

COASTAL RESILIENCE SOLUTIONS FOR SOUTH BOSTON

EXECUTIVE SUMMARY

October 2018



Mayor Martin J. Walsh





October 2018

Dear Neighbors,

Boston is proving that climate resilience doesn't just protect us from storms and rising tides – it also enhances our neighborhoods and improves quality of life all year round. Projects all across the Harbor, from Langone-Puopolo Park in the North End to Martin's Park in the Fort Point Channel, create beautiful green spaces that improve everyone's access to the waterfront. In all of this work, we're engaging residents every step of the way. It's about making sure any action we take has many benefits for our residents, and that residents are always included in the planning process.

Last year, we released our *Coastal Resilience Solutions for East Boston and Charlestown* report. That was our first neighborhood resilience plan. It showed us where we were most at risk and what we need to do to protect our residents, homes, and infrastructure. We immediately went to work to implement those recommendations. This summer, we installed a deployable floodwall across the East Boston Greenway that protects the neighborhood behind it from flooding. We're raising Main Street in Charlestown as part of the Sullivan Square redesign to protect that vulnerable community, as well. We developed resilient infrastructure standards for our public rights-of-way, and we're working on zoning to make sure new development is climate-ready. We also trained more than 70 Bostonians on climate change and how to talk about the impacts to their backyards. In turn, they went out into their communities and led conversations with more than 700 of their neighbors about how we can prepare our city for climate change.

In 2018, we all felt the effects of climate change in our neighborhoods. We saw stronger rains and higher flooding along our waterfront during three big winter storms, and strong heat waves throughout the summer. That's why we're working hard to make sure our city is ready for the impacts we face today, and the changes we know we'll see in the years to come.

I'm proud to build on this momentum by presenting you with our next neighborhood resilience plan, which is focused on another area that is at risk for flooding and storm surges: South Boston. This report, which we created with the support of The Barr Foundation, helps us understand these risks and how we can best address them. We've got a lot of work to do, and in order to make our city stronger, safer, and more equitable, it's important that we work closely with the private sector and community partners.

We look forward to working with you in your neighborhoods.

Sincerely,

A handwritten signature in black ink, appearing to read "Martin J. Walsh".

Martin J. Walsh, Mayor of Boston



Climate Ready South Boston Open House

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Climate Ready South Boston Open House

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The following partners provided valuable insight into the project:

- » Boston Planning & Development Agency
- » Boston Water and Sewer Commission
- » Boston Parks and Recreation Department
- » Boston Public Works Department
- » Boston Inspectional Services Department
- » Boston Landmarks Commission
- » Boston Conservation Commission
- » Boston Housing Authority
- » Mayor's Office of Resilience and Racial Equity
- » Mayor's Office of Neighborhood Services
- » Imagine Boston 2030
- » Massachusetts Executive Office of Energy and Environmental Affairs
- » Massachusetts Department of Transportation
- » Massachusetts Department of Environmental Protection
- » Massachusetts Department of Conservation and Recreation
- » Massachusetts Emergency Management Agency
- » Massachusetts Bay Transit Authority
- » Massachusetts Water Resources Authority
- » Massachusetts Port Authority
- » Massachusetts Office of Coastal Zone Management
- » MassDevelopment
- » University of Massachusetts Boston School of the Environment
- » United States Army Corps of Engineers
- » Green Ribbon Commission

The following organizations helped us engage with their stakeholder communities:

- » A Better City
- » Andrew Square Neighborhood Association
- » Boston Harbor Now
- » Boston Marine Park Business Association, Inc
- » Fort Point Arts Association
- » Fort Point Neighborhood Association
- » Friends of Fort Point Channel
- » Trustees of Reservations

The City of Boston would like to thank the Barr Foundation for their generous support.



View of Fort Point Channel

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01 EXECUTIVE SUMMARY



PROJECT OVERVIEW

This report is the City's second local climate resilience plan that presents district-scale climate adaptation solutions (*Climate Ready Boston Initiative 4.1*). The first was *Coastal Resilience Solutions for East Boston and Charlestown*.

The *Climate Ready Boston* report, released in 2016, updated climate projections, assessed Boston's vulnerabilities to climate change, and developed city-wide strategies and initiatives for reducing vulnerability to sea-level rise and coastal flooding, more extreme heat, and more intense precipitation.

Climate Ready Boston is implementing the Greenovate Boston 2014 *Climate Action Plan Update* strategy of integrating climate preparedness into all aspects of city planning, review, and regulation. One of the overarching goals of *Imagine Boston 2030*, the first city-wide comprehensive plan in 50 years, is to "promote a healthy environment and adapt to climate change." Climate preparedness is also a leading component in *GoBoston 2030* and *Resilient Boston*.

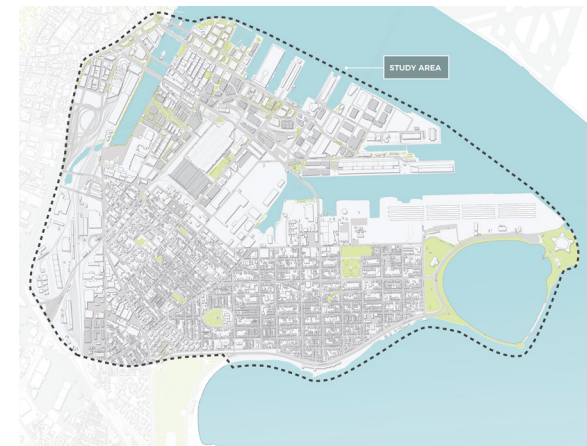
To protect the South Boston community, jobs, and infrastructure, coastal resilience solutions across South Boston combine existing green spaces and built water management systems with new open space intended to be expanded over time. These measures include elevated waterfront open spaces

and Harborwalk, reinforced structures and piers, flood walls, dunes, and a living shoreline that will grow and change over time. Achieving these measures will require public investments, private action, and support through regulatory change.

Together, the solutions generate multiple benefits including flood protection, waterfront access, recreation, and mobility. By the 2030s, these actions will protect over 2,400 residents, as well as businesses, jobs, drainage and combined sewer systems, critical highway and transit infrastructure, first responder facilities, healthcare facilities, and redevelopment areas.

The highest priority opportunity lies within the Fort Point Channel. For \$2 to 3 million, a berm across the 100 Acre Master Plan waterfront could block a low lying and long flood pathway. For \$10 to 12 million total, this berm could be expanded into a waterfront park and integrated with future development to provide increased access to open space and greater neighborhood resilience.

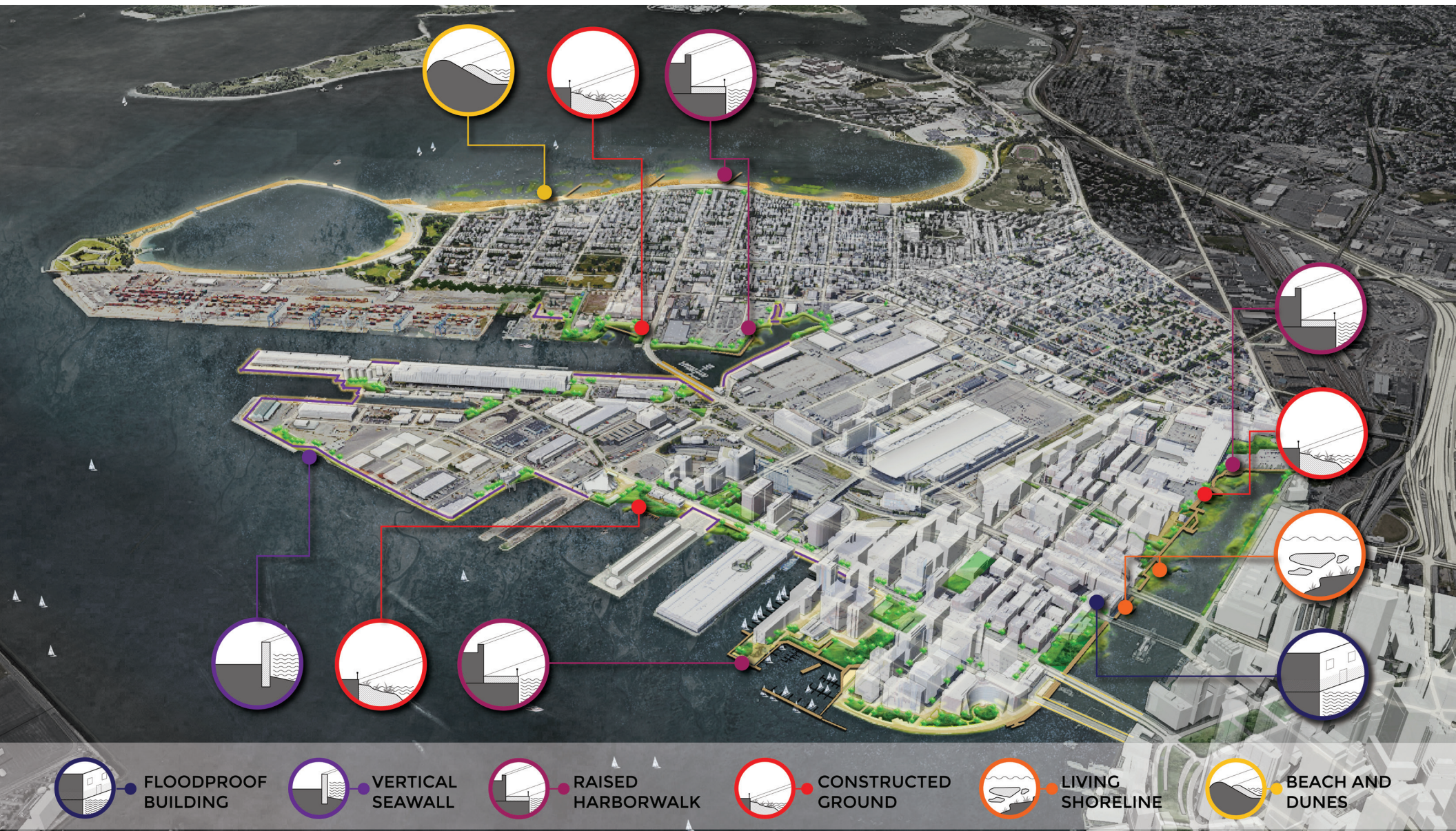
Investment in these South Boston coastal resilience solutions will prevent billions of dollars in estimated direct physical damages and displacement costs.



Climate Ready Boston is the City of Boston's ongoing initiative to adapt to climate change. Working with partners at all levels of government, the community, and in the private sector, we can protect Boston as severe weather and sea level rise increases. There is much more to be done. That's why Boston is getting started now.



Long-term flood protection such as what is shown here for Fort Point Channel can also improve quality of life.



