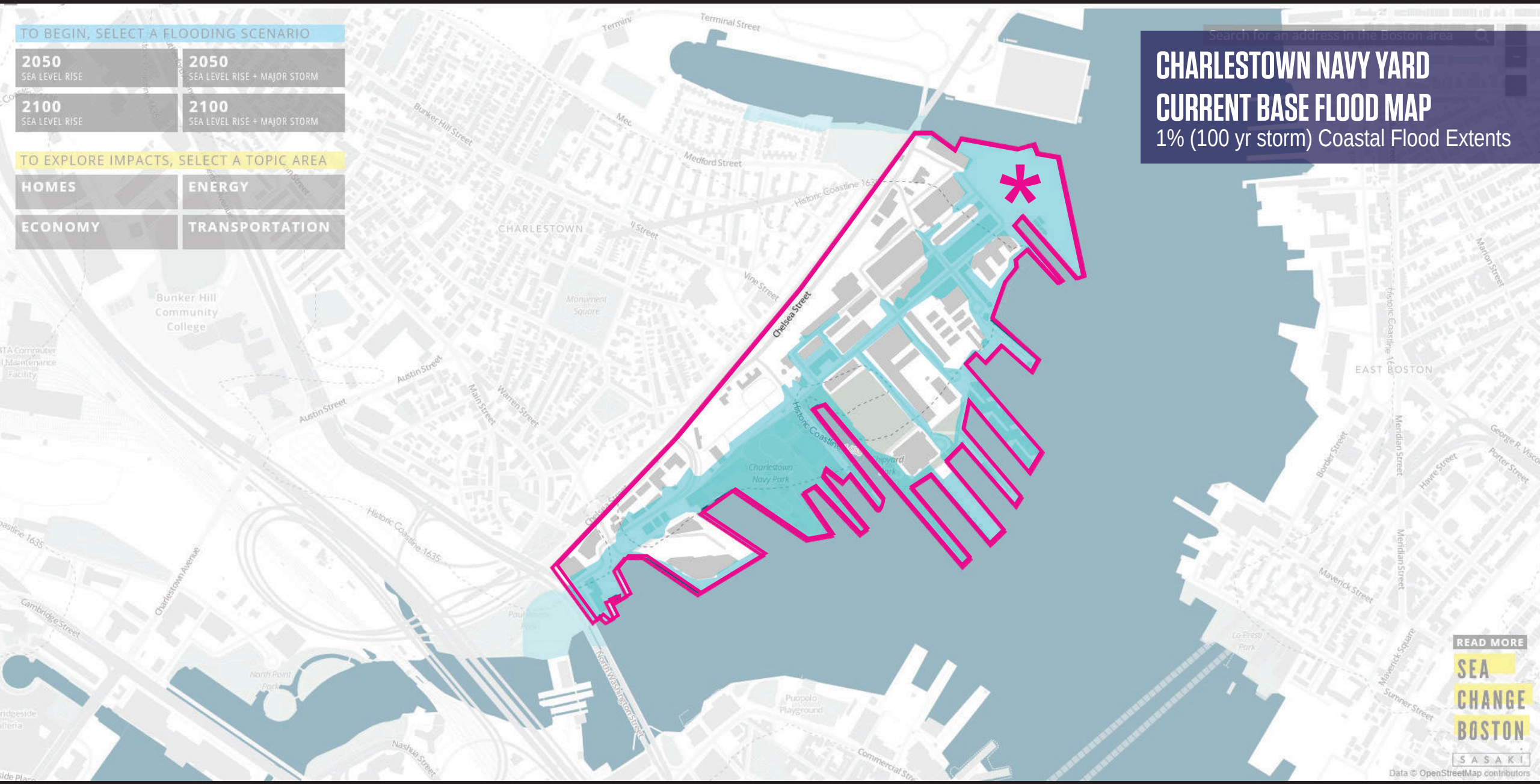
Neighborhoods	Total Land Area (Acres)	LAND AREA EXPOSED (ACRES) 9" SLR 1% annual chance	21" SLR 1% annual chance	36" SLR 1% annual chance	36" SLR AMHT	PERCENT OF NEIGHBORHOOD EXPOSED 9" SLR 1% annual chance	21" SLR 1% annual chance	36" SLR 1% annual chance	36" SLR AMHT
I. Greatest Exposure & increasing throughout century									
Charlestown	870	120	310	460	110	14%	36%	54%	12%
Downtown	770	110	240	350	70	14%	31%	45%	10%
East Boston	3,340	540	1,040	1,680	480	16%	30%	49%	14%
Harbor Islands	820	200	230	260	200	25%	28%	32%	24%
South Boston	1,940	470	930	1,220	360	24%	48%	63%	19%
II. Lower Exposure today, but significant jump late century									
Allston / Brighton	2,940	30	70	240	20	1%	2%	7%	1%
Back Bay / Beacon Hill	460	<10	<10	80	<10	<1%	1%	17%	<1%
Roxbury	2,770	<10	<10	130	<10	<1%	<1%	5%	<1%
Dorchester	3,780	240	430	750	220	6%	11%	20%	6%
South End	640	<10	20	450	<10	<1%	3%	71%	<1%
III. Other Neighborhoods									
Fenway / Kenmore	620	<10	<10	<10	<10	<1%	<1%	<1%	<1%
Hyde Park	3,260	0	0	0	0	0	0	0	0
Jamaica Plain	2,260	0	0	0	0	0	0	0	0
Mattapan	1,560	0	0	0	0	0	0	0	0
Roslindale	2,250	0	0	0	0	0	0	0	0
West Roxbury	3,350	0	0	0	0	0	0	0	0
Boston Total	**31,720**	**1,720**	**3,280**	**5,630**	**1,470**	**8%**	**10%**	**18%**	**8%**

AMHT is the Average monthly highest tide

54% OF CHARLESTOWN EXPOSED WITH 36" SLR

Source: Climate Ready Boston Executive Summary, City of Boston, 2016, boston.gov/departments/environment/climate-ready-boston/.

CHARLESTOWN HISTORIC FILL
MAP OF BOSTON, 1800

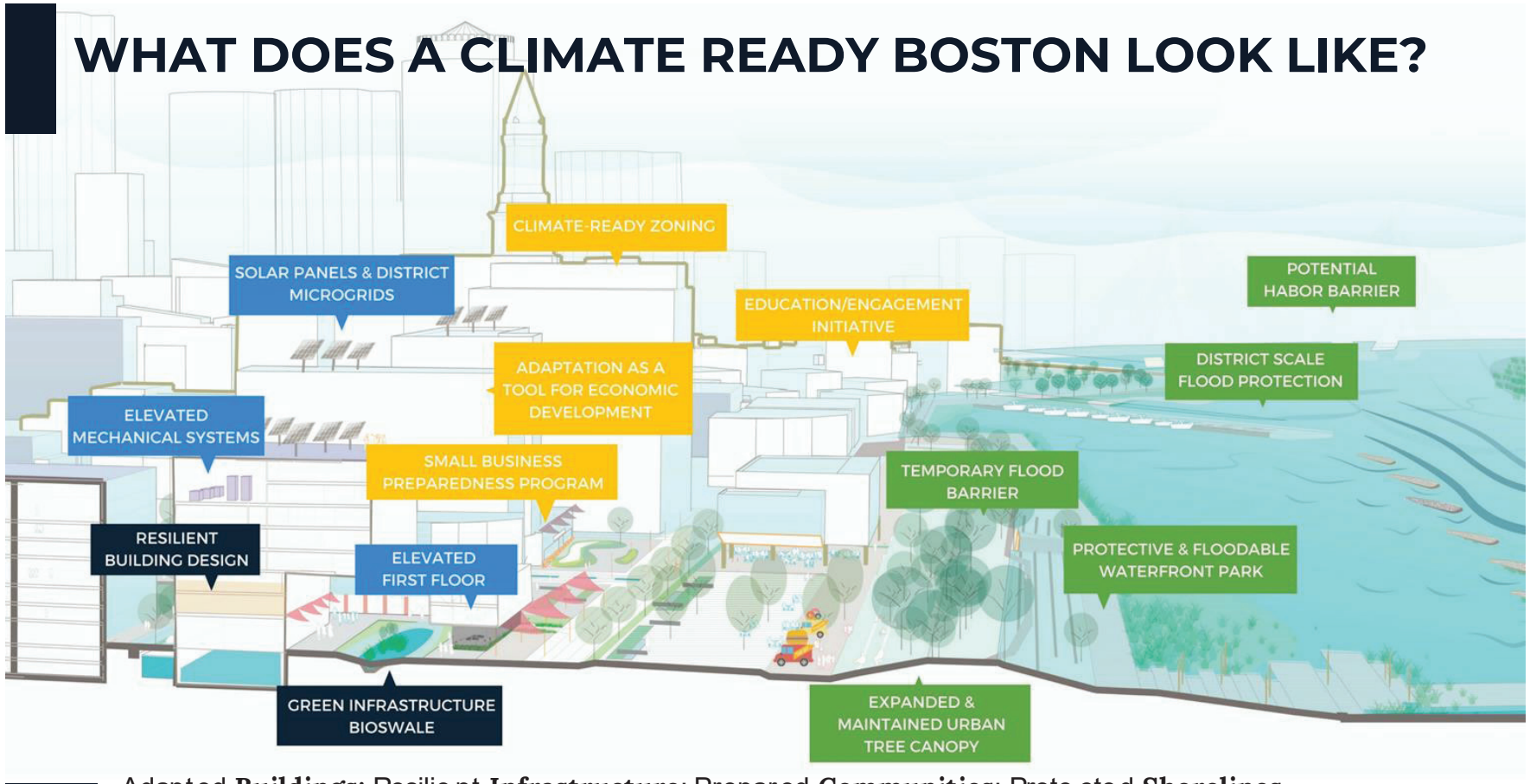

TO BEGIN, SELECT A FLOODING SCENARIO
2050
SEA LEVEL RISE
2050
SEA LEVEL RISE + MAJOR STORM
2100
SEA LEVEL RISE
2100
SEA LEVEL RISE + MAJOR STORM
TO EXPLORE IMPACTS, SELECT A TOPIC AREA
HOMES
ENERGY
ECONOMY
TRANSPORTATION
CHARLESTOWN NAVY YARD
CURRENT BASE FLOOD MAP
1% (100 yr storm) Coastal Flood Extents
*
Chelsea Street
CHARLESTOWN
EAST BOSTON
Bunker Hill Community College
Monument Square
Charlestown Navy Park
Shipyard Park
Historic Coastline 1635
Terminal Street
Medford Street
Bunker Hill Street
Vine Street
Austin Street
Main Street
Warren Street
Charlestown Avenue
Cambridge Street
North Washington Street
Nashua Street
Commercial Street
Meridian Street
Maverick Square
Maverick Street
Sumner Street
Border Street
Havre Street
Porter Street
Marion Street
North Point Park
Puopolo Playground
READ MORE
SEA CHANGE BOSTON
SASAKI
Data © OpenStreetMap contributors


TO BEGIN, SELECT A FLOODING SCENARIO
2050
SEA LEVEL RISE
2050
SEA LEVEL RISE + MAJOR STORM
2100
SEA LEVEL RISE
2100
SEA LEVEL RISE + MAJOR STORM
This map shows potential flooding from a major storm in 2050. Boston could experience 7 feet of flooding (2 feet of sea level rise + 5 feet of storm surge = 7 feet of flooding).
TO EXPLORE IMPACTS, SELECT A TOPIC AREA
HOMES
ENERGY
ECONOMY
TRANSPORTATION
Search for an address in the Boston area
CHARLESTOWN 2050
2' Sea Level Rise + 5' Storm Surge
*
CHARLESTOWN
EAST BOSTON
Bunker Hill Street
Medford Street
Historic Coastline 1635
Vine Street
Chelsea Street
Monument Square
Austin Street
Main Street
Warren Street
Bunker Hill Community College
Charlestown Navy Yard
Paul Revere Park
North Washington Street
Puopolo Playground
Maverick Street
Maverick Square
Sumner Street
Meridian Street
Marion Street
Border Street
Havre Street
Porter Street
Cambridge Street
Charlestown Avenue
Commercial Street
Nashua Street
North Point Park
READ MORE
SEA CHANGE BOSTON
SASAKI
Data © OpenStreetMap contributors


TO BEGIN, SELECT A FLOODING SCENARIO
2050
SEA LEVEL RISE
2050
SEA LEVEL RISE + MAJOR STORM
2100
SEA LEVEL RISE
2100
SEA LEVEL RISE + MAJOR STORM
This map shows potential flooding from a major storm in 2100. Boston could experience 11 feet of flooding (6 feet of sea level rise + 5 feet of storm surge = 11 feet of flooding).
TO EXPLORE IMPACTS, SELECT A TOPIC AREA
HOMES
ENERGY
ECONOMY
TRANSPORTATION
Search for an address in the Boston area
CHARLESTOWN 2100
6' Sea Level Rise + 5' Storm Surge
CHARLESTOWN
EAST BOSTON
Bunker Hill Community College
Monument Square
Bunker Hill Street
Medford Street
Terminal Street
Vine Street
Chelsea Street
Austin Street
Main Street
Warren Street
Historic Coastline 1635
Meridian Street
Marion Street
Border Street
Havre Street
Maverick Street
Maverick Square
Sumner Street
Charlestown Navy Yard
Paul Revere Park
Puopolo Playground
La Presti Park
North Point Park
Cambridge Street
Charlestown Avenue
North Washington Street
Nashua Street
Commercial Street
READ MORE
SEA CHANGE BOSTON
SASAKI
Data © OpenStreetMap contributors

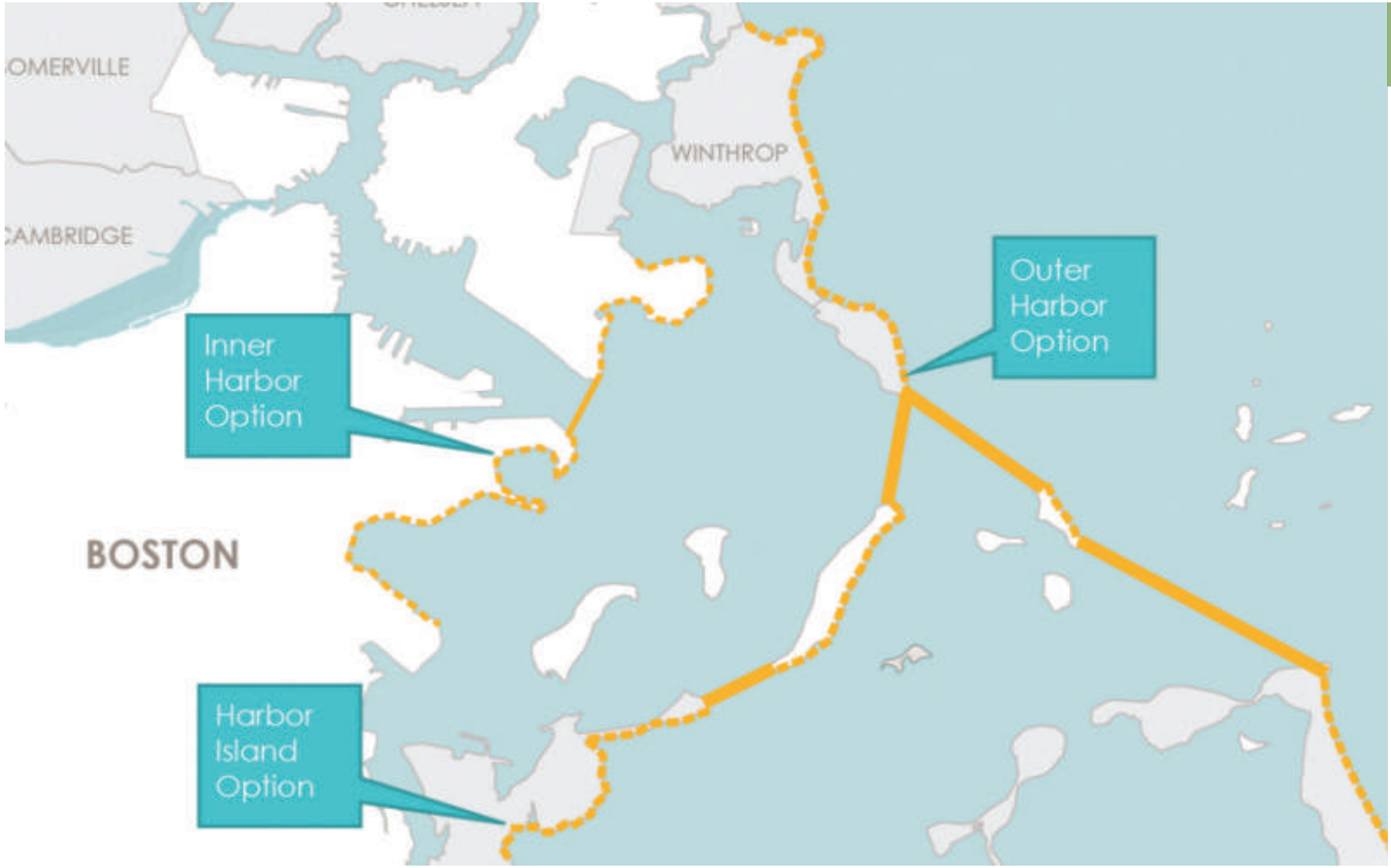
CURRENT IDEAS FOR BOSTON

2017- Climate Ready Boston
Mapped the problem



Adapted **Buildings;** Resilient **Infrastructure**; Prepared **Communities**; Protected **Shorelines**

Climate Ready Boston, Sasaki, City of Boston, 2017, boston.gov/departments/environment/climate-ready-boston/.



CURRENT IDEAS FOR BOSTON

HARBOR BARRIER

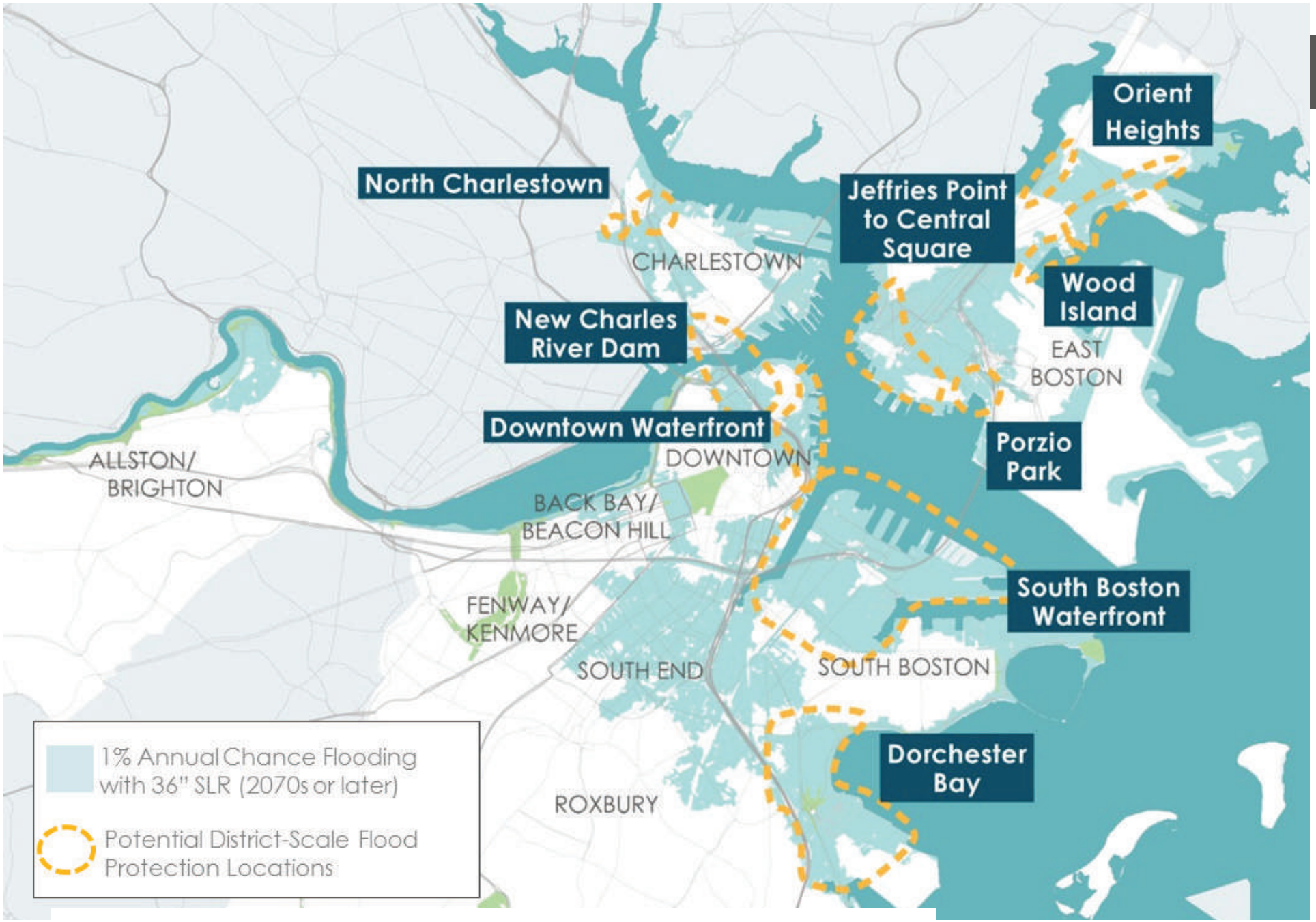
UMASS 2017

- 3 options
- Barrier was recommended in the 2016-2017 CRB Report
- Similar to Big Dig in scale.
- Rough Cost: $10 Billion

+UMass Sustainable Solutions Lab Preliminary Feasibility Analysis to be released in June 2018

Source: Boston Harbor Barrier Study, UMass School for the Environment, 2017, wbur.org/news/2017/09/06/boston-harbor-barrier-proposals

Climate Ready Boston

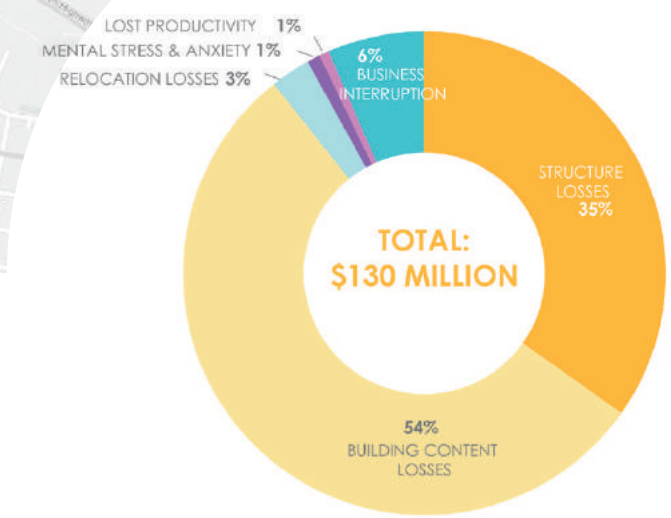


Climate Ready Boston

EXPECTED ANNUALIZED LOSSES TO STRUCTURES AND CONTENTS
36 INCHES OF SEA LEVEL RISE AT 10%, 2%, 1%, 0.1% ANNUAL CHANCE COASTAL FLOOD EVENTS.

