

Navigating Climate Resiliency: A Developer's Guide to Permitting and Planning Along Boston's Waterfront

by

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B.S., Business Administration, 2014

University of Richmond

Submitted to the Program in Real Estate Development in Conjunction with the Center for Real Estate in Partial Fulfillment of the Requirements for the Degree of Master of Science in Real Estate Development

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ABSTRACT

The City of Boston, Massachusetts is vulnerable to coastal flooding and rising sea levels. Tidelands that have historically been filled-in to foster economic growth and prosperity are increasingly at risk as information on climate change continues to evolve.

Recent studies have increased both awareness and regulations for development and redevelopment along high-risk coastal floodplains. Most notably, the City of Boston's Climate Ready Boston report has identified comprehensive planning efforts in Boston's highest-risk neighborhoods, which serve as the benchmark for Boston's planners, architects, and developers. Climate Ready Boston is one of many reports that have framed the discussion of climate resiliency and building for the City's future.

Private developers must navigate increased scrutiny and permitting hurdles to execute large scale developments in vulnerable areas. This paper analyzes the growing issue at hand and the impact it has on both the City of Boston and the private sector. The analysis first looks at the risks Boston faces through the lens of Climate Ready Boston, associated initiatives and the stakeholders involved with pushing forward resiliency policy. The paper then explores the unique impact that coastal resiliency has on the permitting process in Boston and its implications for the private sector. A case study approach is then used to assess the current application of these plans and policies for two different locations in South Boston. Finally, the paper evaluates the ongoing challenges and possible policy changes to guide the development of future resiliency infrastructure.

Thesis Supervisor: Jen Cookke

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1. Introduction

The City of Boston, Massachusetts is vulnerable to coastal flooding and rising sea levels. Tidelands that have historically been filled-in to foster economic growth and prosperity are increasingly at risk as information on climate change continues to evolve. Without intervention, the stark reality of climate change and rising sea levels will cause billions of dollars' worth of damage within this century alone.¹

Recent studies have increased both awareness and regulations for development and redevelopment along high-risk coastal floodplains. Most notably, the City of Boston's Climate Ready Boston report has identified comprehensive planning efforts in Boston's highest-risk neighborhoods, which serve as the benchmark for Boston's planners, architects, and private developers. This report is one of many that have framed the discussion of climate resiliency and building for the City's future.

Private developments must navigate increased scrutiny and permitting hurdles to execute large-scale developments in vulnerable areas. Competing interests from private landowners and public entities create an intricate relationship which sets the stage for development and redevelopment along coastal floodplains. This is a high-risk issue that cannot be solved by a single party and will require cooperation across all fronts to achieve district and city-wide resiliency goals. I aim to take a deeper dive into the current state of resiliency planning and what the future may bring for developments in vulnerable areas of Boston.

This research topic was first brought to my attention when I attended a Real Estate Finance Association ("REFA") panel on designing & financing for resiliency. Rich McGuinness, Deputy Director for Climate Change and Environmental Planning at the Boston Planning and Development Association ("BPDA"), kicked-off the panel with a presentation highlighting recent climate change research to date, what is at stake for the City, and the initiatives that regulators are adopting to help combat these issues. How does this impact private developments situated in high-risk locations? How do these entities work together to achieve a greater mission? This presentation was the spark plug for my interest and has led me to use this forum as the culmination of my degree in real estate development.

The analysis will take a three-pronged approach to the topic at hand. I begin my research from the perspective of the public sector. I first analyze the current state of the climate and how the City's knowledge of climate change has evolved over time. I will then highlight Boston's Climate Ready Boston initiative and how this research has led to further studies and programs over the past 5 years. I will portray the major players involved with pushing these initiatives forward and implementing future policy.

The second layer will turn to assess the implications of these policies from the perspective of the private sector. I will evaluate the challenges of permitting large-scale development projects in Boston and the additional difficulties that arise from development in high-risk neighborhoods under the lens of coastal resiliency. Finally, I will take a case study approach to evaluate the permitting process for several developments along the waterfront in different areas of South Boston. This research will identify both the commonalities and differences

across projects in varying areas of Boston to help depict challenges and trends for future developments.

This thesis relies on several primary sources, including permitting and planning documents such as community meeting minutes, developer presentations and public record approval documents. Additionally, numerous climate reports and studies are utilized in this report, the majority of which have been supported and accepted by the City of Boston. Interviews with current and former developers, city officials and third parties contextualize this information and provide insight to future outcomes.

This report is not intended to provide comprehensive conclusions or solutions to these complex issues. Alternatively, the goal is to analyze the players, mechanisms and processes in place that allow for private developers to build large-scale, mixed use projects through a lens of climate resiliency and sustainability. Further, the report aims to identify trends and areas where policies, framework or strategy may change in the future, and to provide better information for future developments along coastal floodplains.

This report is geographically limited to the City of Boston. Every city faces unique resiliency considerations with Boston being no different. Zoning codes and permitting requirements will differ across municipalities. While some lessons learned may be applicable to projects outside of Boston, the focus of this study is not intended to apply to other regions.

Further, the scope of the case study analysis is limited to projects that have been selected for this thesis. The thesis primarily focuses on projects in excess of 50,000 square feet, the threshold at which requires a Large Project Review permitting process through the BPDA. While certain policies may impact smaller developments throughout the city, the goal of this thesis is to observe the coastal resiliency process at its most publicly criticized level. I will identify areas where conclusions are applicable to smaller-scale developments, however this thesis is not intended to provide a framework for developments less than 20,000 square feet in size (minimum for Boston's "small project review" process). Finally, all development projects are conceived and framed around a myriad of considerations. Every site has its own unique characteristics and challenges that will impact the permitting and planning process. This report is not intended to put a one-size-fits-all blanket on the public-private relationship and process behind developing projects along the waterfront.

Finally, Climate change is an ever-prevalent issue and will continue to be a focus both locally and globally. This report accepts the reality of climate change and is focused on the direct impact it has on the real estate development landscape. Causes of climate change and possible solutions to slow the prevalence of global warming is not considered in this paper.

2. Climate Change, the City of Boston, and the Public Sector

State of the Climate

“Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen... Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems”²

Over the past three decades, climate change has become increasingly relevant in the eyes of policy makers and planners. Growing information and scientific data has continued to inform the public on the dangers of climate change, with prevention and mitigation efforts pushed to the forefront of the public agenda.

Concurrently, this growing body of research and parallel warnings have gradually become a reality, as rising temperatures have exacerbated natural hazards across the globe. To help contextualize this global issue, the following key findings on climate change were released by the Intergovernmental Panel on Climate Change (IPCC) in 2014.³ The IPCC was established in 1988 and has provided the world with a series of scientific reports, assessing the current state of the climate and its potential impacts. Information from this group has been published beginning with their First Assessment report dating back to 1990. The below statistics were released in part of the group’s Fifth Assessment Report on Climate Change in 2014.⁴

- **The Climate is Becoming Warmer, Faster**
 - Each of the last three decades has been successively warmer at the Earth’s surface than any preceding decade since 1850.
 - The period from 1983 to 2012 was likely the warmest 30-year period of the last 1400 years in the Northern Hemisphere, where such assessment is possible.

- **Rising Sea Levels are Consistent with Global Warming**
 - Over the period 1901 to 2010, global mean sea level rose by 0.19 [0.17 to 0.21] m (Figure 1b; approximately 7.5 inches). The rate of sea level rise since the mid-19th century has been larger than the mean rate during the previous two millennia (high confidence).
 - The annual mean Arctic sea-ice extent decreased over the period 1979 to 2012, with a rate that was very likely in the range of 3.5 to 4.1% per decade.

The below figure published by IPCC highlights some of the observed changes in temperature and rising sea level.