Near-, mid-, and long-term coastal resilience solutions in South Boston

Estimated Costs and Benefits of All Recommended Coastal Resilience Actions in South Boston

ESTIMATED CAPITAL COST*	\$513 million to \$1.0 billion
ESTIMATED ANNUAL MAINTENANCE COST	\$7.7 million to \$15 million
NET PROJECT BENEFIT**	\$3.9 billion to \$19 billion
BENEFIT-COST RATIO	8.7 to 44.9

**Includes costs for planning, engineering, permitting, construction*

***Net project benefit refers to the benefits minus costs through 2070 using discount rates of 3 percent and 7 percent. Both benefits and costs have been applied incrementally over time based on an estimated project completion schedule and sea level rise changes over time, assuming zero sea level rise in 2013, 9 inches by 2030, 21 inches by 2050, and 40 inches by 2070. All losses expected to occur more frequently than monthly have been removed from the analysis.*



Exposure and Expected Impacts

Exposure and expected impacts to the 1-percent annual chance flood elevations with 0, 9, 21, and 40 inches of sea level rise. Exposure and expected impacts are relative to specific flood elevations, and not specific flood events. It is very rare that flood elevations are even across a landscape during any given event.¹

	1-PERCENT ANNUAL CHANCE ELEVATION WITH NO SEA LEVEL RISE (2013)	1-PERCENT ANNUAL CHANCE ELEVATION WITH 9 INCHES OF SEA LEVEL RISE (2030s)	1-PERCENT ANNUAL CHANCE ELEVATION WITH 21 INCHES OF SEA LEVEL RISE (2050s)	1-PERCENT ANNUAL CHANCE ELEVATION WITH 40 INCHES OF SEA LEVEL RISE (2070s)
NUMBER OF PEOPLE EXPOSED	980	2,500	7,300	40,200
NUMBER OF BUILDINGS EXPOSED	60	280	920	5,140
EXPECTED DIRECT PHYSICAL DAMAGES AND RELOCATION COSTS	\$140 million	\$1.2 billion	\$2.8 billion	\$8.1 billion

¹ See full report for methodology and assumptions.

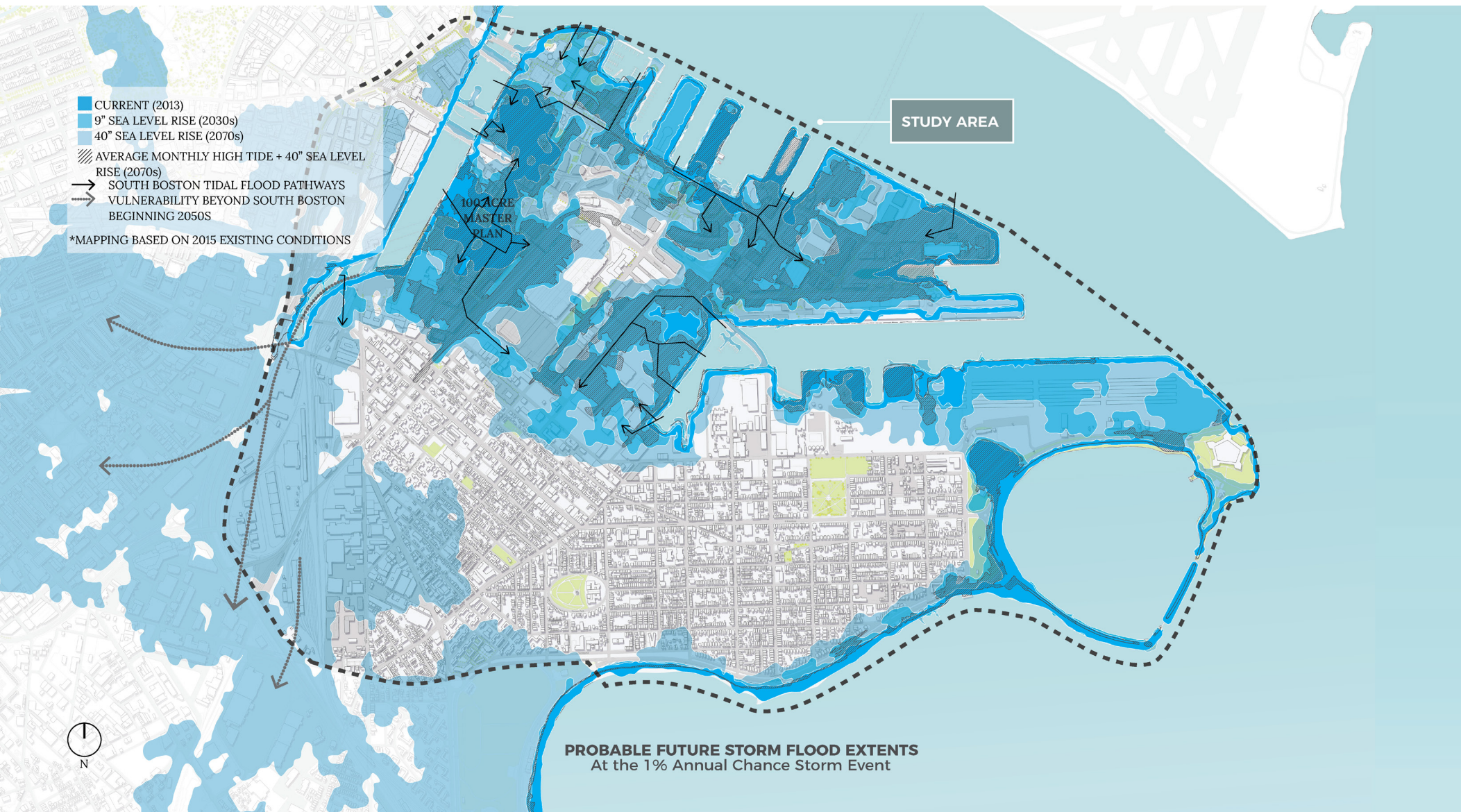
COASTAL FLOODING RISKS

Much of the South Boston Seaport consists of filled land. These historically filled tidelands were often just a foot or two above the high tide line. Sea level rise puts filled tidelands and other low-lying areas at growing risk. These risks are especially clear in South Boston.

Boston's sea level could rise (from 2013 levels) by nine inches by the 2030s and 40 inches by the 2070s. The nine inch rise will result in a ten-fold increase in flood risk. With sea levels 40 inches higher, flooding across most of South Boston, with the exception of the historic residential neighborhood, will occur at least once a year.

There are specific flood pathways associated with present day flood risk (2013) along Fort Point Channel and Seaport Boulevard which can be addressed with near-term strategies along the shoreline. As sea levels rise, these flood pathways begin to merge with more widespread flooding in South Boston and, later in the century with no action, flooding from South Boston could reach beyond the district into the South End and connect with flood pathways from the Charles River and Moakley Park.

Tidal flood maps showed widespread flooding and loss of Harborwalk use with sea level rise. Because most of the waterfront is flat filled land, stakeholders decided shoreline protection was the best approach in South Boston.



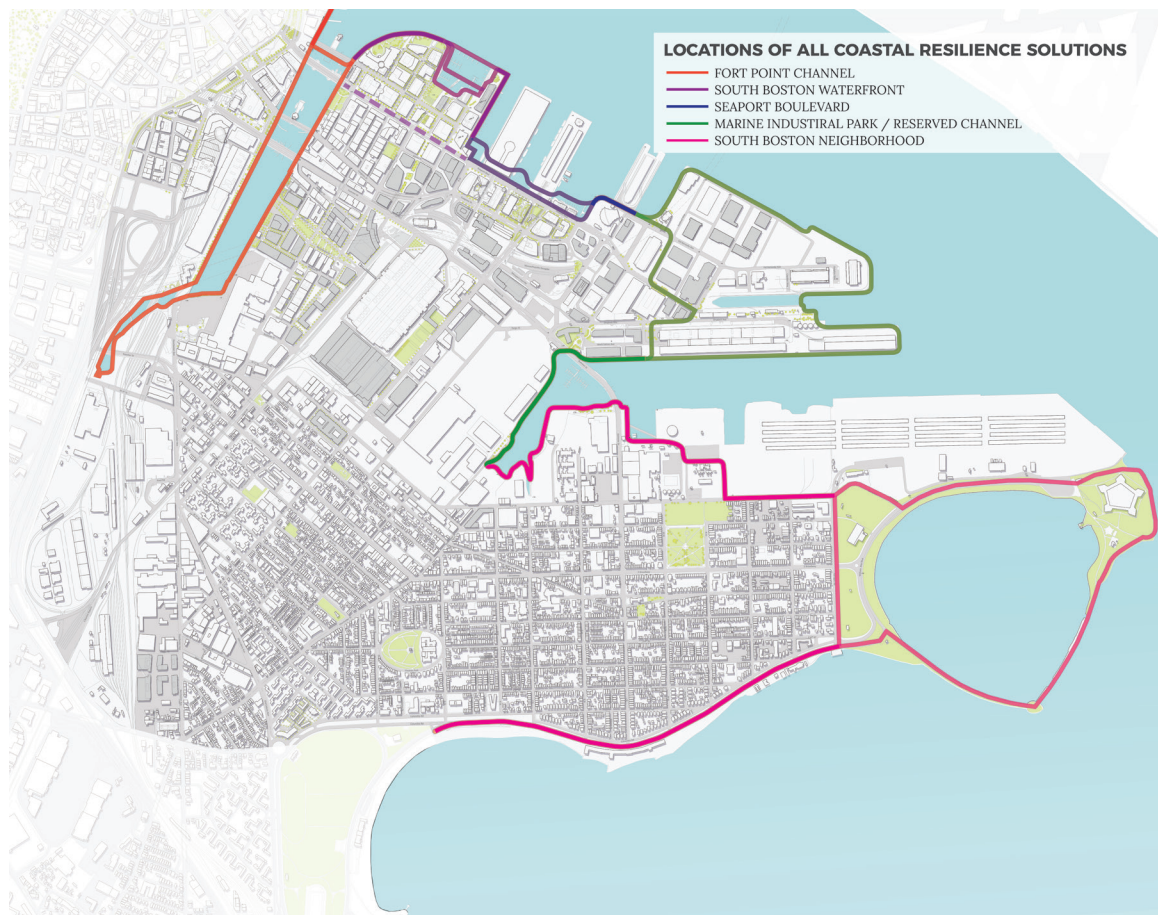
The gradations of blue in the map show how the 1-percent annual chance flood probability changes in South Boston through time. The colors do not indicate depth of flooding. Arrows indicate key flood pathways.

COASTAL RESILIENCE SOLUTIONS

More than 640 Bostonians participated in meetings, interviews, focus groups, open houses, and surveys where they shared their priorities for coastal resilience in South Boston. In addition to protecting their safety, property, and livelihoods, many shared a strong desire for improvements in mobility, affordability, open space, and waterfront access.

The measures proposed in this report include elevated waterfront parks, an enhanced Harborwalk, improved connections to the waterfront, natural wetland buffers, and site amenities such as seating, steps, and furnishings. Such measures can enhance the public realm, social equity, economic opportunity, waterfront access, and natural resources.

Residents placed particular importance on long-term effectiveness. The proposed measures would protect up to the 1-percent annual chance flood level with 40 inches of sea level rise (2070s), plus 1 foot of freeboard. Beyond that, these measures could be elevated at least 2 feet higher by adding fill or integrating structural furniture that adds height and spaces for people. This built-in adaptability could ensure effectiveness for about 70 years, depending on the rate of sea level rise.



Locations of all coastal resilience solutions in South Boston

Design elevation, or the height of the solution, needs to be paired with a continuous line of defense in order to more fully protect against floodwaters flanking the solution and flooding properties from behind. It is particularly important in low lying South Boston that flood pathways originating in multiple areas across the district are addressed. In addition, there are flood pathways in other districts, such as Moakley Park and the Charles River Dam, that must be addressed in order to provide long-term flood mitigation to the South End.

FREEBOARD

“Freeboard is a factor of safety usually expressed in feet above a flood level for purposes of floodplain management. Freeboard tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed.” - FEMA

Near, Mid, and Long-Term Flood Protection Criteria

All mid- and long-term actions and most near-term actions will provide effective flood protection from the 1-percent annual chance flood with 40 inches of sea level rise, and all may be adapted to address higher magnitude flooding over time.