Probable annualized losses are based on generalized assumptions [illegible] structures beyond the reserved initiatives or a next phase of this project.

CHARLESTOWN ANNUALIZED LOSSES
36 INCH SEA LEVEL RISE CONDITION

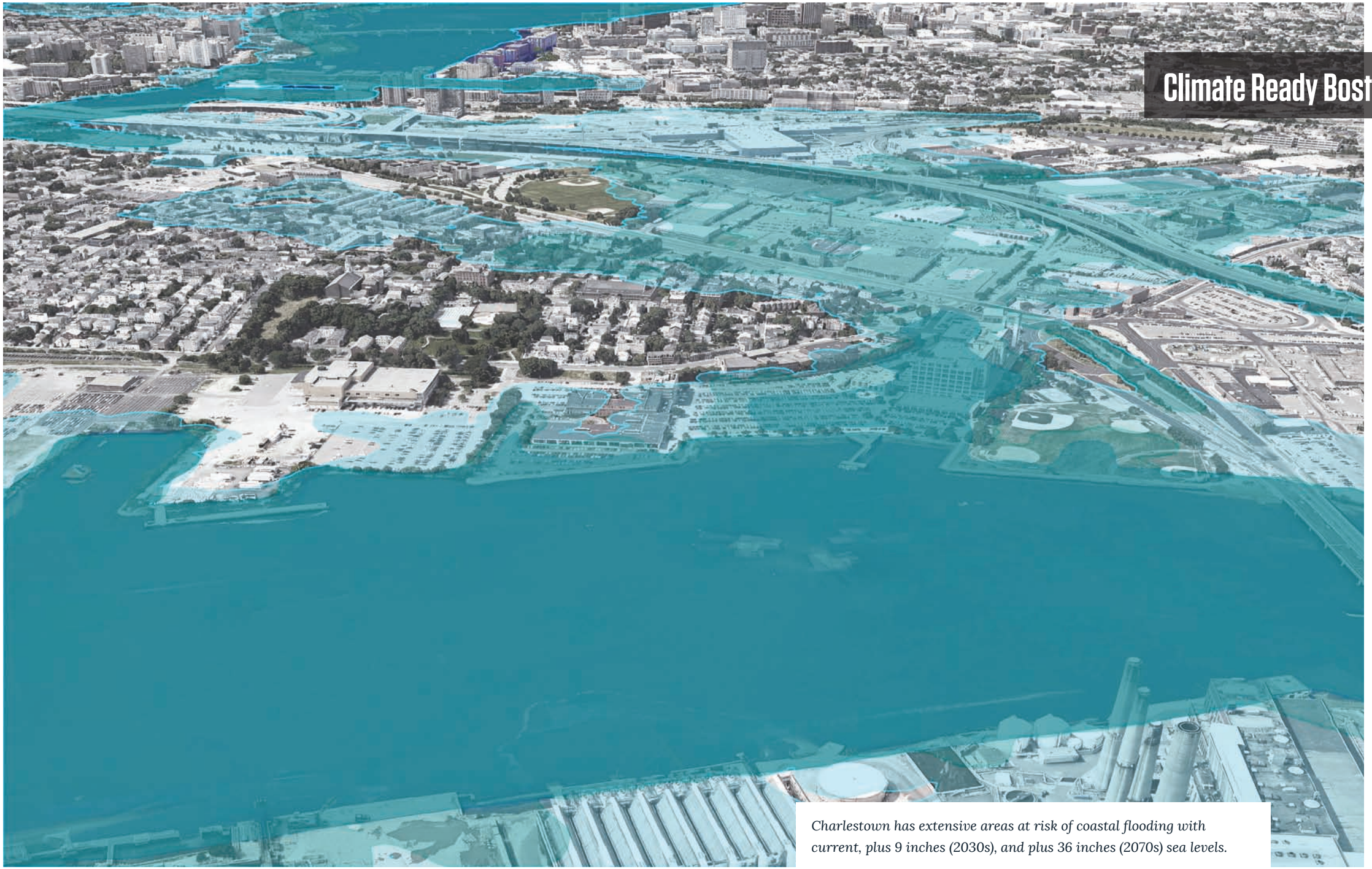


- Commercial ($23.4M)
- Cultural/Religious, Edu, Rec ($8.9M)
- Essential Services ($19.6M)
- General Government ($5.5M)
- Industrial/Transportation($36.5M)
- Mixed Use ($20.6M)
- Residential ($5.5M)

Total ($120M)

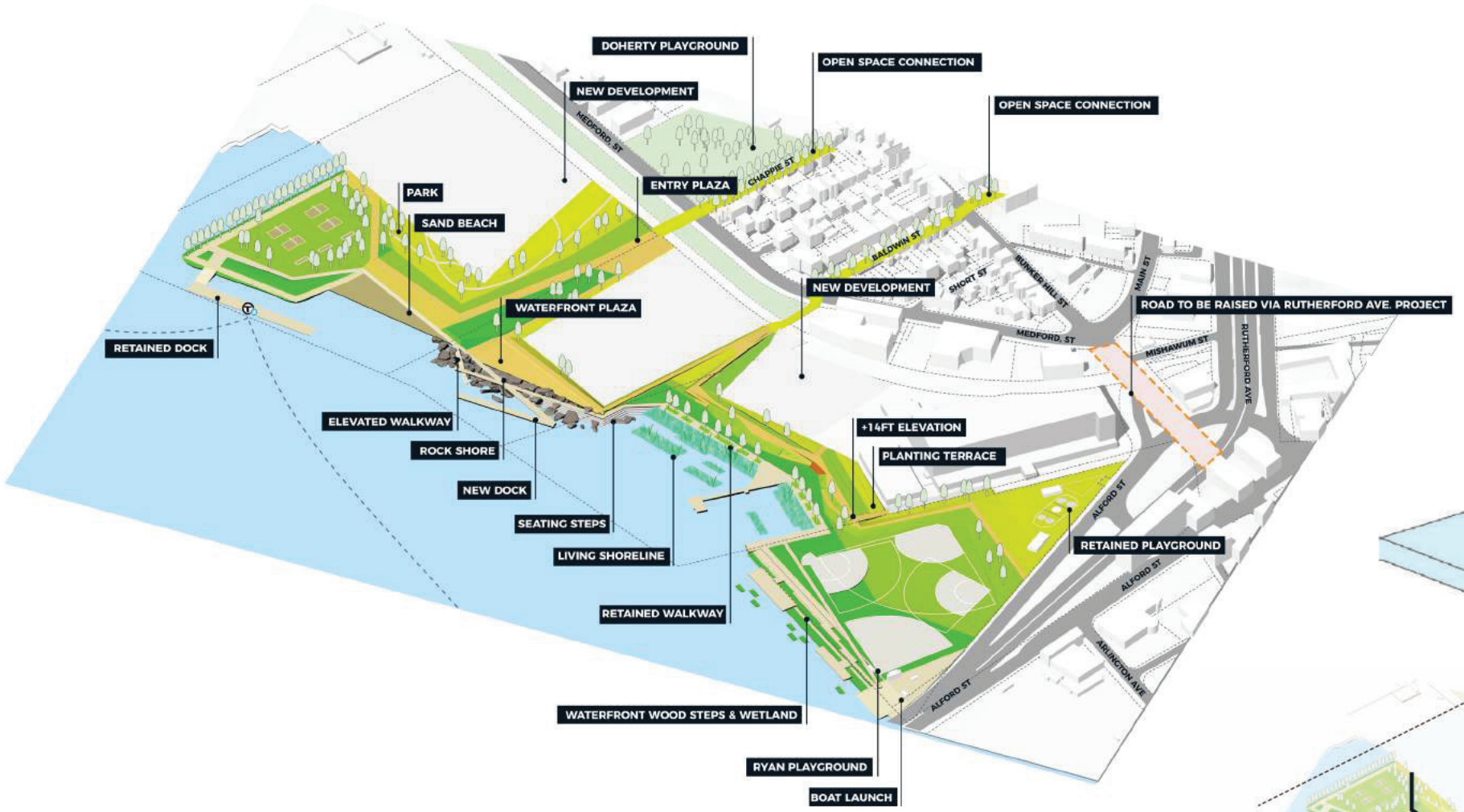
Each circle represents annualized losses suffered by an individual building. Larger circle size indicates higher contents and structures losses. Annualized losses take into consideration the annual probability of an event occurring, as well as the projected impacts of such an event.

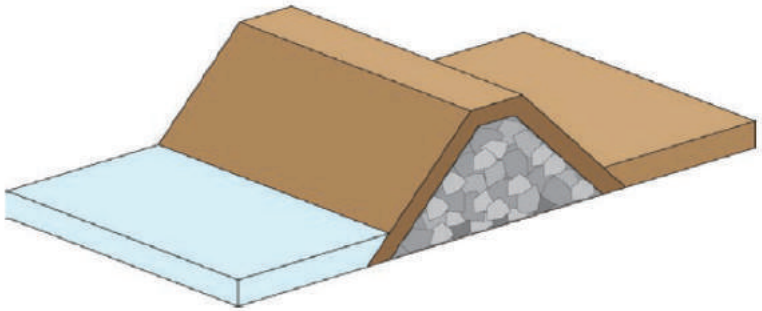

2050
SEA LEVEL RISE
2050
SEA LEVEL RISE + MAJOR STORM
2100
SEA LEVEL RISE
2100
SEA LEVEL RISE + MAJOR STORM
This map shows potential flooding from a major storm in 2050. Boston could experience 7 feet of flooding (2 feet of sea level rise + 5 feet of storm surge = 7 feet of flooding).
TO EXPLORE IMPACTS, SELECT A TOPIC AREA
HOMES
ENERGY
ECONOMY
TRANSPORTATION
Chalrlestown Flooding- 2050
Mystic Avenue
Broadway
Maffa Way
Historic Coastline 1635
Medford Street
Terminal Street
Rutherford Avenue
Bunker Hill Street
Main Street
CHARLESTOWN
Somerville Avenue
Bunker Hill Community College
Warren Street
Chelsea Street
Prospect Street
Cambridge Street
Hampshire Street

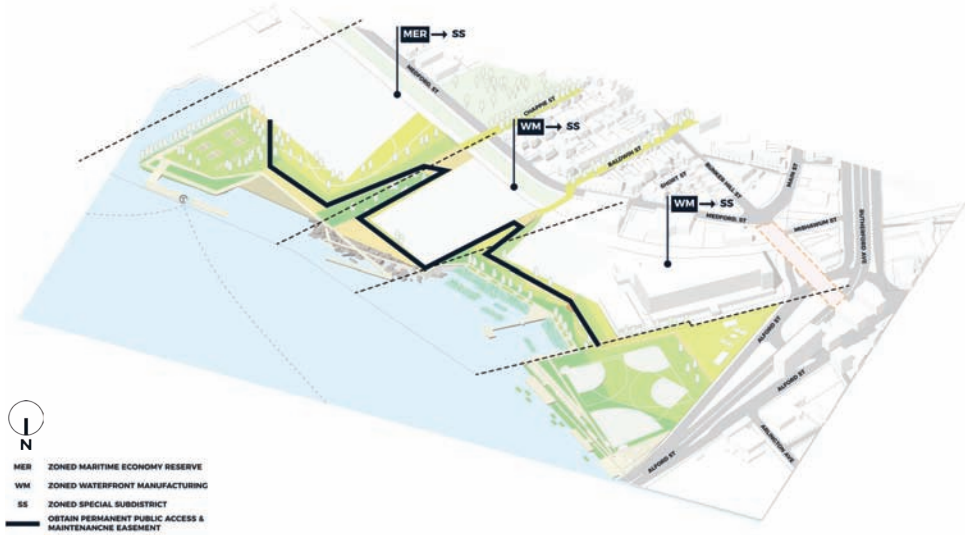


Charlestown has extensive areas at risk of coastal flooding with current, plus 9 inches (2030s), and plus 36 inches (2070s) sea levels.

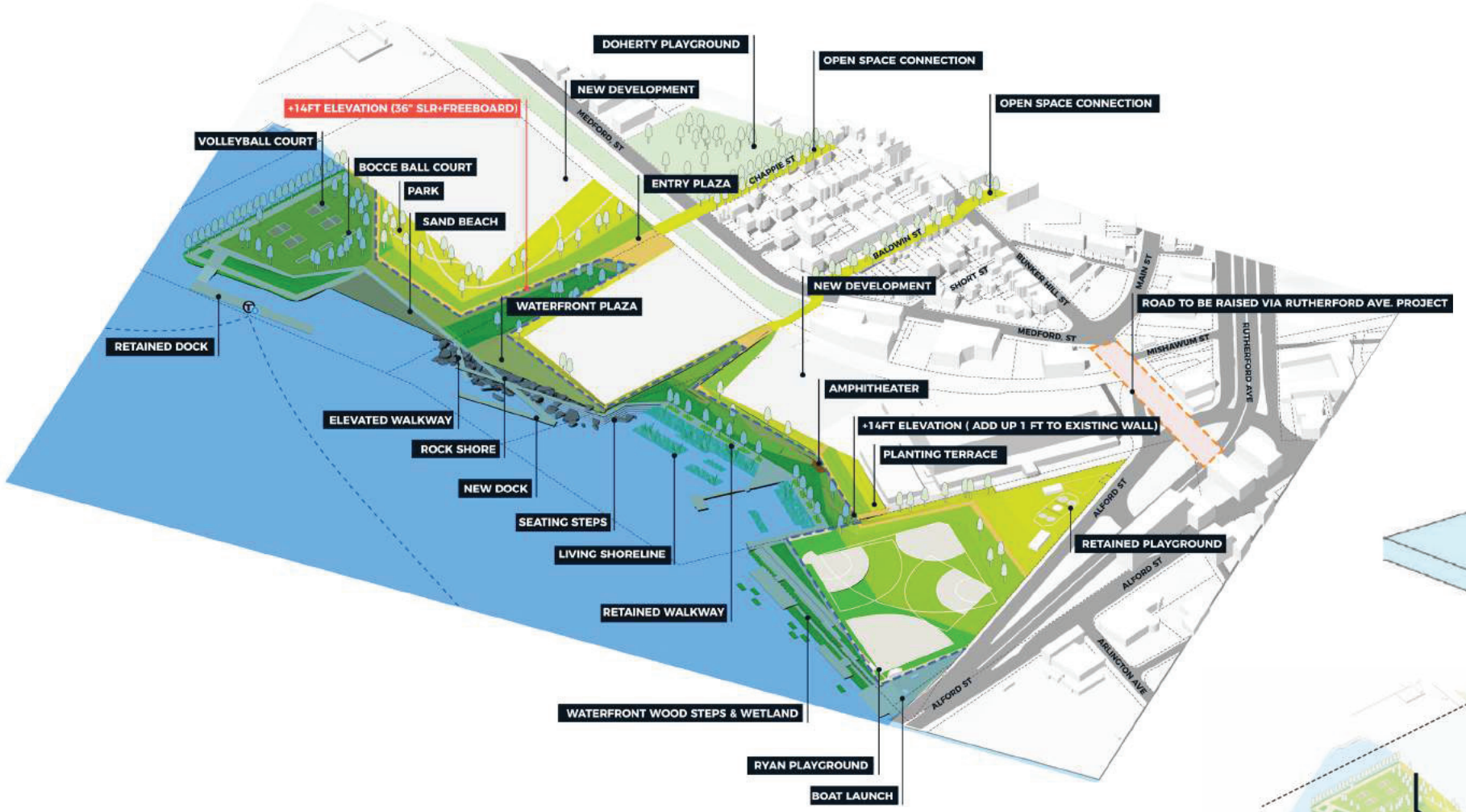
Climate Ready Boston

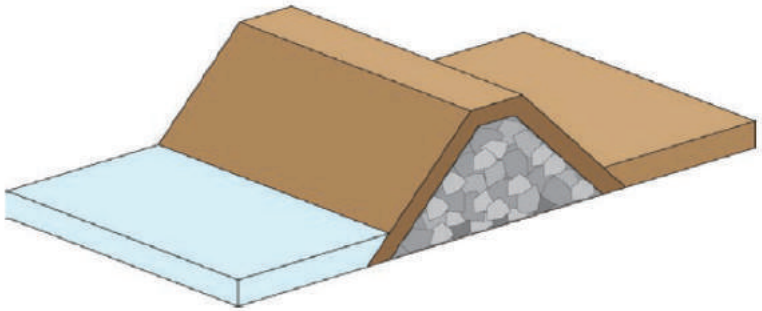


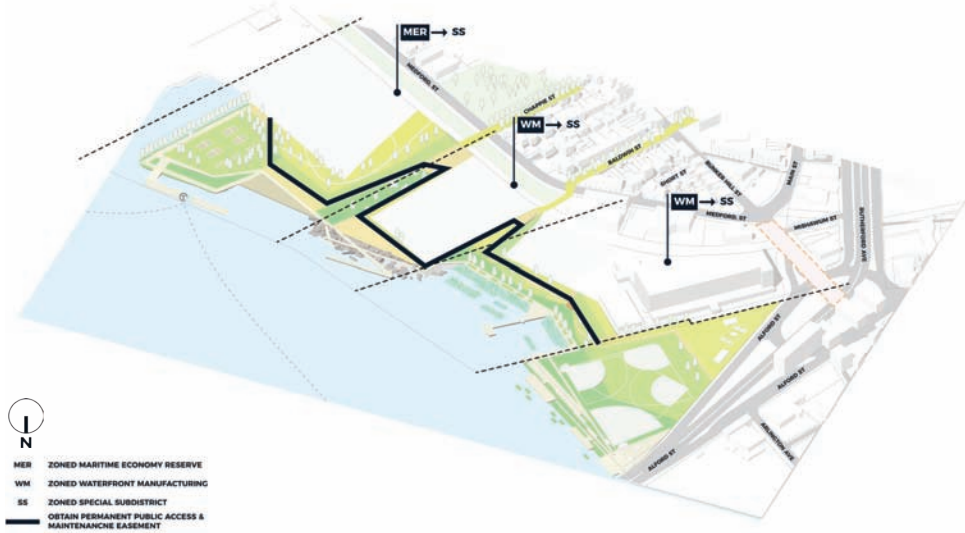




Climate Ready Boston

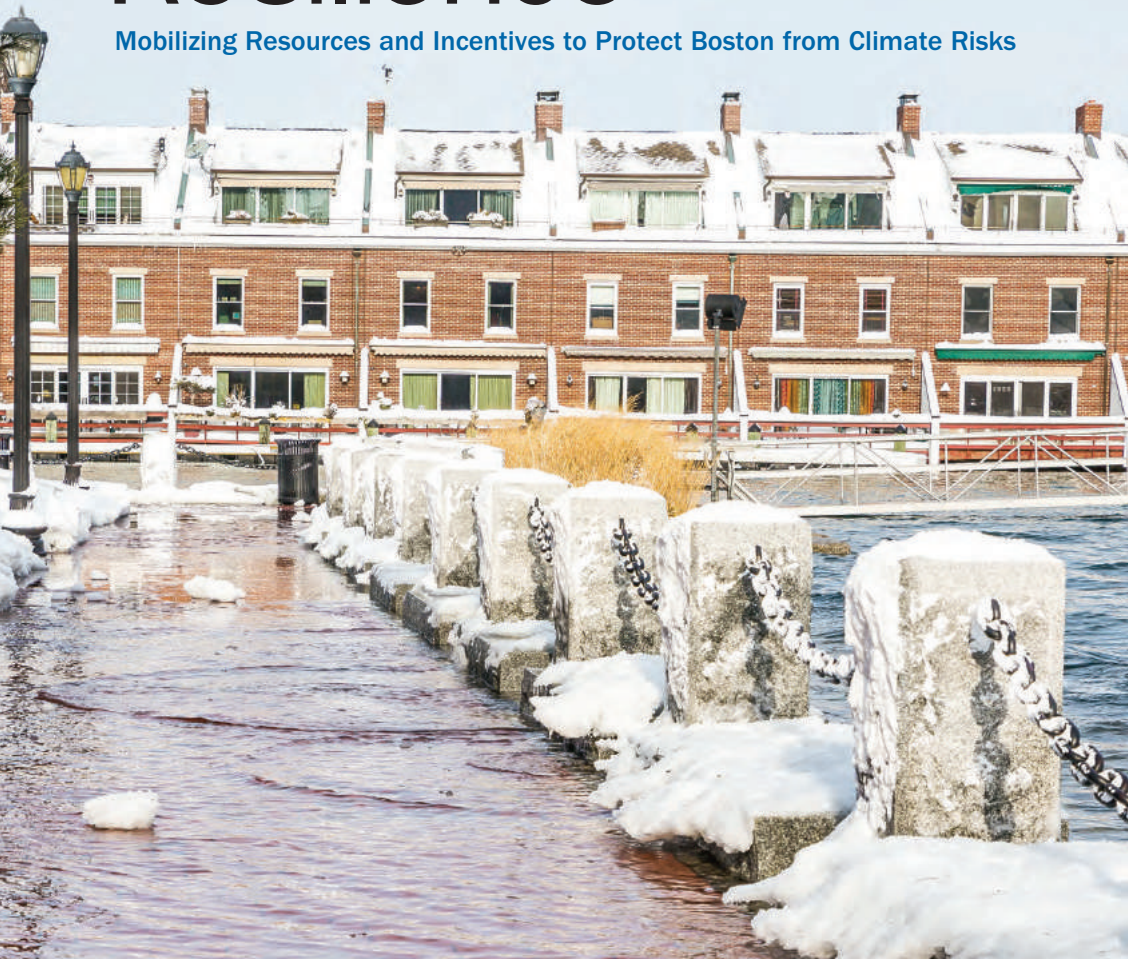






Financing Climate Resilience

Mobilizing Resources and Incentives to Protect Boston from Climate Risks



UMASS BOSTON Sustainable Solutions Lab

Barr Foundation

BOSTON Green Ribbon COMMISSION

TABLE 1

Scale of Investments

	Individuals	Corporate	Public
Individual Buildings—Residential	$10–100 thousand		
Buildings/parcel—Commercial*		$0.1–8 million	
District-level projects		$40–1500 million (per district)	
Region-level (e.g. Harbor Barrier)			$7–15 billion

* Including commercial multi-family residential.

Note: These are very rough estimates based on scenarios derived from interviews, draft reports, and comparable projects in other cities.