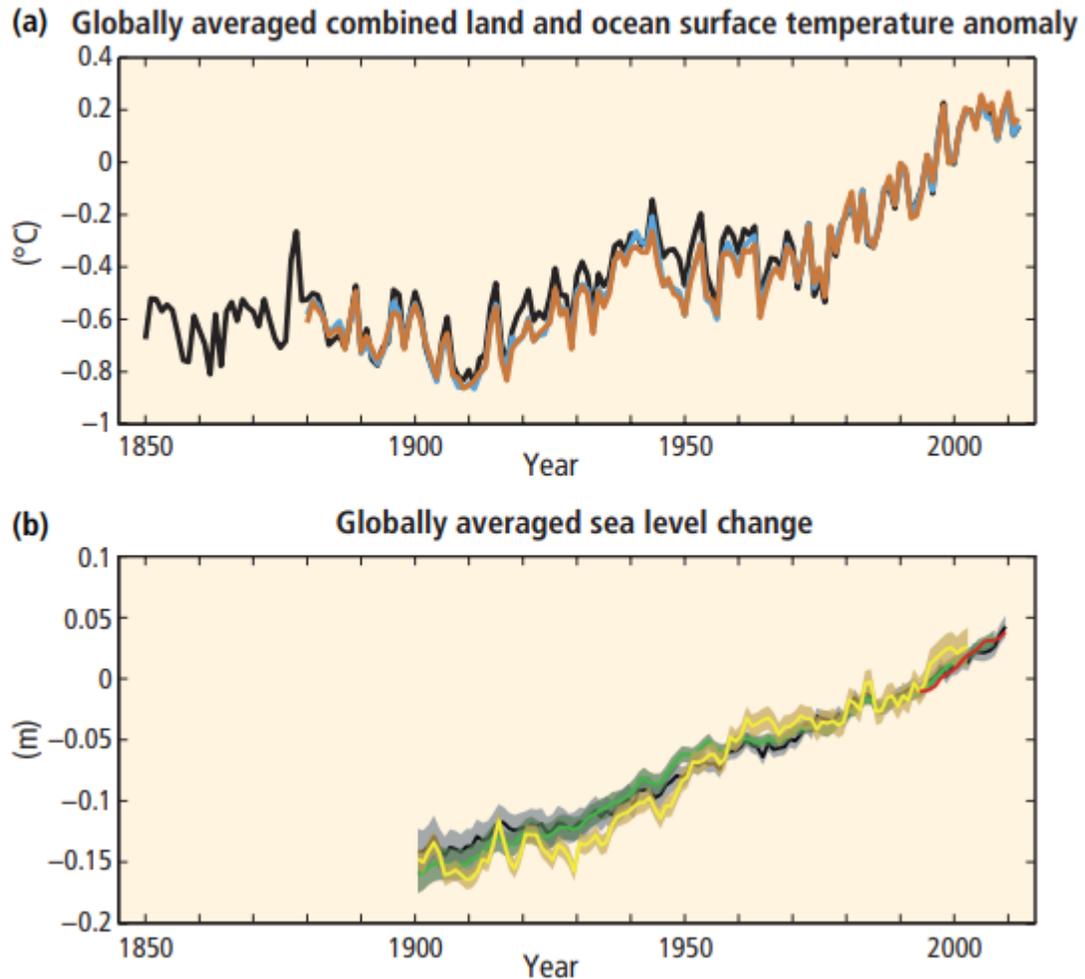


Figure 1: Observations and other indicators of a changing global climate system. Observations: (a) Annually and globally averaged combined land and ocean surface temperature anomalies relative to the average over the period 1986 to 2005. Colors indicate different data sets. (b) Annually and globally averaged sea level change relative to the average over the period 1986 to 2005 in the longest-running dataset. Colors indicate different data sets. All datasets are aligned to have the same value in 1993, the first year of satellite altimetry data (red). Where assessed, uncertainties are indicated by colored shading.⁵

- To add to these findings, there is widespread consensus that **changes in natural and human ecosystems are being affected by climate change.**
 - Many terrestrial, freshwater, and marine species have shifted their geographic ranges, seasonal activities, migration patterns, abundances, and species interactions in response to ongoing climate change.
 - In many regions, changing precipitation or melting snow and ice are altering hydrological systems, affecting water resources in terms of quantity and quality.
 - Assessment of many studies covering a wide range of regions and crops shows that negative impacts of climate change on crop yields have been more common than positive impacts.

- Finally, **Global Warming is linked to more extreme weather and climate events**
 - It is likely that extreme sea levels (for example, as experienced in storm surges) have increased since 1970, being mainly a result of rising mean sea level.
 - Impacts from recent climate-related extremes, such as heat waves, droughts, floods, cyclones and wildfires, reveal significant vulnerability and exposure of some ecosystems and many human systems to current climate variability.

These statistics from the IPCC highlight the global consensus on climate change, its progress over time, and its threat to both natural and human ecosystems across the globe. While the information released from the IPCC is certainly relevant from a continental or regional level, it does not provide detailed framework or assessments at a state or municipal level. The IPCC has set the framework for climate vulnerability assessments, however it must ultimately be adopted and studied at a local scale to be adopted into municipal plans in a meaningful way.

The City of Boston

Founded in 1630, the city of Boston was centered around the Shawmut Peninsula, an approximate 800-acre neck of land positioned amidst the Boston Harbor and the joining of three rivers. As Boston's economic prosperity grew, so did its footprint, as strategic landfill projects expanded the city's shoreline to what is seen today. Parks, neighborhoods, harbor improvements, transportation hubs and shipping facilities were some of what made up the nearly 50% increase to Boston's landmass.⁶

This extensive coastal expansion for the city of Boston allowed for it to become the largest commercial and residential centers in New England.⁸ Fast forward to the 21st century, these coastal tidelands that offered the municipality growth and economic success are now at risk to coastal stormwater flooding as sea levels rise.

Boston's awareness to its climate change vulnerability has evolved over time. Boston's first direct actions towards climate change came about in the early 21st century, primarily focused on the reduction of greenhouse gas emissions. In 2000, Mayor Thomas Menino enrolled Boston in the Cities for Climate

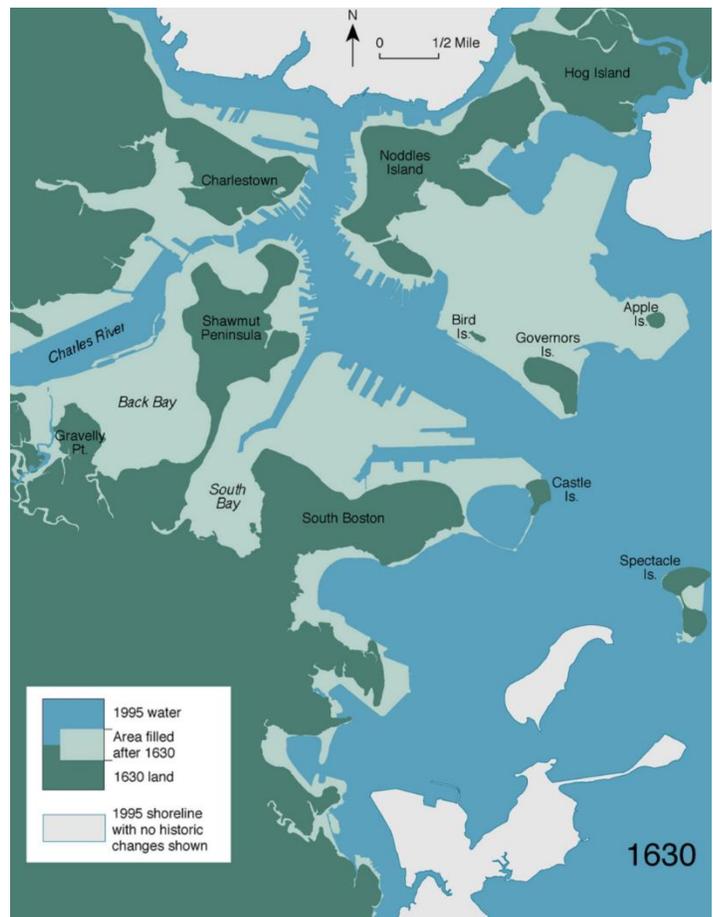


Figure 2: Boston's original shoreline (1630), Landfilled areas since 1630, and existing shoreline as of 1995.⁷

Protection Campaign, which “committed the city to meet or exceed Kyoto Protocol targets”⁹, a global Protocol that sets binding targets for developed countries to limit or reduce greenhouse gas emissions.¹⁰

In the 2000s and into the early 2010s, Boston’s awareness on climate change continued to focus primarily on emissions targets and the growing effects of global warming. During this time, positive strides were taken under Mayor Menino, including the introduction of Article 37 into the City’s zoning code. Article 37 requires that all projects “...achieve at a minimum the ‘certifiable’ level utilizing the most appropriate US Green Building Council Leadership in Environment and Energy Design (LEED) Rating Systems(s).”¹¹ At the time, this Article was primarily focused on the LEED certification and energy reduction.

Further, the Menino administration formulated the Climate Action Leadership Committee in 2009. This committee was one of the first to emphasize the importance of climate adaptation in tandem with climate mitigation. As outlined in the group’s summary report from 2010, a major action item and goal was to “Develop an adaptation plan; focus on sea-level rise, heat waves, and extreme storms; engage all levels of government”.¹²

While the City of Boston was making progress towards recognizing the threat of potential sea-level rise and other climate related risks, it was not until late 2012 when these discussions were pushed to the forefront of the public agenda. Hurricane Sandy, one of the most destructive hurricanes in the history of the United States, made landfall on the East Coast on October 29, 2012. The “Superstorm” was a product of a full moon tide and a high-pressure system, resulting in an estimated \$15.8 Billion in damage to Northeastern communities alone, and upwards of \$70.2 Billion in total damage.¹³ Ocean levels approximately nine feet above high-tide flooded New York and lower Manhattan, a flooding event previously estimated to have less than a 0.1 percent change of occurring.¹⁴ The City of Boston fared better than its New York counterpart, in part due to the storm hitting Boston at low tide. However, the impacts of Sandy were a stark wake-up call for policy makers and planners, as the storm brought to light the potential severity of climate change and coastal storms.