Near-term Actions (As soon as possible)	Mid-term Actions (Next 25 years)	Long-term Actions (2050 and beyond)
» Address most urgent, current flood pathways	» Maximize flood risk reduction and minimize cost	» Represent overall resilience goals for the area
» Should begin and be completed as soon as possible (by 2025)	» Leverage partnerships and existing projects	» May integrate more complex, challenging, resource-intensive, or time consuming elements
	» Do not preclude future action	» May be adaptable to higher magnitude flood events even further into the future
	» Should be completed over the next 25 years	» Should be completed in the 2050s or beyond

TARGET ELEVATION (NEAR-, MID-, AND LONG-TERM GOAL): 14 - 15.5 FEET (+4-7 FEET ABOVE GRADE)

1-percent annual chance flood elevation with 40 inches of sea level rise, plus 1 foot of freeboard

MODULAR ELEVATION (LONG-TERM ADAPTATION GOAL): 16 - 17 FEET (+6-8.5 FEET ABOVE GRADE)

0.1-percent annual chance flood event with 40 inches of sea level rise plus 1 foot of freeboard

Elevations are reported with respect to the North American Vertical Datum of 1988 (NAVD88) and are above sea level. The numerical value of NAVD88 elevations are 6.46 feet lower than those expressed in Boston City Base.

FORT POINT CHANNEL

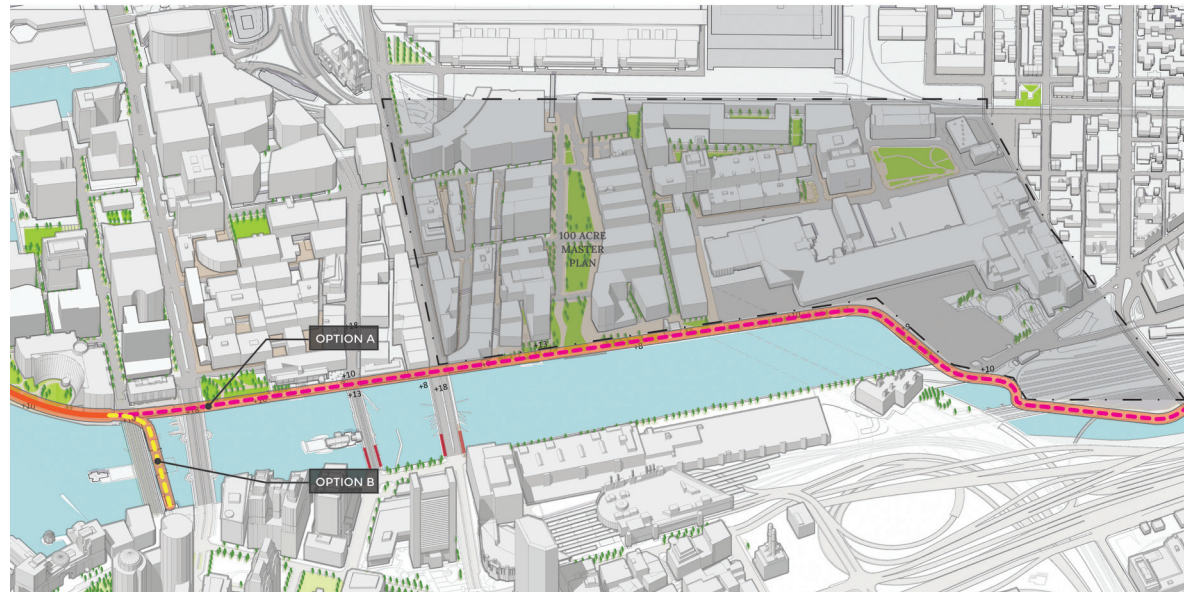
Areas in Fort Point Channel are the highest priority for action in South Boston based on expected impacts and current flood risk.

We explored in detail two possible alignments for resilience measures along Fort Point Channel, and recommend Option A as shown. Coastal resilience in Fort Point Channel could protect over 100 buildings and 1000 people and reduce by over \$300 million the expected losses at the 1-percent annual chance flood elevation with 9 inches of sea level rise. With 21 and 40 inches of sea level rise, coastal resilience measures on the east side of Fort Point Channel could be flanked from other flood pathways and must be combined with coastal resilience measures in South Boston Waterfront, Seaport Boulevard, Raymond L. Flynn Marine Park, and Reserved Channel to remain effective.

The estimated cost of designing and constructing the near- and mid-term projects in Fort Point Channel is \$59 to \$89 million. The full long-term flood protection options along the perimeter of the east side of the Channel have a cost range of \$108 to \$139 million, depending on design approach and technical considerations. These projects are all on private property and likely require public private partnerships.

NEAR-TERM (BY 2025)

The 100 Acre Master Plan area and adjacent parcels need near-term action. Flood risk is expected to



increase rapidly along the channel, and there are opportunities to partner with property owners and others to incrementally implement solutions. Near-term actions range from \$3 to \$16 million depending on design and consist of earthen berms and open park space. The area of the 100 Acre Master Plan makes up the bulk of this cost with a range of \$2 to \$12 million, depending on the extent of park space developed. The area of the Arcade (Area 3 on page 23) requires a more detailed engineering analysis to assess the structural integrity of the buildings and the flood protection solution that would be most appropriate.

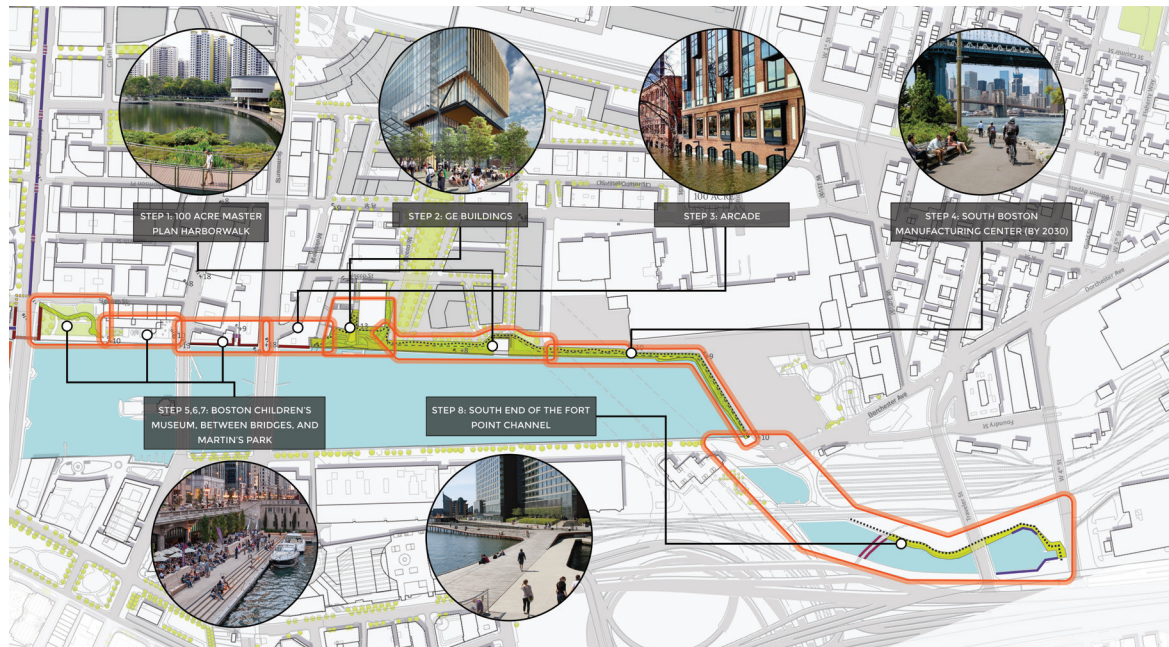
MID-TERM (BY 2030 AND IN THE 2030s)

Mid-term strategies are similar to near-term strategies and extend north from the 100 Acre Master Plan to Martin's Park and south to the base of the east side of Fort Point Channel. Shoreline strategies

include earthen berms and open park space. Along the existing Harborwalk, it would be possible to incorporate building structures into the line of defense or build new barriers in the water. Bridge guardrails would be converted to floodwalls. The many stormwater outfall pipes along the channel will require flap gates. Mid-term coastal resilience solutions range in cost from \$56 to \$73 million.

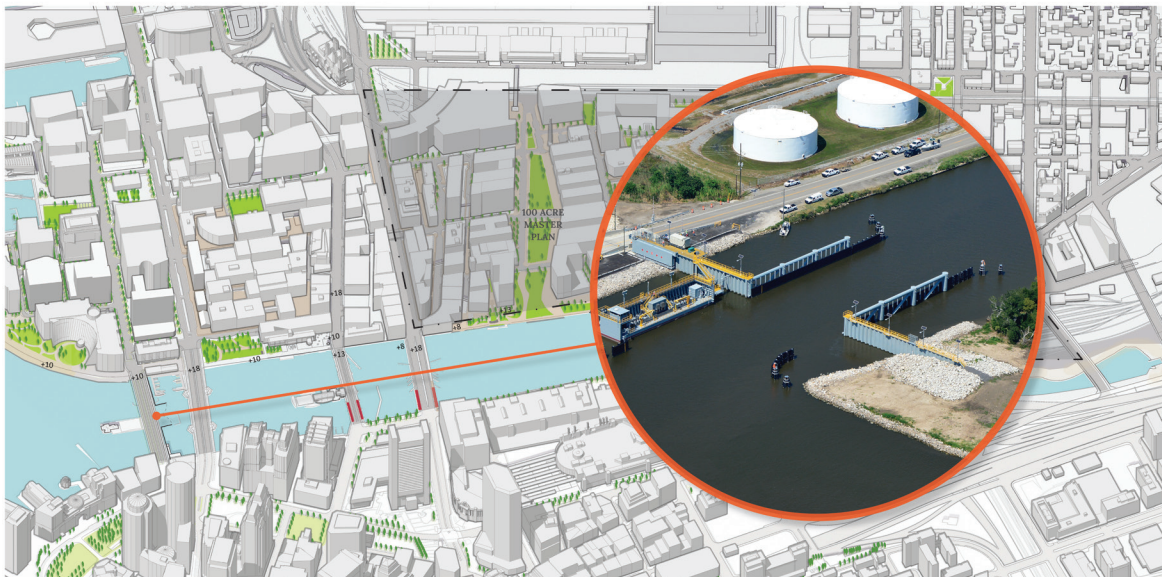
LONG-TERM (2050s AND BEYOND)

In the long term, earlier strategies can be further enhanced through expanded Harborwalk, possible increased fill and enhanced park space along the channel, long-term flood protection measures to the Arcade, and other improvements that increase the overall flood protection, social, and recreational benefits within the area. Such additional enhancements may cost around \$49 million.