TABLE 2

Estimates of Costs by District

	$ Million		
	2018–2025	2026–2030	2030–2050
East Boston	$43–$69	$28–$46	$46–$77
Charlestown	$16–$30	$14–$26	$3–$6
South Boston	TBD	TBD	TBD
Downtown	TBD	TBD	TBD

Source: City of Boston, Coastal Resilience Solutions for East Boston and Charlestown, 2017

TETRA TECH

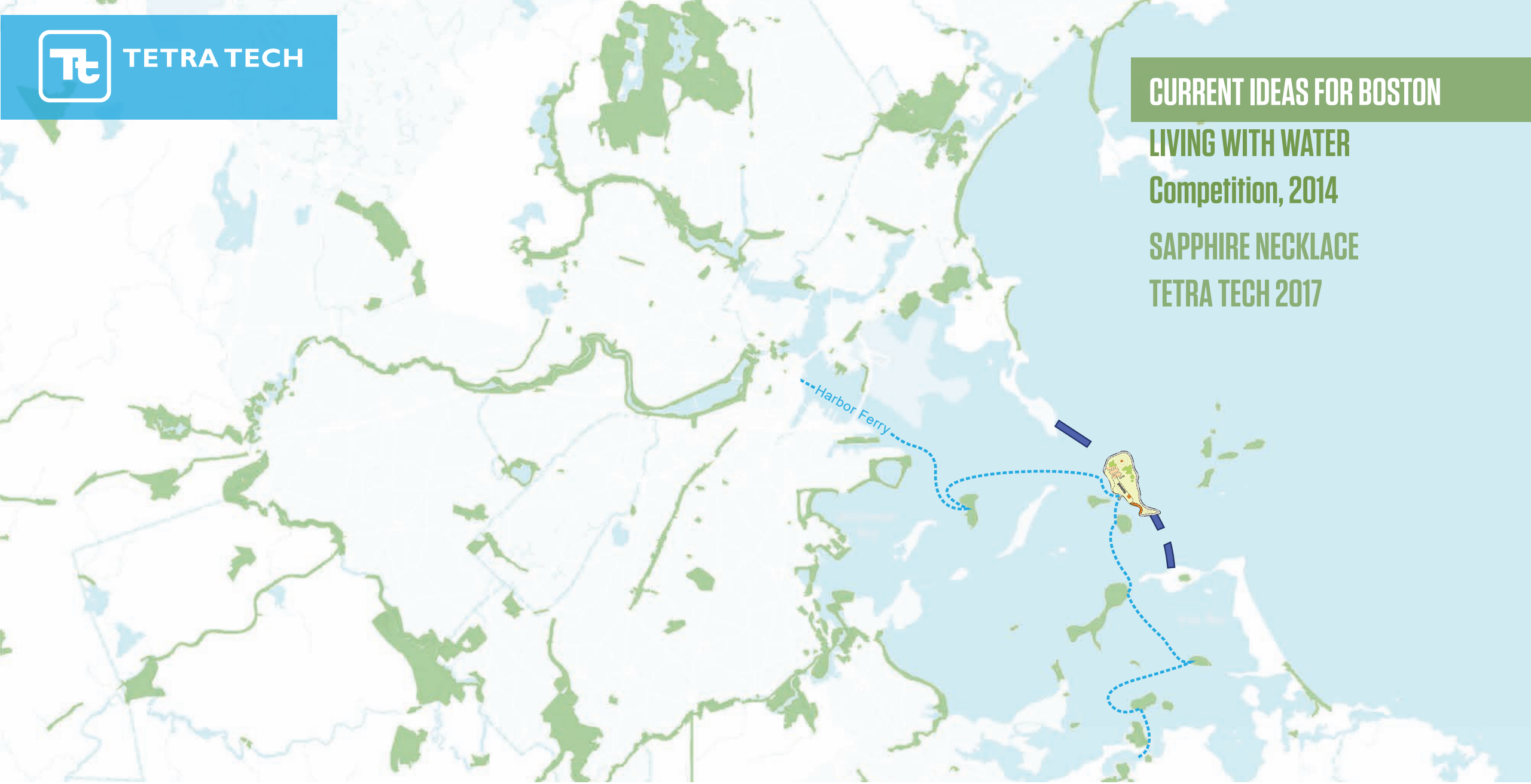
CURRENT IDEAS FOR BOSTON

LIVING WITH WATER

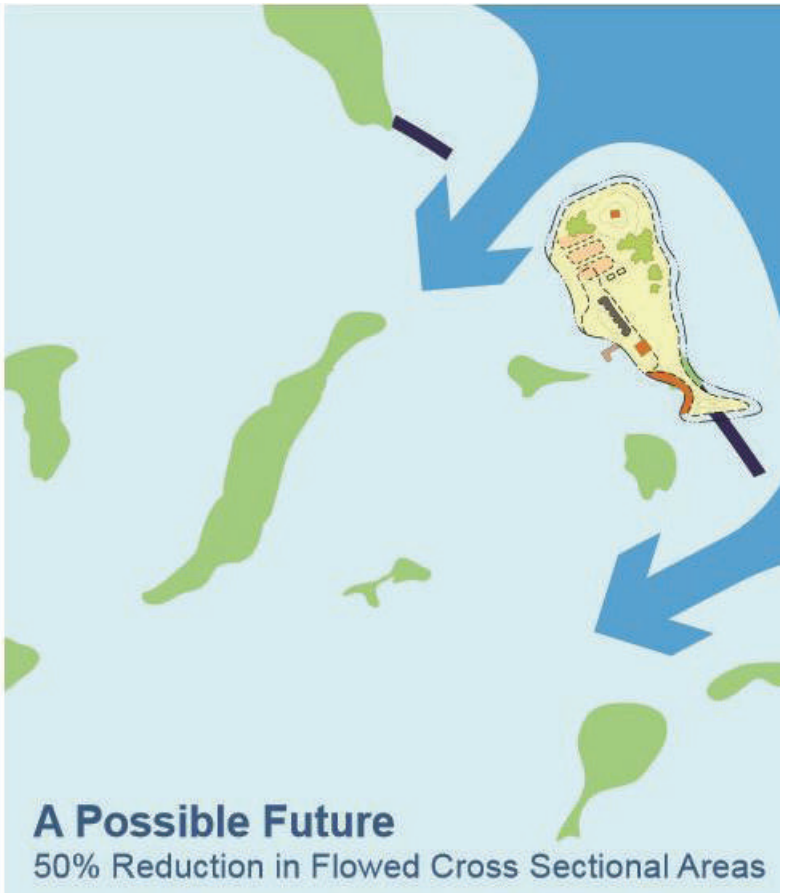
Competition, 2014

SAPPHIRE NECKLACE

TETRA TECH 2017



Source: “The Sapphire Necklace: Building Upon the Olmsted Plan- Parks Connected by Water to Protect the Boston Basin, Robert Daylor, Tetra Tech, 2015, wbur.org/news/2017/09/06/boston-harbor-barrier-proposals



Source: "The Sapphire Necklace: Building Upon the Olmsted Plan- Parks Connected by Water to Protect the Boston Basin, Robert Daylor, Tetra Tech, 2015, wbur.org/news/2017/09/06/boston-harbor-barrier-proposals

CURRENT IDEAS FOR BOSTON

Baker

1.4 Billion Environemental Bond Bill

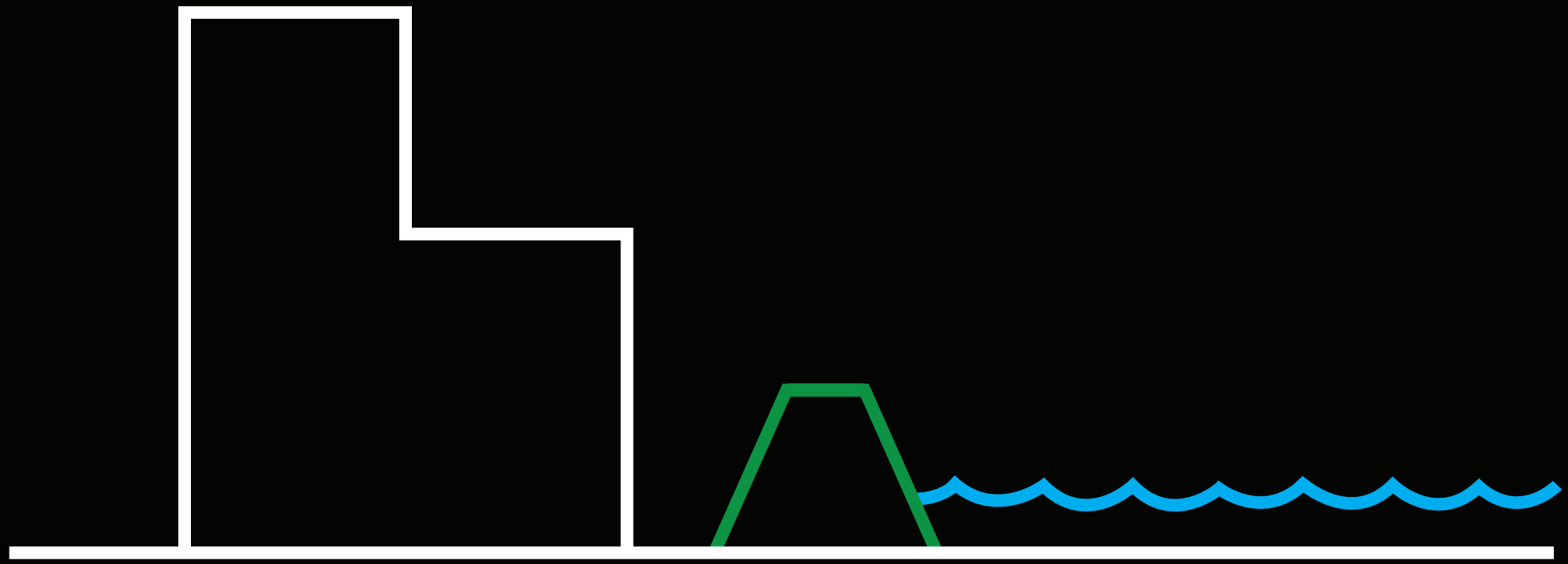
300 Million for Coastal Planning

STRATEGIES

OCEAN WATER

1. BLOCK THE WATER

Use levees or dikes, revetments, bulkheads, seawalls, floodwalls, and other landscape forms to block water



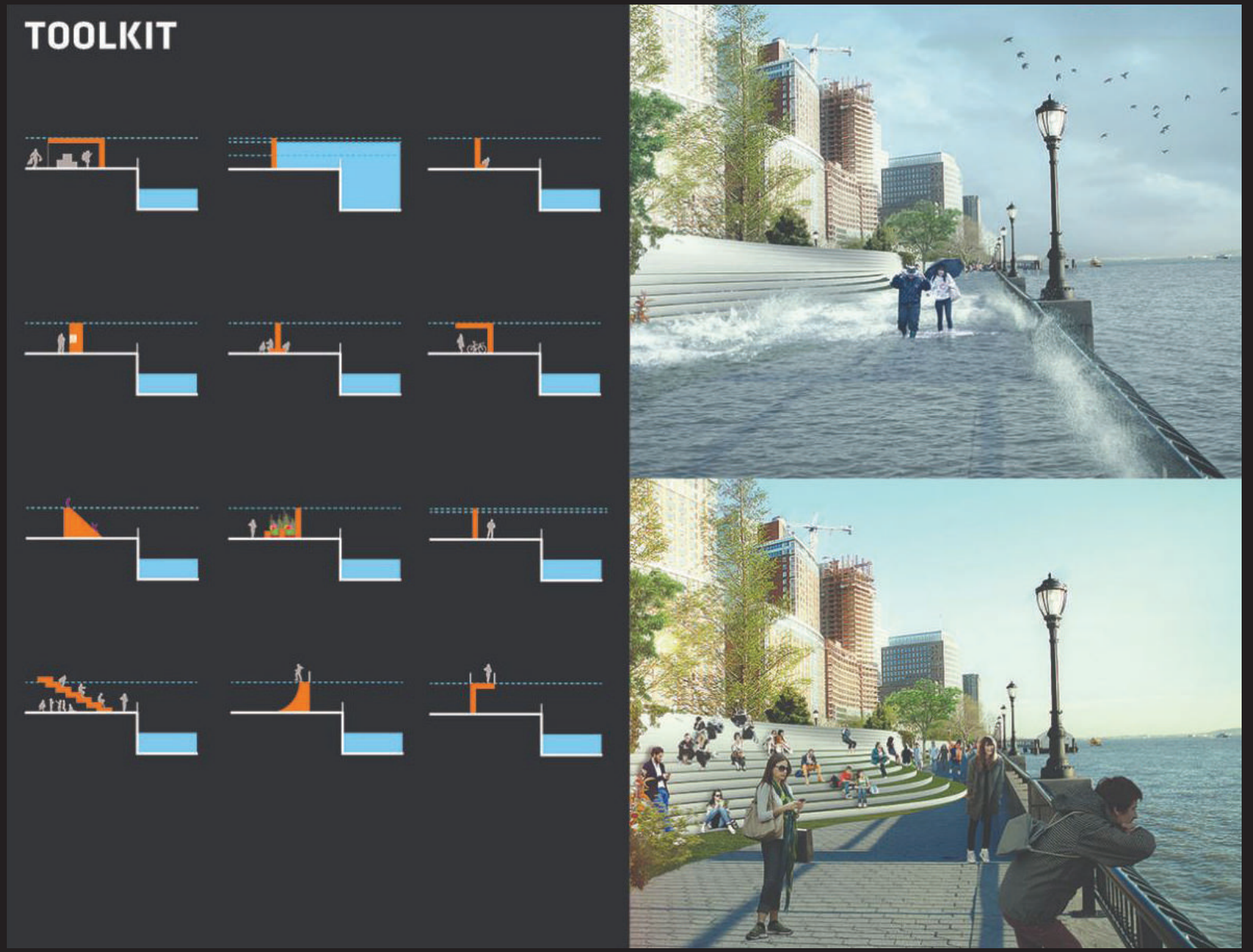
STRATEGIES
BLOCK THE WATER

Block the Water : Navy Yard Barrier

THE BIG U

Bjarke Ingels Group,
NYC Rebuild By Design Competition
2014

The Big U, BIG Architects, NYC Rebuild By Design Competiton, 2016, asla.org/2016 awards/.



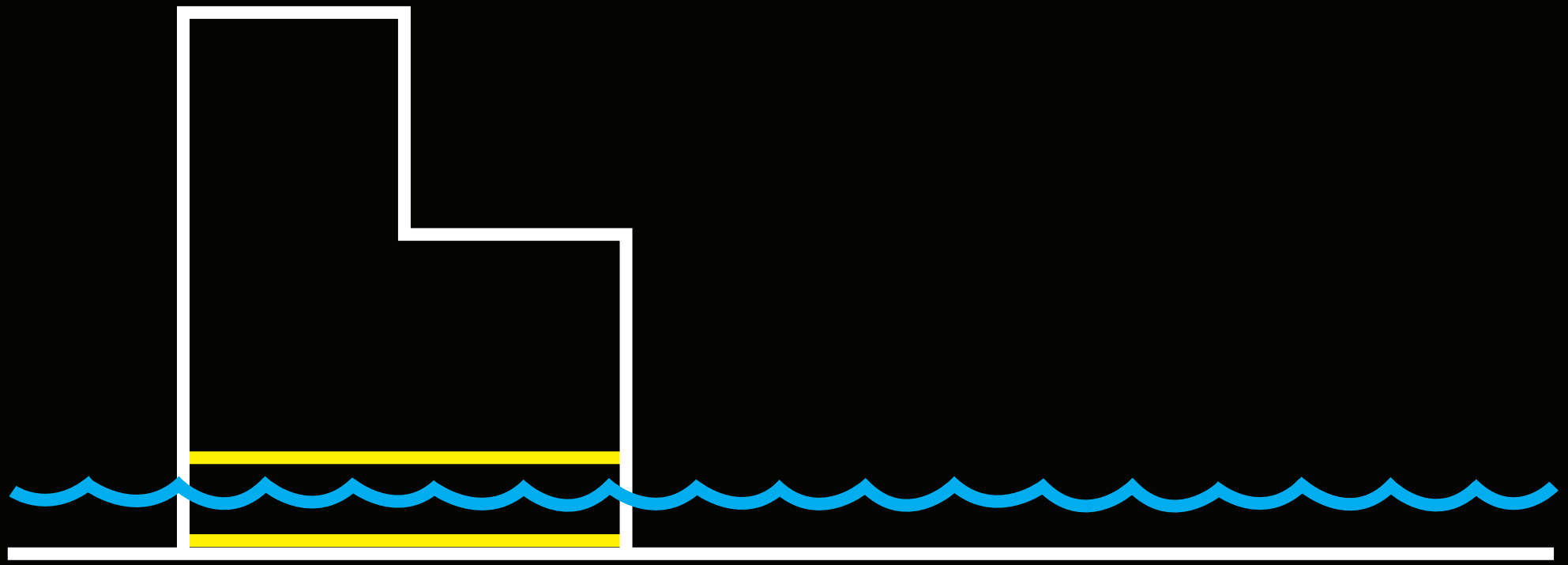
The Big U, BIG Architects, NYC Rebuild By Design Competiton, 2016, asla.org/2016 awards/.

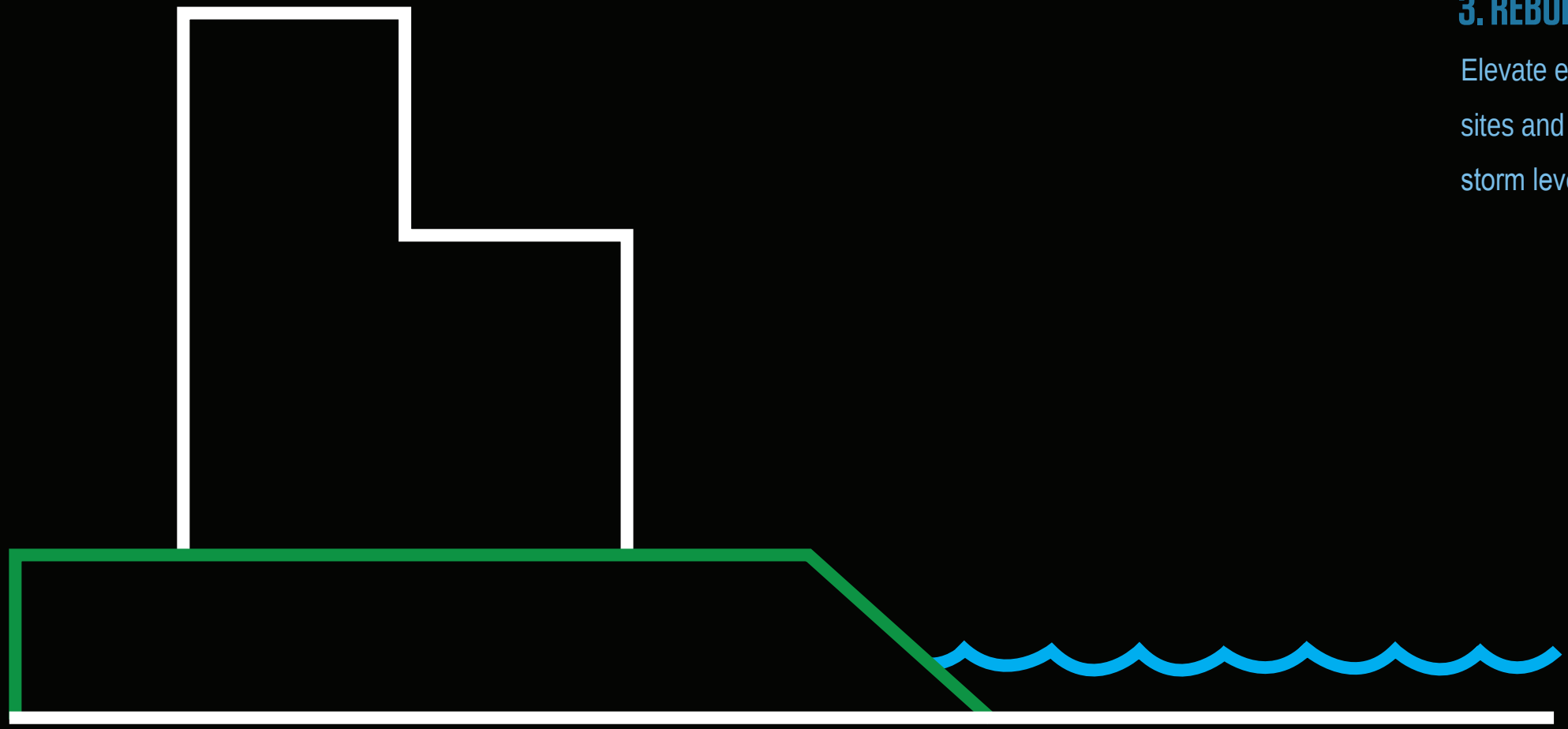
SECTION THROUGH BERM AND HIGHWAY

The Big U, BIG Architects, NYC Rebuild By Design Competiton, 2016, asla.org/2016 awards/.

2. RETROFIT BUILDINGS

Wet Floodproofing
Dry Floodproofing

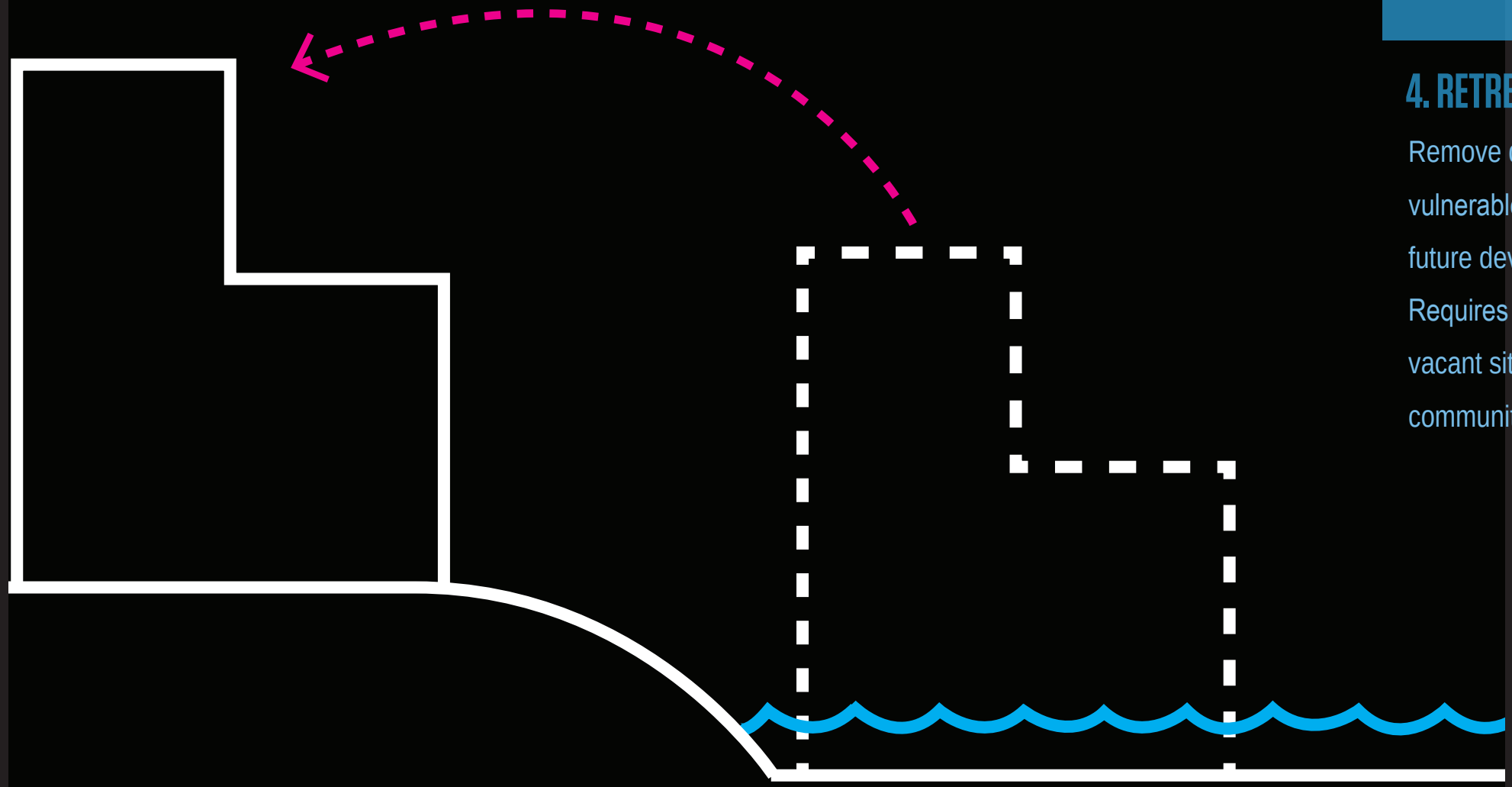




3. REBUILD ABOVE FLOOD ELEVATION

Elevate existing or new development sites and streets above the expected storm level to protect from flooding.