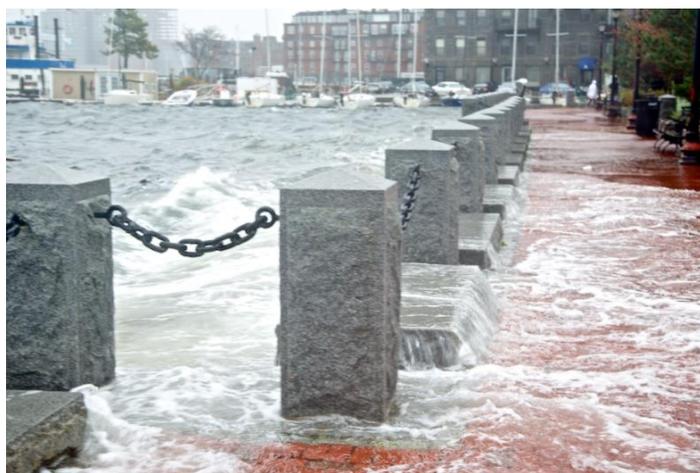


Figure 3: Flooding Along the North End Waterfront during Hurricane Sandy. 2012.¹⁵

Hurricane Sandy was a catalyst for accelerating planning and action on climate change resilience, leading to multiple vulnerability assessments for the city. Reports published in this timeframe include: *Preparing for the Rising Tide* (Douglas, 2013), *Greenovate Boston Climate Action Plan* (Spector, 2013), *The Boston Water and Sewer Commission Master Plan* (BWSC, 2015), and *The City of Cambridge Climate Change Vulnerability Assessment* (City of Cambridge, 2015).¹⁶

Out of these assessment reports, the climate projections and recommendations were catered to specific areas and time periods which caused the available information to be rather inconsistent. To address this issue, the City of Boston sought to find a consensus on sea level rise and the future risks of climate change.

The Boston Research Advisory Group (“BRAG”) was established in 2015 to conduct the scientific analysis and establish undisputed climate projections for the City of Boston. This report, titled “Climate Ready Boston: Climate Change and Sea Level Rise Projections for Boston” was published in June 2016. The report served as the foundation for the City’s Final Climate Ready Boston report and the subsequent action agenda to prevent against sea level rise.

Climate Ready Boston

The research conducted for Climate Ready Boston was the first report that gained consensus amongst stakeholders and policy makers across the Commonwealth of Massachusetts. Further, the research and findings spurred the City to push departments and city agencies to integrate resilience and the challenges of climate change into their work.¹⁷ Climate Ready Boston was centered around four key areas which will be covered in this section:

- Updated Climate Projections for the City of Boston (Sea Level Rise, Extreme Temperatures, Extreme Precipitation and Storms)
- Citywide vulnerability assessments to potential climate changes
- Focus Areas - Identifying the most vulnerable areas to climate change
- Climate Resilience Initiatives - A set of action items to mitigate future climate change risks

Climate Projections & Vulnerability Assessments

The research conducted by the BRAG updated flood maps and climate projections for the City, which became the baseline for future policy. The report highlighted four major climate challenges due to climate change: Extreme Temperatures, Sea Level Rise, Extreme Precipitation, and Storms. For the purposes of analysis and context, this report will highlight the projections and assessments associated with Sea Level Rise and Extreme Storm events due to climate change.

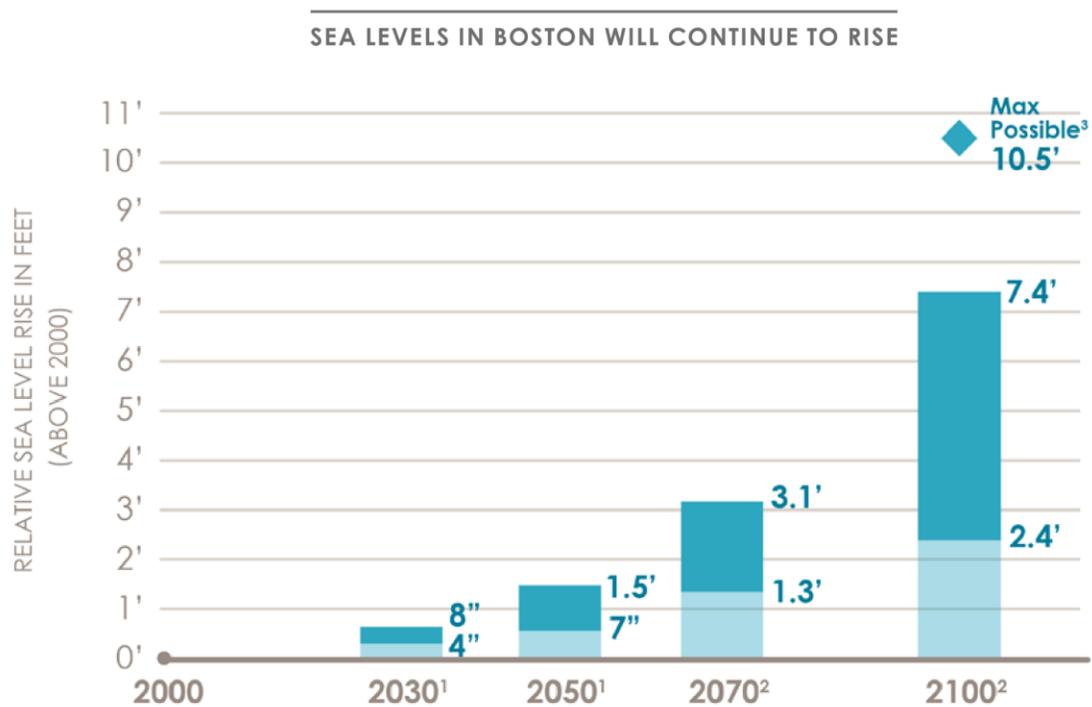
Sea Level Rise & Extreme Storm Events

Consistent with what has been cited with the IPCC, Climate Ready Boston and the BRAG identified that sea level relative to land has been increasing, and that the rate of sea level rise has been accelerating over time. Specifically, relative sea level rose roughly nine inches over the entire twentieth century, and new projections anticipate eight inches of sea level rise by

2030, with sea levels potentially as high as 1.5 feet or higher by 2050 (when compared to 2000 levels).¹⁸

Figure 4 highlights the report’s predictions for future sea level rise in the city. Probabilities associated with these outcomes are linked to global greenhouse gas emissions. Figure 4 explores possible sea level rise given a range of greenhouse gas emissions scenarios (including increased emissions over-time). The bar graph emphasizes the exponential-like growth in sea-level if emissions continue to increase.

Based on this information, the highest outcome considered in the report is 36 inches of sea level rise by 2070, which would require a zero to moderate decrease in global greenhouse gas emissions during this time period. 36 Inches of sea-level rise by 2070 serves as the baseline for future plans and resiliency considerations in the report.



Data Source: BRAG Report, 2016
 1 - Likely under all emission scenarios
 2 - Likely under moderate to high emission scenarios
 3 - Low probability under high emission scenario

Figure 4: Climate Ready Boston: Projected Sea Level Rise Scenarios¹⁹

Figure 5 demonstrates the severity of the projected 36 inches in sea level rise. The image was taken from the Climate Ready Boston Map Explorer, an interactive map that integrates visual data layers to demonstrate sea level rise, flood risks, extreme heat, and social vulnerability. The image shows the 10% Annual Coastal Flood Risk as of 2070 in blue, assuming 36 inches in total sea level rise during this time-period.



Figure 5: *Climate Ready Boston Map Explorer: 10% Annual Flood Risk by 2070.*²⁰

The map is a stark warning of the risks of sea level rise to the city's infrastructure alone if nothing is done to i) reduce greenhouse gas emissions and ii) attempt to mitigate and block the vulnerable flood pathways. The figure shows how the effects of flooding can expand into the city through low-lying entry points and neighborhoods. Even inland neighborhoods such as the South End, Bullfinch Triangle and northern parts of East Boston are at risk of coastal flooding as sea levels rise.

To exacerbate this issue, stormwater flooding and future storms are a growing concern. Current climate projections do not point to a clear projection of how the intensity, frequency, and trajectory of tropical and extratropical storms will change.²¹ Despite this fact, both tropical storm intensity and frequency are susceptible to change as the global climate

changes. Most importantly, as sea levels rise, any given storm will cause more flooding to the surrounding area. As described in Climate Ready Boston, “During a storm, winds can blow ocean water towards the land, creating a ‘storm surge’ on top of the baseline sea level. When storm surge is combined with tidal processes, the result is known as a ‘storm tide’. With higher seas, it takes less precipitation and a less powerful storm surge to produce the same amount of flooding as a more powerful storm would produce when the seas are lower.”²²

Bottom line is that coastal flooding is a severe problem for the city of Boston as climate change continues to evolve. As evidenced by Figure 5, these risks stem beyond just Boston’s coastline.

Vulnerability Assessment

Climate Ready Boston’s Interactive Map Explorer shows the far-reaching effects of sea level rise across the city. A significant point that is made is that damaging flood events will become more and more common over time. As flood risks increase, the expected costs and annualized losses increase dramatically.

