The Boston Climate Progress Report:

# DEFENDING THE WATERFRONT: BUILDING A RESILIENT COASTLINE FOR BOSTON

A big lift necessary for Boston's climate progress

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By the **Dukakis Center for Urban and Regional Policy at Northeastern University**

**SUPPLEMENTARY CHAPTER**

**3**

**The Boston Climate Progress Report:**

# DEFENDING THE WATERFRONT: BUILDING A RESILIENT COASTLINE FOR BOSTON

## A big lift necessary for Boston's climate progress


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# 1. EXECUTIVE SUMMARY

Boston will experience dramatic coastal flooding in the next decades due to sea-level rise and more frequent and severe storms. Already, Boston has more sunny-day flooding from high tides than any other city in the nation. Protecting the city equitably will be quite a challenge over the next decades. The four key barriers intensifying this challenge are:

- limited jurisdiction to act since much of the coastline is privately owned.
- outdated and complex permitting requirements.
- lack of a statewide governance structure to focus on the Commonwealth's entire coastline.
- insufficient funding to pay for costly resilience infrastructure.

Despite these barriers, Boston has made progress on coastal resilience planning. One aspect is requiring more resilient buildings. In 1996 the Boston Redevelopment Authority (now Boston Planning and Development Agency, BPDA) adopted Article 80 of its zoning code to review development projects and added Article 80B, which requests that large projects complete a Climate Change Preparedness and Resiliency Checklist, which asks developers to demonstrate how their plans address sea-level rise and extreme weather events. The code, however, is not mandatory and many new buildings that have gone up since its adoption are not highly resilient. The 2021 coastal flood resilience zoning overlay district (Article 25A) seeks to protect the most flood-prone areas of the city. Building on the Coastal Flood Resilience Design Guidelines that preceded it, the overlay district establishes sea-level rise flood elevations for new construction and retrofits and procedures for reviewing projects subject to Article 80.

Five neighborhood resilience plans have been completed, including the Phase II report for East Boston and Charlestown released in August 2022. Although Mayor Michelle Wu has announced that East Boston's resilience needs will be prioritized over downtown's, the City needs to refocus the actual decision-making on priorities to community members in East Boston and other communities.

Boston is prioritizing nature-based solutions over hard infrastructure for coastal protection. Nature-based adaptation measures are living solutions that provide economic, societal, and ecological benefits. Examples include floodable parks, rain gardens, and constructed wetlands. There is a climate justice element to

nature-based solutions to the extent that they add much-needed green space to low-income neighborhoods and can reduce the urban heat island effect. Several nonprofit organizations also have been building nature-based solutions in Boston.

Nature-based solutions can be difficult to permit because they often extend into the water. Several state agencies charged with protecting waterways under state and federal legislation (e.g., federal and Massachusetts Wetlands Protection Acts) grant permits for proposed projects. In addition, municipalities may have wetlands protection laws. Many of the laws to protect waterways originated in the 1980s when addressing climate change was not so evidently urgent. The need to update laws to respond to current demands for protecting both coastlines and marine life is pressing.

A regional or state-level governance structure is needed to address Boston's limited jurisdictional powers to protect its coast and to focus on the barriers to implementing both hard and nature-based protection measures. This agency would have to be created by the state legislature and have the power to finance improvements, assess costs, conduct engineering studies, manage engineering, design, and construction, administer contracts, and have information systems and environmental planning expertise. It would also need to have the power of eminent domain since many storm-surge and sea-level rise barriers will need to be built on private property.

Protecting Boston's coastline will cost between $1.7 and $3 billion. Federal funding through the American Rescue Plan Act and the Inflation Reduction Act is forthcoming. But ongoing funding will be needed. There is bipartisan support for the Housing and Environment Revenue Opportunities (HERO) Act in the state legislature. It would increase the current Deeds Excise Tax to create new revenue for affordable housing and climate resilience projects. It would generate $150 million in new funding annually. Such a bill was first filed in Massachusetts in 2019 by Governor Baker as An Act Providing for Climate Change Adaptation Infrastructure Investments in the Commonwealth (S.10).[1] Governor Baker's proposal would have increased the Deeds Excise Tax from $4.56 per $1,000 to $6.84 per $1,000. The State's Joint Committee on Revenue sent the Governor's proposal to study and took no further action on it that session (191st). Funding an agency similar to the Mass Clean Energy Center is another state-level option. Even with federal and state funding, private financing will be needed. Public-private partnerships are being developed for this purpose in other cities and states that could be replicated in the Boston region.

In summary, protecting Boston's coastline will require a dedicated funding stream, an overarching governing authority, and a planning process that engages residents of the city's neighborhoods in co-creating solutions. We offer options for all three in this chapter.

Boston's priority actions include engaging with the governor on the form of a regional or statewide agency to manage, fund, and coordinate coastal resilience for the Commonwealth. City and government officials would then have to engage the legislature in supporting and authorizing this agency. A second priority should be reengaging frontline communities on resilience planning embedded in a broader revitalization agenda. Boston and state government officials also must encourage the state legislature to pass the HERO Act to provide an ongoing source of resilience funding.

## 2. VISION STORY: BOSTON HARBOR CLEAN-UP

In the early 1980s, Boston Harbor was considered the most degraded harbor in the country. In 1983, the Conservation Law Foundation filed a suit against the City and the Commonwealth to stop the dumping of about 12 billion gallons of raw or partially treated sewage into it annually.[2] As a result, a consent decree was issued by the U.S. District Court for violating the 1972 Federal Clean Water Act. The court order set milestones for developing a new wastewater system. Under direction of the EPA, the Massachusetts Water Resources Authority was created by the state legislature as a new public agency to manage the region's water and sewer system and to coordinate the harbor clean-up.[3] One of the largest public works projects in New England, it came in on time and under budget.[4] With a $4.7 billion[5] investment in waste treatment facilities at Deer Island and additional cleanup efforts, the harbor was transformed into a "great American jewel."[6]

The technical details of the sewage treatment plant, with its sludge digestors, 9.5-mile discharge tunnel below the ocean floor, and 55 diffuser pipes, are fascinating.[7] But our story focuses on the MWRA's project management. Completing the work required managing almost 80 prime contractors and more than 2,000 construction workers. The MWRA created an in-house team, the Program Management Division (PMD) to manage the project, including two consulting teams. This internal organization protected the resources of the rest of the agency from being tapped by the harbor projects and ensured that staff time was not divided among different projects. PMD staff were selected to include engineering, design, construction management, finance, contract administration, program management, information systems, and environmental planning expertise. When the work was completed, the division was dissolved.[8]

The 1987 National Clean Water Act (which was vetoed twice by President Reagan before passing) allocated $100 million of the $2.4 billion bill for the Boston Harbor clean-up. Another $620 million went to the Commonwealth, from which it allocated special grants to Boston for the harbor. Although insufficient, receiving these funds meant that ratepayers wouldn't have to foot the entire bill. The residents of Boston and surrounding communities served by the MWRA paid at least 90 percent of the project's costs through sewer fees, to the tune of about $545 per household in 1993,[9,10] which would be over $1,000 today.[11] It was its commitment to keeping ratepayer fees down that led the MWRA to be extremely cost-conscious in completing the project.

We now must step up with similar resolve and funding to protect the city's coastline. Boston has the dubious distinction of being the eighth most vulnerable city in the world to flooding due to sea-level rise.[12] While the cost of increasing coastal resilience is high—as much as $3 billion—it's less than the cost of cleaning Boston Harbor.

The task of protecting our city from sea-level rise and storm surges is even more complex than the harbor clean-up. The harbor was funded by federal allocations and a surcharge on water bills so secure funding was in place. A regional authority managed the work.

Like cleaning the harbor, protecting Boston's coastline will require a dedicated funding stream, an overarching governing authority, and a planning process that engages residents of the city's neighborhoods in co-creating solutions. As stressed in the 2020 report by Arcadis for the Boston Green Ribbon Commission, *Expanding Boston's Capacity to Build Coastal Resilience Infrastructure: Lessons from the Seaport District*, "New or evolved governance, funding, and regulatory approaches will need to be developed over the next three to four years to advance project delivery and district-scale coordination to stay on the desired implementation schedule for South Boston projects planned beyond 2025." While the Arcadis report focuses on South Boston, this conclusion applies to the city's overall efforts. This report focuses on these three aspects of Boston's resilience planning—governance, funding, and regulation.

# 3. WHAT WE'RE FACING

The 2022 *Sixth Assessment Report on Vulnerability and Adaptation of the Intergovernmental Panel on Climate Change* (IPCC) predicts that climate-driven growth in storm surge and rainfall intensity, along with more rapidly melting Arctic and Antarctic ice sheets and ocean thermal expansion, will increase the likelihood and severity of flooding throughout Boston.[13] The Greater Boston Research Advisory Group's (GBRAG) 2022 report estimates that Boston will experience 4.8 feet of sea-level rise by 2100 under a high emissions scenario, which is lower than the estimate in the 2016 report of 7.4 feet.[14]

Coastal flooding refers to both flooding caused by sea-level rise, and flooding caused by major storms interacting with tides, especially astronomical high tides. Sea-level rise and storm surge, however, are different processes that require separate, but integrated, solutions. While sea-level rise is happening faster than anticipated,[15] we have time to put solutions in place. In contrast, more frequent and severe storms and the surges they produce are an immediate threat.

Extreme precipitation events have become more frequent and intense in recent decades, and this change is expected to continue. The most recent projections point to a 10–20 percent increase in daily precipitation intensity by 2050 and 20–30 percent increase by 2100. In addition to flooding, increased heavy rainfall will stress stormwater infrastructure.

Boston increasingly experiences sunny-day flooding from high tides. The city had 22 days of such flooding in 2017, and by 2030, is projected to have up to 35 days and up to 95 days annually by 2050.[16] The 2022 GBRAG report estimates that high-tide flooding will occur in about half of the days of a given year. Most of the Boston area's extreme flooding events are caused by winter storms that coincide with astronomical high tides. Under all emissions scenarios, what is now a one in 10-year winter storm flood will likely become an annual event by mid-century.