SPAULDING HOSPITAL

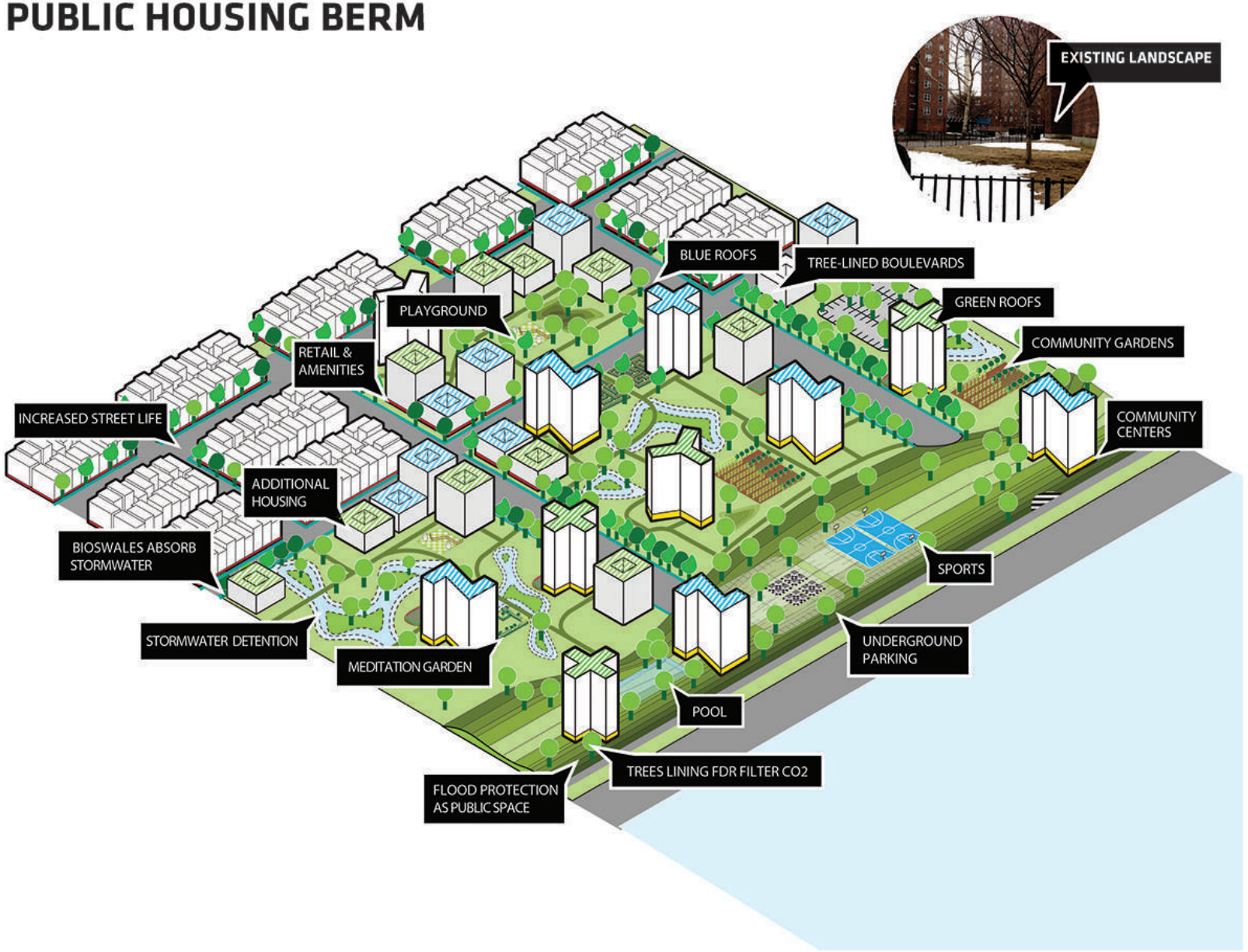


4. RETREAT TO HIGHER ELEVATION

Remove development from areas vulnerable to flooding and prevent future development in those areas. Requires finding availible land or vacant sites at higher elevations for communities to re-locate to.

THE BIG U

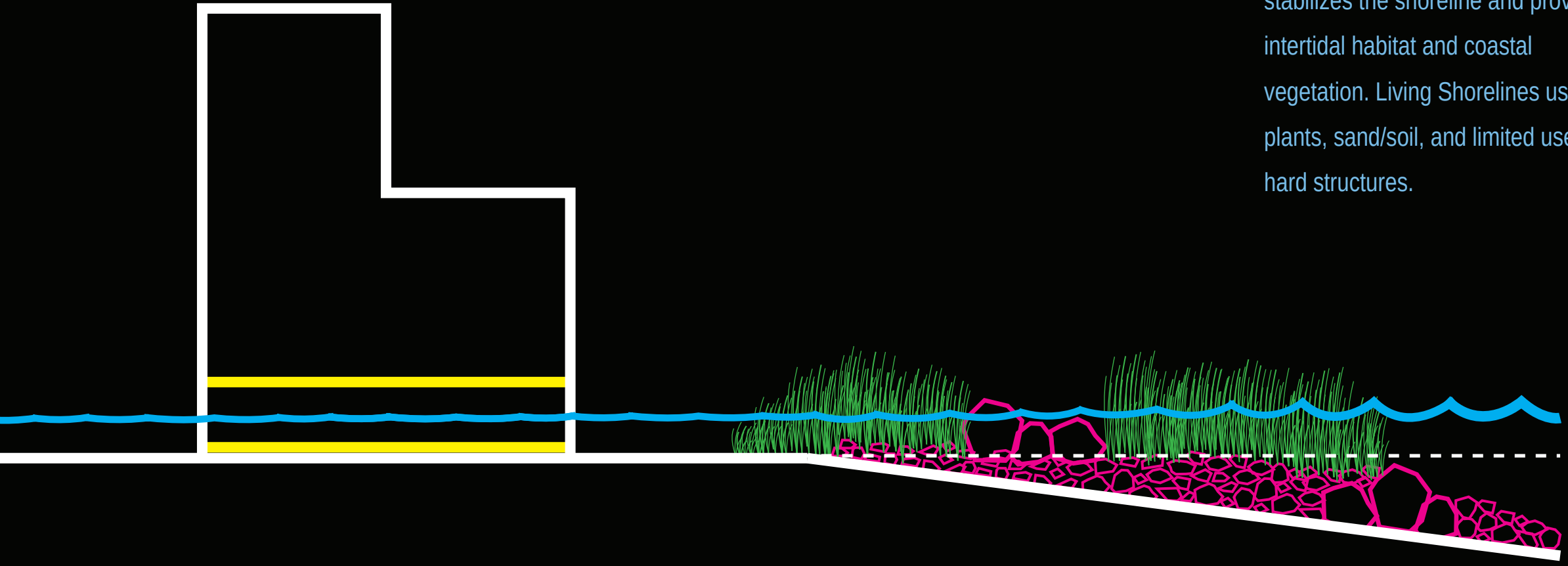
Bjarke Ingels Group,
NYC Rebuild By Design Competition
2014



The Big U, BIG Architects, NYC Rebuild By Design Competiton, 2016, asla.org/2016 awards/.

5. LIVING SHORELINE

Living shorelines are an alternative to bulkheads or revetments that stabilizes the shoreline and provides intertidal habitat and coastal vegetation. Living Shorelines use plants, sand/soil, and limited use of hard structures.



STRATEGIES
LIVING SHORELINES

Living Shoreline

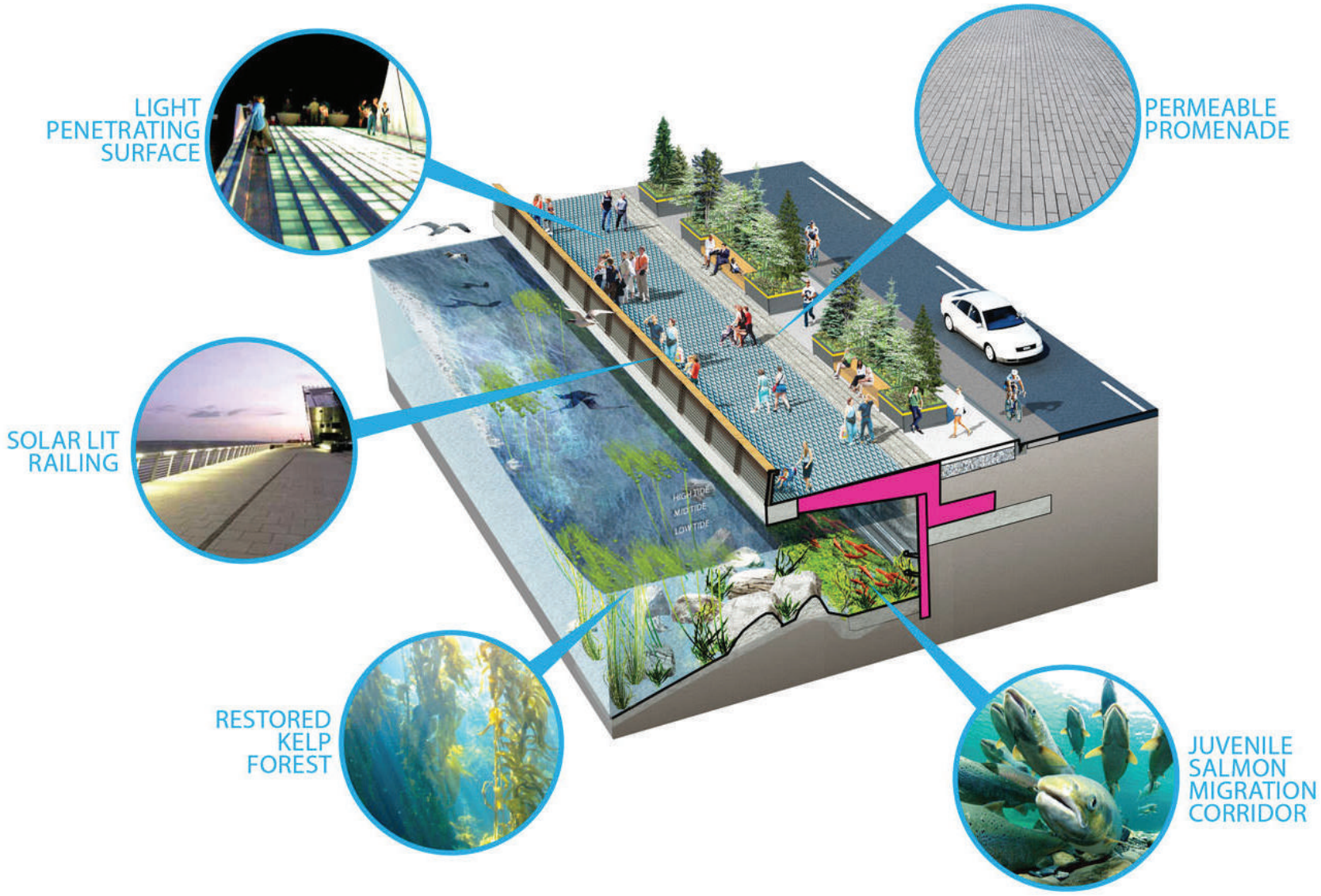
EAST RIVER BLUEWAY

WXY DESIGN
NY State Division of Coastal Resources
2014

East River Blueway Plan, WXY Studio, 2013, wxystudio.com/projects/.

East River Blueway Plan, WXY Studio, 2013, wxystudio.com/projects/.

East River Blueway Plan, WXY Studio, 2013, wxystudio.com/projects/.



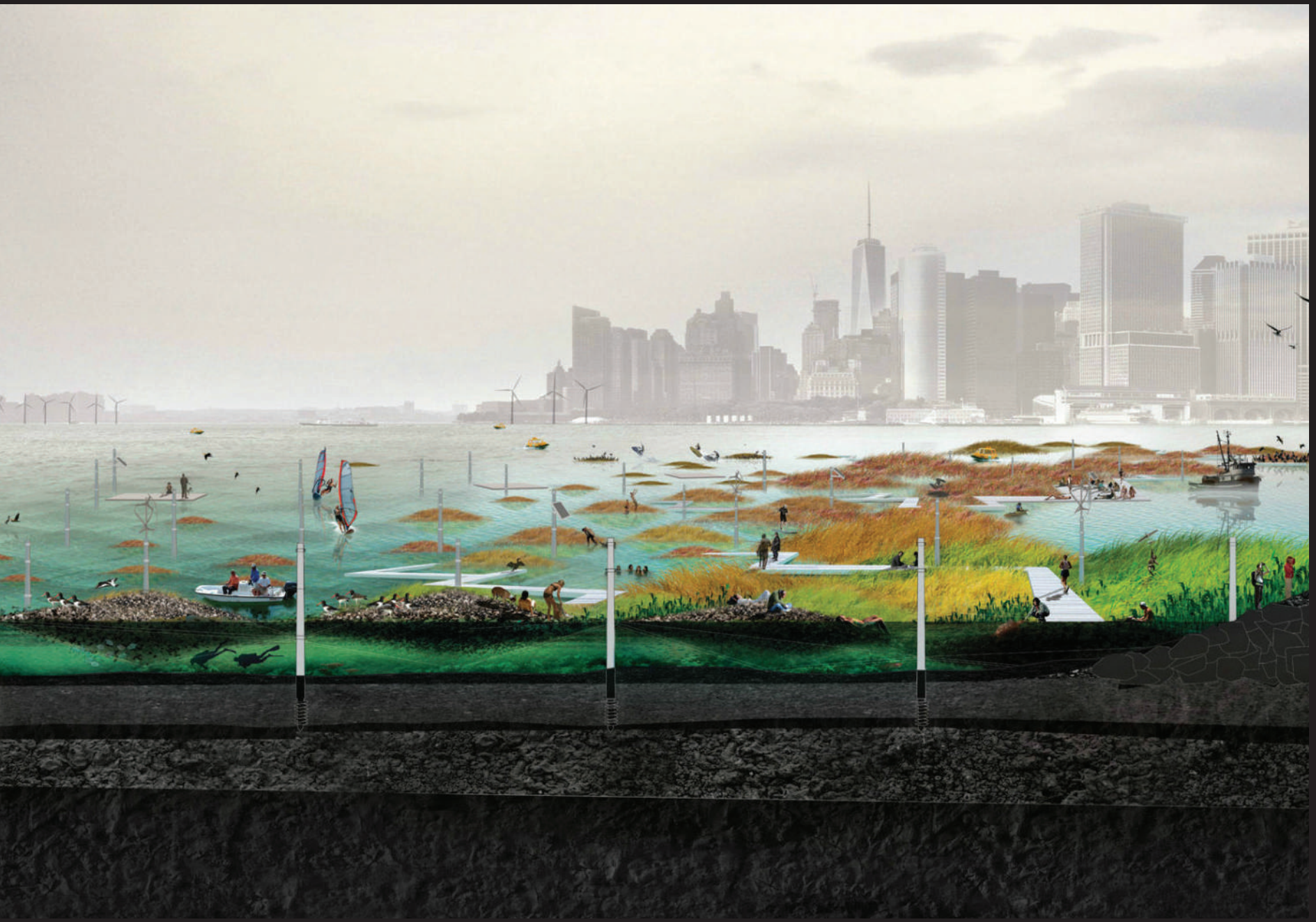
SEATTLE CENTRAL SEA WALL

JAMES CORNER FIELD OPERATIONS
City of Seattle, WA
2017

Seattle's Central Seawall Project, James Corner Field Operations, Seattle, WA, asla.org/2017awards/.

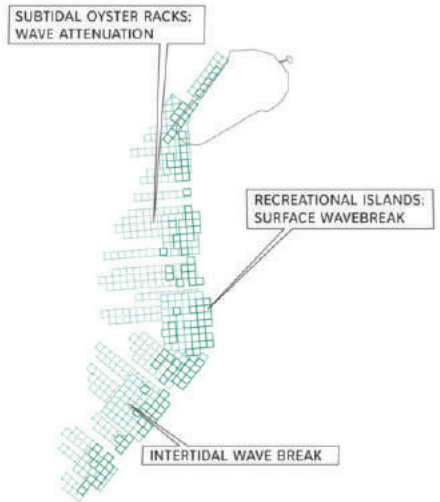
Seattle's Central Seawall Project, James Corner Field Operations, Seattle, WA, asla.org/2017awards/.

Seattle's Central Seawall Project, James Corner Field Operations, Seattle, WA, asla.org/2017awards/.



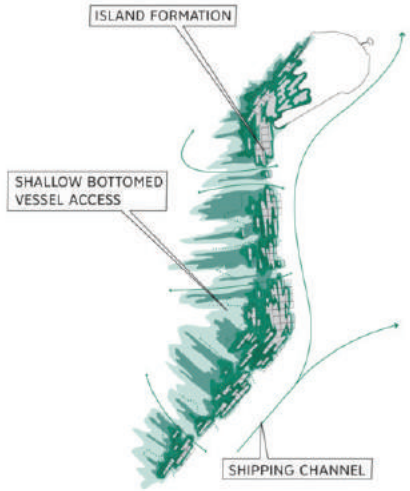
OYSTER-TECTURE

SCAPE STUDIO
NYC, MOMA
2009

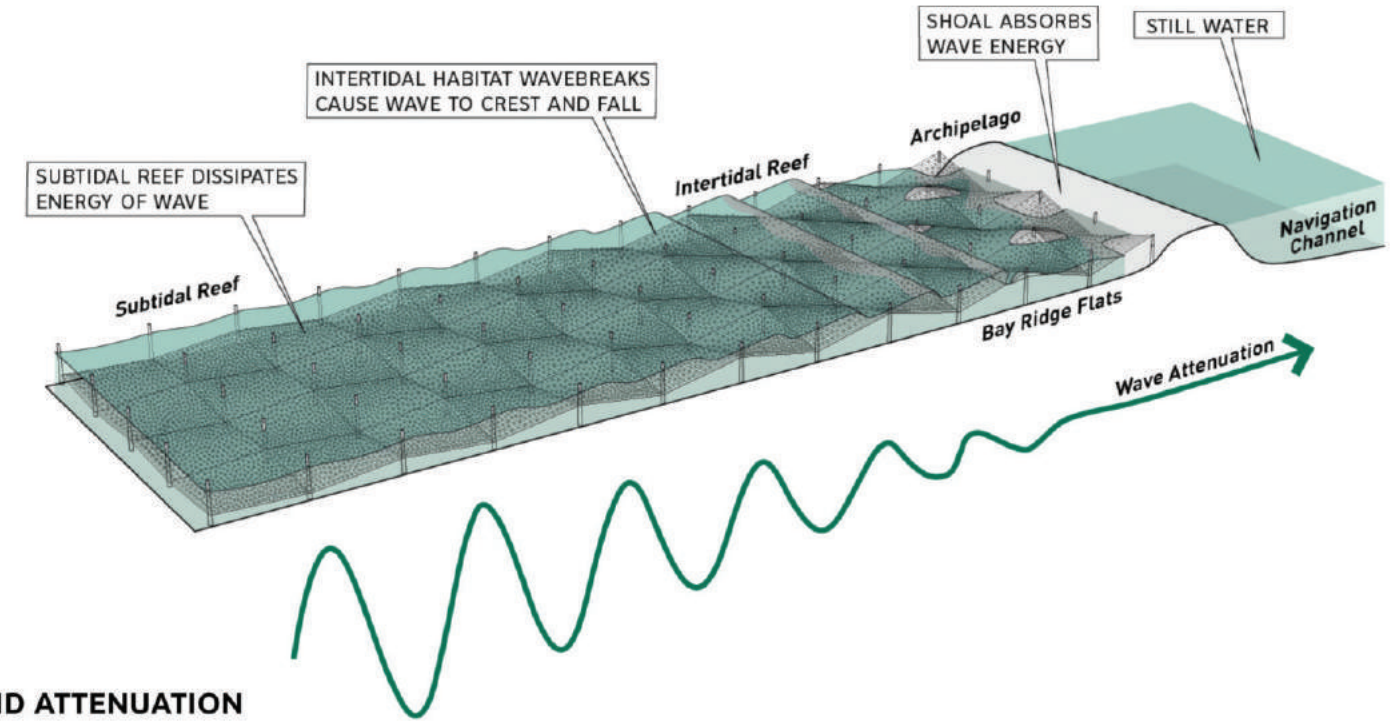


Mollusk Wavebreak Armature

Emergent Habitat



Recreational Archipelago



REEF BUILDING AND ATTENUATION

Oyster-Tecture, Scape Studio, 2009, scapestudio.com/projects/oyster-tecture/.

RED HOEK POINT

SCAPE STUDIO
NYC
2017

Red Hoek Point, Scape Studio, NYC Seattle, scapestudio.com/projects/red-hook-point/.

Red Hoek Point, Scape Studio, NYC Seattle, scapestudio.com/projects/red-hook-point/.

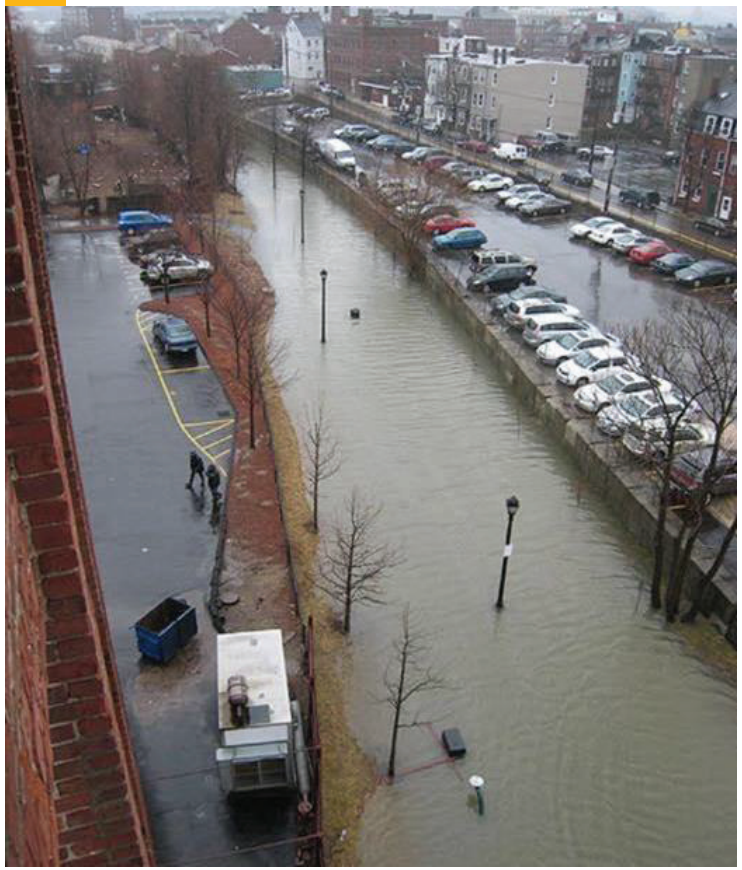
Red Hoek Point, Scape Studio, NYC Seattle, scapestudio.com/projects/red-hook-point/.