City of Boston Projected Annualized Losses

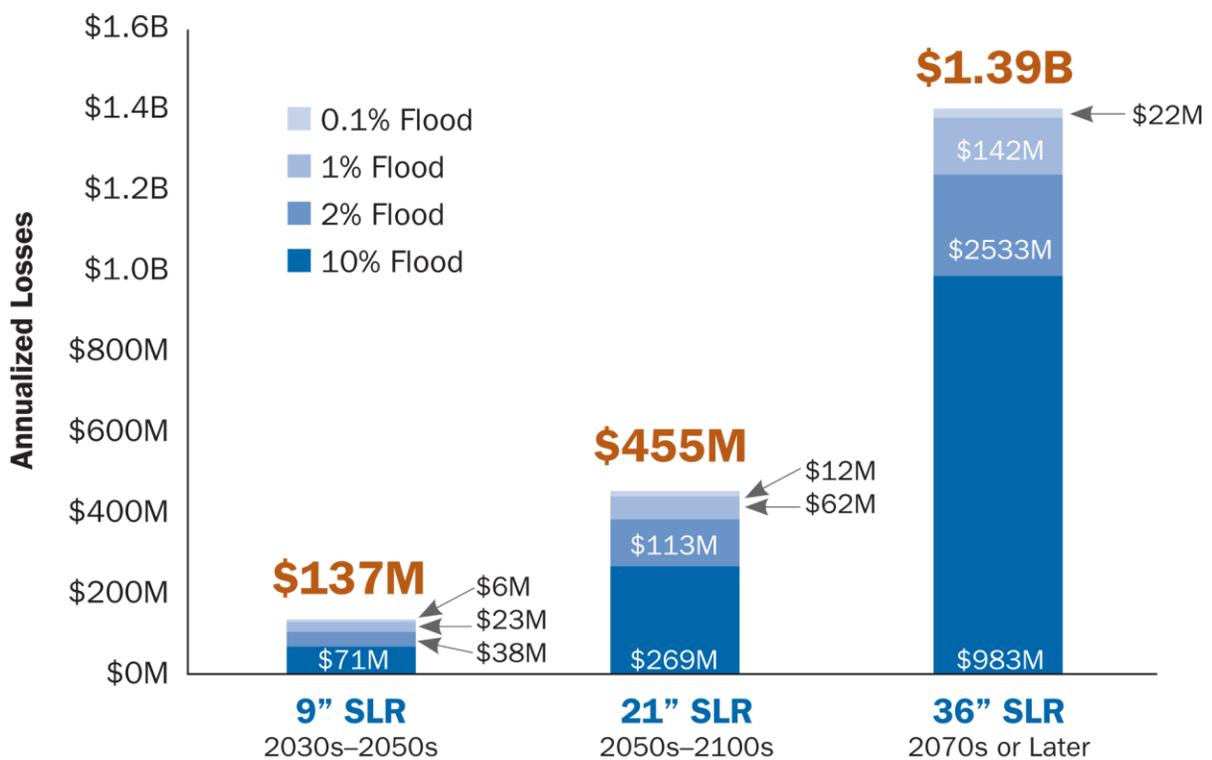


Figure 6: Estimated annualized losses given various sea-level rise scenarios and 0.1%, 1.0%, 2.0% and 10% Annual Chance flood scenarios. (Data)²³ (Image)²⁴

Figure 6 puts the previous map explorer into quantitative context, estimating annualized losses by 2070 to be in the billions of dollars. These estimates are based on a number of factors, including physical structure loss, building content losses, business interruption costs, as well as lost productivity and relocation costs.²⁵ Because each storm event is low-probability and rather high expected loss in any given year, estimated costs are evaluated as annualized costs over time.²⁶ Figure 7 identifies the breakdown of expected losses by category for the City of Boston.

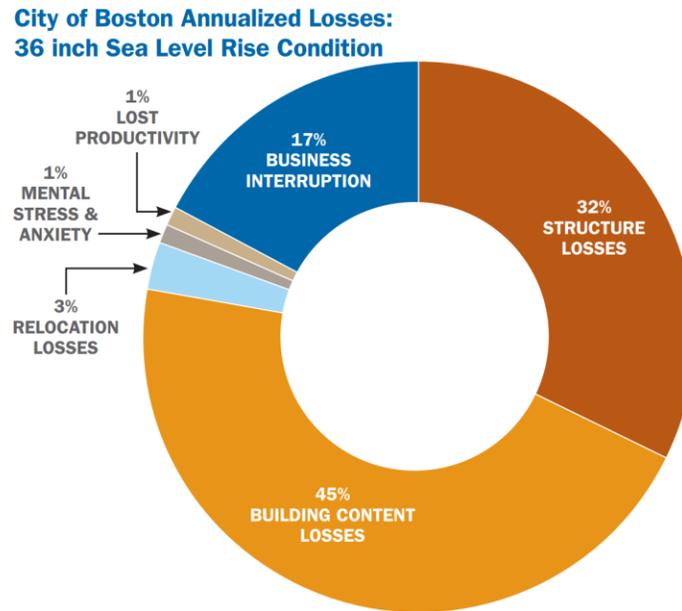


Figure 7: (Data)²⁷ (Image)²⁸

Focus Areas, Strategies and New Initiatives

Focus Areas

To better plan for various climate adaptation strategies, Climate Ready Boston highlighted eight focus areas (largely coastal neighborhoods) to provide deeper insight into both the type of vulnerabilities faced as well as how a citywide resilience plan can be applied to specific areas. These areas include Charlestown, the Charles River, Dorchester, Downtown, East Boston, Roxbury, South Boston and the South End.

Climate Ready Boston took a deeper dive into these neighborhoods to assess the unique risks of each area and how they can be addressed. Through these focus area analyses, Climate Ready Boston proposed nine locations for flood-protection interventions. These locations are highlighted in Figure 8 below.

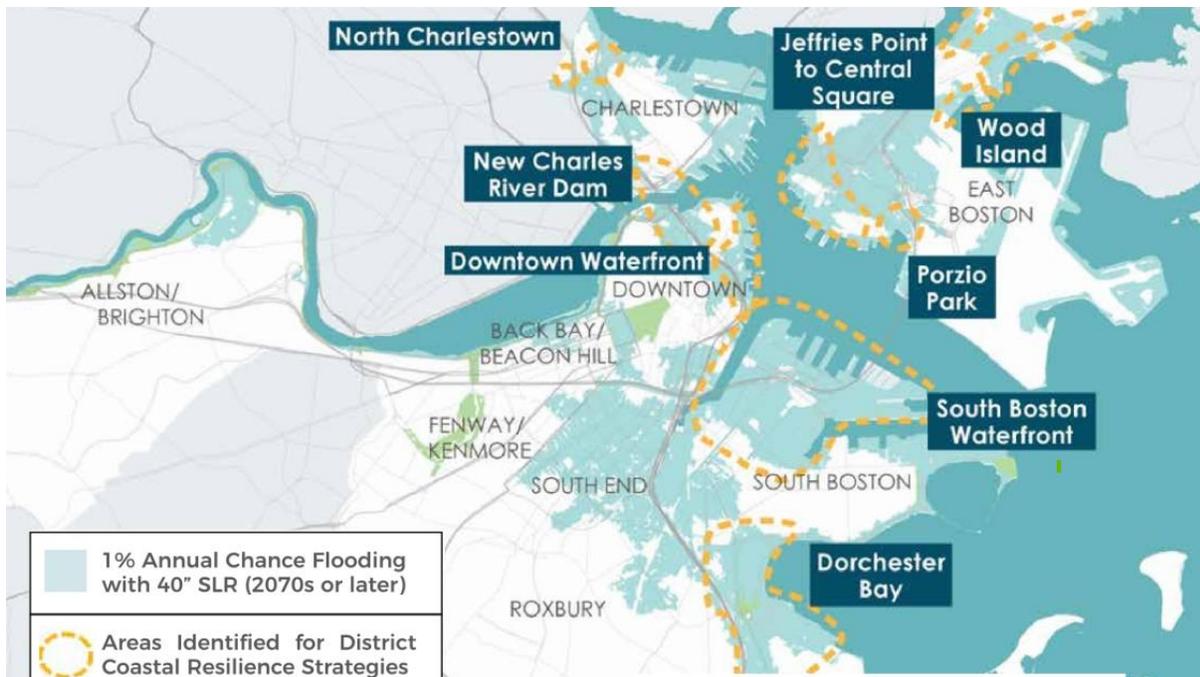


Figure 8: The City of Boston identified nine locations throughout the city to prioritize for future flood protection.²⁹

Climate Ready Boston goes into expanded detail into these focus areas, highlighting specific neighborhood vulnerabilities and providing initial recommendations to district-level coastal adaptation strategies. In terms of resiliency considerations, these eight flood prevention areas will continue to be a major focus for the city moving forward.

Strategies

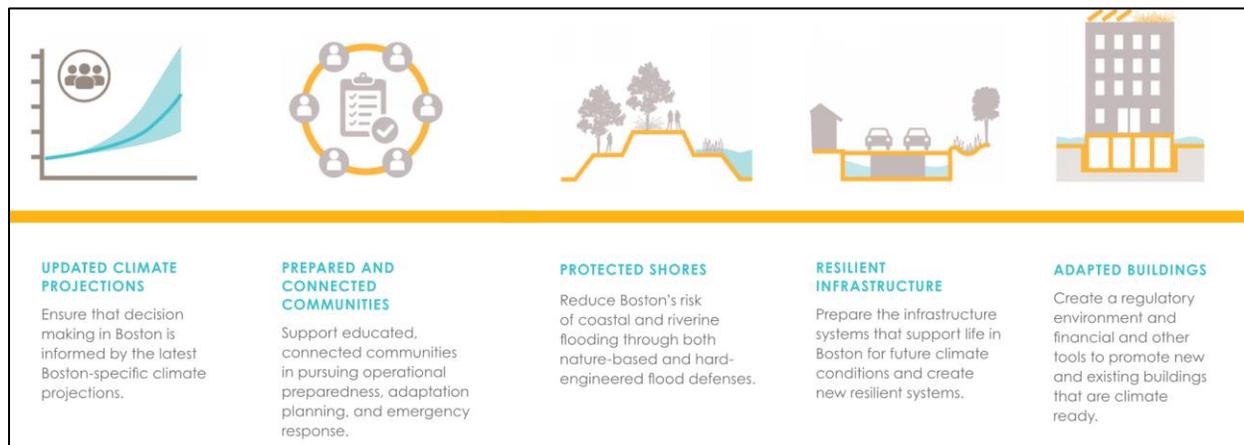


Figure 9: A summary of the five overarching themes of Climate Ready Boston and a diagram which categorizes many of the climate resilience initiatives outlined in the report.³⁰

Stemming from Climate Ready Boston's vulnerability assessment, the City of Boston developed eleven action plan strategies for the city. The eleven strategies are below, with the

majority of these strategies having implications on future development in Boston.³¹ Figure 9 defines the five overarching goals which encompass these strategies.