While Boston has billions of dollars of infrastructure and buildings to protect, resilience must prioritize people—and particularly the most vulnerable, based on likely exposure to coastal flooding and their ability to withstand and recover from extreme weather. The need for equitable resilience was raised in the IPCC's 2022 *Sixth Assessment Report on Vulnerability and Adaptation*: "The greatest gains in well-being in urban areas can be achieved by prioritizing investment to reduce climate risk for low-income and marginalized residents."[17] With this understanding, Boston's coastal resilience planning must both prepare for harsher flooding events and commit fully to prioritizing our most vulnerable communities in the adaptation process beyond a narrow focus on open-space access.

In this context, it matters that Mayor Wu is prioritizing East Boston—she has signaled that equity is at the forefront of decision-making. Mariama White-Hammond, Chief of Energy, Environment, and Open Space, reinforced that priority: "We can't say 'equity' and prioritize downtown over East Boston."[18]

The dilemma is that East Boston and downtown are part of one coastline. We cannot focus on protecting one neighborhood or individual parcels—a regional solution that centralizes equity is the only answer. As noted by environmental lawyer Jeffrey Porter, "The City deserves a planning department with the resources to move forward on plans for East Boston and the Downtown Waterfront and the Fort Point Channel Neighborhood and Dorchester, and anyplace else needing attention, all at the same time."[19] The flood pathways in some parts of South Boston, Downtown, and Dorchester are also quite serious and urgent. The key question is who will benefit and who should pay in each area.

To the extent that the public sector is not protecting them, large landowners in the downtown and Seaport will find their own solutions to protect their properties, which is already happening. Privatized solutions can be partial and potentially harmful to adjacent properties. But they can also provide strong resilience measures, increase public access to the waterfront, and benefit inland property owners and residents. We see evidence in the strategies employed by Related Beal and other developers along the Fort Point Channel.

At some point, coastal resilience must be integrated with stormwater management and urban heat island abatement. Our focus in this first Climate Progress Report for Boston is on the most urgent matter at hand—figuring out the governance, funding, and regulatory changes needed for coastal resilience.

Table 1: **Strategies and Actions on Coastal Resilience**

| PLAN/ ACTIVITY | ACTOR | YEAR | DESCRIPTION |
|---|---|---|---|
| **Preparing for the Rising Tide** | Boston Harbor Assn. | 2013 | Provides predictions of climate impacts in New England, looks at Boston's climate change preparedness, assesses Boston's vulnerability to coastal flooding, develops vulnerability analyses and sample preparedness plans for two case studies (Boston's Long and Central wharves and the UMass Boston campus), and offers recommendations for the public and private sectors on how to prepare for the impacts of sea-level rise due to climate change. |
| **Metropolitan Boston Regional Climate Change Adaptation Strategy** | MAPC | 2015 | Creates a strategy for Eastern Massachusetts to prepare the region to be resilient and reduce the impacts of climate change through risk management, including specific sub-strategies and recommendations. It includes a vulnerability assessment, goals and objectives, adaptation strategies, and identifies local, regional, and state actions. |
| **Executive Order 569** | Gov. Baker | 2016 | Lays out an approach for the Commonwealth to reduce greenhouse gas emissions, safeguard from the impacts of climate change, and build resilience. It is a collaboration of the Office of the Governor, Executive Office of Energy and Environmental Affairs, Executive Office of Public Safety and Security, and other stakeholders, and requires a variety of actions to be taken across different governmental bodies. It was reviewed in 2019 and will be again every five years after that to build upon existing efforts. |
| **Climate Ready Boston** | Boston | 2016 | Climate Ready Boston provides a roadmap for ongoing actions to create a more resilient city. It addresses coastal and riverine flooding, stormwater flooding, and extreme temperatures. Its three key elements are: seeking consensus; assessing vulnerability; and implementing initiatives. It seeks to build resilience equitably and to create economic opportunity. |

| | | | |
|---|---|---|---|
| **Resilient Boston** | Boston | 2017 | Advances a comprehensive action roadmap to build upon past efforts, including Imagine Boston 2030, to address racial equity and the physical, environmental, and economic threats facing the city. It outlines visions, initiatives, goals, actions, and targets to address the city's resilience. The City of Boston worked with 100 Resilient Cities and the Rockefeller Foundation to develop the plan. |
| **Mass. State Hazard Mitigation and Climate Adaptation Plan** | Mass. | 2018 | Allocates $2.4 billion to climate mitigation and adaptation statewide, with $500 million dedicated to resilience. It was the nation's first hazard mitigation plan to integrate with climate planning. |

# 4. PROGRESS TO DATE

With a proposed harbor barrier system ruled out for the near future due to its high cost and marginal effectiveness, Boston is focusing on shoreline-based protection systems to defend the city from sea-level rise and storm surge.[20] The city, state, and various groups have been proposing solutions for almost a decade (Table 1).

## Zoning

Boston has taken several steps to update its zoning code to promote building resilience. In 1996, the BPDA adopted Article 80 to Boston's Zoning Code. It established guidelines for the review process of development projects, including reviewing their impact on transportation, public realm, the environment, and historic resources.[21] Article 80B was added to require that all large projects complete a Climate Change Preparedness and Resiliency Checklist, which asks developers to demonstrate how sea-level rise, extreme weather events, and FEMA flood zones were taken into account in their designs and plans.[22] In 2007, Article 37 expanded the guidelines of projects subjected to Article 80 to include consideration in the planning, designing, and construction phases to minimize any adverse environmental impacts, conserve natural resources, and be resilient to climate change. The BPDA released coastal flood resilience guidelines in 2019 for

reviewing projects to ensure that they use best practices for flood resistant design. The guidelines offer specific approaches to retrofitting every building type for resilience.

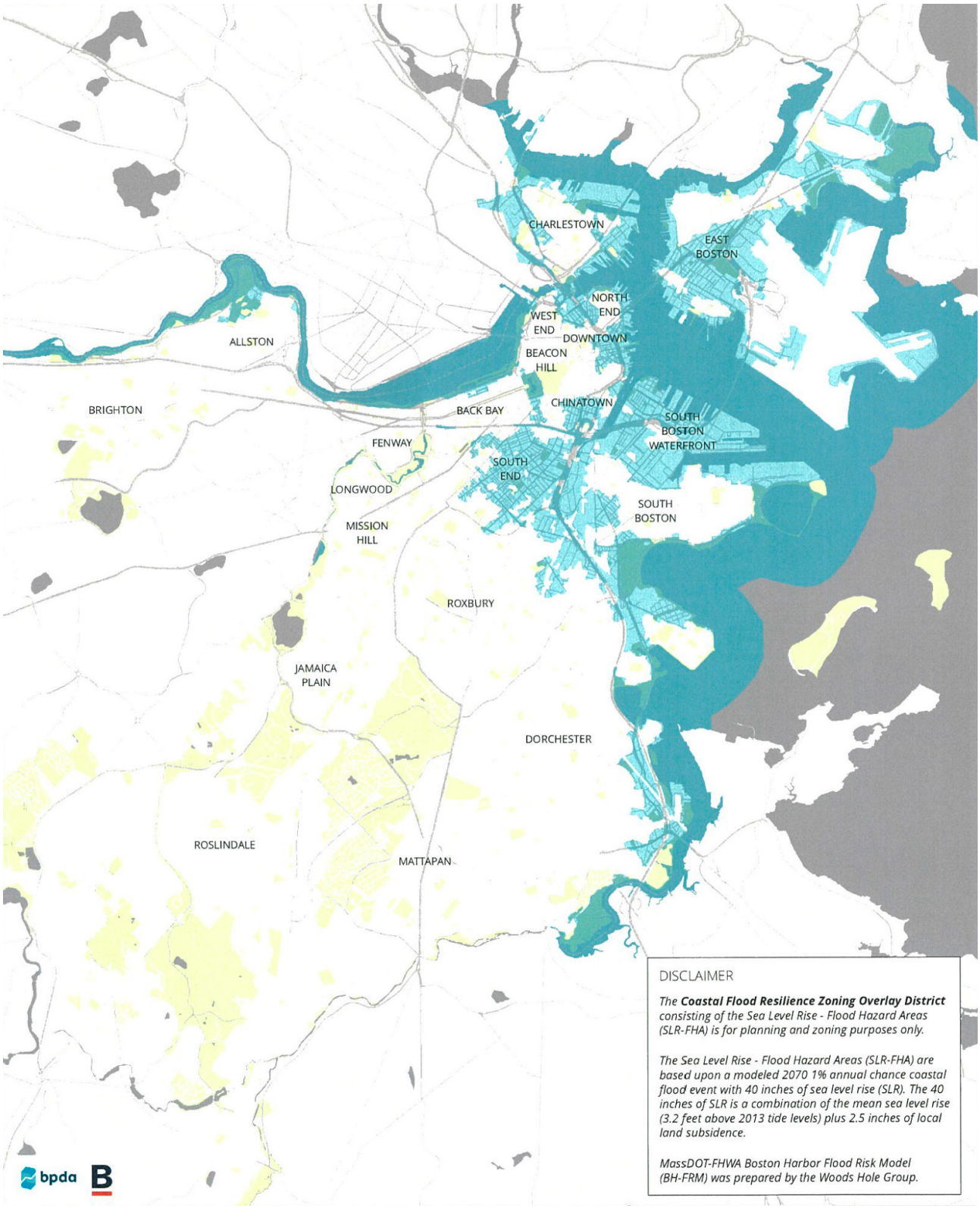
Articles 80 and 37 are guidelines, not requirements. Which has meant that many buildings constructed since they were passed are not at the highest level of resilience that they could be. It is a frequent complaint that the BPDA needs to extract more from developers. A recent illustration that developers would be more responsive to City demands is a challenge to Cronin Holdings on its luxury condo complex at 150 Seaport Boulevard brought by the Conservation Law Foundation. Jon Cronin agreed to a settlement that would require 60 percent of the project's land be maintained for public use, including a large dock. He also agreed to pay $13 million into a fund over 35 years to build a new waterfront park in South Boston as a resilience measure.[23]

The City went beyond guidance when City Council passed the Boston coastal flood resilience zoning overlay district (Article 25A) in October 2021 to protect the areas of Boston projected to be at risk of a 1 percent chance storm event in 2070 with 40 inches of sea-level rise. The overlay builds upon and formalizes the Coastal Flood Resilience Design Guidelines and establishes sea-level rise flood elevations for new construction and retrofits. It promotes designs that prevent flood damage by elevating a building's occupiable space and flood proofing areas beneath flood elevations in both new and retrofit projects.[24] The new standards also set requirements for a project's height and setbacks and include new open space requirements. While the regulations will mostly apply to larger projects, some smaller projects (10,000 square feet and under) will undergo the review in parts of the city closest to the harbor. The Zoning Overlay District extends beyond the FEMA-designated flood plain and covers more than 5,000 acres of land at risk from coastal flooding, including the Seaport, Chinatown, South End, and East Boston neighborhoods, as well as parts of South Boston, the North End, Dorchester, Charlestown, and the Downtown area.[25] The overlay district covers what will be 85,000 people and $85 billion in buildings by 2070[26] (Figure 1).