STRATEGIES

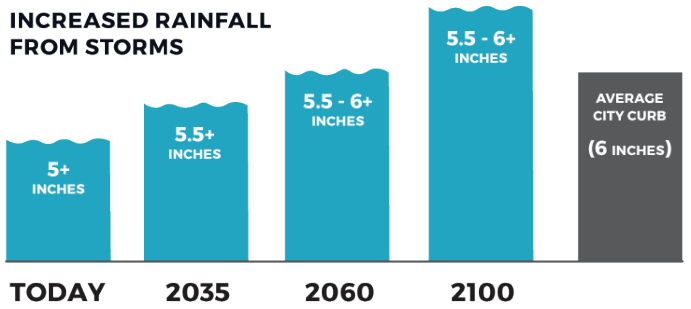
STORMWATER

INCREASED PRECIPITATION

INCREASING STORM EVENTS



By 2060, heavy precipitation events could drop **more than 6 inches** of water within **24 hours**, which is the height of an average city curb, and **20% more** than what we get now.

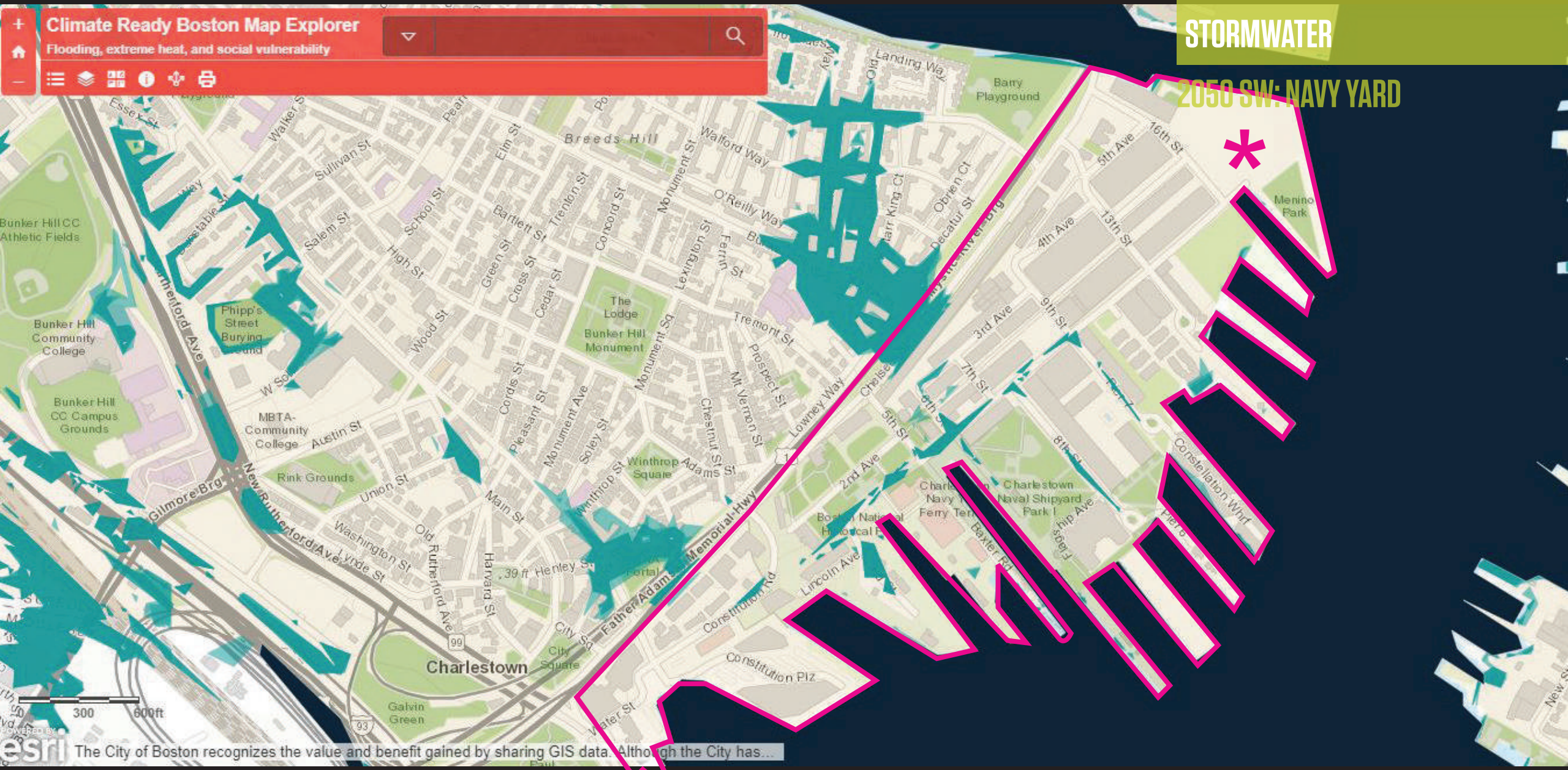


20% MORE WATER

Source: Climate Ready Boston, 2017, boston.gov/departments/environment/climate-ready-boston/.

STORMWATER

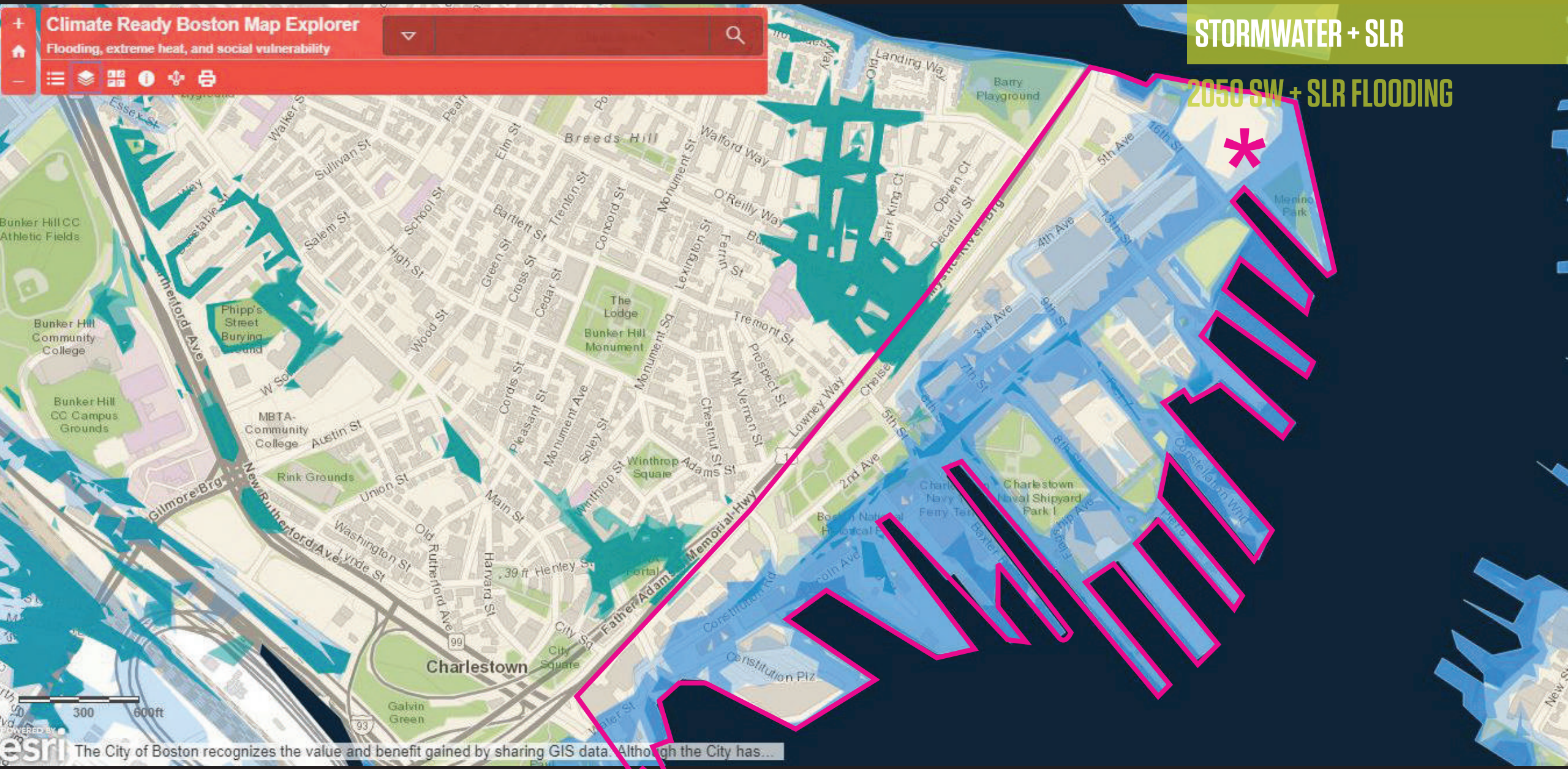
2050 SW: NAVY YARD



Source: Climate Ready Boston Map Explorer, City of Boston, 2018, boston.maps.arcgis.com/.

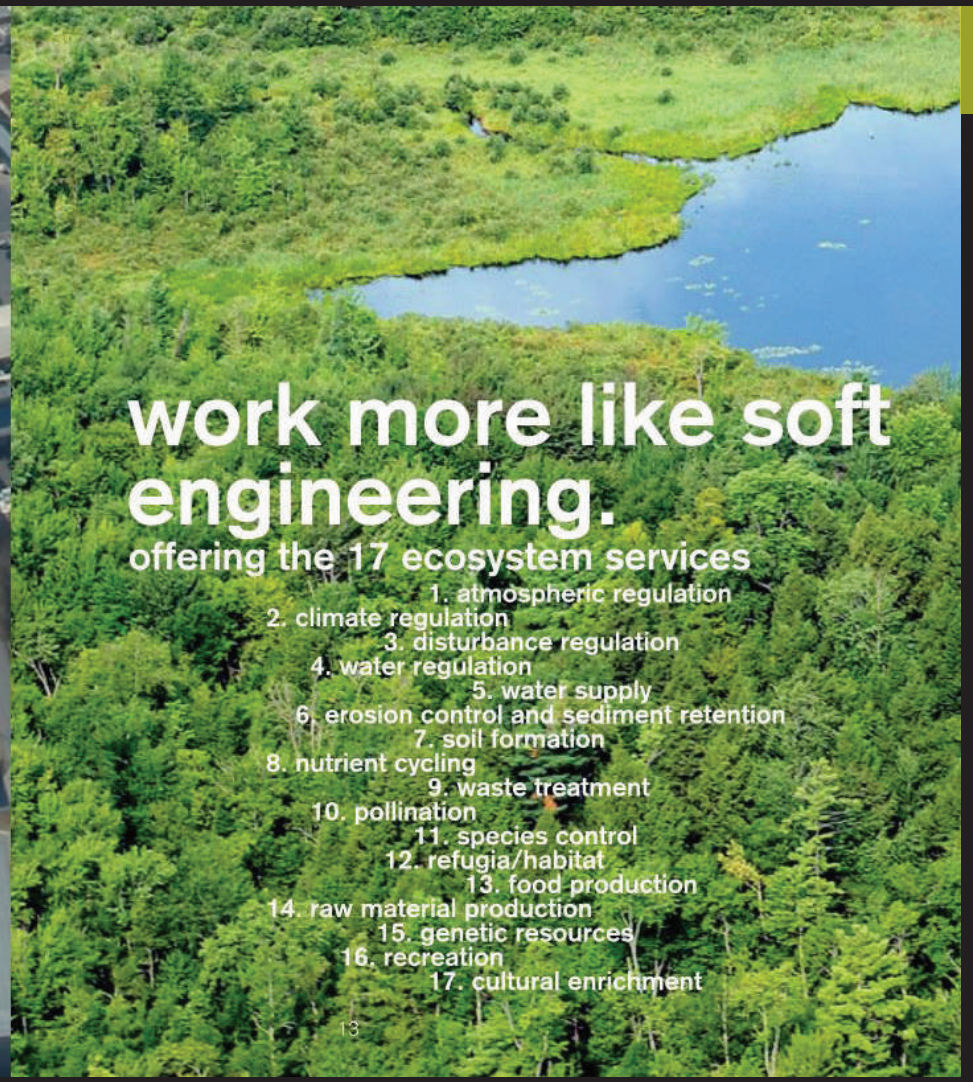
STORMWATER + SLR

2050 SW + SLR FLOODING

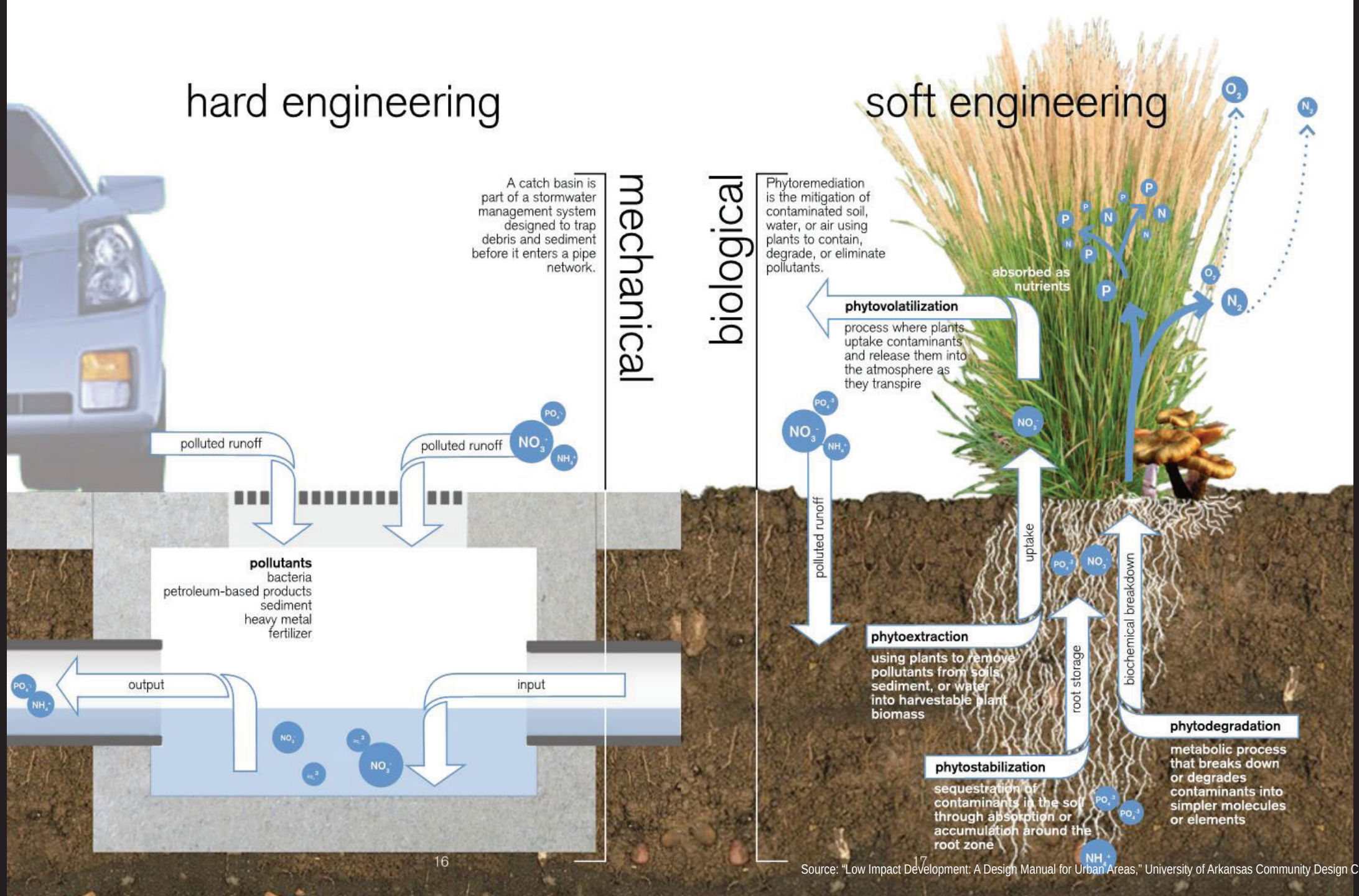


Source: Climate Ready Boston Map Explorer, City of Boston, 2018, boston.maps.arcgis.com/.

STORMWATER STRATEGIES



Source: “Low Impact Development: A Design Manual for Urban Areas,” University of Arkansas Community Design Center, 2010



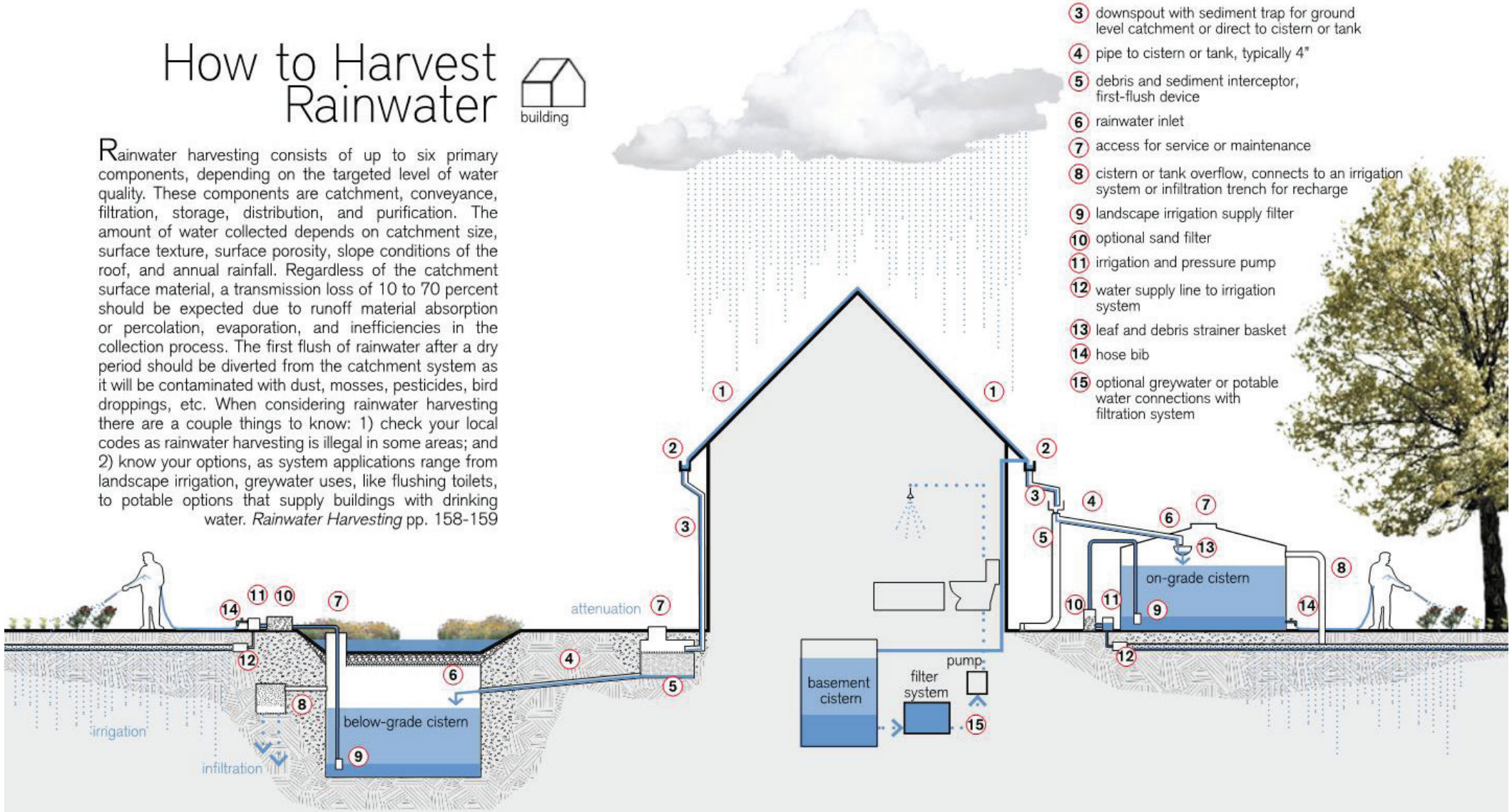
Source: "Low Impact Development: A Design Manual for Urban Areas," University of Arkansas Community Design Center, 2010