- 1) Maintain up-to-date projections of future climate conditions to inform adaptation**
 - Recommendation to establish a *Greater Boston Panel on Climate* and update climate projections every five years. These projections will inform plans, policies, and regulations across the city.
- 2) Expand education and engagement of Bostonians on climate hazards and action**
 - Seek out strategic partners to inform the general public, building owners, community facilities, businesses and vulnerable populations on the risks of climate change.
- 3) Leverage climate adaptation as a tool for economic development**
 - Job training for jobs that will arise from climate adaptation.
- 4) Develop local climate resilience plans to coordinate adaptation efforts**
 - Create community-specific plans which include district-scale flood protection, infrastructure adaptation, and land-use planning, all in coordination with existing Boston city master plans.
- 5) Create a coastal protection system to address flood risk**
 - The City should not only investigate major infrastructure investments to address flood risk, but should also ensure that development in flood-prone areas does not prevent the future implementation of flood protection.
- 6) Coordinate investments to adapt infrastructure to future climate conditions**
 - Establish an Infrastructure Coordination Committee to develop planning and design standards, identify vulnerabilities, establish coordination mechanisms, and align adaptation efforts with other planning priorities.
- 7) Develop district-level energy solutions to increase decentralization and redundancy**
 - Pursue district energy systems or microgrids that increase reliability and decrease greenhouse gas emissions
- 8) Expand the use of green infrastructure and other natural systems to manage stormwater, mitigate heat, and provide additional benefits**
 - This involves seeking out sustainable funding sources and maintenance programs.
- 9) Update zoning and building regulations to support climate readiness**
 - The current regulations that govern development in Boston do not have specific requirements for future climate conditions.
 - The Boston Planning and Development Authority should propose land-use and other regulations that ensure new development is ready for future climate conditions. The City should also advocate for changes to the Massachusetts building Code and explore measures that increase climate-ready retrofits in existing buildings.
- 10) Retrofit existing buildings against climate hazards**
 - Prioritize buildings facing near-term flood risk, buildings with a public purpose, and vulnerable communities.
- 11) Insure buildings against flood damage**

- The City should promote appropriate flood insurance for property owners. This includes joining the National Flood Insurance Rating System to obtain flood insurance discounts through advanced floodplain management and advocating for reforms to better align premiums with actual risk.

Many of these strategies will impact how buildings are built along the waterfront. Strategies 1, 4, 5, 6, 9, 10 & 11 all incorporate components that will be considered throughout a private development process.

From these strategies, the City of Boston developed 39 recommended resilience initiatives to address identified vulnerabilities. These specific action items range from a short-term time horizon (1-2 years) to action items extending into the long-term (5+ years). A full list of the 39 initiatives can be found in **Exhibit A**. These resiliency initiatives serve as guided recommendations to the City moving forward.

New Initiatives

Climate Ready Boston created a chain-reaction of follow-up research and reporting since its release. Climate Ready Boston served as an undisputed report on the impacts of climate change, the risks specific to the city of Boston, and provided an action agenda to inform policy makers moving forward. Several of these initiatives focused directly on coastal resiliency and potential implications for private developers.

The following represents a timeline of the most relevant resiliency reports published over the last 5 years, many of which were initiated from the initial recommendations from Climate Ready Boston. The timeline represents the immediate response from the City and its stakeholders which continues to evolve as the city becomes more focused on specific challenges across the city. These reports were primarily driven by Strategies 4, 5 and 9, which hone-in on developing neighborhood specific resiliency solutions and exploring the feasibility of district-scale and harbor-wide flood protection.

- **2016 - Climate Ready Boston Published along with BRAG statistics**
 - Strategies and Initiatives established for further research moving forward
- **2017 - Coastal Resilience Solutions for East Boston and Charlestown**
 - The first neighborhood-scale flood and vulnerability study, established conceptual solutions specific to neighborhood flood pathways
- **2018 - UMass Sustainable Solutions Lab**
 - Three reports were published evaluating various funding and governance approaches for the City of Boston, including evaluating the feasibility of a harbor-wide flood barrier.
- **2018 - Coastal Resilience Solutions for South Boston**
 - The second neighborhood-scale flood and vulnerability assessment. The study provided neighborhood specific solutions and rough cost estimates for various levels of implementation.
- **2018 - Resilient Boston Harbor**

- Mayor Walsh’s comprehensive vision for coastal resilience, knitting together long-term approaches to provide flood protection through a network of new waterfront open space.³²
- **2019 - Implementing District Scale solutions for the Border Street area of East Boston**
 - A second neighborhood study commissioned by the City of Boston
- **2019 - Coastal Flood Resilience Design guidelines**
 - Provides design guidance and best practices for flood risk mitigation improvements to new and existing buildings³³
- **2020 - Expanding Boston’s Capacity to Build Coastal Resilience Infrastructure**
 - A second neighborhood-scale report focused on refining implementation pathways for coastal resilience with a focus on the Seaport District and South Boston.
- **2020 - Coastal Resilience Solutions for Downtown & North End**
- **2020 - Coastal Resilience Solutions for Dorchester**

These reports continue to evolve and inform policy makers as greater levels of research and progress have been made throughout the last 6 years. Climate Ready Boston and subsequent targeted neighborhood-scale reports issued a profound message of the severe costs that could stem from coastal flooding. These neighborhood-scale reports and supplemental research continue to inform development across the City of Boston. While these reports have not been officially codified into the development process, all stakeholders involved have access to these reports for guidance towards resiliency design and implementation along the waterfront.

Players

The City of Boston is not solely responsible for the dramatic increase in both awareness and action towards climate change and resiliency over the past decade. There are several organizations that have helped push coastal resiliency to the forefront of the public agenda. These organizations are involved in various ways, either to provide funding, research, or influence over permitting and planning in these high-focus areas. The following will summarize some of the major actors in this space and provide high-level abstracts of their purpose and involvement. While these organizations help play a part in influencing climate awareness and future policy, there are many other organizations that are tangentially involved with climate resiliency advocacy. This chapter does not begin to capture all of the interested and engaged parties in that influence Boston’s climate change awareness and regulations, rather, it provides a window into some of the major actors in this space today.

Boston Planning and Development Agency (BPDA)

Formerly known as the Boston Redevelopment Authority (BRA), the BPDA is the planning and economic development agency for the city of Boston. The BPDA is responsible for growing the city's tax base, cultivating the private jobs market, training the workforce and encouraging new businesses to expand. The group plans the future of neighborhoods with the community, identifying height and density limits, charting the course for sustainable development and resilient building construction, advocating for multi modal transportation, responding to the city's changing population, producing insightful research on our City, and ensuring Boston retains its distinctive character.³⁴

The BPDA's community and resilience planning is framed by Climate Ready Boston and more broadly, how it fits within the City of Boston's master plan: Imagine Boston 2030. Both plans emphasize the inclusiveness of all stakeholders and encourage collaboration with citizens, private organizations, businesses, and public entities such as other municipalities or the state of Massachusetts as guiding principles for all decision-making processes.³⁵

The BPDA utilizes internal zoning capabilities, coupled with broad-based planning initiatives to accomplish its resiliency planning. As evidenced by the subsequent list of stakeholders, many different groups are leveraged to support and improve the City's climate resiliency on an ongoing basis.

Barr Foundation³⁶

Based in Boston, the Barr Foundation focuses both regionally and nationally, working in partnership with nonprofits, foundations, the public sector, and civic and business leaders to elevate the arts and creative expression, to advance solutions for climate change, and to connect all students to success in high school and beyond. Founded in 1997, Barr now has assets of \$1.7 billion, and has contributed more than \$838 million to charitable causes. Barr's mission is to invest in human, natural, and creative potential, serving as thoughtful stewards and catalysts.

The Barr Foundation's climate resilience goal is to "increase the capacity of Metro Boston communities to prepare for and adapt to the impacts of climate change." The group aims to do this through three key strategies:

- Build awareness of climate impacts, risks, and resilience strategies
- Mobilize key constituencies to advance policy and implement resilience plans
- Support demonstration projects that integrate resilience into the fabric of cities

The Barr Foundation has been heavily involved with some of the aforementioned climate resilience initiatives. The group serves as a funding source for many resiliency focused organizations and supports much of the research, education, and advocacy behind coastal resiliency in Boston. The Barr Foundation does not fund any capital projects.