While the guidelines are rigorous, the new rules may not fully address serious urban design problems. One expert told the *Boston Globe* that the new overlay district's height requirements for a new building's first floor will mean that it will be much higher than its neighbors and the current street, leading to an unappealing street-level view.[27] Some also question whether the requirements sufficiently consider potential flooding like that seen from hurricanes Sandy or Ida. The Zoning Overlay District is a significant step toward more resilient construction. The City can adapt the code to address these concerns, but because much of this area is already built and not undergoing major retrofits, many property owners won't be required to become flood resilient.

## Figure 1: **Coastal Flood Resilience Zoning Overlay Map**

Source: City of Boston



## Staffing

When *Climate Ready Boston* was published, the City assigned and/or appointed staff members from numerous departments responsible for addressing resilience as defined in the report's recommendations. Because most departments didn't have funding to add a new staff person, responsibilities were often shifted or expanded. For example, at the BPDA (then BRA) the title of Richard McGuinness changed from Deputy Director for Waterfront Planning to Deputy Director for Climate Change and Environmental Planning, a position in which he oversees consolidated Article 37 review, updates and reviews projects subject to Article 25A (Coastal Flood Resilience Guidelines & Zoning Overlay District) and the BPDA's Smart Utilities program, and connects with the Environment Department on the development and implementation of the Climate Action Plan, heat resilience, and coastal infrastructure to address sea-level rise.

As department budgets have increased, more hires have been made. The BPDA now has a full-time staffer for reviewing development proposals for the overlay district. Kate England recently was appointed the City's first Director of Green Infrastructure, working with Public Works and other departments and the Boston Water and Sewer Commission. In his position as Green New Deal Director, Oliver Sellers-Garcia will also oversee resilience as will new BPDA Chief of Planning Arthur Jemison.

## The Neighborhood Resilience Plans and the Equity Agenda

Climate Ready Boston called for developing local climate resilience plans to coordinate adaptation efforts and to create a coastal protection system to address flood risk. Boston's Office of Energy, Environment, and Open Space has completed five neighborhood plans for coastal resilience and is in the design process for several resilience projects (Table 2). A Phase II plan for East Boston and Charlestown was released in 2022.

Table 2. **Cost of Boston's Resilience Plans**

| PLAN | KEY PROJECT AREAS | RESILIENCE IMPLEMENTATION COSTS (in Millions) |
|---|---|---|
| **Coastal Resilience Solutions for South Boston** | Fort Point Channel<br>South Boston Waterfront<br>Seaport Boulevard<br>Flynn Marine Park<br>South Boston Neighborhood | $108 - $197<br>$25 - $150<br>$37 - $161<br>$132 - $228<br>$210 - $299<br>TOTAL: $521M - $1B |
| **Coastal Resilience Solutions for Dorchester** | Columbia Point/Morrissey Blvd.<br>Tenean Beach & Clam Point<br>Port Norfolk<br>Neponset Circle<br>Neponset Riverfront | $55.6 - $90.8<br>$22.6 - $45.6<br>$20.5 - $65.7<br>$10.8 - $14<br>$1.8<br>TOTAL: $111 - $215 |
| **Coastal Resilience Solutions for East Boston and Charlestown** | East Boston Greenway<br>Harborwalk<br>Mario Umana and Shore Plaza<br>Border Street<br>Marginal Street | East Boston: $121 -$200<br>Charlestown: $33 - $62<br>TOTAL: $154 - $262 |
| **Coastal Resilience Solutions for Downtown Boston and North End** | Harbor Towers<br>Central Wharf and NEAQ<br>Long Wharf<br>Christopher Columbus Park<br>Atlantic Avenue<br>US Coast Guard (South)<br>Rowes Wharf | $4.8 - $8<br>$17.9 - $29.8<br>$27.9 - $46.4<br>$10.2 - $16.9<br>$0.6 - $1<br>$1.2 - $1.9<br>$13.6 - $22.7<br>TOTAL: $76.2 - $126.7 |
| **Climate Ready East Boston - Phase II** | Chelsea Creek<br>Belle Isle Marsh<br>Orient Heights Rail Yard<br>Constitution Beach<br>Wood Island Marsh | Total: $424- $639 |
| **Climate Ready Charlestown - Phase II** | Navy Yard<br>Little Mystic Channel<br>The Boston Autoport | Total: $410 - $690 |

The plans do not reflect the emphasis on equity called for in *Climate Ready Boston*. The reports define equity mostly by expanding waterfront access but not by protecting affordable housing or addressing historic racial injustices. *Climate Ready Boston* calls for long-term community partners in the form of local climate resilience committees to co-develop the city's approach to resilience in their neighborhoods. These local committees have not been created and are currently noted as "in progress" on the Climate Ready Boston website.[28] In contrast, the Phase II reports for East Boston and Charlestown, released in August 2022, discuss the importance of protecting affordable housing and addressing racial injustices.

We focus our neighborhood planning discussion on East Boston because of its vulnerability to sea-level rise, concerns about equity in how resilience has been implemented to date, and the announced focus on the neighborhood by the Wu administration. Recognizing the limits of the City's neighborhood resilience planning, Boston Waterfront Partners, a group of local and statewide advocacy organizations emphasizing the need for fairness and integrity, equity and inclusion, and community benefit in resilience planning, contracted with the Sustainable Solutions Lab at UMass Boston to assess how these goals could be achieved in East Boston. Released in December 2021, *Opportunity in Complexity: Recommendations for Equitable Climate Resilience in East Boston* cataloged resident resilience priorities. A not-surprising finding is that residents prioritized several needs above the threat of climate change, including fear of gentrification and displacement, overcrowded living conditions (particularly at the height of the COVID pandemic), and high rents.

The report called for significantly more resident participation to develop approaches that benefit the community.[29] The seven recommendations focused on prioritizing equity and shifting decision-making to community members. To accomplish this, the authors called for establishing a permanent committee with bilingual members, involving neutral mediators in meetings with planning agencies and the community, and hiring paid community-based residents to engage with the community.

Despite the East Boston neighborhood planning initiatives organized by the Boston Planning & Development Agency and other city agencies, our conversations with East Boston residents also point to a need for coastal resilience to be part of an integrated neighborhood-scale planning strategy that addresses multiple neighborhood concerns. The Phase II plans for East Boston and Charlestown do not accomplish that but, in fairness, the process for developing it began under a prior administration.

For the most part, coastal resilience in East Boston has been funded through private high-end redevelopment, leading to gentrification and economic displacement. The BPDA-funded *Implementing District Scale Solutions for the Border Street Area of East Boston—Climate Resiliency, Financing, and Funding Options* report, for example, mostly proposes privately funded measures.[30]

Though there has been significant planning progress, and many of the plans have moved through stages of the design process and have received funding, few publicly funded resilience measures have been implemented in East Boston. The Greenway has been completed and the proposed deployable flood gates are now operational and managed by the City, protecting over 4,200 residents and 70 businesses from coastal flooding.[31] Additional Greenway capital improvements were also included in the FY21 capital budget.

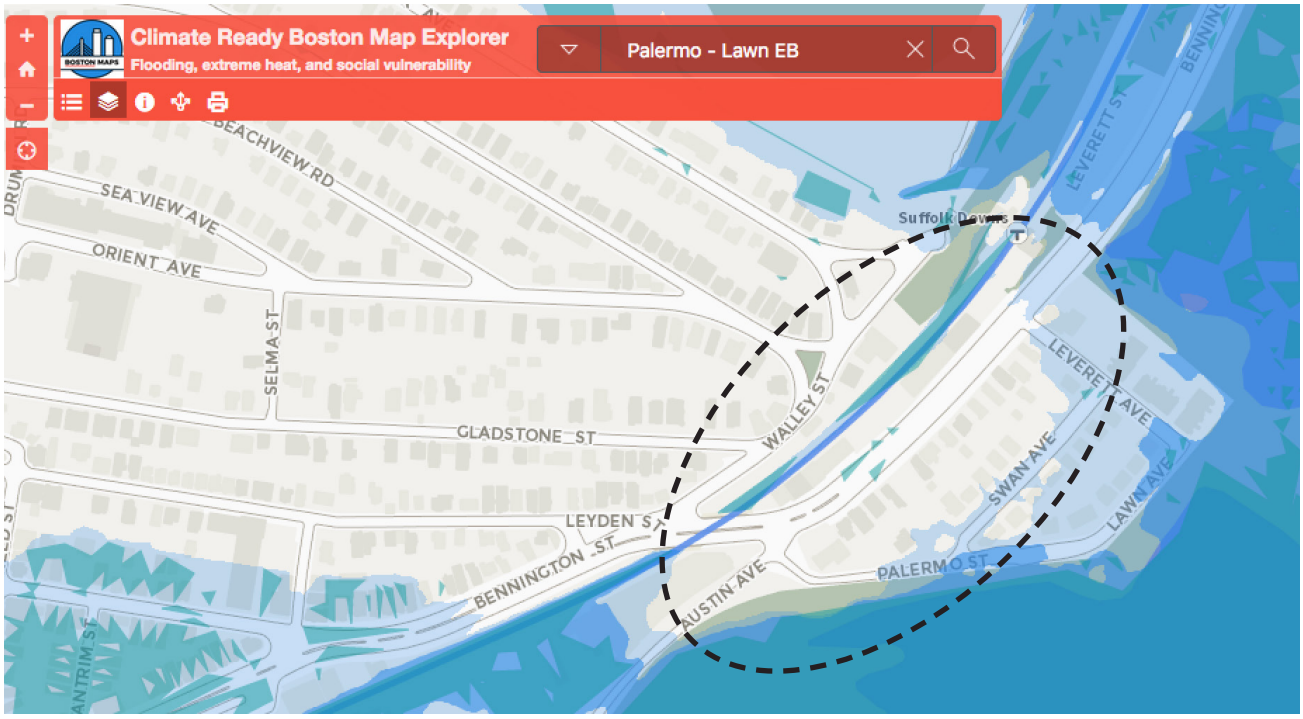
The proposed designs for Lewis Mall are primarily focused on extending the Harborwalk through green terraces, raised walkways, and multipurpose seating/floodwalls, which received positive feedback from community members. At Carlton Wharf, the flood adaptation plan is primarily centered on a "living shoreline" that is widely supported conceptually by the community, though it presently lacks detail. There are stark differences between the floor heights of newer residential developments such as the Clippership Apartments and Hodge Boilerworks, which have incorporated flood resilience into their designs, and only slightly older apartment complexes in Carlton's Wharf that will require significant grading efforts to protect from flooding.