Disconnect Your Roof Drains

How to Harvest Rainwater

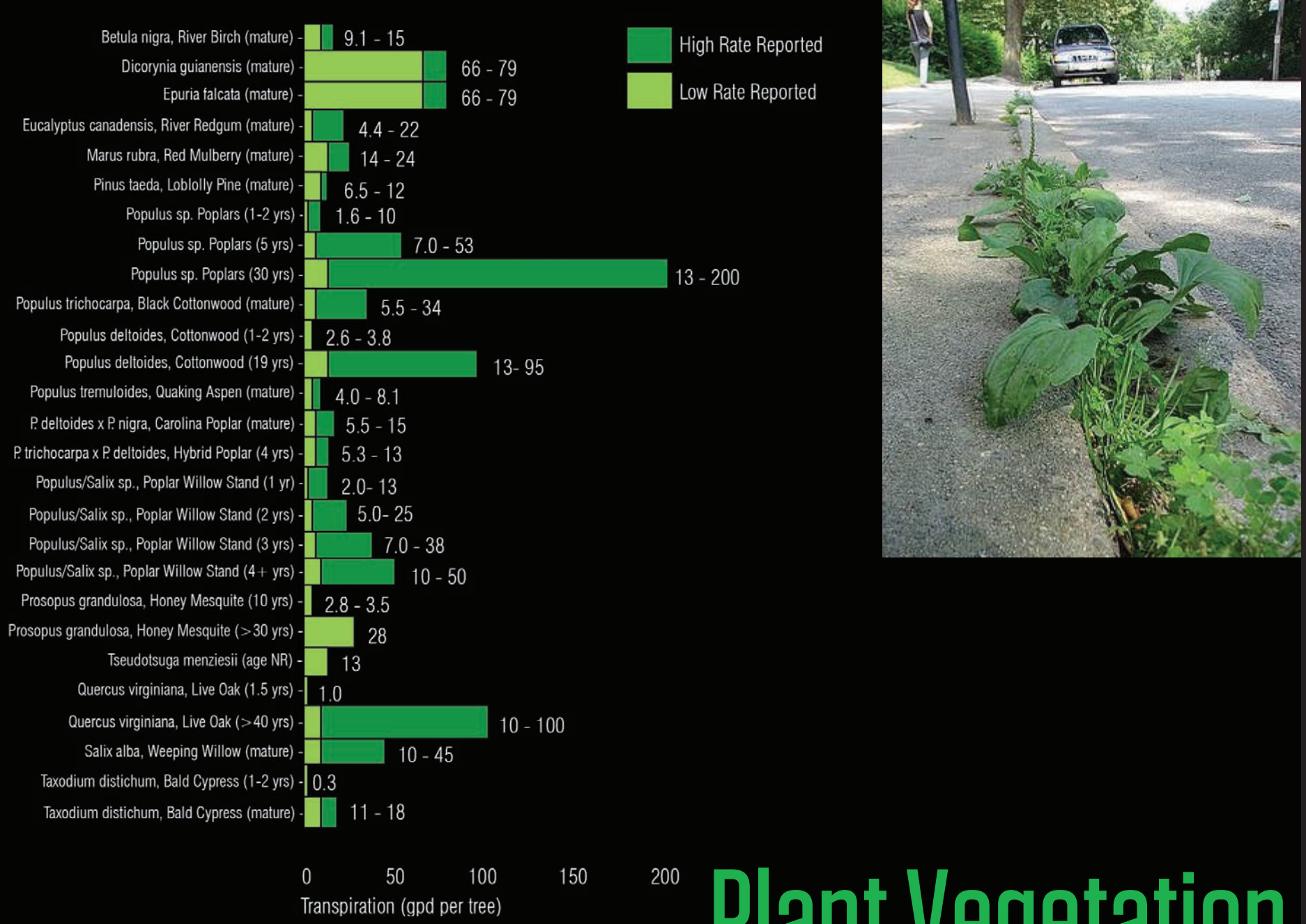
building

Rainwater harvesting consists of up to six primary components, depending on the targeted level of water quality. These components are catchment, conveyance, filtration, storage, distribution, and purification. The amount of water collected depends on catchment size, surface texture, surface porosity, slope conditions of the roof, and annual rainfall. Regardless of the catchment surface material, a transmission loss of 10 to 70 percent should be expected due to runoff material absorption or percolation, evaporation, and inefficiencies in the collection process. The first flush of rainwater after a dry period should be diverted from the catchment system as it will be contaminated with dust, mosses, pesticides, bird droppings, etc. When considering rainwater harvesting there are a couple things to know: 1) check your local codes as rainwater harvesting is illegal in some areas; and 2) know your options, as system applications range from landscape irrigation, greywater uses, like flushing toilets, to potable options that supply buildings with drinking water. *Rainwater Harvesting* pp. 158-159



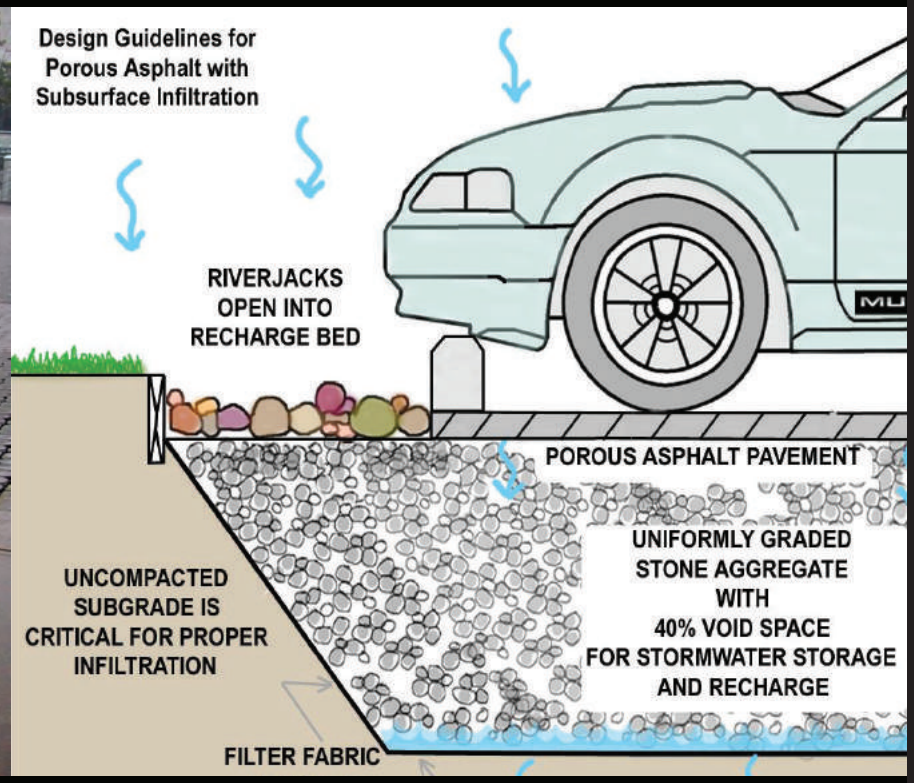
Source: "Low Impact Development: A Design Manual for Urban Areas," University of Arkansas Community Design Center, 2010

Rain Reuse



Plant Vegetation


Add a Green or BLUE Roof

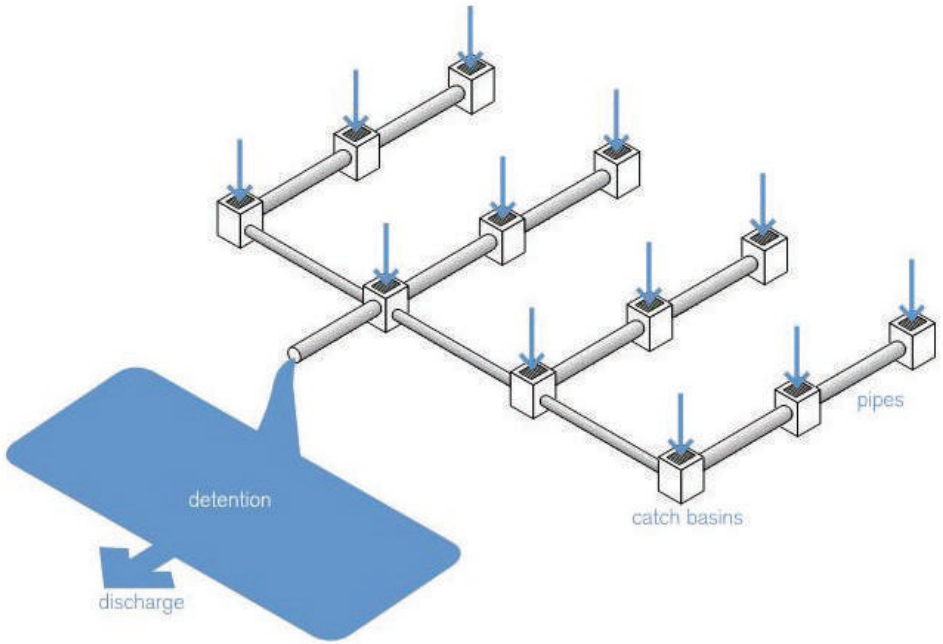


Use Permeable Pavement

STORMWATER STRATEGIES

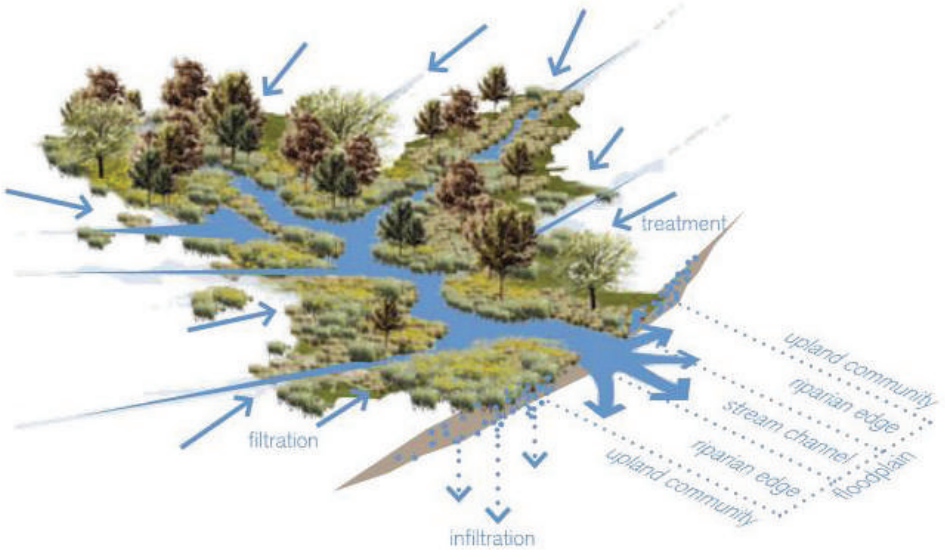
NEIGHBORHOOD + CITY WIDE

hard engineering
...just transfers pollution
to another site



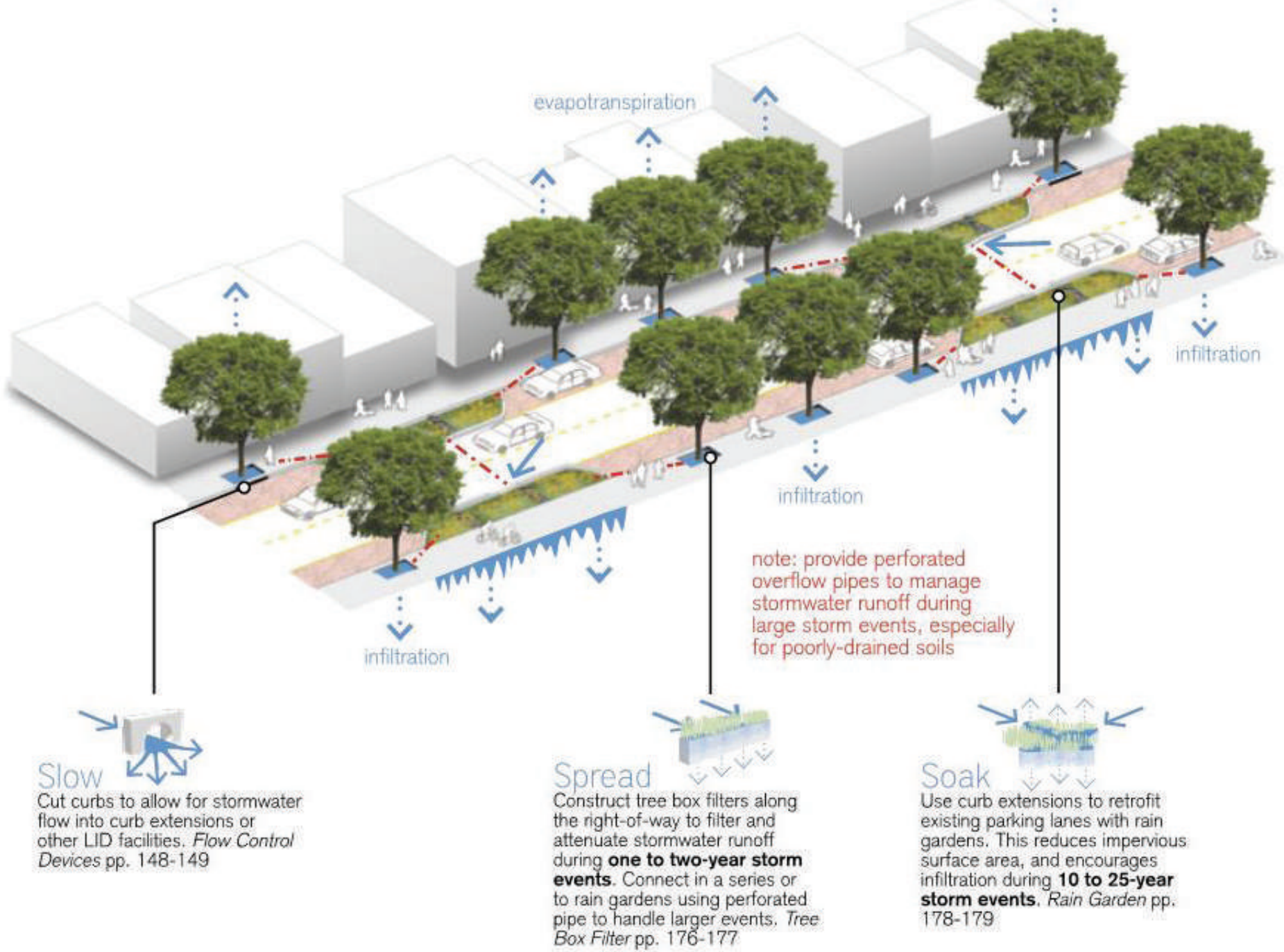
conventional management: "pipe-and-pond" infrastructure
drain, direct, dispatch

soft engineering
...metabolizes pollutants
on site—parks, not pipes!



low impact management: watershed approach
slow, spread, soak

Source: "Low Impact Development: A Design Manual for Urban Areas," University of Arkansas Community Design Center, 2010



Slow

Cut curbs to allow for stormwater flow into curb extensions or other LID facilities. *Flow Control Devices* pp. 148-149

Spread

Construct tree box filters along the right-of-way to filter and attenuate stormwater runoff during **one to two-year storm events**. Connect in a series or to rain gardens using perforated pipe to handle larger events. *Tree Box Filter* pp. 176-177

Soak

Use curb extensions to retrofit existing parking lanes with rain gardens. This reduces impervious surface area, and encourages infiltration during **10 to 25-year storm events**. *Rain Garden* pp. 178-179

Source: “Low Impact Development: A Design Manual for Urban Areas,” University of Arkansas Community Design Center, 2010

Soak Up Stormwater

PRECEDENTS

THE SOUL OF NØRREBRO

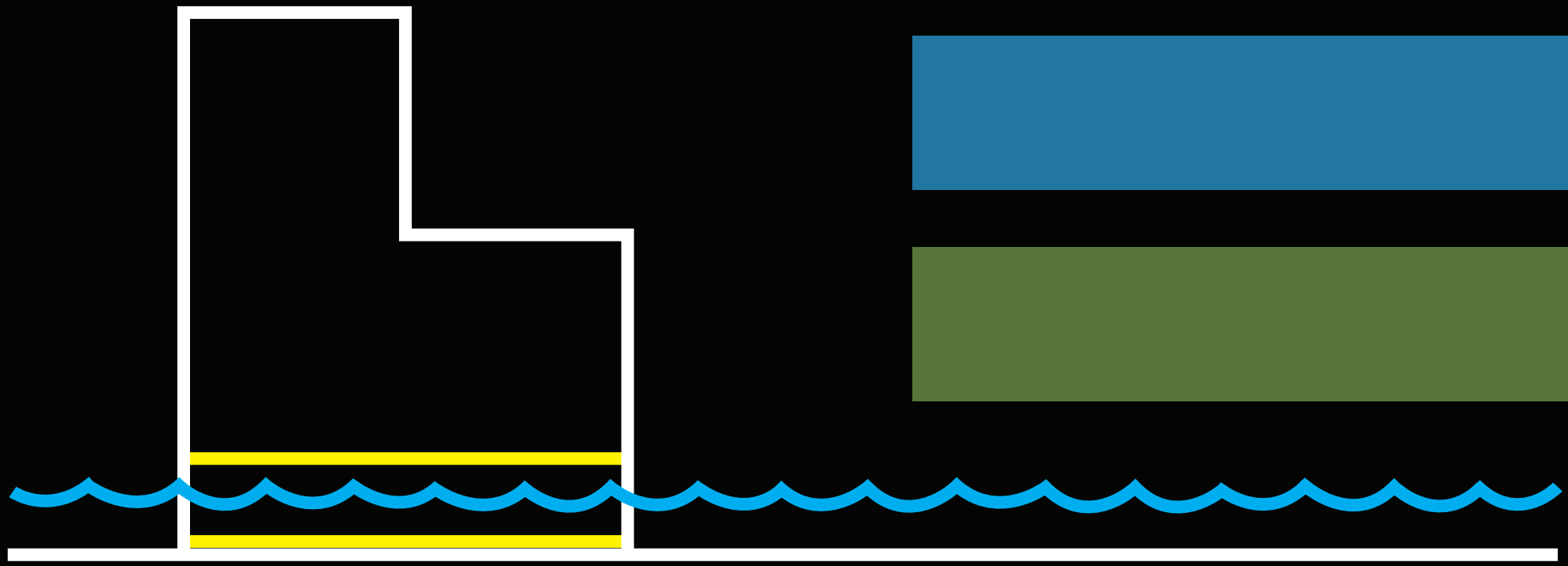
SLA - Stig L. Andersson Architecture
Copenhagen, Denmark
2016

Source: Landezine, landezine.com/index.php/2016/11/nature-based-climate-adaptation-wins-scandinavias-biggest-architecture-award/

Source: Landezine, landezine.com/index.php/2016/11/nature-based-climate-adaptation-wins-scandinavias-biggest-architecture-award/

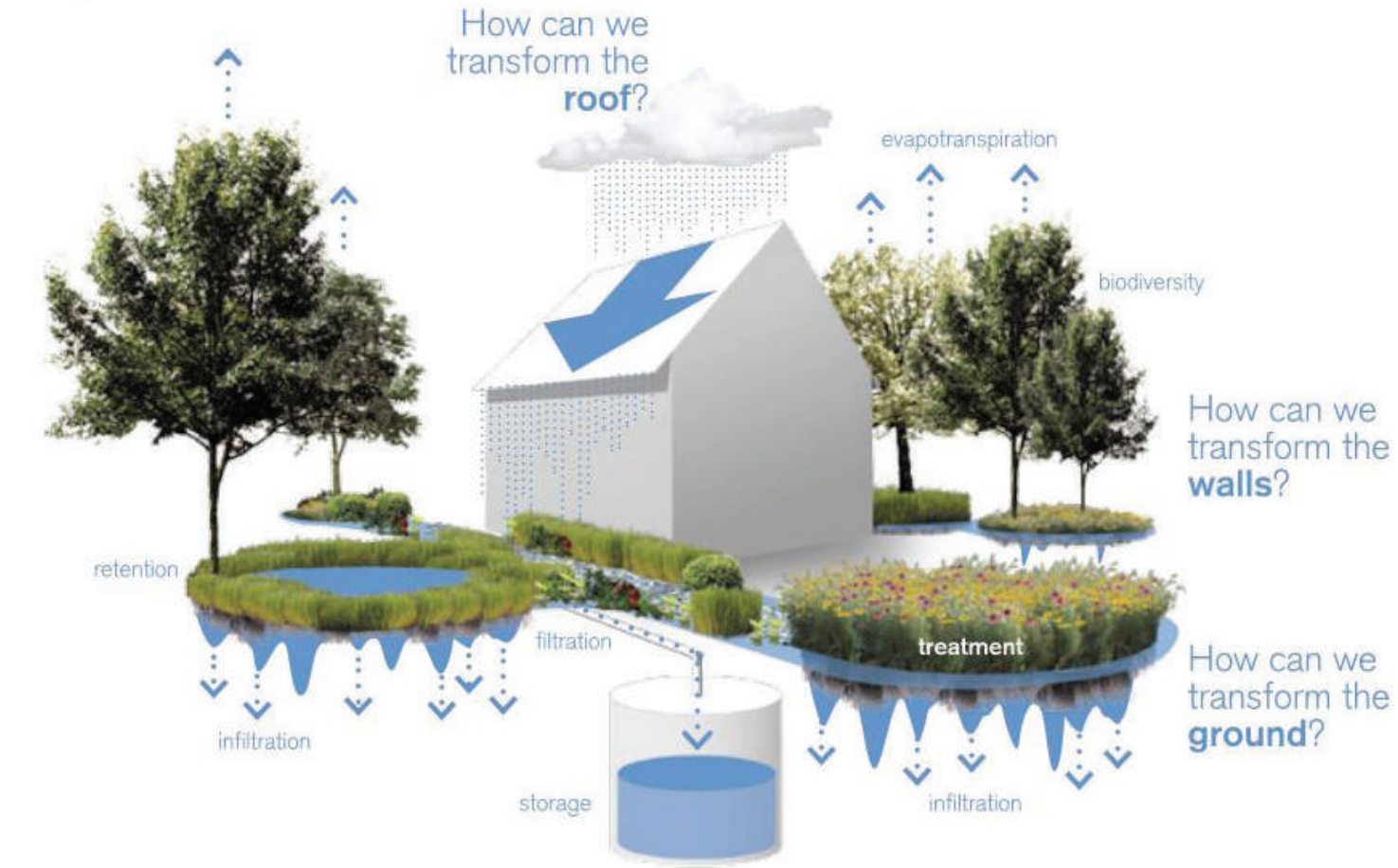
RETROFIT BUILDINGS

Wet Floodproofing
Dry Floodproofing



WHAT CAN WE DO?

SEEP STOMRWATER AT THE SOURCE



INTEGRATE GREEN INFRASTRUCTURE

Source: “Low Impact Development: A Design Manual for Urban Areas,” University of Arkansas Community Design Center, 2010

FLOOD ZONES OVERVIEW AND ALLOWED MITIGATION STRATEGIES

Coastal Engineering Company

April 24, 2018

COASTAL
engineering co.

1. Understanding a Flood Map and the different zones

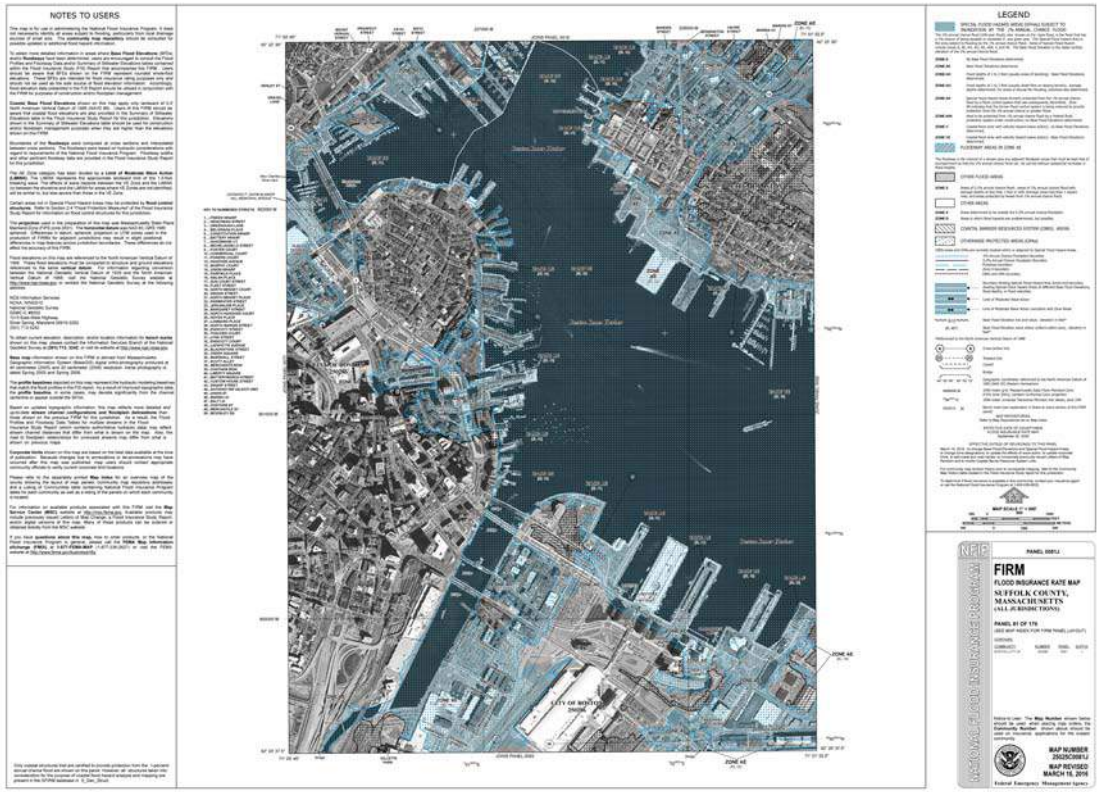
2. Determining which Flood Zone your building falls within

3. Regulations (Federal, State, Local)

4. Design implications for retrofit projects

- Administered by FEMA
- Offers flood insurance to property owners
- Flood Insurance required if you have a mortgage

- Shows the special flood hazard areas (SFHA)
- Shows the locations of buildings in relation to these zones (must be verified by site survey)
- Used for more than just Insurance:
  - Wetland Regulation
  - Building Code
  - Site Sanitary (Title V)
  - Floodplain Management



Flood Insurance Rate Map (FIRM): Official map of a community on which FEMA has delineated the Special Flood Hazard Areas (SFHAs), the Base Flood Elevations (BFEs) and the risk premium zones applicable to the community. Flood hazard areas identified on the Flood Insurance Rate Map (FIRM) are identified as a Special Flood Hazard Area (SFHA). SFHA are defined as the area that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 1-percent annual chance flood is also referred to as the base flood or 100-year flood. SFHAs are labeled as Zone A, Zone AO, Zone AH, Zones A1-A30, Zone AE, Zone A99, Zone AR, Zone AR/AE, Zone AR/AO, Zone AR/A1-A30, Zone AR/A, Zone V, Zone VE, and Zones V1-V30. Moderate flood hazard areas, labeled Zone B or Zone X (shaded) are also shown on the FIRM, and are the areas between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood. The areas of minimal flood hazard, which are the areas outside the SFHA and higher than the elevation of the 0.2-percent-annual-chance flood, are labeled Zone C or Zone X (unshaded).