Boston Harbor Now

Boston Harbor Now focuses on maximizing the benefits of Boston Harbor for everyone through quality programming, policy, planning, and design. It is committed to a vision of a future Boston Harbor waterfront that is prepared for and resilient to climate change. Boston Harbor Now works with leaders from all levels of government along with the private and nonprofit sectors to design a waterfront that is more accessible, resilient, and inclusive.³⁷

Boston Harbor Now has a long history of shaping waterfront development along the Boston Harbor. While involved with some aspects of planning, the group reviews every major development project in conjunction with the BPDA to prioritize access to the waterfront and coastal resiliency. The organization is part of a team working with the Boston Planning and Development Agency (BPDA) to develop a flood resiliency zoning overlay district and related design guidelines for new construction and building retrofits.³⁸

A Better City (ABC)

A Better City (ABC) is a diverse group of 130 business leaders united around a common goal—to enhance Boston and the region’s economic health, competitiveness, vibrancy, sustainability, and quality of life. It operates between the private and public sectors using technical expertise and research capabilities to shape key policies, projects, and initiatives. The group influences policy in three critical areas - transportation and infrastructure, land use and development, and environment and energy.³⁹

The core program areas impact infrastructure, finance, and policy, the Municipal Harbor Plan, public realm planning, driving carbon reduction, and building climate resiliency.

ABC’s board comprises of roughly 100 individuals from a wide range of industries, including but not limited to, contractors, developers, engineers, institutions, commercial brokers and architects. ABC represents the business community of Boston and serves as a voice for the private sector as new municipal regulations are proposed.

Conservation Law Foundation (CLF)

Conservation Law Foundation (CLF) is a non-profit advocacy organization which aims to protect New England’s environment for the benefit of all people. The group uses the law, science, and the market to create solutions that preserve natural resources, build healthy communities, and sustain a vibrant economy.⁴⁰

CLF works closely with local communities across New England. In terms of climate resiliency and adaptation, the CLF’s work is focused on “research, laws and policies to hold private actors accountable; modernize our building and land use code, promote health and safety of all Massachusetts residents in the face of extreme weather; and address disparate burdens for environmental justice communities.”⁴¹

For developers, CLFs' involvement in the permitting and planning process is usually surrounding litigation and enforcing existing laws and policies. As such, CLF is positioned to be involved with future policy and push for modernization of building codes and standards addressing climate resiliency.

Boston Green Ribbon Commission

The Boston Green Ribbon Commission is a non-profit group of business, institutional and civic leaders in Boston working to develop shared strategies for fighting climate change in coordination with the City's Climate Action Plan. The group's mission is to convene leaders from Boston's key sectors to support the outcomes of the City's Climate Action Plan. Members of the GRC are the leaders of Boston's largest property-owning businesses, educational institutions, and hospitals, as well as top representatives from the three major utilities.

The Green Ribbon Commission plays three important roles in advancing progress on climate action:

- Advise the City on the implementation of its Climate Action Plan
- Engage sector leadership in aligning their assets and initiatives to support the plan outcomes
- Lead, by practicing and promoting best practice examples within and across sectors that advance the Climate Action plan goals.⁴²

The Green Ribbon Commission has overseen many of the subsequent climate resilience reports that have been released since Climate Ready Boston, including the second neighborhood-scale report for South Boston and the UMass Sustainable Solutions reports.

Massachusetts Office of Coastal Zone Management (CZM)

Massachusetts Office of Coastal Zone Management (CZM) is the lead policy, planning, and technical assistance agency on coastal and ocean issues within the Executive Office of Energy and Environmental Affairs (EEA) and implements the state's coastal program under the federal Coastal Zone Management Act.⁴³

CZM acts as the lead policy and planning agency on coastal issues for the Commonwealth of Massachusetts. CZM works with project proponents to address sea level rise and coastal flooding and provides coastal communities technical assistance and support on these issues. CZM also administers the Coastal Resilience Grant Program, which funds local efforts to increase awareness and understanding of climate impacts, identify and map vulnerabilities, conduct adaptation planning, redesign vulnerable community facilities and infrastructure, and implement non-structural (or green infrastructure) measures to provide flood and erosion control and improve community resilience.⁴⁴

Massachusetts Department of Environmental Protection (DEP) / Chapter 91

The Massachusetts Department of Environmental Protection (DEP) is a state organization whose mission is to protect and promote the public's interest in tidelands in accordance with the Public Trust Doctrine. This mission provides a duty to ensure that tidelands are used for water-dependent purposes or otherwise serve a proper public purpose, and to protect the public health, safety and general welfare as it may be affected by any project in tidelands.

From the perspective of climate change, The Mass DEP requires approval by licensure of any proposed construction, placement, excavation, addition, improvement, replacement, construction reconstruction, demolition or removal of any fill or structures in tidelands.⁴⁵ MassDEP is the principal entity behind the Chapter 91 approval process, which will be discussed in the permitting section of this paper.

3. Implications for the Private Sector

Permitting Hurdles

Private development of large-scale development projects in Boston, Massachusetts can prove challenging given the numerous layers of development review. The following looks to take a deeper dive into the permitting process for private developers and the specific hurdles that may arise from large scale development along coastal floodplains. The various approvals and processes can be assessed across local, state and federal governance in which large projects are reviewed. This section highlights most of the major permitting steps that developers along coastal floodplains must endure. While this summary captures much of the process, permitting for coastal development may vary by location and this section is not intended to capture every layer. Alternatively, this section aims to feature several of the major components that arise for developments along Boston's coastline.

As it exists today, coastal resiliency requirements in Boston are largely evaluated and negotiated through the city's Article 80 process and the State's Chapter 91 licensure requirements. These two methods are the primary tools the public sector uses to vet and establish proper adherence to the targeted resiliency goals. Both processes are time consuming and involve public input to achieve the proper resiliency measures based on the project's purpose, location, and impact.

The biggest drawbacks to these processes are that i) information is constantly evolving and ii) the existing regulations lack a set of concrete expectations and guidelines. Virtually all of these layers require approvals in which resiliency measures and efforts are assessed on a case-by-case basis.

Local Regulation

Article 80 Project Review

Article 80 of the Boston Zoning Code was established in 1966, with the purpose to “provide clear, predictable, and unified requirements for the review of development projects throughout the City.”⁴⁶ This section of the zoning code applies to four different project types that may be proposed in the City of Boston:

- Large Project Review - Projects adding more than 50,000 square feet
- Small Project Review - Projects adding more than 20,000 square feet
- Planned Development Areas (PDA) - Establishment of a new overlay area for projects in excess of 1 acre
- Institutional Master Plans (IMP) - Projects relating to academic and medical campuses

Several of the projects that will be highlighted in this paper involve PDA review. A PDA Development Plan creates new zoning regulations for that specific area. PDA review contemplates new density restrictions, however, it does not examine the effects that a project’s design may have on specific areas. This is contemplated in Large Project Review.

For purposes of this report, the large project review process will be highlighted which encompasses the most common process of development approval, as both PDAs and IMPs must also go through Large Project Review. The Article 80 Large Project Review applies to virtually all major projects in Boston and is one of the most publicly scrutinized processes for private developers.



Figure 10: Use cases for Large Project Review under the Article 80 Process⁴⁷

In Large Project Review, The BPDA works with local communities to examine the impacts of the subject project on the immediate neighborhood and the City of Boston. Such project impacts that are evaluated include design, density, physical and social impacts.⁴⁸ Throughout this process, the BPDA is afforded an opportunity to have a significant influence on the overall dimensional features of a project and the overall site plan that will be developed. Despite the City of Boston having established zoning regulations, density and dimensional restrictions are often negotiated throughout the Article 80 process.

There are five steps to achieve approval under the Large Project Review Process, which include several additional hurdles within each step. Below is a summary of the five steps

toward approval⁴⁹, however a full visual outline of the Article 80 Large Project Review process from inception through construction completion can be found in **Exhibit B**.

- 1) **Letter of Intent (“LOI”)** - This document formally initiates the Article 80 review process. The LOI will include basic project information including the developer, intended use and rough sizing of the project. A LOI is then followed by the formation of an Impact Advisory Group (IAG). These groups are appointed by local officials and can comprise of up to 15 members.
 - a. IAG groups play an important role in the development process and incorporate insights from residents, business owners or community organizations within the impacted area.⁵⁰ Beyond broad-based community meetings, this is an area where specific organizations can influence the development of specific areas in the City of Boston.

- 2) **Project Notification Form (“PNF”)** - Following initial review and community feedback, the PNF initiates the formal review period, which allows for a 30-day public comment period. This period includes meetings with the IAG, “scoping sessions” with the BPDA alongside city & state agencies, and community meetings to present the project and its impacts. In addition to these meetings, projects in excess of 100,000 square feet are reviewed by the Boston Civic Design Commission (BCDC) to assess impacts to the public realm.
 - a. If the initial PNF is determined to have appropriately addressed the potential impacts and mitigation for the project, then the BPDA may issue a scoping determination, allowing the project to proceed to BPDA Board approval. If the project is not approved at this stage and it is determined that more analysis needs to be done, the project will move to a Draft Project Impact Report.