The cost of the resilience efforts at Carlton Wharf is estimated at $18 million. The developers are long gone, so it is up to the City to find funding for this project, which will also provide protection to properties behind it. The BPDA is seeking funding from Massachusetts' Hazard Mitigation Grant Program to cover 75 percent of its cost.[32]

The Phase II East Boston report identifies two major flood pathways, one starting in Liberty Plaza on Border Street and the other running up the East Boston Greenway. Flooding in low-lying areas will increase (Belle Isle Marsh, Chelsea Creek, and Coleridge Street), and new flood pathways will emerge. Proposed solutions call for constructed infrastructure such as elevating roads and parts of the Harborwalk, and vertical concrete floodwalls. Other measures include raised landscaped berms and dunes. The report provides estimated cost ranges for each of the measures but does not identify sources of funding.

## Figure 2. **Anticipated New Flood Zones, East Boston**

Pale blue shading indicates projected high tide levels to come.
Source: Climate Ready Boston




Several East Boston activists in climate and resilience expressed frustration that land-buybacks in the highest risk areas (using eminent domain) have not been identified or evaluated as a strategy. They commented that a gradual buyout strategy could have been proposed for willing residents of a small residential section of East Boston between Bennington Street and Palermo Street/Lawn Avenue (circled on the map) identified in *Climate Ready Boston* as being at risk from sea-level rise and high tides. If these homes were abandoned, the area could create a migration path for Belle Isle Marsh. Instead, the report recommends only a berm or wall between private homes and the Marsh (Figure 2).

Although the City tracks progress on the resilience plans on its website, several residents commented that there needs to be more communication so they understand why goals are not being met. Further, residents said they don't know who to contact as it isn't clear which city departments are responsible for implementing climate readiness measures.

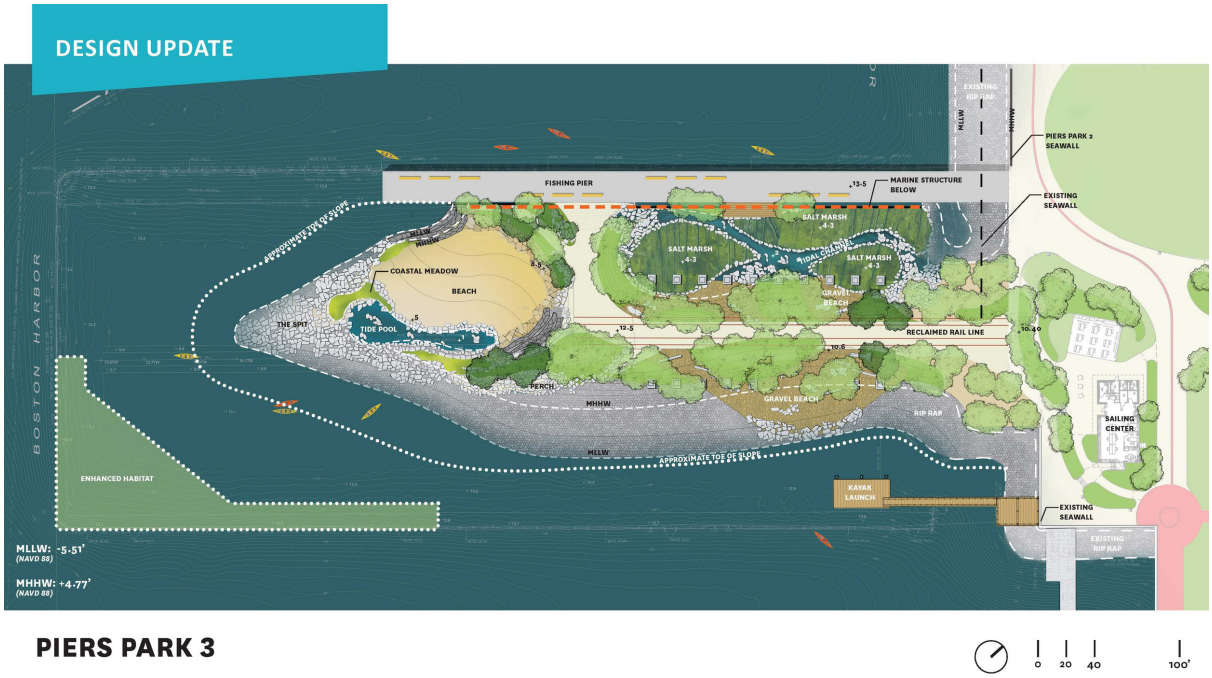
# Nonprofit and Private Sector Resilience Planning

Private sector and nonprofits have been implementing nature-based solutions aimed at protecting Boston's coastline as well. We mention some of them here to provide a sense of their scope.

The Wharf District Council is a public-private partnership that is designing a district-wide barrier for Downtown Boston as called for in *Climate Ready Boston*. Along with $250,000 from the state, the Wharf District Council Climate Resiliency Task Force has solicited $10,000 per WDC member to develop a resilience plan for the area surrounding Columbus Park to Fort Point Channel. It has considerable public input.

Figure 3: **Piers Park 3 Design.**

Source: Trustees of Reservations



The Trustees of Reservations launched One Waterfront in 2016, which is responsible for developing Piers Park III in East Boston. After soliciting community feedback, the project will begin construction in 2023. This third phase of the park includes planted corridors, coastal meadows, a beach, and salt marshes (Figure 3). The Trustees anticipate the completion of the proposed design in 2025.[33] The Piers Park III project is estimated to cost $30–$40 million. In 2020, the *Boston Globe* reported that the Trustees has sourced $20 million from private donors.[34] An additional $2 million was proposed in a 2022 state legislature economic development bill that did not pass.

The New England Aquarium unveiled a master plan for a Blueway in 2016. It proposes an active, educational public environment extending from the Greenway to the waterfront. The concept incorporates resilience measures on the Aquarium property that could connect to measures implemented on adjacent properties.[35] This proposal was supported and promoted through the 2018 Downtown Boston Municipal Harbor Plan, which allocated funds for its continued development.

In addition, local universities are testing and piloting nature-based solutions. The Stone Lab at UMass Boston tests and scales nature-based approaches to climate adaptation, coastal resilience, and ecological restoration in Boston Harbor Islands National and State Park. Partners include the City of Boston, UMass Boston School for the Environment, Boston Harbor Now, the National Parks of Boston, the Massachusetts Department of Conservation and Recreation, and the James M. and Cathleen D. Stone Foundation, which provided UMass Boston with a $5 million grant to fund the research.

Northeastern University and independent coastal engineering researchers are piloting an "Emerald Tutu," which seeks to create a network of floating modular biomass marsh mats and walkways to reduce coastal flooding by dampening incoming wave energy (Figure 4). The project's name plays off Boston's iconic interlinked Emerald Necklace of parks.

Critics suggest that the Emerald Tutu would not be compatible with large ships that bring liquid natural gas, salt, and autos to the harbor (all other traffic goes to the port terminal outside of the inner harbor) and other water uses. According to Gabriel Cira, the project lead, because the mat network is flexible and adaptable, it could easily be configured to accommodate major shipping lanes and other recreational uses such as swimming, boating, and fishing. A feasibility analysis would have to establish whether shipping and recreational uses are compatible and how much protection it could deliver at scale.

Another concern is that even at the depicted scale, it would not have enough impact to slow storm surges. Other professionals we talked to raised questions about the impact the Emerald Tutu would have on the marine ecosystem below the project. Cira notes that the mats would be consistently wet and thus be consistent with plant growth.

Figure 4. **Renderings of the Proposed Emerald Tutu**

Source: The Emerald Tutu

# 5. BOSTON'S STRATEGIES AND CHALLENGES IN IMPLEMENTING RESILIENCE INFRASTRUCTURE

Boston needs three types of flood protection: flood-resilient buildings; constructed barriers; and nature-based solutions. Except for individual buildings, these solutions need to be regional in scale as flooding does not recognize property or jurisdictional boundaries.[36] Many parts of Boston will require a multi-layered approach.[37]

There are three key challenges to implementation. First, the City has limited jurisdiction to act since much of Boston's 47-mile coastline is privately owned and heavily developed. Second, coastal resilience projects must obtain permitting from multiple agencies with sometimes contradictory goals. A third challenge is the lack of a consistent and sufficient funding stream to pay for costly resilience infrastructure. Even when projects are approved for federal funding, it can take years for the money to flow to the city. The first type of flood protection, flood-resilient buildings, was discussed earlier. We turn to explaining the second and third types of flood protection, then to a discussion of these challenges and possible solutions to them.