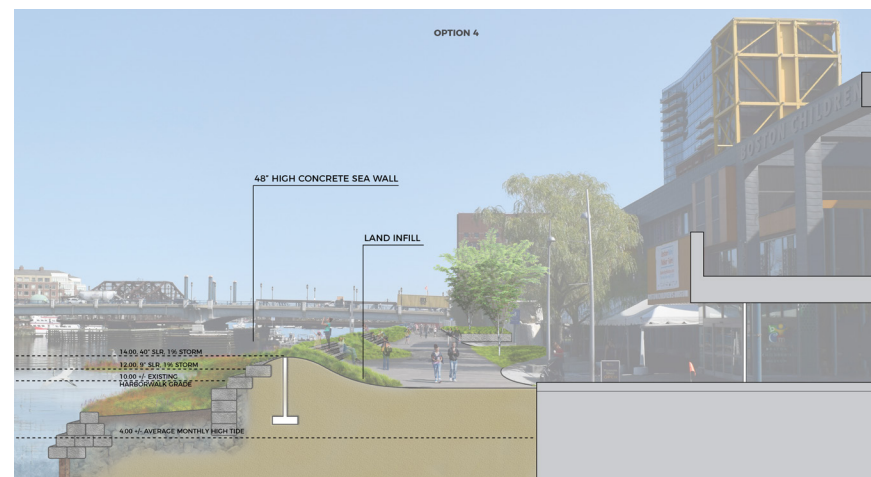
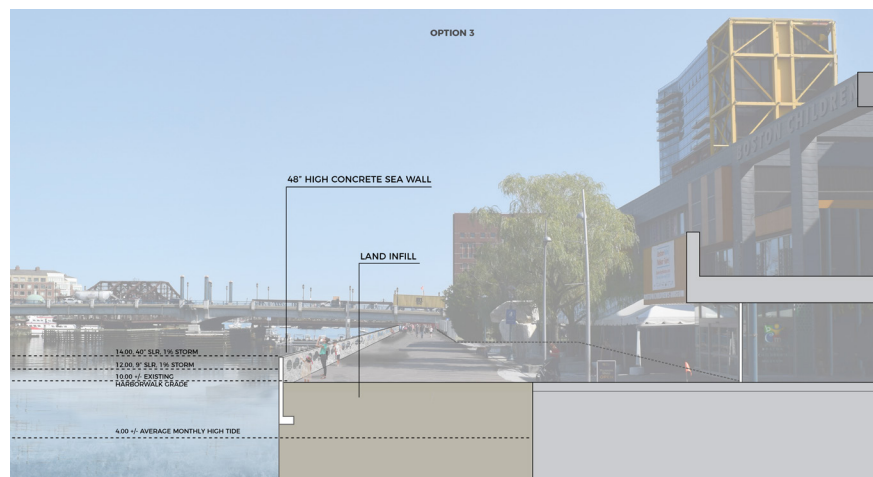
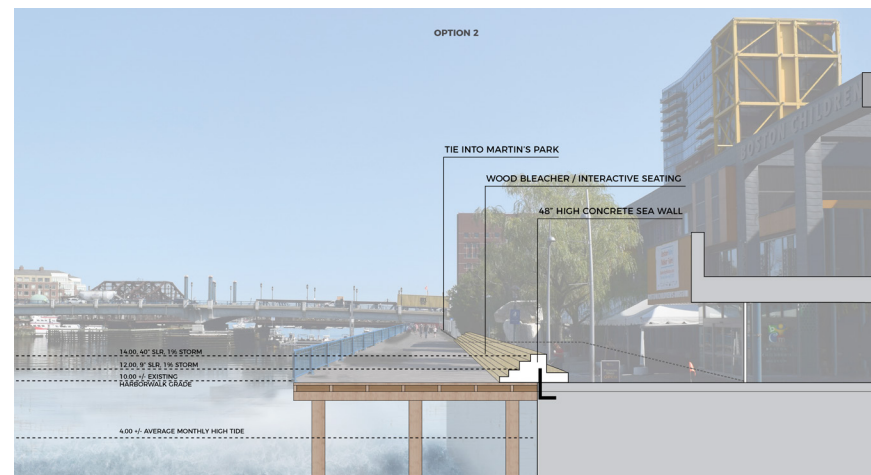
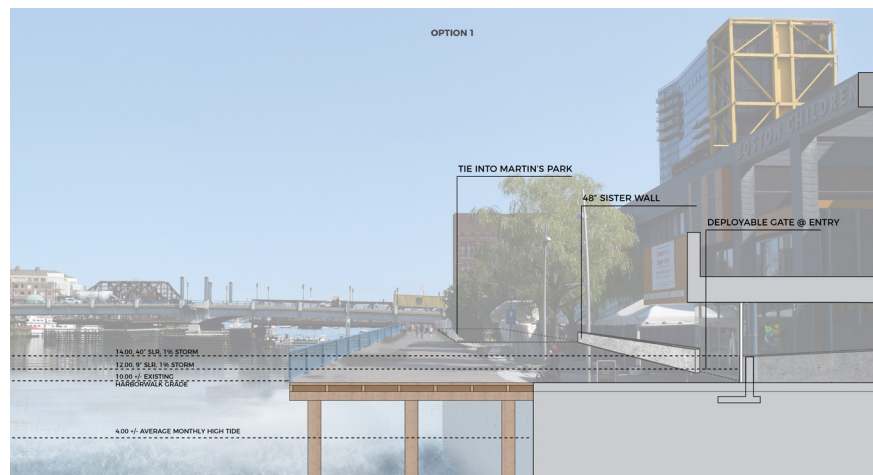
We explored two primary options for coastal resilience solutions in Fort Point Channel: flood protection at the mouth of the Channel, and flood protection along the perimeter of the Channel. Only flood protection actions around the perimeter of the Channel can be completed incrementally. In the long term, these two options could possibly be combined. **Option A is the preferred option.**

Option A aligns with the perimeter of the Fort Point Channel.

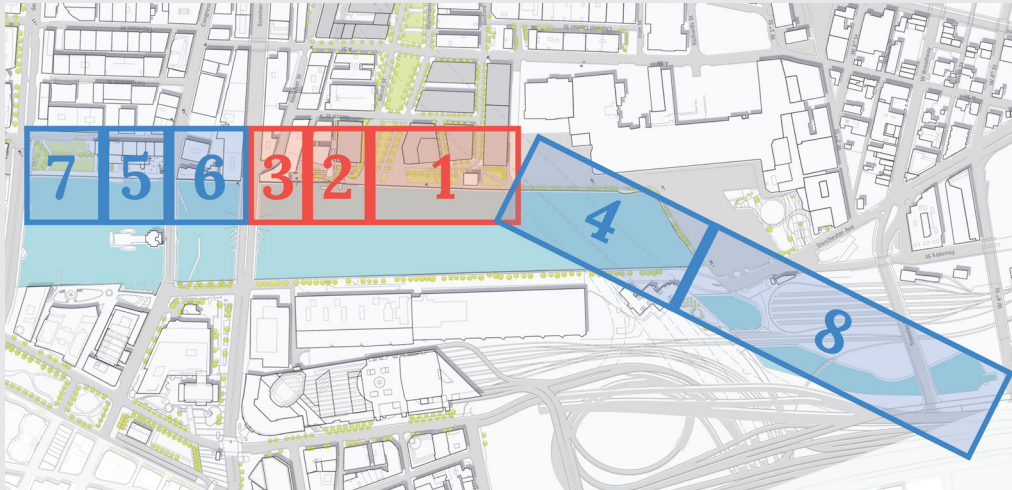


Option B would install a gate or series of gates that could be closed before an approaching high-water event such as a nor'easter.

Four possibilities at the Children's Museum in Fort Point Channel demonstrate how similar coastal resilience solutions can differ in their form and function. Options 1 and 2 make use of existing space, while Options 3 and 4 require building into the Channel. The alternatives prioritize different relationships to the waterfront. All designs are to a height of 4 to 6 feet above the existing ground to protect from future flooding that could occur with 40 inches of sea level rise (2070s).



Costs of Recommended Coastal Resilience Options in Fort Point Channel



Implementation Period	Area	Capital Cost Range	Annual Maintenance Cost Range
Near-term	1. 100 Acre Master Plan	\$2M to \$12M	\$0.03M to \$0.18M
	2. GE Headquarters	\$1M to \$4M	\$0.02M to \$0.06M
	3. Arcade	*	*
Mid-term	4. South Boston Manufacturing Center (by 2030)	\$3M to \$13M	\$0.05M to \$0.19M
	5. Boston Children's Museum (by 2030)	\$5M to \$6M	\$0.08M to \$0.09M
	6. Between Bridges (by 2030)	\$9M to \$10M	\$0.13M to \$0.15M
	7. Martin's Park (by 2030)	\$4M to \$5M	\$0.07M to \$0.08M
	8. South End of the Fort Point Channel (2030s)	\$34M to \$39M	\$0.51M to \$0.59M
Long-term	Additional Enhancements to Fort Point Channel	\$49.3M to 49.5M	\$0.74M
Total		\$108M to \$139M	\$1.6M to \$2.1M

**more detailed engineering assessment required*

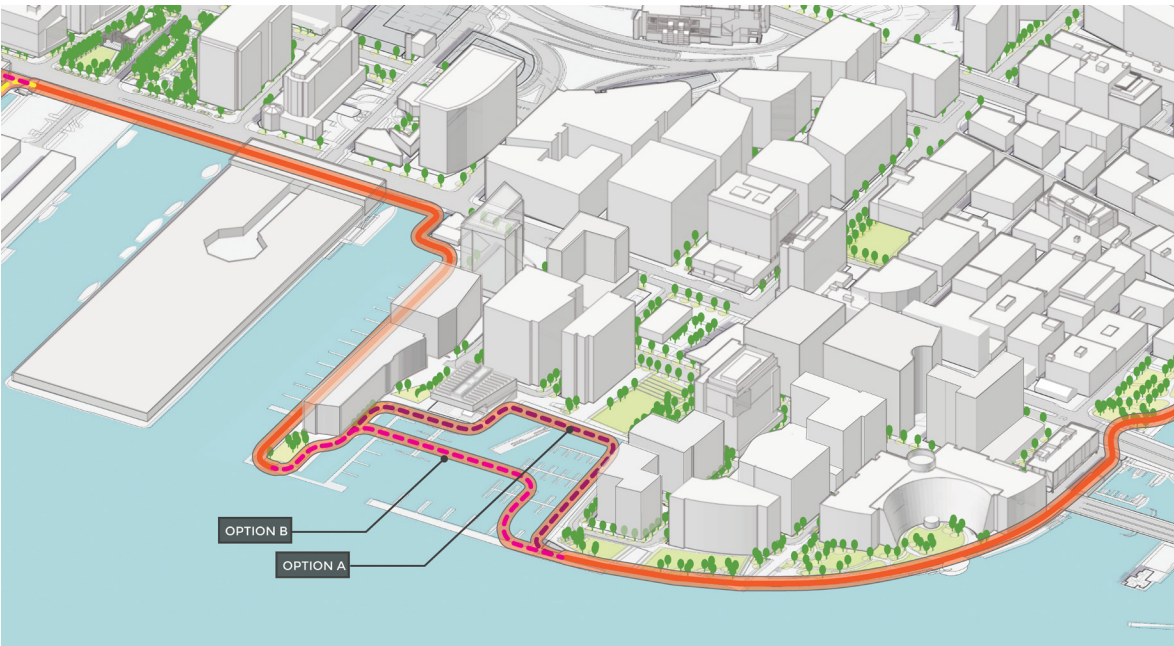
THE SOUTH BOSTON WATERFRONT

MID-TERM SOLUTIONS (2030s AND 2040s)

Two of four alignments examined along the South Boston Waterfront are recommended to move forward for further evaluation. These are Option A, which is aligned with the existing shoreline, and Option B, which expands available space for flood protection by adding fill in the marina. Flood protection within the South Boston Waterfront could be completed incrementally around the perimeter and vertically, adding height over time. An initial step could make use of existing space near the Institute of Contemporary Art and then expand into the marina later in the century.

Recent development, such as Pier 4, has reduced flood risk in this area, lowering required heights of coastal resilience solutions by 1 to 2 feet. The Harborwalk around Fan Pier Civic Park, however, forms a flood pathway and requires solutions up to 6 feet above existing grade to mitigate flooding to the target elevation.