- 3) **Draft Project Impact Report (“DPIR”)** - This document is a reiteration of the initial PNF process, further addressing potential impacts, mitigation, community benefits and other criteria that surfaced during the PNF process. The public comment period for the DPIR can range from 30 - 75 days.
 - a. At the end of this stage, a Preliminary Adequacy Determination (“PAD”) will be issued to determine if the DPIR has properly addressed impacts raised in the scoping determination. If not, the project will move to a Final Project Impact Report.

- 4) **Final Project Impact Report (“FPIR”)** - This document is the fourth document furnished by the developer which is designed to further address issues that have been brought up in previous steps and follows the same review process as the DPIR. Typically, if a FPIR is not deemed adequate at the end of this step, the developer will remove itself from the approval process.

- 5) **Adequacy Determination (“AD”)** - The BPDA will issue a recommendation to the BPDA Board for approval

The Article 80 process is an iterative process in which a major project is scrutinized by multiple stakeholders impacted by the project. This highly public process is an important component of private development in Boston and relies heavily on public input and negotiation. There is no standard that is set through the existing zoning code, and future developers must frame their development plans around past precedents and what will be accepted by these various stakeholders.

Iterations of projects and review are often framed around the following categories⁵¹:

- Transportation
 - Impacts on traffic and parking
- Environmental Protection
 - Impacts on environment, including wind, shadows, and noise
- Urban Design
 - Impacts on the urban design and quality of pedestrian space
- Infrastructure Systems
 - Impacts on water, sewer, electricity, and other infrastructure systems
- Green Building
 - Article 37 of the zoning code (to be discussed)
- Site Plan
 - Measuring a project's impact on surrounding significant natural features
- Tidelands
 - Chapter 91 recommendation required from the BPDA (to be discussed)
- Development Impact Project (DIP)
 - Per Boston's zoning code, certain projects must contribute linkage payments, which are payments that contribute to a city-wide fund for affordable housing and job training programs.

While the Article 80 process applies to virtually every major project in Boston, there are additional layers of approval under Article 80 that apply to climate resiliency considerations. The following are components that must be considered and completed in order to gain approval for a project along the waterfront.

Article 37

Article 37 was first introduced into the zoning code in 2007 with a focus on green buildings and LEED certification standards. In accordance with the Mayor's 2014 Climate Action Plan and the release of Climate Ready Boston in 2016, the code was updated in 2017 as a Climate Change Preparedness and Resiliency Policy. Per the BPDA, "All development projects subject to Boston Zoning Article 80 Large Project, Planned Development Area, and Institutional Master Plan review, including modifications and updates, are to consider and analyze the impacts of future climate conditions and to incorporate measures to avoid, eliminate, or mitigate greenhouse gas emissions and impacts related to climate change in project planning, design and construction."⁵²

As part of Article 37, developers must submit a climate resiliency checklist, which not only addresses the green building components of the project, but also addresses the major vulnerabilities addressed in the Climate Ready Boston report, which include Extreme Heat, Extreme Precipitation, and Sea Level Rise and Storms.

If any project falls within a Federal Emergency Management Agency (FEMA) Special Flood Hazard Area (SFHA) Zone, or if any portion of the site falls within a designated BPDA Flood Hazard Area, developers must complete an additional questionnaire which addresses sea level rise on the site. At this stage, this questionnaire serves as a guideline for developers in coastal floodplains and provides recommended finished floor elevations for projects. The baseline is provided by the BPDA in the questionnaire and is measured from Boston City Base (BCB), the uniform elevation measurement for the city. The Article 37 Sea Level Rise and Storms questionnaire, along with the BPDA Sea-Level Rise Flood Hazard Map is featured in **Exhibit C**.

Article 37 is an important component of the zoning code when it comes to resiliency considerations. The article serves as a tool to raise awareness to developers and starts an on-going discussion around resiliency considerations. Currently, the only concrete regulations that stem from Article 37 are the recommended finished floor elevations for projects. Interestingly, these elevations are still just recommendations, and are used to frame future discussions and negotiations. Other coastal resiliency features are typically proposed by developers and then discussed in the context of sea level rise.

Article 25

Article 25 of the zoning code is another section that has implications for private development along coastal floodplains. The purpose of this article is to “to promote the health and safety of the occupants of land against the hazards of flooding, to preserve and protect the streams and other water courses in the city and their adjoining lands, to protect the community against detrimental use and development, and to minimize flood losses, by provisions designed to:

1. Restrict or prohibit uses and structures which are dangerous to health, safety, or property because of water hazards or which cause damaging increases in flood heights or flood velocities.
2. Consider flood plain management in neighboring areas.”⁵³

Article 25 was originally implemented to conform with the minimum requirements of the National Flood Insurance Program (NFIP), which states that participating communities must enforce sound floodplain management.⁵⁴ As a zoning district, Article 25 is applicable when structures are built, reconstructed, or altered. The boundary of Article 25 is currently the same as the Special Flood Hazard Area (SFHA) designated by FEMA, which is captured under Article 37.

The implications of Article 25 point to the NFIP, which in turn, the NFIP encourages communities to tailor their floodplain management activities to local conditions by i)

recommending that communities adopt floodplain regulations that are more restrictive than the minimum requirements of the NFIP and ii) noting that communities may enforce some or all of their floodplain management requirements in areas outside the SFHA. As a result, Article 25 continues to bring awareness and minimum construction / design standards based on where a site falls within a flood zone, however, in most cases, regulations are more stringent on a local level.

FEMA flood insurance maps serve as the original benchmark for planning around coastal flooding. These maps are based upon the 1% annual sea level rise. Several state and federal ordinances on coastal development also look to this benchmark to impose jurisdiction. The FEMA flood projections are based upon historical data, and do not include factors related to future sea level rise.

State Regulation

Chapter 91

Established in 1866, Chapter 91, the Massachusetts Public Waterfront Act, traces its philosophy all the way back to the early colonial ordinances of 1641-1647. Through this state law, the Commonwealth of Massachusetts seeks to preserve and protect the rights of the public, and to guarantee that private uses of tidelands and waterways serve a proper purpose.⁵⁵ An example Chapter 91's enforcement towards preserving public access to the waterfront was the catalyst for implementing the original Boston Harborwalk, which is currently a near-contiguous 43-mile linear park along Boston's shoreline.⁵⁶

Chapter 91 is administered by the Massachusetts Department of Environmental Protection (MassDEP) and its approval would be sought after obtaining Article 80 zoning approval. As part of Article 80 approval, the BPDA must submit a formal recommendation to MassDEP for Chapter 91 approval. Chapter 91 review applies to six basic activities that require authorization and four different areas of geographical jurisdiction which are outlined below⁵⁷.

Activities requiring authorization include:

- Structures
- Filling
- Dredging
- Change in Use
- Structural Alteration
- Demolition/Removal of Structures

A brief description of the four areas of Chapter 91 jurisdiction is below. Figure 11 gives a visual representation behind the jurisdiction for both filled and flowed tidelands.

- **Flowed Tidelands** - Any project located in, on, over or under tidal waters seaward of the present mean high water (MHW) shoreline.
- **Filled Tidelands** - The limit on filled tidelands is:

- Outside Designated Port Areas, the first public way or 250 feet from mean high water, whichever is further landward and
- Inside Designated Port Areas, the historic MHW shoreline (i.e., all filled areas)
- **Great Ponds** - Any project located in, on, over or under the water of a great pond.
- **Non-Tidal Rivers and Streams** - Project located in, on, over, or under and non-tidal, navigable river or stream on which public funds have been expended.

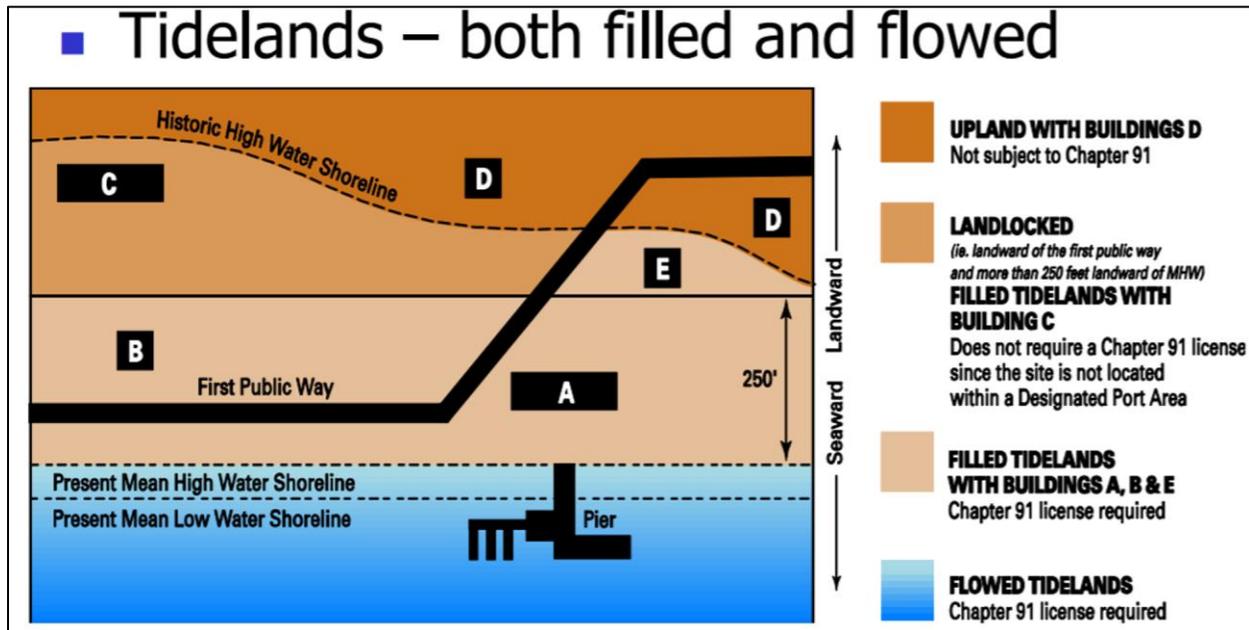


Figure 11: Chapter 91 Tidelands Jurisdiction⁵⁸

Chapter 91 Tidelands jurisdiction captures virtually all waterfront sites along the Commonwealth and would apply to coastal development sites within the City of Boston.