Base Flood: A flood having a 1% chance of being equaled or exceeded in any given year.

Base Flood Elevation (BFE): The elevation of surface water resulting from a flood that has a 1% chance of equaling or exceeding that level in any given year. The BFE is shown on the Flood Insurance Rate Map (FIRM) for zones AE, AH, A1–A30, AR, AR/A, AR/AE, AR/A1– A30, AR/AH, AR/AO, V1–V30 and VE.

Floodproofing: Any combination of structural and nonstructural additions, changes or adjustments to structures, which reduce or eliminate risk of flood damage to real estate or improved real property, water and sanitation facilities or structures with their contents.

Zone VE (V1-30) – Areas of 100-year coastal flood with velocity waves

- Wave height 3 feet or greater
- Wave runup depth 3 feet or greater
- Within primary frontal dune (first dune landward of the beach)

Zone AE (A1-30) – Areas of 100-year flood; flood elevations

- May be coastal or riverine
- Coastal can contain up to 2.9 feet wave height
- Coastal flood elevations at top of wave envelope

Coastal A Zone (MoWA) – Portion of A Zone with 1.5 – 3.0' waves

- Separated from the rest of the A Zone by the LiMWA

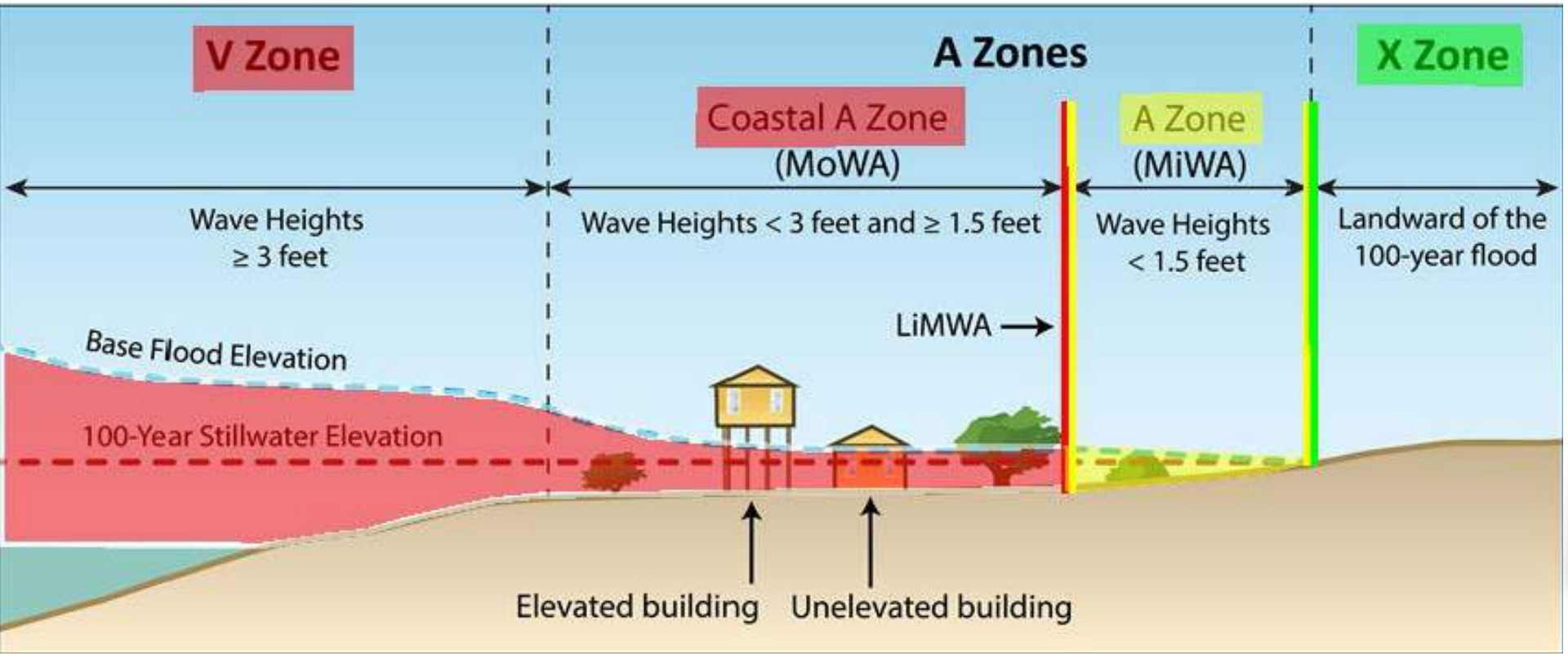
Zone AO – "Overwash" areas with flow depths of 1 to 3 feet

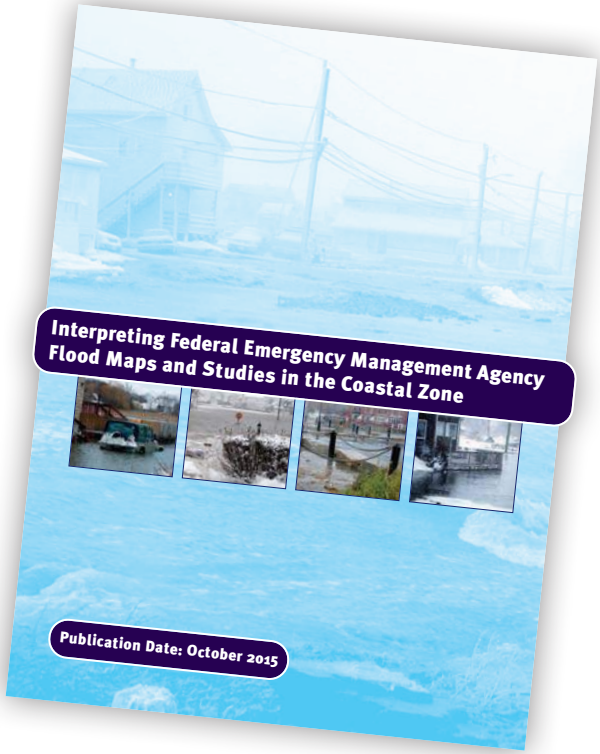
- Generally coastal with sloping ground
- Flow velocities can vary greatly
- Flow paths are typically not well defined

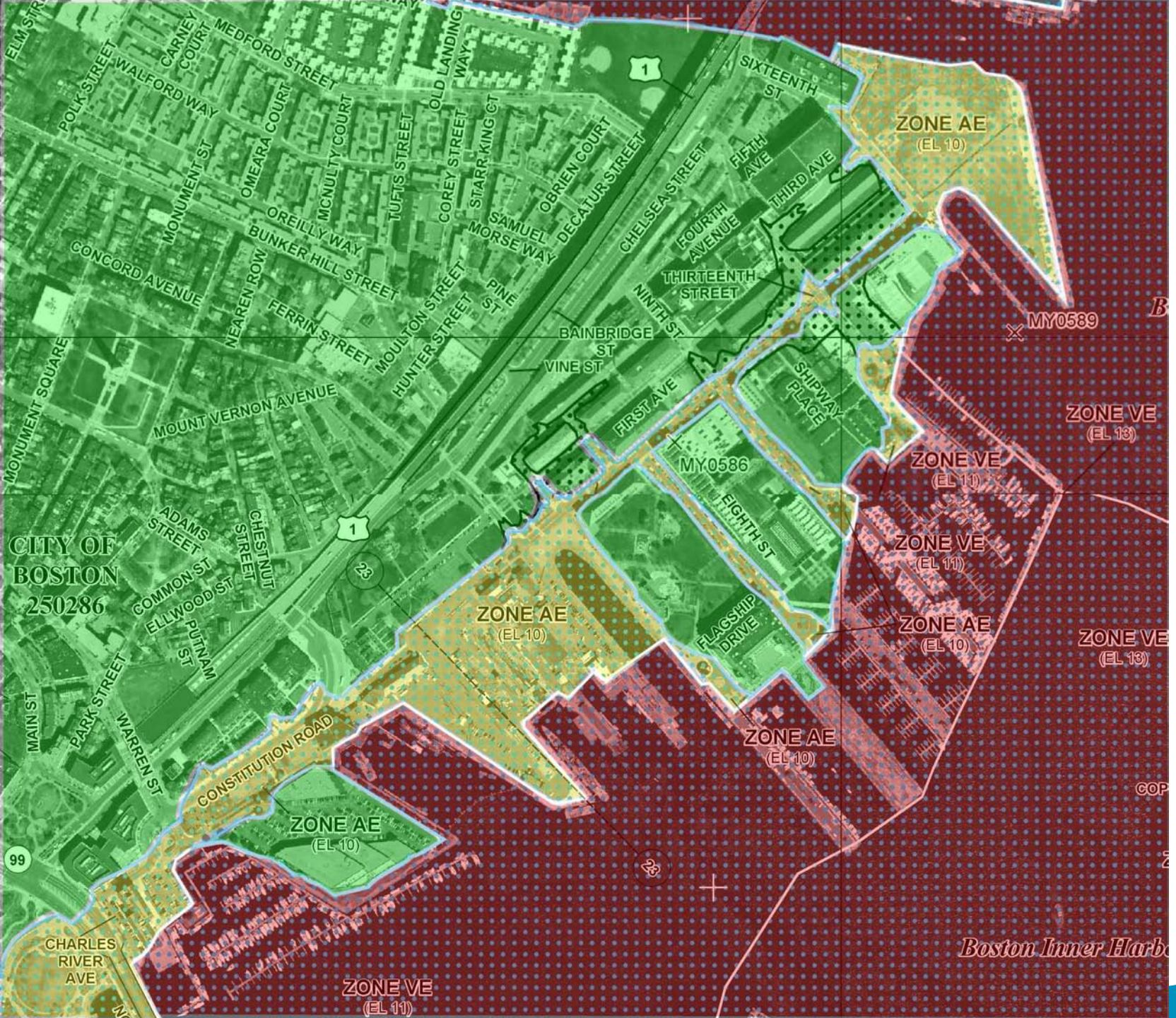
Zone A – Areas of 100-year flood; NO flood elevations given

Shaded Zone X (B) – Areas of 500-year flood

Unshaded Zone X (C) – "Areas of minimal flooding"


V Zone
A Zones
X Zone
Coastal A Zone
(MoWA)
A Zone
(MiWA)
Wave Heights
≥ 3 feet
Wave Heights < 3 feet and ≥ 1.5 feet
Wave Heights
< 1.5 feet
Landward of the
100-year flood
LiMWA
Base Flood Elevation
100-Year Stillwater Elevation
Elevated building
Unelevated building


Interpreting Federal Emergency Management Agency Flood Maps and Studies in the Coastal Zone
Publication Date: October 2015



Zone VE (EL 13)

Zone VE (EL 11)

Zone AE (EL 10)

Zone X (Shaded)

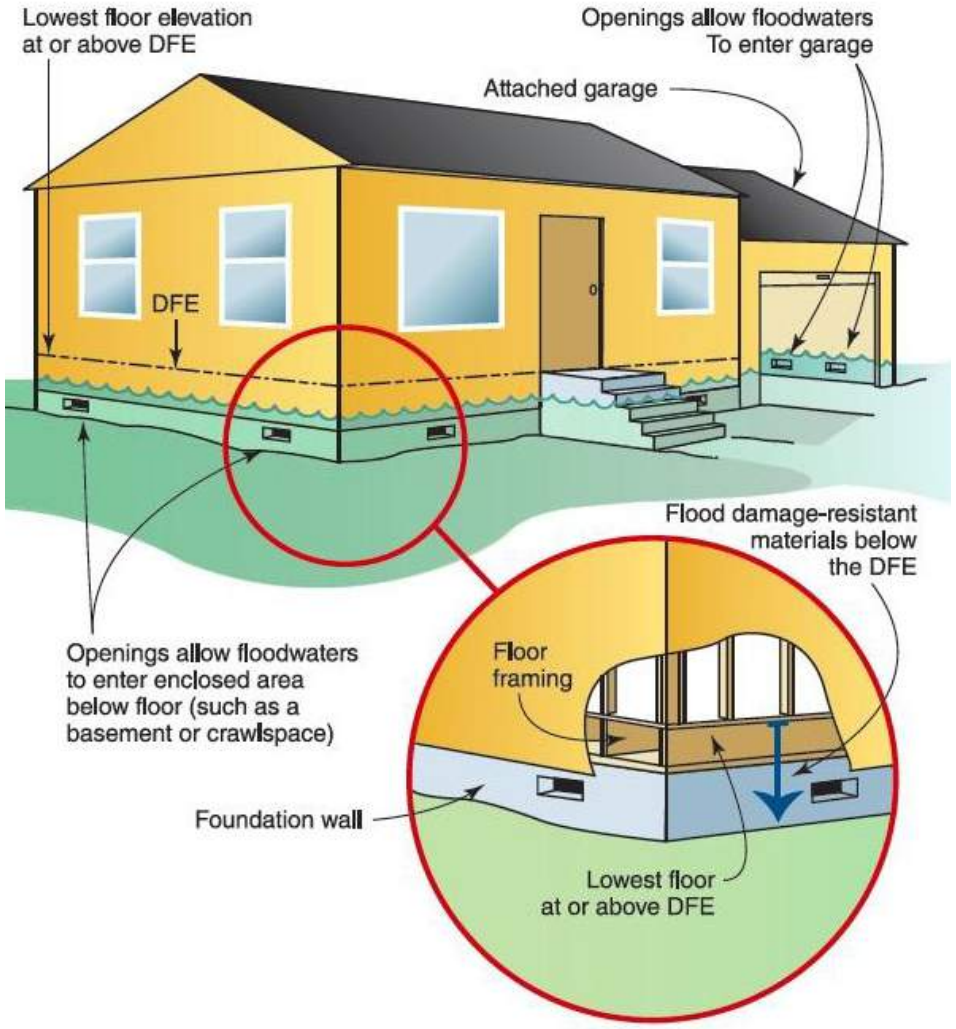
Zone X (Unshaded)

SPECIFIC TO THE NAVY YARD

Similar to any other structure located in the Coastal Flood Plain:

- Conformance to the State Building Code (IBC/IRC-2015, with MA Code Amendments)
- FEMA/ASCE regulations
- MA DEP/Wetland Protection By-Law (310 CMR)
- DEP Waterways (Ch. 91 license required for any site located in filled tide lands)
- Any local zoning ordinance and wetlands bylaw

1. WETPROOFING



NFIP General Wet Floodproofing Requirements
Permitted only for attached garages or parking, access, and storage areas below the BFE
Some historic structures, accessory structures, structures functionally dependent on proximity to water, and agricultural buildings may be wet floodproofed
Portions of the structure below the BFE must be constructed of flood-resistant materials
Must be designed to allow for automatic entry and exit of floodwaters

2. DRYPROOFING

NFIP General Requirements for Dry Floodproofing
For new construction and Substantial Improvement/Damage, permitted only in non-residential buildings in special flood hazard areas not subject to high velocity wave action (i.e., permitted in Zone A).
Must be designed so the structure is watertight below the BFE with walls substantially impermeable to the passage of floodwater.[a]
Attendant utility and sanitary facilities must be completely floodproofed to below the BFE.[a]
A registered design professional must develop and/or review structural designs, specifications, and plans and certify that the design and methods of construction are in accordance with accepted standards of practice.
Not permitted in Coastal High Hazard Areas (Zone V).

Application of a waterproof membrane on the exterior (positive side) of a wall (top) and fiber-reinforced polymer wrap applied to the interior (negative side) of a wall (bottom)

3. UTILITIES PROTECTION

Elevate mechanical and electrical equipment: furnace, water heater and electric panel

- Install housekeeping pads
- Suspend above basement ceiling
- Raise above basement

4. MISCELLANEOUS

- Repair/retrofit surface corrosion on structural steel columns and beams in the basement
- Upgrade sump system and install “check valves”
- “Harden” exterior walls
- Regrade the site to divert water away from the building
- Seal wall openings and install barriers around basement window wells


Flood Mitigation
Charlestown Navy Yard
Medford St
Terminal St
Charlestown
Community Center
Medford St
Bunker Hill St
Main St
Charlestown Navy Yard
CHARLESTOWN
Bunker Hill Monument
BHCC
THOMPSON
SQUARE /
BUNKER HILL
USS Constitution
Museum
y College
n Sand & Gravel

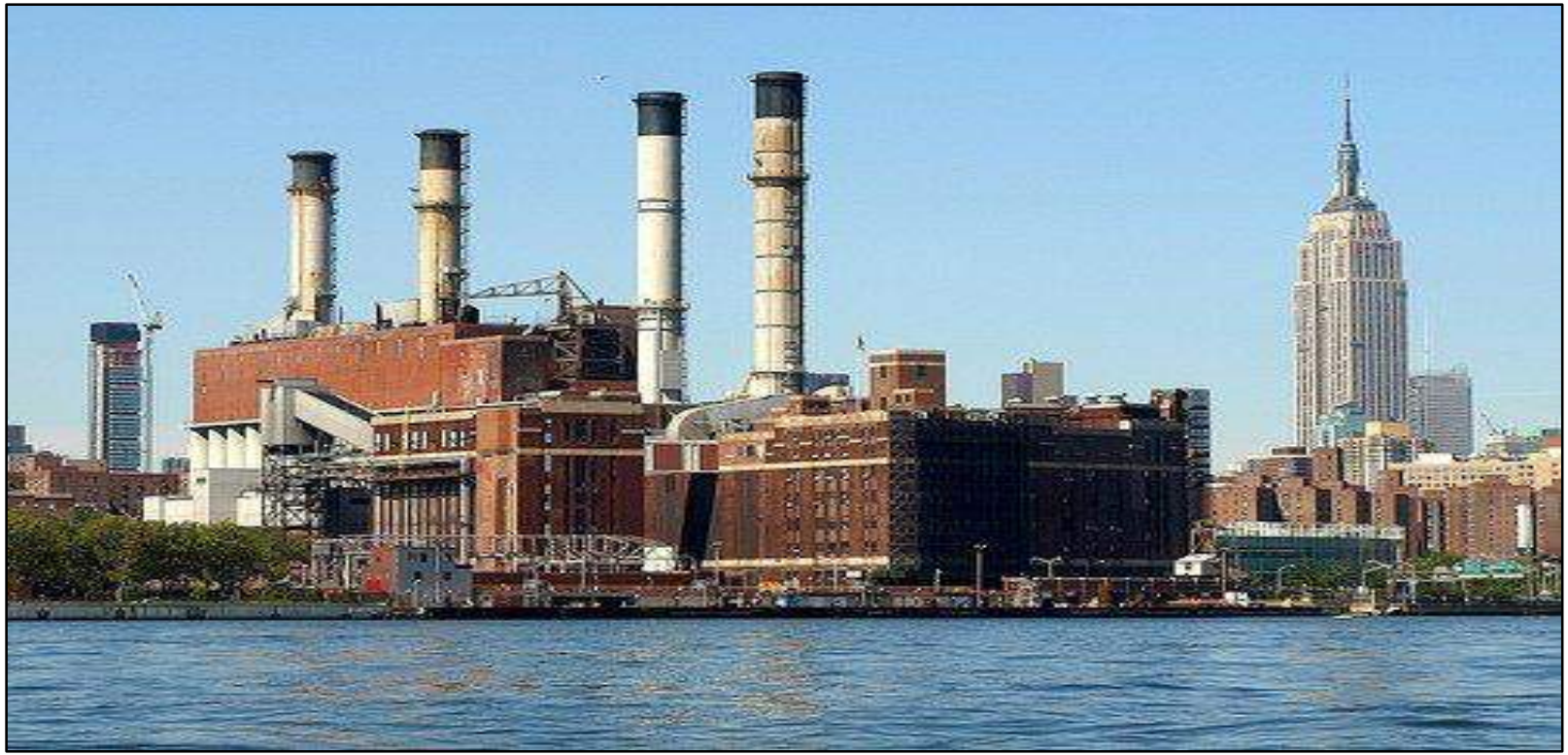
Effects of Lateral and Vertical Hydrostatic and Hydrodynamic Forces

Debris is a Fact of Flood

Performance Testing Video

Non-Residential Buildings Wet Floodproofing

Major Power Generation Company Along East River, NY

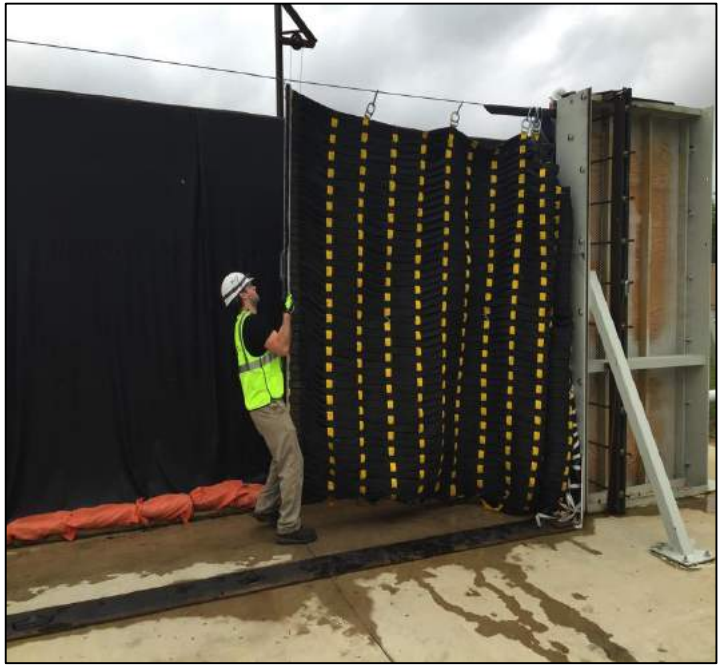


Careful Planning Needed

Planning: Is it possible? What to consider?