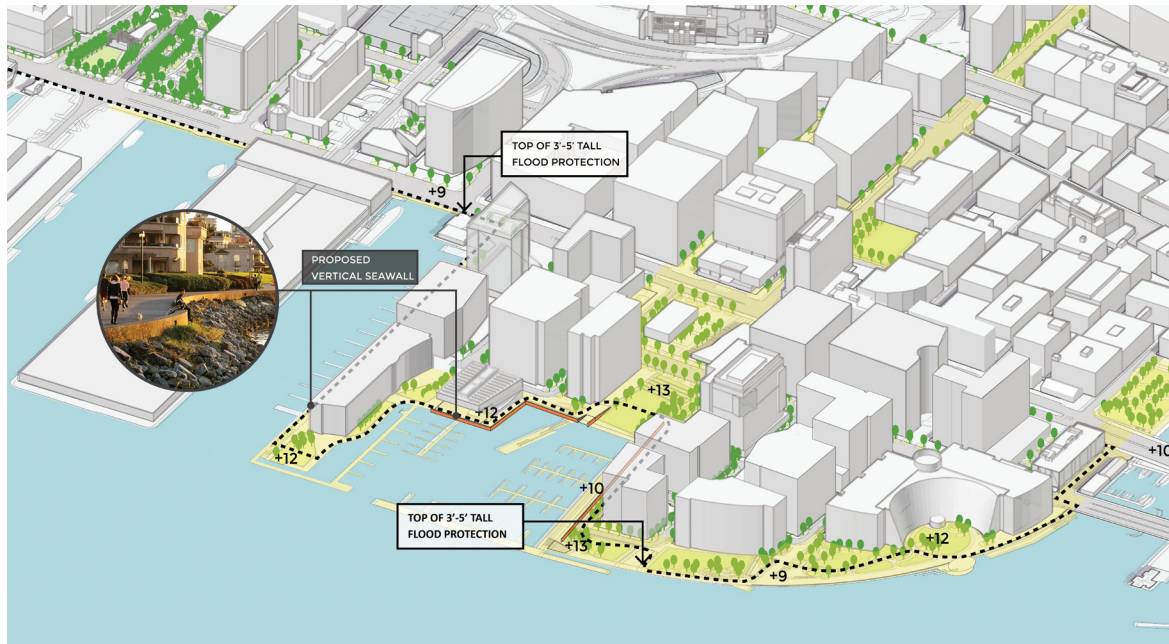
At the 1-percent annual chance elevation with 9 inches of sea level rise, Option A or B will protect 250 people and avoid \$85 million in direct physical damages and displacement costs. At higher flood depths, South Boston Waterfront could still flood from Fort Point Channel, Seaport Boulevard, Raymond L. Flynn Marine Park, and Reserved Channel if action is not taken to reduce risk in those areas.



Costs of Recommended Mid-term Coastal Resilience Options in the South Boston Waterfront

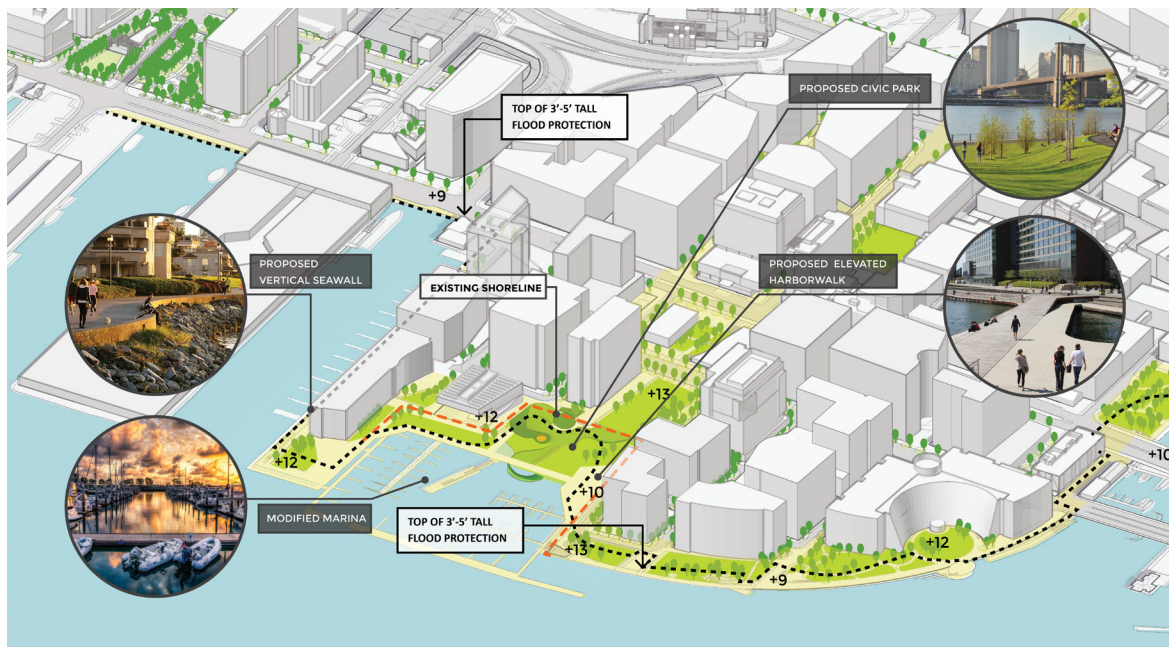
	OPTION A	OPTION B
ESTIMATED CAPITAL COST	\$53 - \$61 million	\$91 - \$106 million
ESTIMATED MAINTENANCE COST*	\$800,000 - \$900,000 per year	\$1.4 - \$1.6 million per year

**Maintenance costs are expected to be 1.5 percent of the implementation cost.*



Options A and B are recommended to move forward for further evaluation.

Option A makes use of existing space to reduce flood risk.



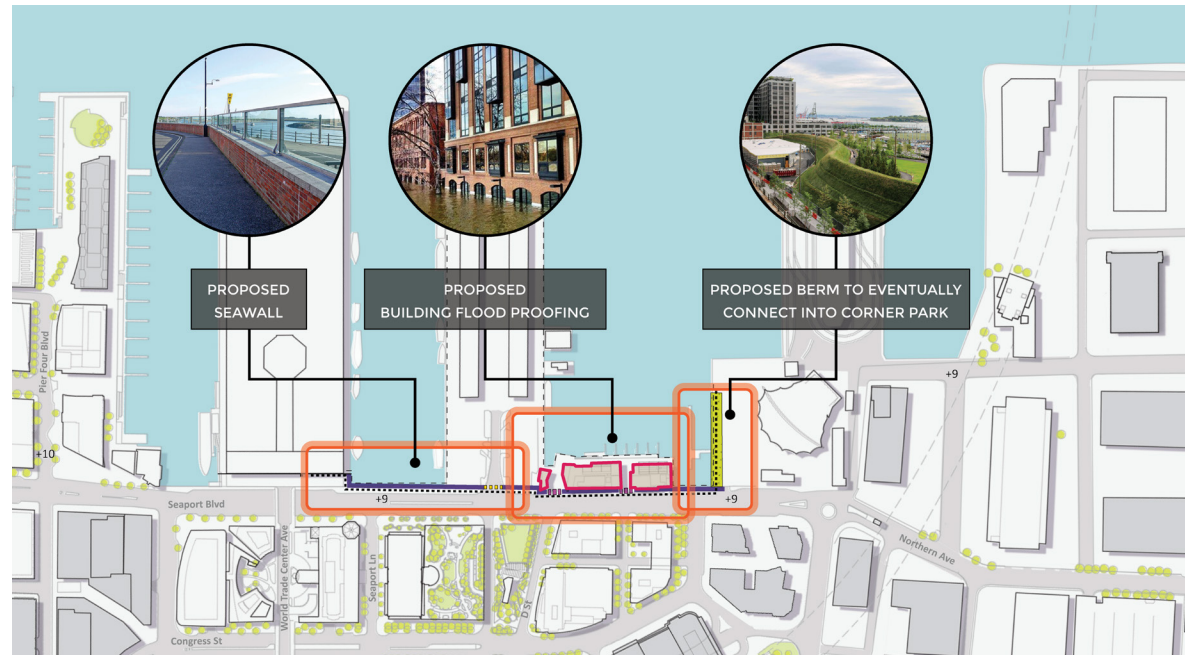
Option B would build out into the existing marina at the Waterfront. This design would not significantly improve effectiveness over Option A, but would increase enjoyment and accessibility to the waterfront.

SEAPORT BOULEVARD

NEAR-TERM SOLUTIONS (BY 2025)

Near-term coastal flood protection can be completed in steps in the most urgent areas for action along Seaport Boulevard. The cost to complete a flood barrier along Seaport Boulevard between the World Trade Center and Dry Dock 4 is between \$19 million and \$22 million. Floodproofing the Fish Pier would add an additional \$29 million to \$33 million. Near-term improvements could prevent tens of millions of dollars in direct physical damage and displacement costs. Earthen berms or floodwalls designed and constructed in the mid term could be raised in the long term as sea level rises.

Coastal resilience solutions along Seaport Boulevard are interdependent with coastal resilience solutions in other areas in the mid term. With 9 inches of sea level rise, Seaport Boulevard coastal resilience design strategies must be combined with measures in Raymond L. Flynn Marine Park, Reserved Channel, and South Boston Waterfront to be effective. With 21 inches and 40 inches of sea level rise, Seaport Boulevard coastal resilience measures must be combined with coastal resilience measures in Fort Point Channel, Raymond L. Flynn Marine Park, Reserved Channel, and South Boston Waterfront.

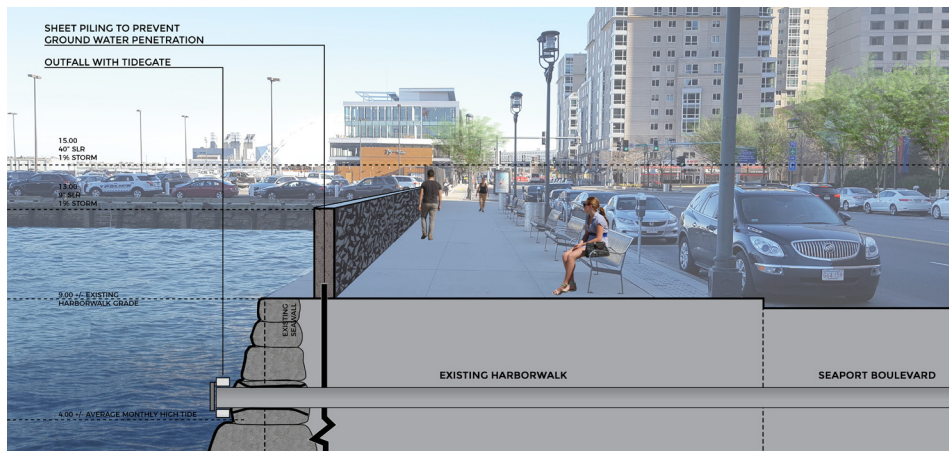


The highest priority area along Seaport Boulevard is located between the World Trade Center and Dry Dock 4. Proposed actions include a flood wall that may be integrated with the harborwalk, floodproofing of existing structures, and a berm near the dry dock that could be integrated with future open space improvements. The flood pathway that originates here could cause \$26 million in damage at the 1-percent annual chance elevation in the near term.