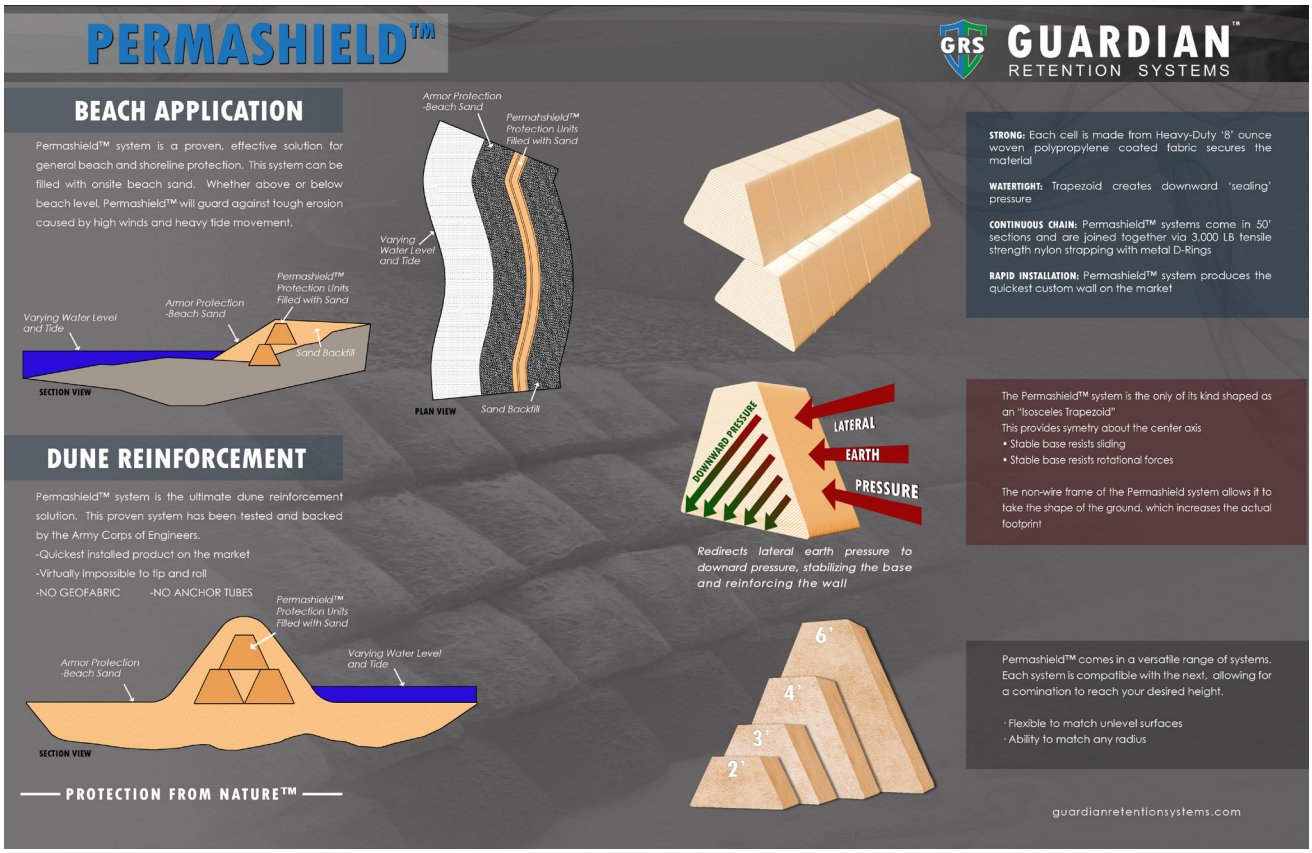
## Constructed Barriers

U.S. cities have been employing constructed barriers or gray infrastructure such as levees, seawalls, or gates to protect themselves from the seas for at least 200 years. Hard-engineered coastal infrastructure is typically installed to protect built-up areas from severe flooding and other extreme weather events. Although some constructed barriers will be necessary to protect Boston, the concern is that they can cause coastal habitat loss and harm ecosystem services,[38] while offering none of the co-benefits of nature-based solutions.[39]

Several experts we interviewed for this chapter acknowledged that some hard infrastructure will be needed. They pointed to hybrid approaches that are "less hard" because they incorporate gray and green components. Some examples of hybrid infrastructure can be found around the Greater Boston area, including reinforced dunes or living shorelines that contain engineered levees (Figure 5).[40] These systems are designed to manage potential storm surges and provide some benefits of green coastal infrastructure. A recent example of a project that is mostly constructed infrastructure is Fort Port Channel. The BPDA recently secured a $10 million federal grant to build a berm along the east side of Fort Point Channel.[41] The proposed plan is "2,300 feet of berm and floodwall mitigation features"[42] that will be 8 feet high and tree lined.[43]

Figure 5: **Reinforced Dune Components**

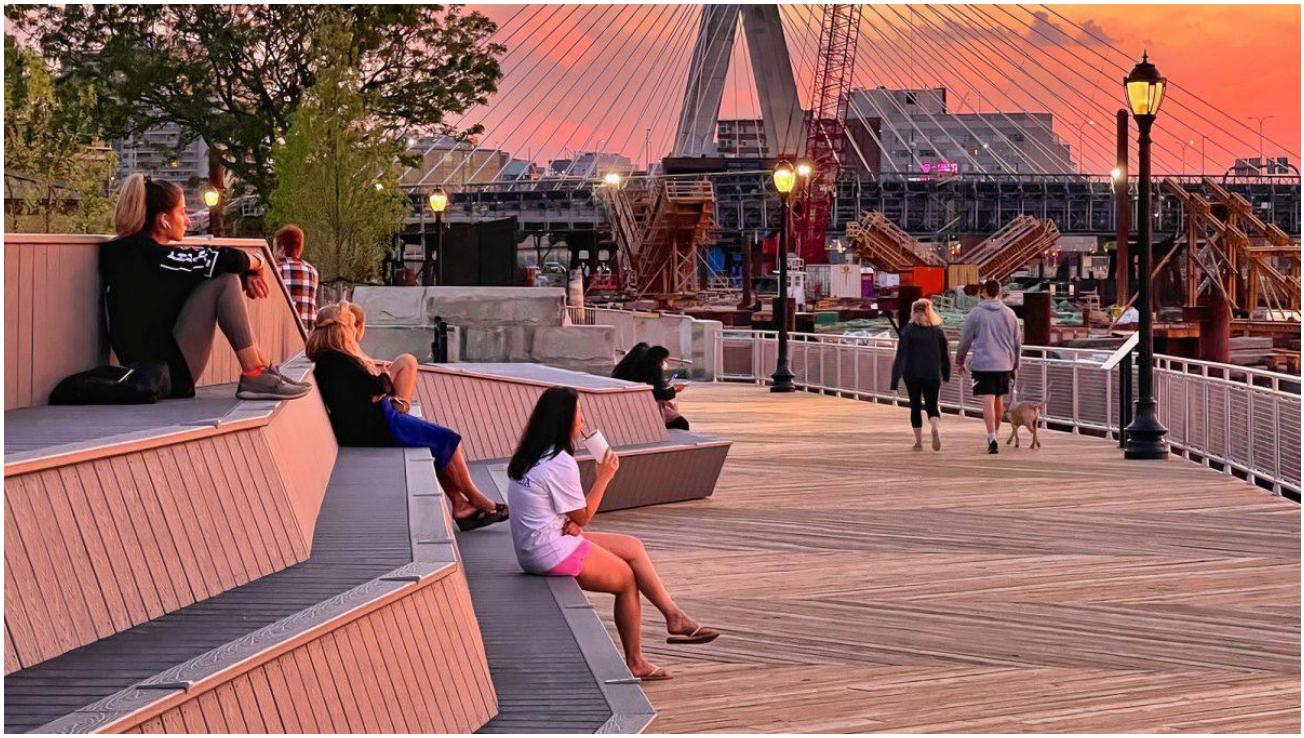
Source: Guardian Retention Systems




Designed under Boston's Climate Resilient Design Standards and Guidelines, the North End's Langone Park and Puopolo Playground is a more integrated hybrid approach. The redesigned park improved resilience by raising the Harborwalk along the edge of the park and integrating seating with flood barriers, referred to as a "seatwall" (Figure 6). It demonstrates that constructed barriers can provide multiple benefits. The refurbishment had several sources of funding, the largest of which was $14.3 million from former Mayor Martin J. Walsh's Capital Improvement Plan, which also includes bonds and $95,000 from the City of Boston's Emelie Pugliano Trust Fund and $1 million from the Community Preservation Act.[44] The park illustrates how the new standards should be applied and how new green infrastructure creates a community amenity.[45] The successful integration of these standards, alongside robust community engagement and collaboration, earned the project the 2021 Green Steps Award from the New England Water Environment Association.

Figure 6: **Climate Resilient Design Elements from Langone Park & Puopolo Playground Refurbishment**

Source: Weston & Sampson



## Nature-Based Solutions

The city of Boston and several other groups are focusing on nature-based solutions (NBS), which are adaptation measures designed to protect, restore, and manage ecological systems. Inspired by, supported by, or copied from nature, NBS are living solutions that provide economic, societal, and ecological benefits. NBS safeguards public health by fostering clean air and water, increasing natural resilience, and sequestering carbon.[46] Coastal NBS include living shorelines like marshes, oyster beds, etc., that provide habitat while elevating the coastline above projected flood levels. Examples of nature-based solutions protecting from stormwater include floodable parks, rain gardens, and constructed wetlands. Parks with nature-based features allow stormwater to flow in and out without causing permanent damage and add to a neighborhood's social fabric. There is a climate justice element to nature-based solutions to the extent that they add much-needed green space to low-income neighborhoods and can reduce the urban heat island effect. But for residents to embrace NBS, they must be involved in the planning and design process.[47]

Langone Park & Puopolo Playground is a major success. The City is planning a much more ambitious project on the border of South Boston and Dorchester. Joe Moakley Park, just inland from Carson Beach, is designed to provide both coastal flood resilience and much improved recreational amenities by combining land-use planning and nature-based solutions. A dune would act as the first line of defense, while flooding would be managed through a series of rising landforms and terraces (Figure 7). Playing fields will be able to absorb rainwater while also keeping the park a functional public space.