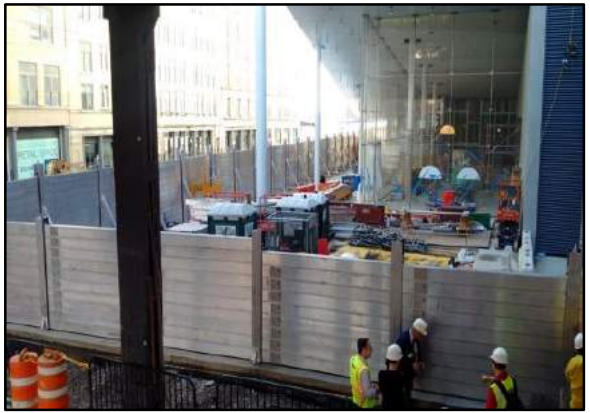
- Warning Time, Safety & Access Frequency, Set Up Time
- Flood Velocities, Depths, and Debris
- Emergency, Maintenance, Inspection Plan
- Cost and Liability

Dry Floodproofing FEMA TB-3 / ASCE 24-14



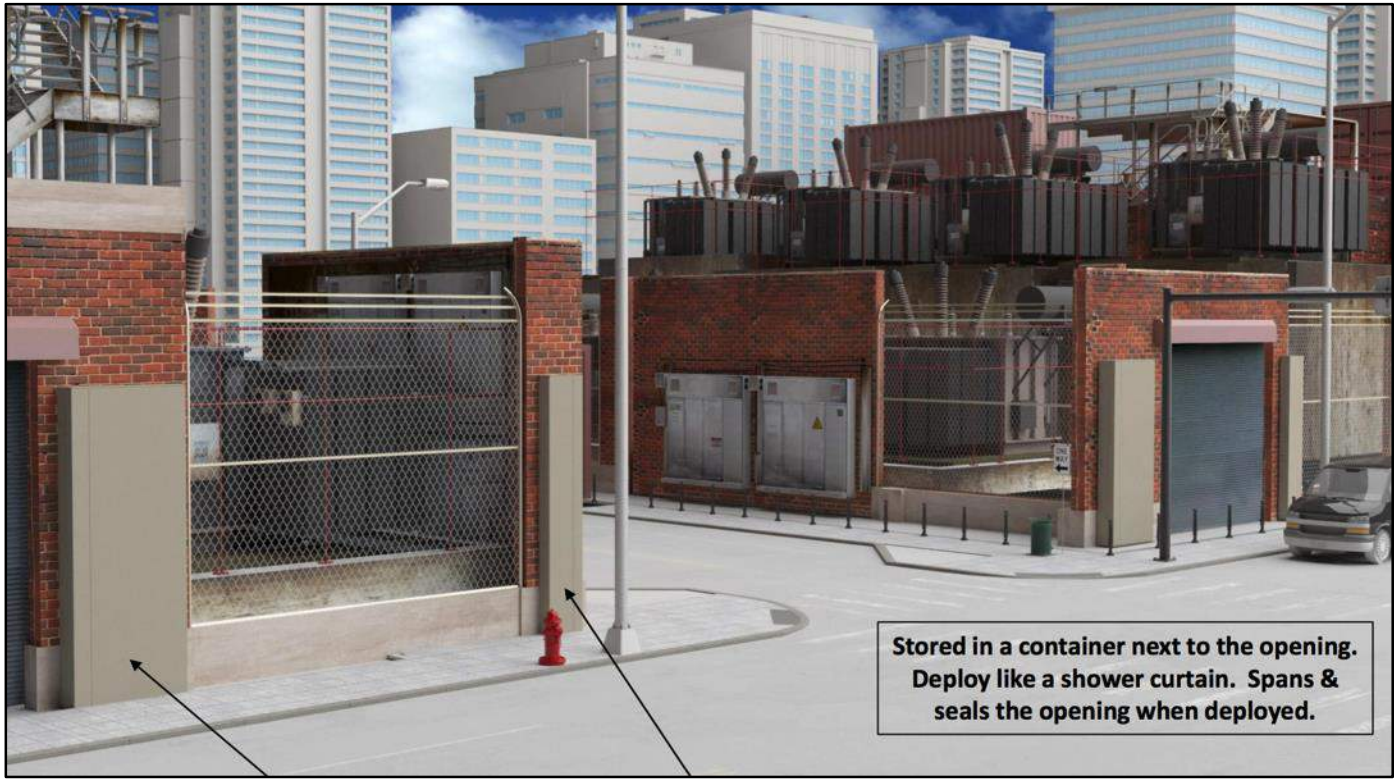
- Makes Building watertight, impermeable to Floodwaters.
- Nonresidential or mixed us structures shall be allowed to have the lowest floor (including basements) below the DFE, provided the structures meet the dry floodproofing requirement.
- Maximum accumulation of 4 in. of water depth in such space during a period of 24 hours.
- Requires flood emergency and inspection plans and for a periodic deployment of shields and barriers. Just like a fire drill we need to practice to insure the system will work.
- Floodwarning time of 12 hours dry floodproofing must be installed in this time.
- Sump pumps shall remove water during flood.
- Design must to certified.

Whitney Museum: Active Deployment Dry Floodproofing System



2 days, a lot of people, and $50,000 each time

Major Power Generation Company Along East River, NY



Major Power Generation Company Along East River, NY

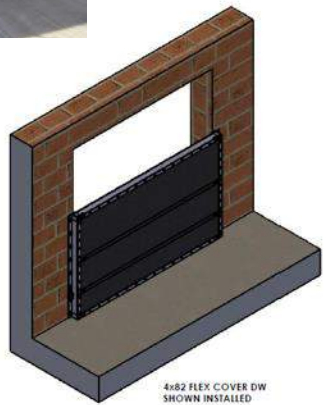
Examples of Spans for Point-of-Use Storage Systems

Vertically Deployed Flexible Wall

Flex Cover

Flex-Cover® DW System

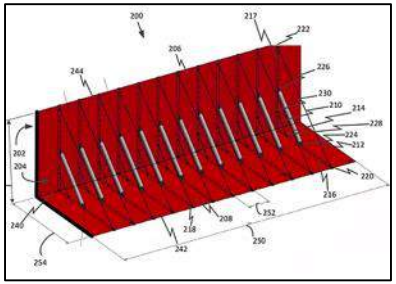
- Standard Sizes Up to 6’
- Up to 70% lighter than traditional metal shields/barriers.
- Deployed in minutes by 1-2 people.

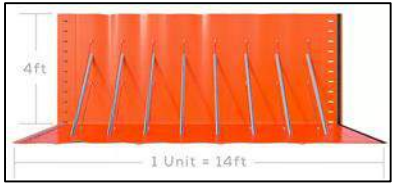


Perimeter Protection Boston

Perimeter Flood Barriers

Diluvium Flood Barriers



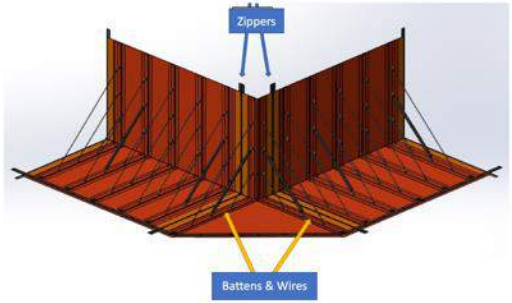


Standard Production Dimensions: **14’ x 4' / 70 lbs.**

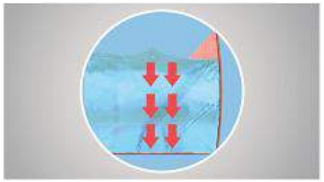
Find one or two people and unroll the barrier to set it up yourself. It uses a simple set of cables and battens.

Attach multiple pieces together as needed with a waterproof zipper.

Rinse the barrier with fresh water and dry completely before storing after a flood emergency.



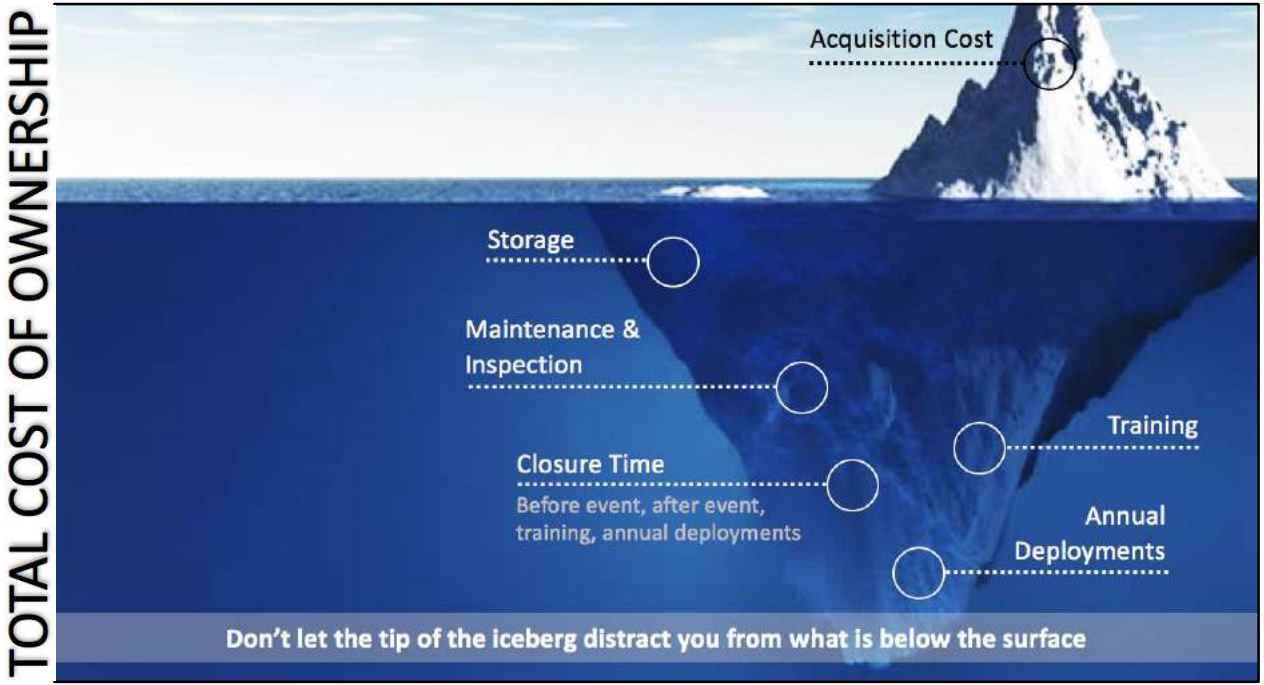
Diluvium Outside Corner



Exterior Barrier Systems

- **Applications** – Protection for Residential, Commercial, Transit, Farmland, Livestock
- Ability to **air drop** in **emergency situations**
- **Point-of-use stored** solutions available
- **Materials** – Coated PVC Fabric, Fiberglass Batons & Rods, Stainless Steel Cables
- **Best solution** on the market for **long spans** of protection needed (perimeter)

Considerations for Floodproofing Strategy



Comments From Helge Krogenes Site Visit

- **Shipway Place-(Protectable)** FlexWall or FlexCover opening protection, upon inspection if sufficient water load and waterproofing is found. Perimeter protection could also be used away from the building wall.
- **Constellation Wharf-(Protectable**) Vertical FlexWall or FlexCover, upon inspection if sufficient waterload and watherproofing in walls and floor.
- **Flagship Wharf-(Protectable)** Window sills are base level to pavement, possible vertical FlexWall or perimeter protection away from the building.
- **Harborview-(Protectable)** Base of building a little higher. Perimeter protection place around the building effective or vertical FlexWall.
- **Building 125-(Protectable**) Protectable with Flex Wall or FlexCover opening protection, upon inspection if sufficient water load and waterproofing is found.
- **Parris Landing-(Protectable**) Protectable with FlexWall or FloodCover opening protection, upon inspection if sufficient water load and waterproofing..
- **Constitution Inn & 45 1st Avenue (Protectable)** Theses building are higher so would not be at as great a chance of flooding. The best option is perimeter protection.

Shipway Place

Constellation Wharf, Pier 7

Constellation Wharf , Pier 7

Building 125

Flagship Wharf

Harborview

Harborview

Parris Landing

3rd Avenue and 9th Street

45 1st Avenue

Additional Sites

- Ropewalk Buildings
- Bricklayers Row Houses
- Marina Office

Ropewalk Buildings

Bricklayers Row Houses

Marina Office

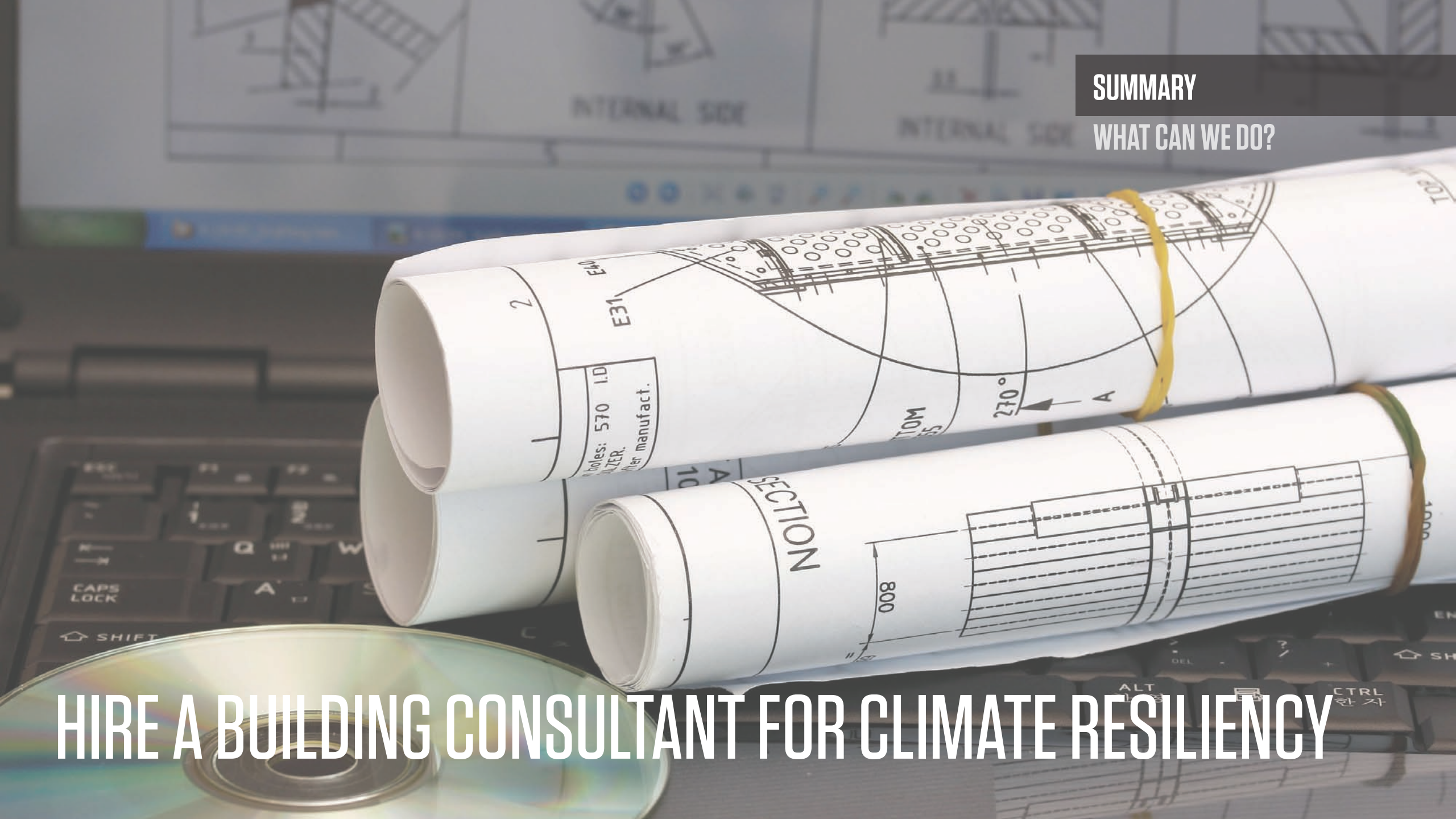
Get Started Today

Flood Plans Division

- Our team of Certified Floodplain Managers and Engineers will customize any Wet and/or Dry Floodproofing solution to your residential or non-residential floodplain projects.
- We will make sure your project is compliant with all FEMA and NFIP Regulations, ICC Building Codes, as well as is receiving the lowest flood insurance premium possible.

FLOOD PLANS DIVISION

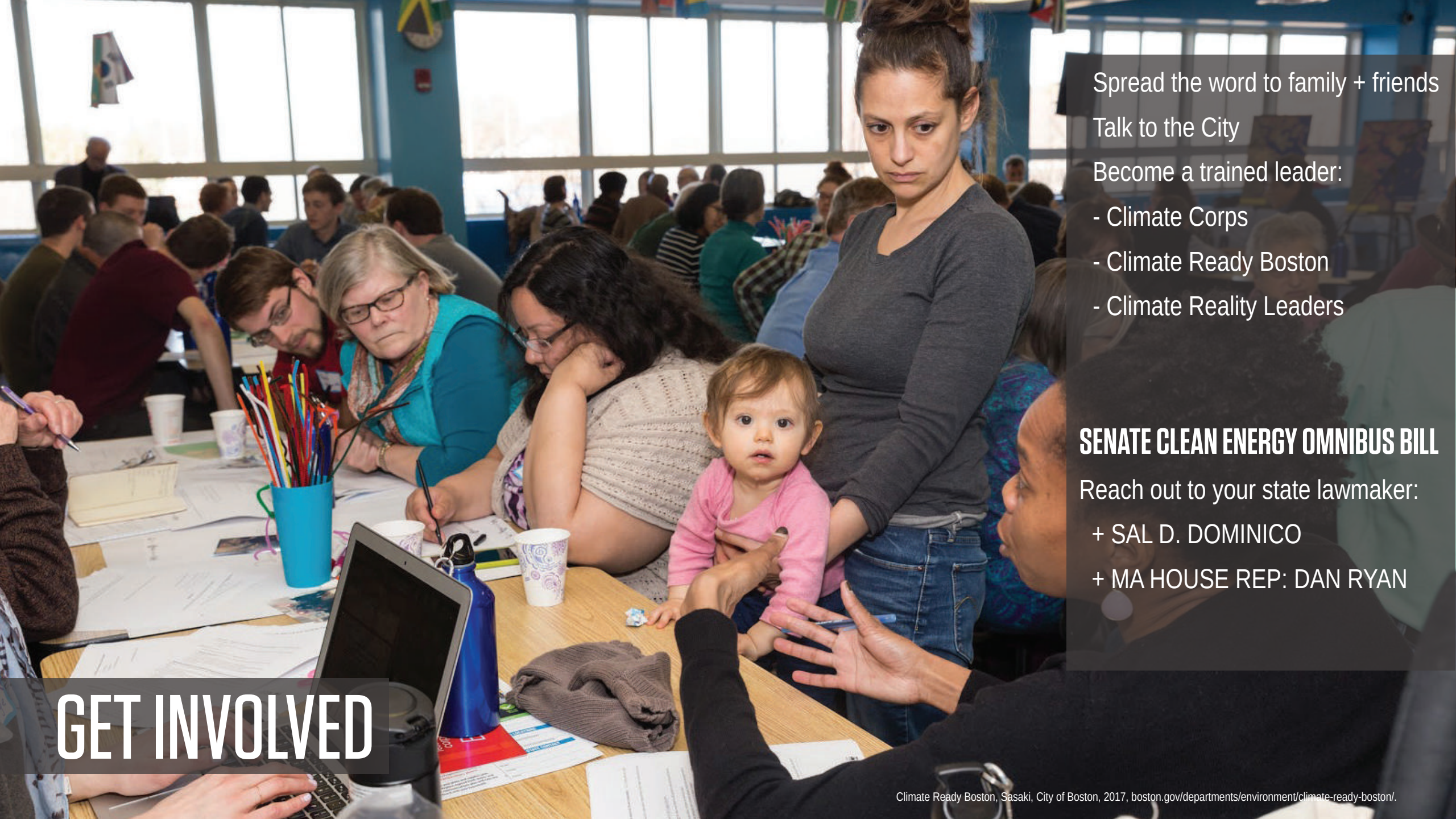
Send plans to:
plans@smartvent.com



SUMMARY

WHAT CAN WE DO?

HIRE A BUILDING CONSULTANT FOR CLIMATE RESILIENCY



GET INVOLVED

Spread the word to family + friends

Talk to the City

Become a trained leader:

- Climate Corps
- Climate Ready Boston
- Climate Reality Leaders

SENATE CLEAN ENERGY OMNIBUS BILL

Reach out to your state lawmaker:

+ SAL D. DOMINICO
+ MA HOUSE REP: DAN RYAN

Climate Ready Boston, Sasaki, City of Boston, 2017, boston.gov/departments/environment/climate-ready-boston/.


2050
SEA LEVEL RISE
2050
SEA LEVEL RISE + MAJOR STORM
2100
SEA LEVEL RISE
2100
SEA LEVEL RISE + MAJOR STORM
This map shows potential flooding from a major storm in 2050. Boston could experience 7 feet of flooding (2 feet of sea level rise + 5 feet of storm surge = 7 feet of flooding).
TO EXPLORE IMPACTS, SELECT A TOPIC AREA
HOMES
ENERGY
ECONOMY
TRANSPORTATION
Sullivan Square and Rutherford Ave Redesign
GET INVOLVED
Mystic Avenue
Broadway
Maffa Way
Rutherford Avenue
Medford Street
Terminal Street
Bunker Hill Street
Main Street
Warren Street
Chelsea Street
CHARLESTOWN
Bunker Hill Community College
Somerville Avenue
Prospect Street
Cambridge Street
Washington Street
Historic Coastline 1635

Source: https://s-i.huffpost.com/gen/1524679/images/o-COW-FEED-facebook.jpg

FLY LESS

Source: https://media.cntraveler.com/photos/57067c1e9adc6caf5afe3f4c/master/pass/plane-landing-cr-getty-sb10062851ai-001.jpg

Source: https://cdn.vox-cdn.com/thumbor/l5748mogq_IVblg6MHP94TdHsqQ=/0x0:5685x4061/

RESOURCES

GREENOVATE BOSTON greenovateboston.org
Climate Ready Boston & Zero Waste Boston

BOSTON HARBOR NOW bostonharbornow.org

CLIMATE REALITY climaterealityproject.org

CITIZENS CLIMATE LOBBY citizensclimatelobby.org

HUB EVENTS BOSTON hubevents.blogspot.com

SENATE CLEAN ENERGY OMNIBUS BILL

Reach out to your state lawmaker and advocate today!

+ MA SENATOR: SAL D. DOMINICO
+ MA HOUSE REP: DAN RYAN