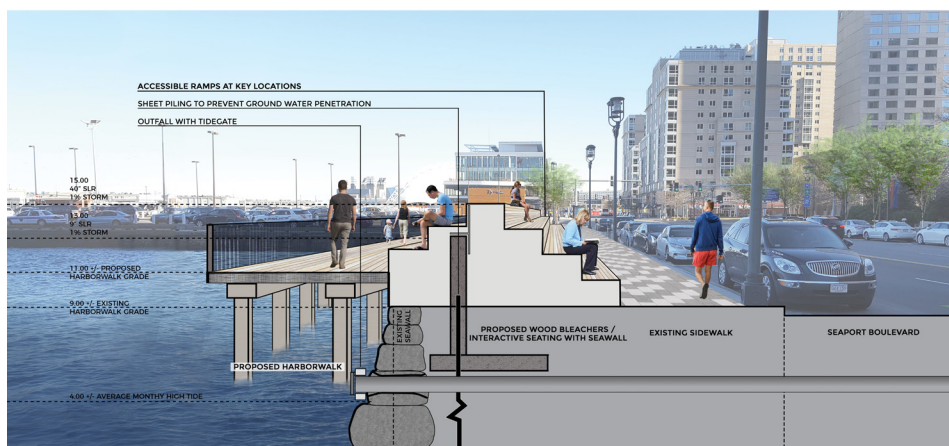


These three images demonstrate how the Harborwalk along Seaport Boulevard could be adapted for flood protection. The cost range for Seaport Boulevard includes these options.

A floodwall adjacent to the existing harborwalk may not disrupt existing sight lines if it is first built to 13 feet NAVD88, which is the 1-percent annual chance flood elevation with 9 inches of sea level rise and 1 foot of freeboard.



Higher elevations could be adapted with creative additions and expansions of the Harborwalk.

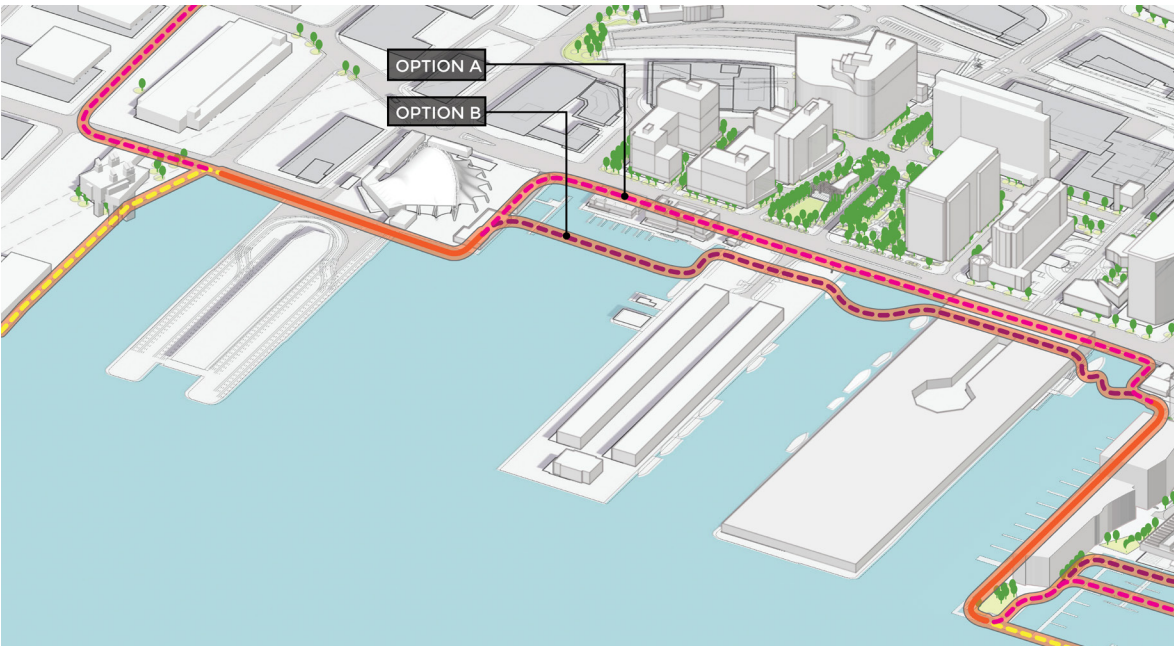


The longer-term target elevation is 2 feet higher. Solutions such as elevated sidewalks or stepped planters would preserve sight lines and avoid significantly disrupting the existing pedestrian relationship with the waterfront.

MID-TERM SOLUTIONS

The Seaport Boulevard area is significantly space-constrained between the existing waterfront and the roadway. We examined two alignment alternatives for this area: Option A locates flood protection along the existing shoreline, and Option B, builds flood protection out into the water. They are not mutually exclusive. Option A could be implemented as near- to mid-term actions, and Option B could be long-term. Both alternatives propose a minimum of 15 feet NAVD88 as the design elevation and could be adapted to higher design elevations.

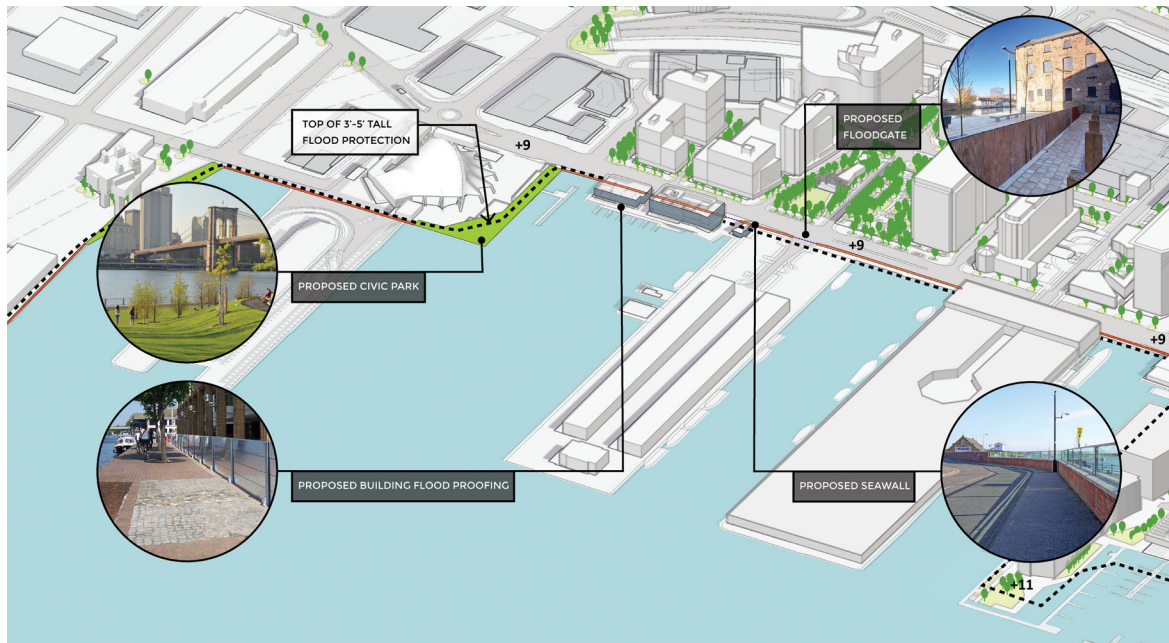
Option B introduces technical approaches with significant current permitting and regulatory obstacles. Large fill-based flood protection solutions that extend into Boston Harbor, such as proposed by Option B, are not currently encouraged by the regulatory community and regulatory change may be needed to help implement this option in the mid term (see Section 4 Regulatory Resilience Strategies).



Costs of Recommended Near- and Mid-term Coastal Resilience Options in Seaport Boulevard

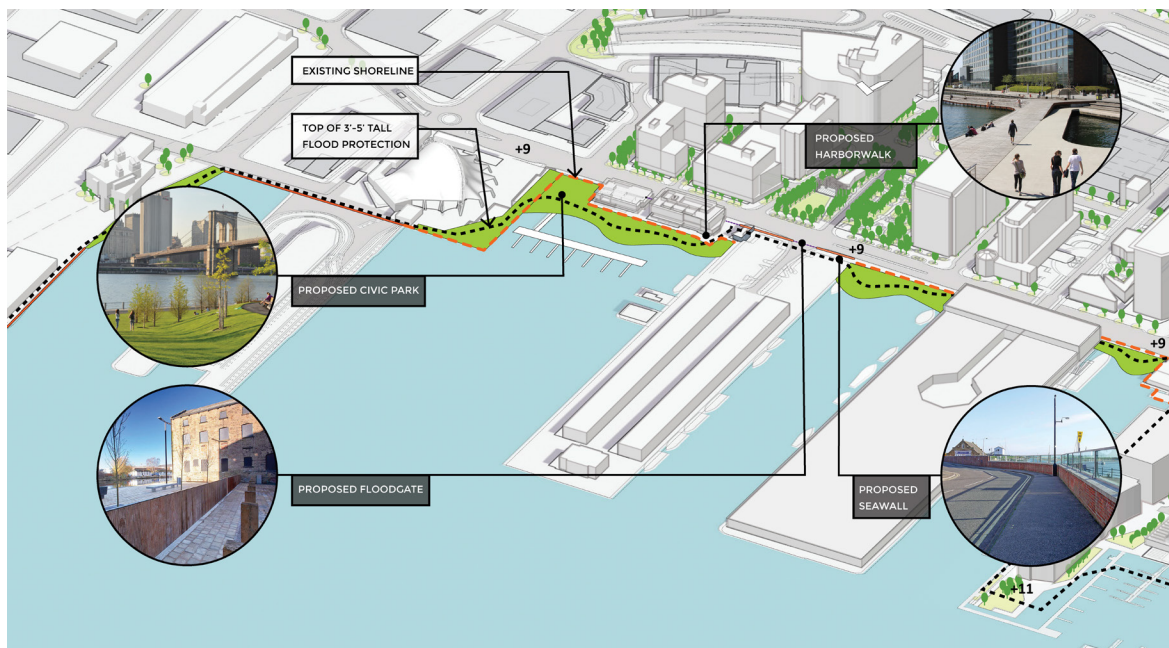
	OPTION A	OPTION B
ESTIMATED CAPITAL COST	\$37- \$42 million	\$140 - \$161 million
ESTIMATED MAINTENANCE COST*	\$550,000 - \$640,000* per year	\$2.1 - \$2.4 million* per year

*Maintenance costs are expected to be 1.5 percent of the implementation cost. Floodproofing of buildings represents an additional cost of \$113 million - \$131 million due to the large footprints of the World Trade Center and Fish Pier.



Both Options A and B are recommended to move forward for further evaluation.

Option A makes use of existing space to reduce flood risk.



Option B would build out into the existing water. Its effectiveness is not significantly higher than Option A's, but it would increase accessibility to the waterfront.