The redesign of the space has been an ongoing priority and project for the city since 2018, but the lack of funding has slowed implementation. Revitalizing the 60-acre park has an estimated cost of $240 million; as of fall 2022, it had only secured 1 percent of that total in federal and local funding. Completing fundraising for this project could take years, highlighting the challenge of raising public funds for resilience.

Funding challenges are significant, but unfortunately not the only barrier to implementing the solutions we've outlined. Next we examine some of those barriers.

Figure 7. **Joe Moakley Park Design**

Source: City of Boston


## Implementation Barrier: Jurisdictional Limits and Contradictions

Just because a property is city-owned doesn't mean Boston is in full control of building on it. The logistical and legal challenges to completing the Moakley Park project include coordinating with the state, which owns the surrounding roads and lands, including Carson Beach, Kosciusko Circle, Morrissey Boulevard, and Old Colony Avenues. Ultimately, building the park will require collaboration and coordination among city, state, and federal officials. The proposed plan calls for removing the state-owned Day Boulevard, which currently separates the park from Carson Beach. Both Day Boulevard and Carson Beach are managed by the Massachusetts Department of Conservation and Recreation as part of the Metropolitan Park System of Greater Boston. While the assets are managed by the Urban Parks and Recreation division within the Department of Conservation and Recreation, any design updates to the parkways and roads within the system must be approved by DCR's Bureau of Engineering.

Further, Day Boulevard also is protected under the state's Article 97, an amendment to the Massachusetts Constitution that prevents state-owned assets from being used or disposed of for other purposes without the majority vote of the Conservation Commission, the City Council, approval of the Mayor, and a two-thirds vote of both houses of the state legislature. It is also zoned in the City of Boston as an open space district and is on the National Register of Historic Places as part of Frederick Law Olmsted's Old Harbor Reservation Parkways. Open Space Districts are defined in the City of Boston Zoning Ordinances as prohibiting the development of open space land and requiring development reviews. In short, the city's desire to remove Day Boulevard would require the sign-off of numerous city and state actors, a time-intensive process.

Unfortunately, the solutions proposed for Day Boulevard have been dropped out of the plan for the park because DCR was not ready to engage in approving them. This case illustrates the need for streamlining multiple approval processes to allow effective designs to be implemented.

## Implementation Barrier: Conflicting Interests

The Climate Ready Boston plan identified the need for coastal protection in East Boston's Central Square.[48] In 2017, the City released plans to advance resilience projects in this area, including a nature-based design with open areas, a waterfront plaza, floating green and gray structures to slow storm surge, and docks to improve maritime connectivity.[49] While Boston is moving ahead with some plans such as Lewis Mall, Carleton Wharf, and the Greenway entrance, others are on hold as they do not comply with regulatory restrictions on Designated Port Areas (DPAs), which were established in 1978 to protect coastal areas that support water-dependent industrial and commercial uses.[50]

Four of the 10 DPAs are in Boston. Because the current designation interfered with the redesign of the coastline of Central Square in East Boston, in January 2020, the BPDA submitted a written request to the Massachusetts Office of Coastal Zone Management to perform a boundary review. The letter asks for the de-designation of four parcels of the East Boston DPA included in the Climate Ready Boston plan for the area (Figure 8).[51]

Figure 8. **East Boston Designated Port Areas**

Source: Massachusetts Office of Coastal Zone Management

In December 2021, the Office of Coastal Zone Management ruled against de-designating three of the four DPAs because they contain or support water-dependent industrial uses. The nine-acre DPU at Jeffries Point was deemed eligible for review.[52] In response, in September 2022 Mayor Wu made the case for removing the DPAs along East Boston's Inner Harbor and Chelsea Creek because the future of the neighborhood is not industrial. She proposed instituting "community resilience zoning" in these areas to prevent speculative real estate investment. Instead, the zoning designation would require developers to contribute funds for affordable housing and create open space.

While the BPDA argues that the DPAs make it impossible for the City to incorporate coastal resilience into development, the real problem is that the City is forced to fund resilience by leveraging private development, which cannot be done if market-based development is not allowed in the DPAs. It isn't clear that "community resilience zoning" would be enough to prevent further gentrification and displacement of East Boston residents.

Opening DPAs for market-rate development to stimulate privately funded climate resilience projects is a decision that cannot be taken lightly given that the reason the DPAs are protected is that they are a finite resource—deep water access on the harbor. The DPAs serve to depress real estate values on that section of the water to allow maritime industrial businesses that would otherwise be unable to compete against market-value real estate development. Although water-dependent industrial uses have declined during the past 20 or 30 years, there may be a new need for deep water access for the offshore wind industry or other uses. Wu's vision conflicts with the stated needs of the Commonwealth for protecting industrial uses.

There is community opposition to having the DPA designation removed. East Boston residents are concerned that de-designating the port areas will pave the way for expensive new housing developments that will add to the ongoing gentrification and displacement the neighborhood is experiencing.[53] Although an industrial use on the East Boston waterfront may not be ideal, many residents see it as the only thing preventing them from being priced out of their neighborhood.

The bottom line is that Massachusetts has many active DPAs with profitable and vital port operations and maritime industrial users (e.g., Ray Flynn Marine Park in South Boston). Salem's port is innovating in offshore wind uses. To address these competing interests, we need an assessment of how state government could use DPAs for innovative blue tech and clean energy uses and how to link these uses to climate resilience. The economic development opportunities could be large for offshore wind in particular. The equity implications here are that the DPAs are the first line of defense for the neighborhoods behind them and the potential to provide jobs that don't require college degrees.

## Implementation Barrier: Misalignment of Goals

Depending on the scope, coastal resilience projects must be permitted by the Massachusetts Department of Environmental Protection (MassDEP), which enforces the federal Wetlands Protection Act. Projects that discharge dredged or fill material into waters and wetlands must be permitted by the Army Corps of Engineers (USACE) as per Section 404 of the federal Clean Water Act. The USACE denies permits if "(1) a practicable alternative exists that is less damaging to the aquatic environment or (2) the nation's waters would be significantly degraded."[54] The Clean Water Act criteria require the applicant to prove that the project does not negatively impact the water source.

To be permitted, projects must also comply with the Massachusetts Wetlands Protection Act of 1972. It requires anyone seeking to "remove, dredge, fill, or alter any bank, fresh water wetland, coastal wetland, beach, dune, flat, marsh, meadow, or swamp bordering on the ocean or on any estuary, creek, river, stream, pond, or lake, or any land under said waters or any land subject to tidal action, coastal storm flowage, or flooding" to obtain a permit from the local conservation commission.[55] NBS typically are constructed on coastal banks. The DEP interprets the law to prohibit any engineering structure on coastal banks, which means that many projects are denied permitting. Additionally, Massachusetts allows cities and towns to add more restrictive wetlands bylaws, which could present an additional barrier to a project.

MassDEP follows specific criteria for water-dependent projects, including shoreline protection. A type of project that encounters permitting problems uses landfill, which is a common resilience measure in human-created wetlands. It is not prohibited by DEP, but it is not preferred. Another example is living shoreline projects, which NOAA defines as "building up a shoreline by planting riparian, marsh, and submerged aquatic vegetation or installing organic materials such as bio-logs and organic fiber mats; and constructing oyster reefs or 'living breakwaters' that dissipate wave energy before it reaches the shore."[56] UMass Boston Professor of Climate Adaptation Paul Kirshen notes that the original nature-based plans for Border and Marginal Streets and Maverick Square in East Boston will be challenging to build with current permitting. Likewise, he points out, Fort Point Channel's solutions had to be built on land because permitting would not allow a solution in the water.

Stakeholders we talked with argued that Mass DEP guidelines created in the early 1980s are no longer useful as they are based on historical rates of sea-level rise that are outdated. While some stakeholders mentioned the Public Waterfront Act (Chapter 91) as a barrier, a 2019 Conservation Law Foundation report concludes that other state and federal regulations and permitting programs—such as sections 401 and 404 of the Clean Water Act—are more significant barriers to improved climate adaptation measures. The report recommended that MassDEP fine tune some of the regulatory language to allow some nature-based solutions and flood-control measures to protect shorelines.[57] We agree with the need to reassess and update state regulations to better reflect the current climate crisis and conditions and better support resilience measures. There is no reason this can't be done in a way that still protects waterways and marine ecosystems.

## Implementation Barrier: Misalignment of Goals, Competing Interests, and Conflicts

There are also problems with resilience project reviews from the Massachusetts Office of Coastal Zone Management. It was one of 34 state offices created by the Coastal Zone Management Act of 1972 and administered by NOAA's National Coastal Zone Management Program.[58] The Massachusetts program began in 1974 with the Governor's Task Force of Coastal Resources, and in 1978 NOAA approved the Commonwealth's final coastal zone management program plan (Massachusetts was the first state on the eastern seaboard to get this federal approval for its coastal program).[59] In 1983, the Massachusetts Office of Coastal Zone Management was officially established within the Executive Office of Energy and Environmental Affairs (EEA).[60]

Municipal Harbor Plans further complicate the regulatory landscape. Overseen by the Office of Coastal Zone Management, municipal harbor plan regulations are designed to "establish the voluntary process by which cities and towns may develop and submit a Municipal Harbor Plan (MHP) to the Secretary of EEA for approval. A state-approved MHP establishes a community's objectives, standards, and policies for guiding public and private use of land and water within the proposed planning area."[61]

The MHPs were intended to give municipalities flexibility in modifying waterways regulations if the new regulations "offset adverse effects on water-related public interests."[62] Several stakeholders we interviewed for this chapter pointed to misuse of the MHP regulations process by allowing new waterfront developments to be built to more lenient standards. While the MHP program has the potential to allow communities to go beyond the requirements of the Public Waterfront Act or the

waterways regulations in their climate resilience and adaptation planning, some municipalities have used the MHP process to take "excessive liberties."[63] The Conservation Law Foundation filed a lawsuit with the Massachusetts Supreme Judicial Court arguing that the Secretary of Energy and Environmental Affairs, who is politically appointed, did not have the legal authority to approve the City's initial waterfront development plan. The court ruled in CLF's favor in July 2022, concluding that this authority was exclusive to DEP professional staff. DEP will issue a regulatory response to amend the program in accordance with the Court's decision.