RAYMOND L. FLYNN MARINE PARK AND RESERVED CHANNEL

MID-TERM SOLUTION (BY 2030 AND 2030s)

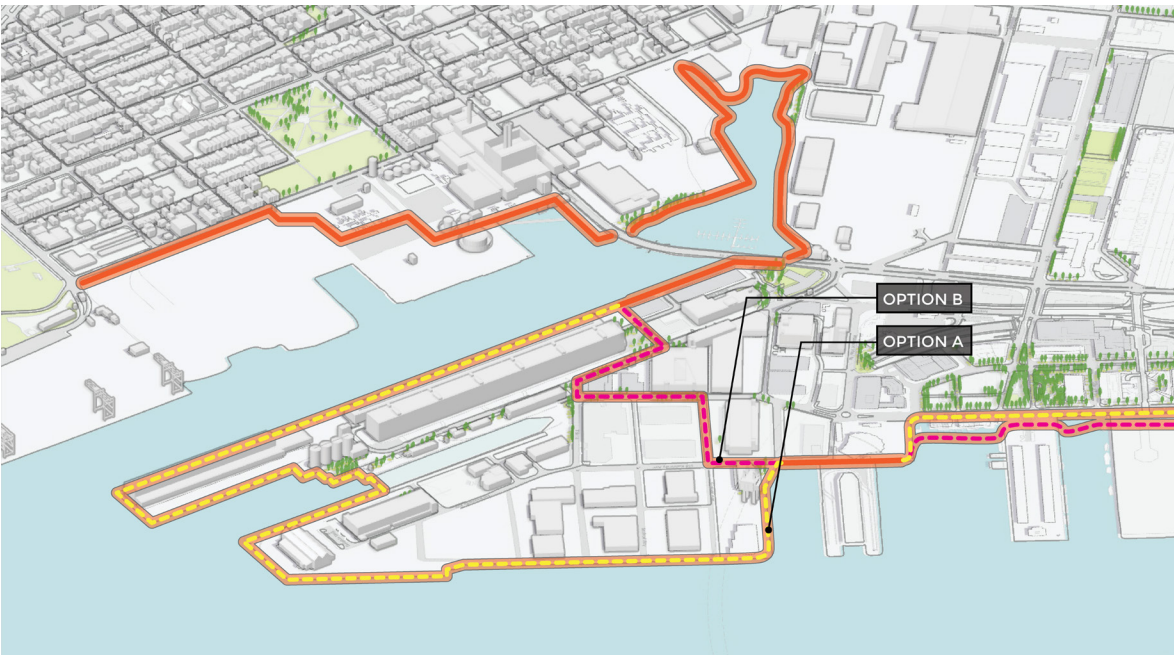
We examined two alignment alternatives for the Raymond L. Flynn Marine Park and Reserved Channel: Option A provides flood protection along the perimeter of the Raymond L. Flynn Marine Park, and Option B aligns flood protection along interior roadways to cut off a flood pathway. Option B would require floodproofing as a first line of defense for many structures, as well as other actions to protect access and egress. Option A is recommended for further evaluation.

While action in this area is critical to reduce flood risk across South Boston, effectiveness of both Options A and B is limited without also including coastal resilience actions along Fort Point Channel and Seaport Boulevard.

With just 9 inches of sea level rise, flood pathways originating in the Seaport Boulevard area could connect with flood pathways originating in the Raymond L. Flynn Marine Park and the Reserved Channel.

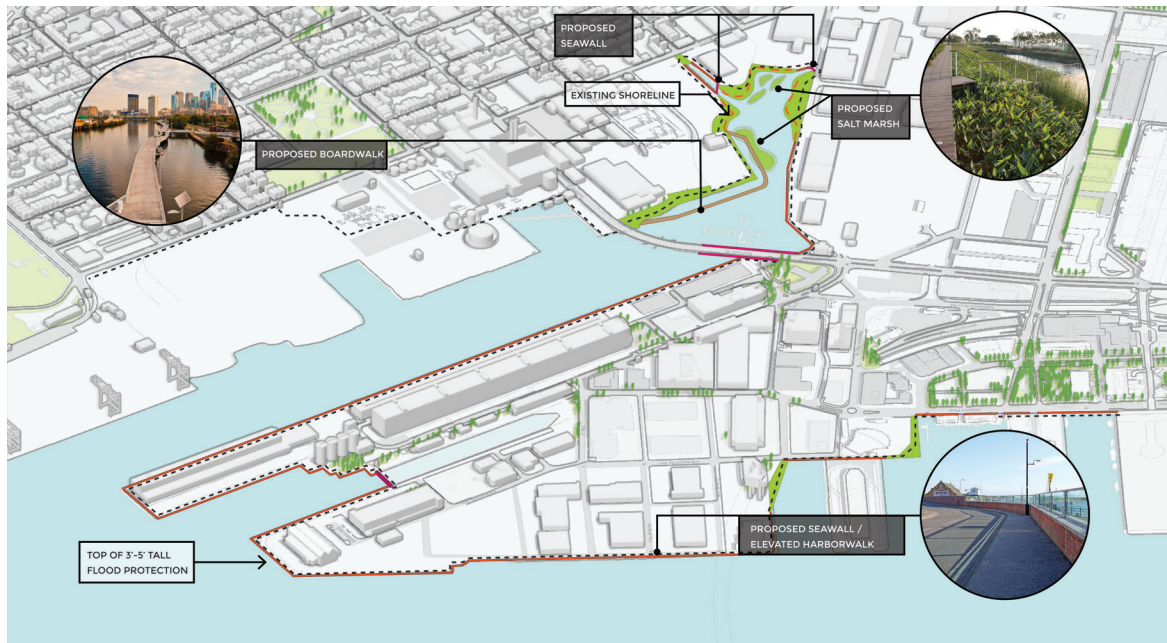
LONG-TERM ACTIONS (2060s)

The Flynn Cruiseport Boston at the Black Falcon Terminal is at lower risk, though may require more site specific flood risk evaluation.



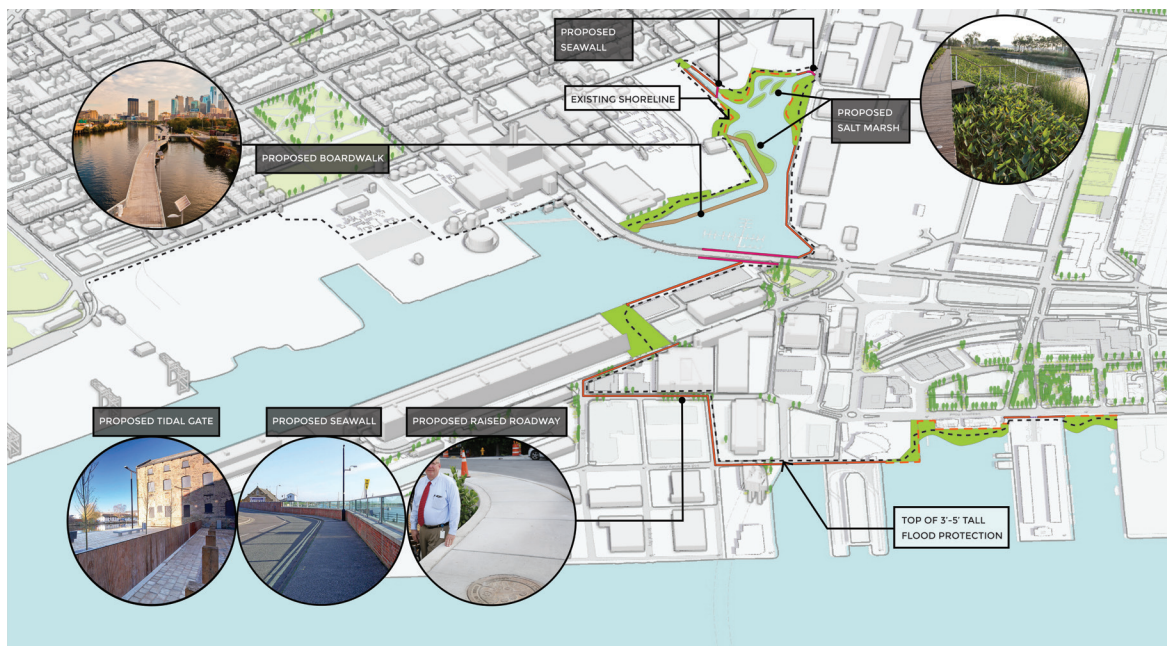
Costs of Recommended Coastal Resilience Option for the Raymond L. Flynn Marine Park and Reserved Channel

Implementation Period	Area	Capital Cost Range	Annual Maintenance Cost Range
Mid-term	Raymond L. Flynn Marine Park (by 2030 and 2030s)	\$108M to \$124M	\$1.6M to \$1.9M
Mid-term and Long-term	Reserved Channel (by 2030, 2030s, and 2060s)	\$90M to \$104M	\$1.4M to \$1.6M
Total		\$197M to \$228M	\$3.0M to \$3.4M



Options A is recommended to move forward for further evaluation.

Option A provides flood protection along the perimeter of the Raymond L. Flynn Marine Park and Reserved Channel.



Option B involves installing a barrier the interior roadway cut off flood pathways to the rest of the district.

SOUTH BOSTON NEIGHBORHOOD

MID-TERM SOLUTIONS (2030 TO 2050)

We examined two practical alignment alternatives for the South Boston neighborhood. Option A is aligned with the perimeter of the neighborhood, including Pleasure Bay, and involves floodwall or raised Harborwalk along Day Boulevard and the beaches of the neighborhood's southern shores. Option B is characterized by coastal restoration and inland flood protection, and involves beach nourishment and elevation of park space along Farragut Road. Option B is slightly more inland than Option A through the Marine Park and along Day Boulevard/Columbia Road. Option B is inland of Pleasure Bay and would not protect its outer harborwalk. Option A is inland of the beaches along Day Boulevard and would not protect the beaches from erosion and coastal storm impacts.

This area does not require flood protection in other parts of the neighborhood to remain effective. Additionally, South Boston neighborhood has more design options than other areas of South Boston due to space availability. For example, the public right-of-way between Columbia Drive and the beach could be adapted through elevated roadways, Harborwalk, beach renourishment, flood walls, and more.



Costs of Recommended Mid-term Coastal Resilience Options in South Boston Neighborhood (Pleasure Bay and Day Boulevard)

	OPTION A	OPTION B
ESTIMATED CAPITAL COST	\$210 million - \$243 million	\$260 million - 299 million
ESTIMATED MAINTENANCE COST*	\$3.2 million - \$3.6 million per year*	\$3.9 million - 4.5 million per year*

**Maintenance costs are expected to be 1.5 percent of the implementation cost.*



Both Options A and B are recommended to move forward for further evaluation.

Option A includes perimeter protection of South Boston along Pleasure Bay and the seashore along Day Boulevard. Coastal adaptations would include elevating the Harborwalk along its current path or routing the line of protection down the right-of-way of Day Boulevard/ Columbia Road. It also would include converting the concrete wall along the southern edge of the Conley Terminal to a flood wall.



Option B includes berm adaptations in the Marine Park along Farragut Road rather than perimeter protection around Pleasure Bay. Along Day Boulevard, the line of protection would incorporate restored beach and dune features instead of elevating the Harborwalk.

IMPLEMENTATION ROADMAPS



South Boston residents attended two public open houses where the project team shared ideas and received feedback on their preferences and concerns.

The roadmaps to guide the implementation of coastal resilience solutions in South Boston include high level phasing plans, cost estimates, benefit-cost analyses, potential partnerships, and funding. The roadmaps also take into account foreseeable cycles of development and redevelopment and the time necessary for completing different actions.

The near-term implementation period consists of actions that should be initiated now, and completed by 2025. These actions address the most urgent flood pathways associated with current flood risk along Fort Point Channel and Seaport Boulevard.

The mid-term implementation period consists of actions that should be in place by 2050, or sooner, should opportunities for earlier implementation arise. In the case that sea level rise accelerates, the schedule should be accelerated. The majority of South Boston, including the east side of the Fort Point Channel, the South Boston Waterfront, Seaport Boulevard, most of the Raymond L. Flynn Marine Park, Reserved Channel, Pleasure Bay, and Day Boulevard fall in the mid-term implementation period.

The long-term implementation period consists of actions that should be taken in the 2050s and beyond. The long-term implementation period consists of actions on the west side of the Fort Point Channel and the northern edge of the Reserved Channel / southern edge of the Raymond L. Flynn Marine Park. When the west side of Fort Point Channel is redeveloped, that would be an ideal time to integrate resilience measures into the area's new site plan and design guidelines.

Preliminary cost estimates for the various feature components, such as waterfront parks, berms, and shoreline protection features required to achieve flood protection are based on readily available data. They do not reflect design-level considerations for the area, such as as-built surveys of existing underground utilities or geotechnical information.

The benefits of fully implementing the identified coastal resilience solutions extend beyond flood protection to include social, ecological, and economic factors, although many of these benefits have not been quantified within the scope of this study. The directly quantifiable benefits of flood protection, or “avoided loss” include damages to buildings and their contents, displacement costs, impacts to productivity, and mental stress and anxiety.

REGULATORY RESILIENCE STRATEGIES

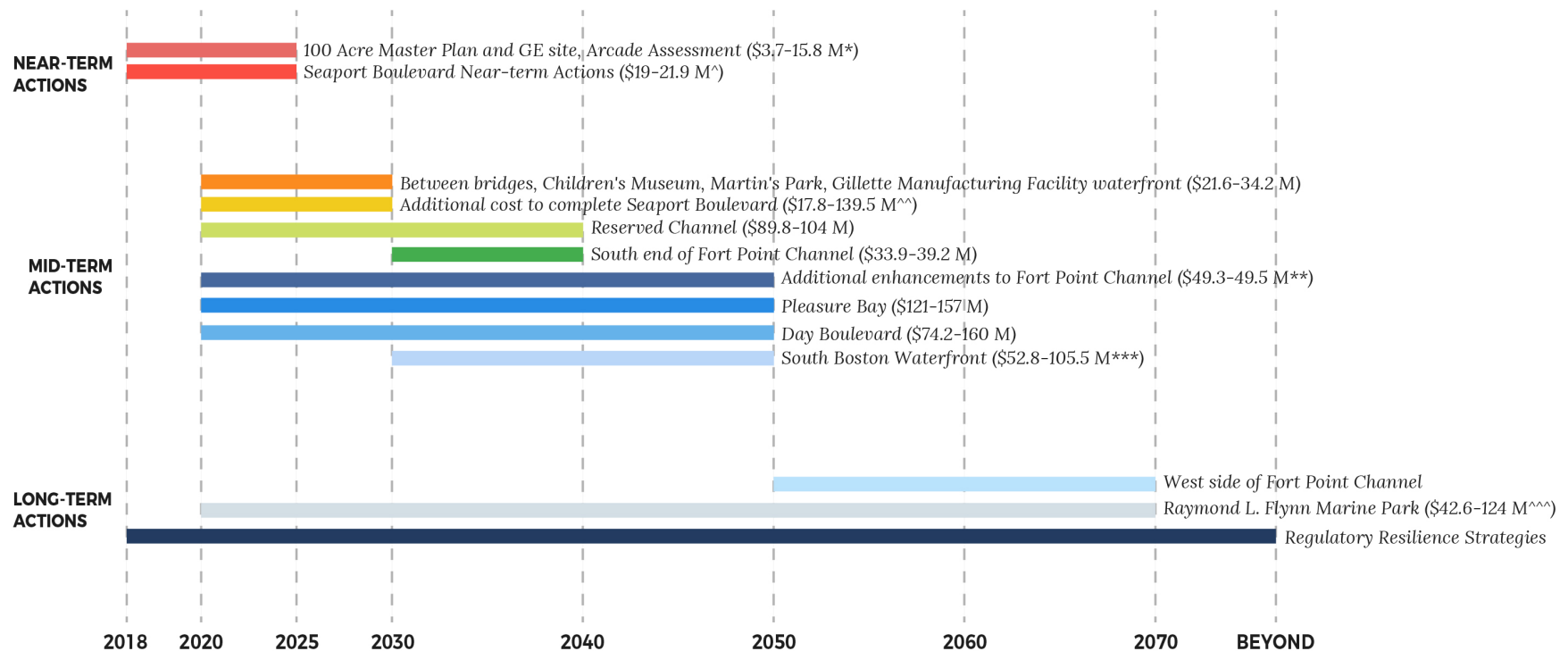
A comprehensive approach to resilience includes regulatory strategies that guide future development and investment toward long-term risk reduction and climate change adaptation, and allow implementation of coastal resilience design. Federal and State environmental regulations developed decades ago protect important water and wetland resources, but do not always consider flood protection or the consequences of warming oceans, sea level rise, or pollution caused by flooding. As our understanding of sea level rise evolves, laws and regulations will need updating at all scales of development, from individual buildings to the whole City.

The full report describes recommended changes to zoning, coastal zone management, and other regulatory tools.



South Boston residents attended two public open houses where the project team shared ideas and received feedback on their preferences and concerns.

RECOMMENDED TIMELINE



* Upper limit includes additional park space

** Costs for Option A only

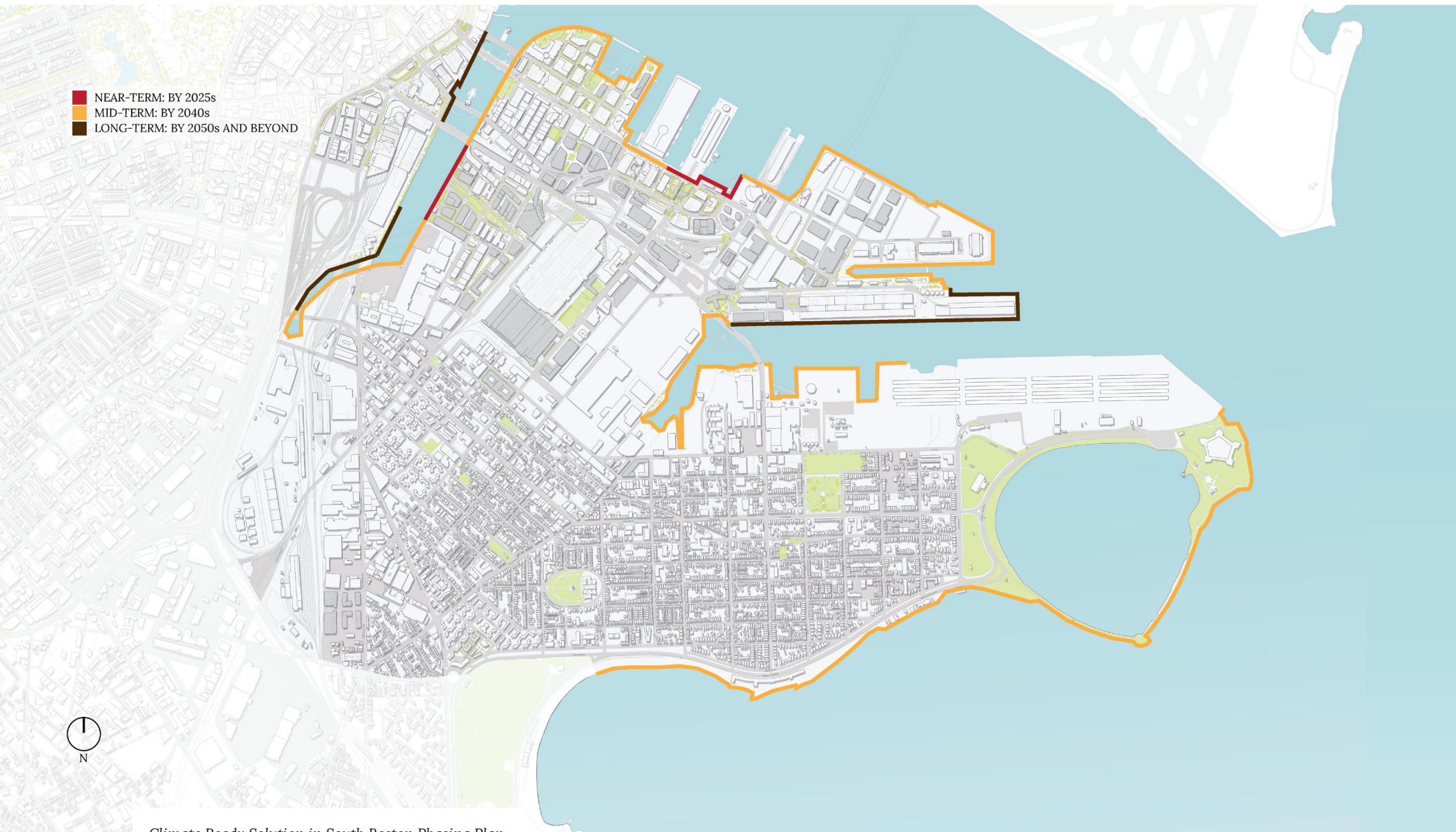
*** Costs for Options A and B only

^ Costs for Option A only. Does not include costs to floodproof the Fish Piers

^^ Cost range includes Options A and B. Floodproofing of Piers not included. No Dry Dock 4 costs included.

^^^ Floodproofing all structures seaward of Option B would add \$113 - \$131 million. Costs not included

Both costs and phasing plans are estimates and recommendations only, and will require more detailed planning, design, and engineering.



Climate Ready Solution in South Boston Phasing Plan

Next Steps

Area	Actions
Fort Point Channel and the South Boston Waterfront	<ul style="list-style-type: none"> » Continue engagement with property owners and stakeholders » Complete agreements with near-term action area property owners » Advance near-term recommended option to engineering and design » Coordinate with property owners to initiate the Arcade engineering study
Seaport Boulevard, Raymond L. Flynn Marine Park, and Reserved Channel	<ul style="list-style-type: none"> » Initiate more detailed planning process for the area to advance and refine options (City and Massport in coordination with stakeholders)
Pleasure Bay and Day Boulevard	<ul style="list-style-type: none"> » Initiate more detailed planning process for the area to advance and refine options (City and DCR in coordination with stakeholders)
Regulatory Resilience Solutions	<ul style="list-style-type: none"> » Coordinate design standards for infrastructure agencies » Continue discussions with agencies that regulate fill and construction in/over water; U.S. Army Corps of Engineers (USACE), Massachusetts Department of Environmental Protection (MassDEP) Wetlands, MassDEP Waterways, Boston Conservation Commission, Department of Conservation and Recreation (DCR), Massachusetts Office of Coastal Zone Management (CZM) » Develop Flood Resilience Overlay District that enables stricter design standards in the future floodplain

Capital and Maintenance Costs for South Boston Coastal Resilience

Study Area	Implementation Cost	Annual Maintenance Cost
Fort Point Channel	\$108M* to \$197M*	\$1.6M* to \$3.0M*
South Boston Waterfront	\$25M to \$150M^	\$0.4M to \$2.3M^
Seaport Boulevard	\$37M to \$161M^^	\$0.6M to \$2.4M^^
Raymond L. Flynn Marine Park and Reserved Channel**	\$132M to \$228M^^^	\$2.0M to \$3.4M^^^
South Boston Neighborhood	\$210M to \$299M	\$3.2M to \$4.5M
Total	\$521M to \$1.0B	\$7.8M to \$15.2M

*Only includes costs for the east side and base of the Fort Point Channel. Does not include costs for the west side of the Fort Point Channel.

** Does not include Conley Terminal. Massport is conducting a separate resilience planning effort for this area

^ Option D within the South Boston Waterfront would require floodproofing of at least 15 structures that would be left outside of the alignment. This would add \$137 to \$158 million to capital costs and \$2.1 to \$2.4 million in annual maintenance costs

^^ Floodproofing of the Fish Piers and World Trade Center are not included in these costs. Floodproofing of these assets would add \$113 to \$131 million to capital costs and \$1.7 to 2.0 million in annual maintenance to the project costs. Converting the dry dock into a 7 acre park could add \$75 to \$87 million.

^^^ Option B within the Raymond L. Flynn Marine Park would require floodproofing of at least 20 structures that would be left outside of the alignment. This would add \$291 to \$335 million to capital costs and \$4.4 to 5.0 million in annual maintenance costs.