Conflict can also arise among cities and towns. Under the Wetland Protection Act, many municipalities are permitted to have their own local wetland bylaws and additions to the state law. This power can sometimes create conflict. A high-profile example is the Quincy Conservation Commission denying Boston permission to rebuild the Long Island bridge from Long Island to Quincy because it violated its wetland protection laws. In July 2022 the Massachusetts Supreme Judicial Court ruled against Quincy on the grounds that a more stringent local bylaw must specifically establish how it surpasses the DEP's regulation of the activity in question and explain how the stricter bylaw applies to the activity in question. Although the court ruled that Quincy's bylaw did not do that, it preserved the right of municipalities to establish independent bylaws providing the two criteria are met.[64]

## Implementation Barrier: Inadequate Funding

Several reports examining Boston's capacity to protect its coastline from sea-level rise and storm surge note that considerably more funding will be needed. For example, Boston's May 2022 application for state funding for the Ryan Playground resilience project in Charlestown states, "As of Spring 2022, the City has identified 70 priority projects needed to protect the health, safety, and welfare of residents in Boston. The cost to implement the projects is estimated at about $3 billion." This is considerably more than the estimates from the neighborhood plans.

Federal funding from the 2022 Inflation Recovery Act will help, but a consistent source of state funding is needed. The main funding mechanism for NBS projects at the state level is the Municipal Vulnerability Preparedness program, which was created by Governor Baker via an executive order in 2017. The annual budget for this program for cities and towns to plan and implement climate resilience projects is about $20 million. Most grants are less than $30,000, meaning they cover only initial planning.

# 6. GOVERNANCE OPTIONS FOR COASTAL PROTECTION

There is widespread agreement that coastal resilience needs to be more effectively managed. There are too many cooks in the kitchen, so to speak. There are agencies working at cross purposes. There are jurisdictional limits that constrain action. Cities and towns can block each other's projects. There is little coordination among the many agencies and organizations involved.

There is not widespread agreement, however, on a particular governance solution. Some argue that we need a new statewide agency to orchestrate integrated solutions and manage resilience for the entire Massachusetts coastline. Others suggest that a coordinating function could be undertaken by an existing organization. But which existing organization? Opinions vary. Some argue for a regional authority such as the Massachusetts Water Resources Authority (MWRA). Others look to the example of Maryland and its Regional Authorities.

Going back to our harbor clean-up vision story, the guiding agency would need considerable power to finance improvements; assess costs; conduct engineering studies; manage engineering, design, and construction; administer contract; and have information systems and environmental planning expertise. Some also add the power of eminent domain to the list since many storm-surge and sea-level rise barriers will need to be built on private property. We explore these options below.

## Massachusetts Water Resources Authority

The mission of the Massachusetts Water Resources Authority (MWRA) is to provide reliable, cost-effective, high-quality water and sewer services. Like the BWSC, the MWRA has been investing in making its infrastructure more resilient. While many people point to MWRA's success in the Boston Harbor clean-up and suggest it would be the ideal agency to coordinate and deliver on coastal resilience, there are reasons to suggest not. First, since much of the clean-up involved building the Deer Island facility and related piping, the task was closely aligned with MWRA's narrowly defined mission. Adding coastal resilience would require protecting state assets affected by sea-level rise and storm surges such as roads and highways, a transit system, and the Amtrak system—which would take the agency far afield from its current mission. Second, MWRA created a separate division to manage the clean-up, which it disbanded once the task was completed. Coastal resilience management is an ongoing task that would require permanent staff. Stephen Estes-Smargiassi, Director of Planning & Sustainability at MWRA, comments that their success has been the result of focusing exclusively on managing potable water and wastewater in close coordination with cities and towns within its system.

## Massachusetts Coastal Defense Agency

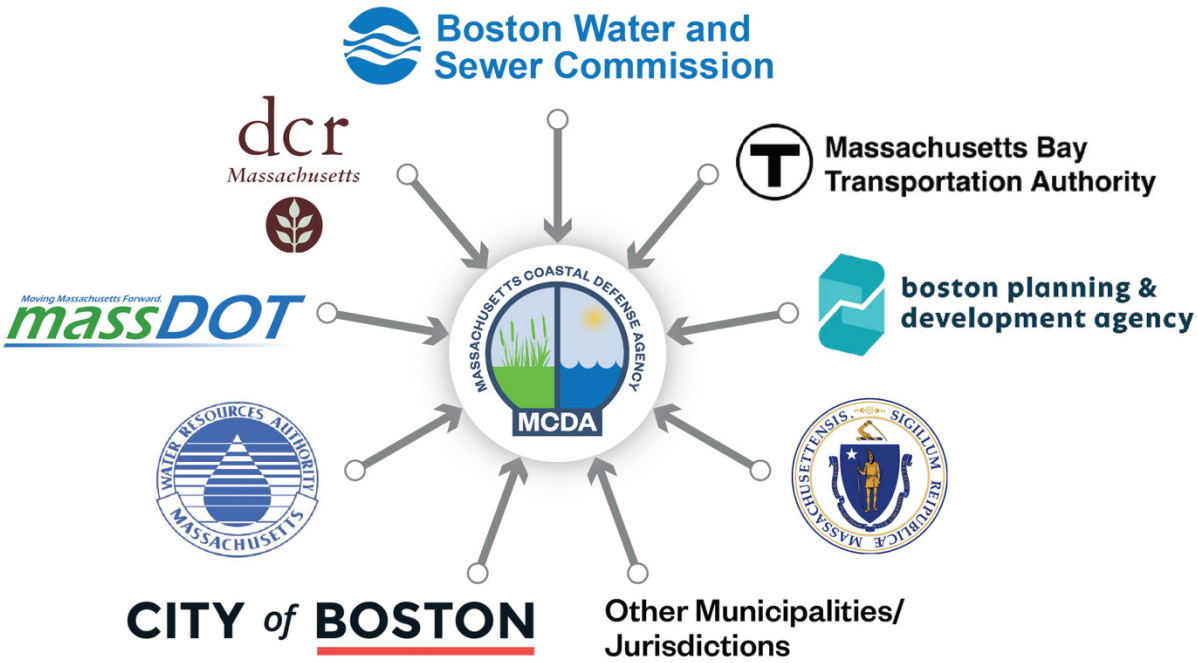
In a recent speech, Chief Engineer John Sullivan at the Boston Water and Sewer Commission (BWSC) made the case for a new special purpose state agency to coordinate coastal resilience (Figure 9).[65] A state agency is desirable since protecting the coast also protects critical state assets such as Logan Airport, the MBTA, and transportation routes in general. As a state agency, it could be granted the required authorities identified above: finance, engineering, project management, contract administration, information systems, environmental planning expertise, and power of eminent domain.

Once the political decision by Boston, other municipalities, and the governor to establish such an authority is made, political, legal, and tax experts would write the legislation to be considered by the state legislature. This is similar to the process used by the legislature in 1977 when it created the BWSC as an independent agency to protect the people of Boston.

Once established, the idea would be to consult experts from around the world to develop approaches to protect the Commonwealth's entire coastline. Like the MWRA's harbor clean-up, once the task is accomplished, the agency's staff could be pared down to maintenance only.

Figure 9: **A Massachusetts Coastal Defense Agency**

Source: John Sullivan, BWSC



## Resilience Authorities

The Maryland legislature has created resilience authorities to address both the governance and financing of coastal resilience. A problem local governments face in implementing climate resilience infrastructure projects is that they are often limited in available financing options due to insufficient revenue streams as well as restrictions on debt financing dictated by statutory debt ceilings. Joanne Throwe and Dan Nees, part of a team from the Center for Global Sustainability located at the University of Maryland's School of Public Policy, worked with municipal governments to overcome these and many other financing barriers by establishing locally based independent resilience financing authorities that have the capacity to receive, leverage, and invest revenues in support of critical infrastructure projects. "As nonprofit (501c3) organizations operating independently, Resilience Authorities operate outside of jurisdictional budgets and debt ceiling restrictions."[66]

In May 2020, the Maryland legislature passed a bill (Senate Bill 457) that authorizes local governments to establish and fund Resilience Authorities for the purpose of identifying and prioritizing resilience needs and securing funding to implement projects. The legislation allows Resilience Authorities to use any powers—except eminent domain—needed to manage, acquire, or support infrastructure projects, including their construction, alteration, and operation.[67] Authorities can, for example, develop flood barriers, stormwater infrastructure, and green spaces, and elevate buildings. The bill was written in a way to allow Resilience Authorities flexibility in how they raise funds for projects and allows any combination of collecting fees that are non-tax related, issuing or selling state or local tax-exempt bonds, and using local, state, or nonprofit funding to provide capital for projects. Levying new taxes is the only prohibition. Resilience Authorities can partner with private investors for funding as well as apply for foundation grants.

The Authorities help speed up the process of planning, funding, and completing resilience projects. Throwe explains that the municipal procurement processes can be very prescriptive and involve considerable red tape with little flexibility to allow for more innovative financing. A Resilience Authority is not bound by the same rules and can be more efficient and effective on moving projects toward implementation. Every Resilience Authority is set up to be as unique as the community it serves and can become an important mechanism for long-term resilience financing.

In Maryland, Resilience Authorities are accountable to the state legislature in that they must submit annual reports of their activities. Further, in the interest of transparency, members appointed by county or city elected officials must comply with the Open Meetings and Public Information Acts. Best practices in meeting these obligations includes making meeting minutes and related documents publicly available.

A Resilience Authority can be set up to include more than one city or county, allowing regional-scale action. It can also be a state agency or a state or municipal green bank if there is mission alignment. A good example of this is Maryland's Montgomery County Green Bank, which has recently expanded its scope beyond its traditional work of providing flexible and affordable financing for clean energy to include financing resilience projects. A Resilience Authority, like city government, can target environmental justice communities for needed resilience infrastructure.

In conclusion, the Massachusetts Coastal Defense Agency and Maryland's Resilience Authorities offer two viable options for governance of coastal resilience. There are several funding options, discussed below.

# 7. FUNDING COASTAL PROTECTION

Local funding options are limited. Proposition 2½ makes it difficult for municipalities to raise property tax rates. In several states, regional ballot initiatives allow local governments—cities, towns, or county governments—to sponsor ballot initiatives to allow voters to decide on funding for local projects. In Massachusetts cities and towns are prohibited from putting forward revenue-related ballot initiatives.

If permitted, Boston could use ballot initiatives to fund resilience projects for needed infrastructure such as coastal protection, mass transit, bike lanes, etc. Several organizations, including the Massachusetts League of Women Voters[68] and the Sierra Club,[69] support local ballot initiatives to allow cities and municipalities to have more autonomy over resilience and climate planning. Regional ballot initiatives were listed as part of former Mayor Walsh's legislative priorities for Boston.[70] Although legislation to give municipalities the authority to generate revenue for financing regional investments has been filed in the state of Massachusetts for over a decade, the Massachusetts legislature has taken no action on it.

Nor has the state legislature acted to raise multi-year funding for large infrastructure projects. As to available state and federal funds, distribution must move beyond competitive grants to prevent extraordinary inequity between less and more well-resourced communities. We examine several options below.

## State Funding: Municipal Vulnerability Preparedness Program

While many interviewed for this chapter were supportive of the MVP program, they also called out the need for consistent streams of dedicated funding. The MVP program provides small grants on a competitive basis, which disadvantages poorer cities and towns. More funding is needed to support implementation and the competitive nature of distribution needs to be reformed. Boston alone needs between $2 and $4 billion—we have no idea what the other 351 communities need collectively.

## State Funding: Hero Act

An idea that has bipartisan and multi-branch support is increasing the current Deeds Excise Tax to create new revenue for affordable housing and climate resilience projects. Such a bill was first filed in Massachusetts in 2019 by Governor Baker as An Act Providing for Climate Change Adaptation Infrastructure Investments in the Commonwealth (S.10).[71] Governor Baker's proposal would have increased the Deeds Excise Tax from $4.56 per $1,000 to $6.84 per $1,000. The $150 million in new funding generated would have been directed to the State's Municipal Vulnerability Preparedness (MVP) program. The State's Joint Committee on Revenue sent the Governor's proposal to study and took no further action on it that session (191st).

A second proposal has been filed in the Massachusetts state legislature (192nd) in both the House and the Senate and is supported by the Housing and Environment Revenue Opportunities (HERO) Coalition. The Hero Coalition comprises environmental and housing advocates—many based in Boston[72]—who advocate for more affordable housing and protection from climate change.[73] It seeks to double the current Deeds Excise Tax (from $4.56 per $1,000 to $9.12 per $1,000), upon the sale of real property in Massachusetts and using the additional $300 million in new revenue each year for affordable housing and climate resilience projects. The bill was not enacted in the most recent session, but the bill will be refiled in the upcoming session (193rd).

## State Funding: A New State Agency

The Commonwealth designed and funded a quasi-public research and development entity focused on promoting clean energy in Massachusetts, the Massachusetts Clean Energy Center (MassCEC). It was established under Chapter 23J of the Massachusetts General Laws and began operating in 2009.[74] The

creation of the MassCEC aligned with the reconfiguration of the Massachusetts Renewable Energy Trust Fund in the 2008 Green Communities Act. The center is the administrator and recipient of the Massachusetts Renewable Energy Fund. A similar agency could be created to fund resilience projects.

MassCEC is funded by a ratepayer fee of approximately 30 cents per month for the average residential customer ($0.0005 per kilowatt hour).[75] Along with the ratepayers of the investor-owned electric utilities in Massachusetts, six municipal electric departments have joined the fund. Critically, the trust fund does not have an expiration date. This allows for the MassCEC, in partnership with the Massachusetts Department of Energy Resources (DOER), to plan and fund long-term innovation and workforce development. MassCEC has a diverse and consistent stream of funding (Table 3).

Table 3. **Massachusetts Clean Energy Center Budget, Fiscal Year 2022**

| REVENUE / OTHER INCOME | FY 2022 BUDGET |
|---|---|
| System Benefit Charges | $21,500,000 |
| Climate Bill Allocation | $12,000,000 |
| ACE/RET Trust Interest & Dividend Income | $2,000,000 |
| ACE/RET Trust Realized/Unrealized Gains (Losses) | - |
| Investment Division Income | $132,922 |
| Intergovernmental Revenue | $4,191,483 |
| Renewable Energy Certificate Income / (Loss) | $61,450 |
| Other Gain (Loss) | $181,250 |
| Wind Technology Testing Center Revenue | $3,000,000 |
| Marine Commerce Terminal - Port Fee Revenue | $1,000,000 |
| **TOTAL REVENUE / OTHER INCOME** | **$44,067,105** |

Source: MassCEC

On August 11, 2022, Governor Baker signed legislation to promote clean energy and offshore wind production. The new law grants MassCEC additional authority to expand the state's green infrastructure and training programs. MassCEC will now oversee the administration of grants, loans, tax incentives, and other investment opportunities to encourage new technologies, support the state's supply chain of green materials and establish more job training programs for developing industries like offshore wind.

The MassCEC funding model could be replicated to support the state's resilience projects—including coastal resilience, green stormwater management, and urban heat island reduction. It would be funded by a similar fee imposed on water and sewer bills. This idea could be linked to a new Massachusetts Coastal Defense Agency if its mission were expanded beyond coastline protection.

## Federal Funding: American Rescue Plan Act Funds

In 2021, President Biden announced plans for a far-reaching emergency legislative package in response to the coronavirus pandemic. The resulting American Rescue Plan Act (ARPA) has dedicated funding for states. Of the $8.7 billion funding allocated for Massachusetts, state government will distribute $5.3 billion and municipalities $3.4 billion. From these funds, the City of Boston has received $551.7 million in discretionary funds. As of July 31, 2022, the City has budgeted all but $7 million for various projects, including $50 million "to advance climate resilience and improve mobility."[76] Of that $50 million, none has been allocated for specific coastal resilience projects.[77]

Massachusetts has $5.3 billion to allocate in two spending packages. The first package will distribute $3.82 billion to various state projects. In the almost $4 billion spending plan is about $377.6 million in investments in climate and nature, including $15 million in parks and open space; $100 million for environmental infrastructure, including local resilience measures; $100 million for clean drinking water and sewer infrastructure; $25 million for tree planting, particularly in Gateway cities; and $7.5 million for green job workforce development.[78]

Several stakeholders we interviewed pointed to the missed opportunity of investing additional funds into the MVP program in the first round of ARPA distribution. The program is essential to helping municipalities prepare for extreme weather events and changing coastlines. To this end, Governor Baker supports directing $300 million of ARPA funding over three years to the MVP program.

## Federal Funding: Inflation Reduction Act

The 2022 Inflation Reduction Act will invest $47 billion to help communities prepare for extreme fires, floods, storms, and droughts caused by climate change.[79] How much Massachusetts and Boston receive is yet to be determined, but it will be enough to jumpstart delayed projects.

## Private Funding

Coastal resilience will require a mix of public and private funds. Maryland offers another replicable public-private partnership approach to resilience funding. The 40-year-old Noah Hillman parking garage in Annapolis was crumbling to the point of being unsafe, but the city did not want to assume debt or bonds in the amount of $28 million to tear it down and replace it. At the same time, the land adjacent to the garage—the city's historic district and City Dock were particularly vulnerable to storm surges. City Dock alone flooded 65 times in 2019, which is predicted to increase to 200 by 2030 and 350 by 2040.[80]

So, what are the options if a city does not have the funds to address either problem?[81] Annapolis issued a request for proposals for a project that would both build a new parking garage and a park that provides resilience to sea-level rise. The winning proposal from Annapolis Mobility & Resilience Partners, a consortium of 10 companies, will build the garage and invest up to $25 million to transform City Dock into an elevated park (Figure 9).[82] Other resilience measures include heightened sea walls, hydraulic and flip-up flood gates, and a pump station.[83]

Annapolis Mobility & Resilience Partners will design, build, and finance the garage and recoup their costs with revenues from the garage. The deal allows the city to maintain ownership of the garage, but Annapolis Mobility & Resilience partners will receive its revenue for 30 years and will also maintain and operate it. Once the group starts collecting parking revenue, it will use it to finance the City Dock project. The City will retain about $1 million annually from garage revenue, which will be invested in public transportation. Annapolis must raise between $10 and $15 million of the $35 million cost of the park, for which it is seeking state and federal support.

As many experts have pointed out, a critical component of successful resilience planning is shifting from one-time grants to dedicated funding streams. Federal dollars, through ARPA and the IRA bill, will provide dedicated funding streams. State funding streams are also opening, but in the end, an agency with bonding authority will be needed to support statewide coastal resilience.

# 8. CONCLUSION

Public planning for coastal resilience is not easy when much of the land is privately owned. Until recently, Boston used its zoning power only to create guidelines. Thus, much of the recently developed Seaport is vulnerable buildings along a vulnerable coastline. We have seen examples where the private sector steps up voluntarily (the Wharf District Council) or in response to pressure from outside the city (Conservation Law Foundation's settlement with Cronin Holdings on 150 Seaport Boulevard). Rather than letting developers drive development, the City must encourage and pressure private developers to make their buildings more resilient and to finance broader resilience projects in their neighborhoods.

Too many resilience projects are being slowed or stopped by complex and outdated permitting requirements and regulation. Ongoing efforts to align regulations with coastal resilience need to be accelerated so projects can advance.

We presented two alternatives for governing coastline resilience—a new state agency or a new regional authority. The mayor and her new planning team need to work with the governor to figure out the best approach for Boston and the Commonwealth.

Finally, we will need considerably more money to finance this enormous undertaking. While new federal funding will be welcome, the state also needs an ongoing source of capital. The HERO Act is a viable new tax with bi-partisan support. The legislature needs to pass it in the next session.

Our window to act effectively is closing. The cost of action will only increase. We will need all hands on deck to protect Boston's coastline: city, state, and federal government; nonprofit organizations; frontline communities and the organizations that represent them; and the private sector. There is no time to lose.

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