Upon application of a Chapter 91 license, the department will first determine as to whether the project or use is water-dependent or non-water dependent. Water dependent uses are those that require direct access to tidal or inland waters.⁵⁹ Most private, commercial developments along the waterfront do not constitute a water-dependent use. Office, Retail, Hotel, Residential and most industrial / R&D spaces would not qualify, and therefore would be considered to not serve a proper public purpose. For the sake of analysis, this paper will focus on the process of filing a non-water dependent application.

MEPA Environmental Review

Prior to filing an application for a non-water dependent use project, the developer must file and Environmental Notification Form (ENF) with the Massachusetts Environmental Policy Act (MEPA). A project falls under MEPA jurisdiction if it requires a permit from a state agency, is being proposed by a state agency, or exceeds certain MEPA review thresholds. MEPA's review thresholds identify categories or Projects or aspects thereof a nature, size or location that are likely, directly or indirectly, to cause damage to the environment.⁶⁰ In this case, a

Chapter 91 waterways license would trigger a MEPA review process. This pre-filing process and would occur in tandem with the Article 80 review period.

The Massachusetts Environmental Policy Act is intended “to provide meaningful opportunities for public review of the potential environmental impacts of Projects for which Agency Action is required.”⁶¹ MEPA will primarily review a submitted ENF and Environmental Impact Report (EIR) for a project.

- **Environmental Notification Form** – A standard form to initiate a formal MEPA review process of the environmental impacts of a project. The form will clearly identify the MEPA review thresholds that the project meets or exceeds and any Agency Actions that it may require.⁶² Typical review of an ENF is 30 days, which includes a 20 day public comment period.
 - A developer may choose or be required to submit an Expanded Environmental Notification Form (EENF), which must include more extensive and detailed information describes and analyzes a proposed project and its alternatives and assesses its potential environmental impacts and environmental mitigation measures.
- **Environmental Impact Report** – Through the ENF review process, the developer may be required to prepare an Environmental Impact Report (EIR) if there is substantial evidence that the project may have a significant impact on the environment. The report is an in-depth assessment of all possible impacts that a land development or construction project may cause on the environment.

In 2014, MEPA released a Draft Climate Change Adaptation and Resiliency Policy which has increased its awareness towards climate change, greenhouse gas emissions and sea level rise relative to environmental impacts of a project. While this is not a concrete policy, the MEPA Office intends to revise and update the Draft Policy on a periodic basis, with input from stakeholders, to reflect new data and resources as they become available and to incorporate benchmarks and standards for review and mitigation, including specific design criteria, where appropriate.⁶³

Following MEPA certification, a Chapter 91 application can be filed. In the case of a large-scale, private development, the developer would need to apply for a MassDEP Waterways License.

Similar to the Article 80 process, the Chapter 91 process heavily relies on public input. Chapter 91 regulations require that non-water dependent projects add more benefits than harm to the public’s rights to the waterfront. Areas of a project which lie within Commonwealth Tidelands, meaning areas seaward of mean low water, are owned by the Commonwealth of Massachusetts and the public retains all rights. The amount of public benefits an applicant must provide varies depending on whether the project is situated on Private Tidelands or Commonwealth Tidelands.⁶⁴

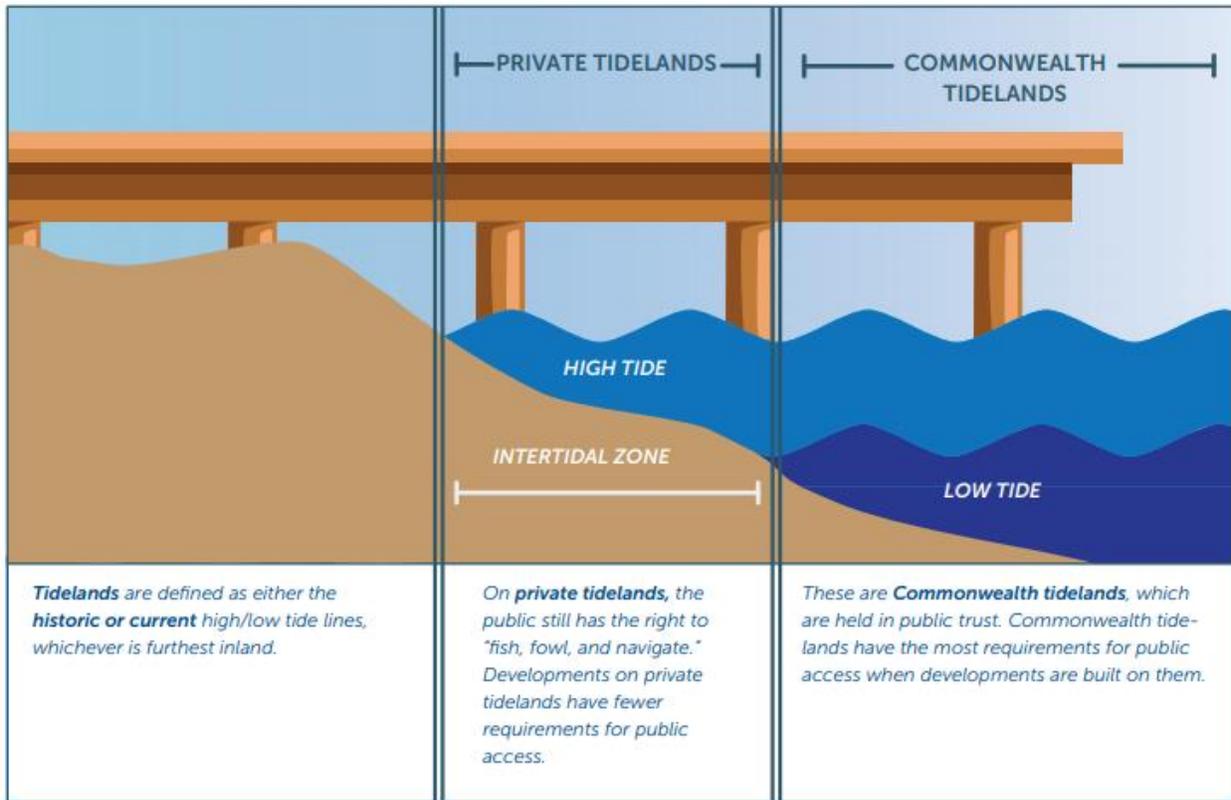


Figure 12: Description of Private vs. Commonwealth Tidelands⁶⁵

Following determination of water dependency, the Waterways Regulation Program sends a notice of license or permit application to the applicant or his/her representative for publication and distribution to property abutters and to certain municipal, state, and federal officials, or agencies. In order to achieve a Chapter 91 license, non-water dependent projects will require both public notice and a public hearing, at which Developers must prove "that the structures or fill serve a proper public purpose; that the purpose provides greater public benefit than public detriment to the rights of the public in tidelands; and that the determination is consistent with the policies of the Massachusetts Coastal Zone Management (MCZM) Program".⁶⁶

The Massachusetts Office of Coastal Zone Management reviews federal activities to ensure they meet state standards. This is required for projects that require federal licenses or permits, receive federal funds, or are reasonably expected to affect a use or resource of the Massachusetts Coastal Zone.⁶⁷

Wetlands Protection Act

The Wetlands Protection Act (WPA) is another state law that may have implications for developers along Boston's coastline. Established by the MassDEP and administered by the Boston Conservation Commission, the WPA seeks to protect and regulate eight public interests⁶⁸:

- Protection of public and private water supply
- Protection of ground water supply
- Flood control
- Storm damage prevention
- Prevention of pollution
- Protection of land containing shellfish
- Protection of fisheries
- Protection of wildlife habitat

This state law requires a public review and decision-making process surrounding these public interests. As it pertains to coastal storm water flooding, the WPA bases its jurisdiction on the FEMA Flood Insurance Rate Maps which is consistent with the Article 80 Review in the Boston Zoning Code. Projects in this area are considered land subject to coastal storm flowage, or LSCSF. As it stands today, there are no dedicated performance standards applicable to the LSCSF. Similar to previous regulations and hurdles, this is merely another approval process required for qualifying projects. Project proponents must seek and obtain an Order of Conditions (OOC), Determination of Applicability (DOA), or Order of Resource Area Delineation (ORAD) prior to the start of work.⁶⁹

Federal Regulation

Rivers and Harbors Act & Clean Waters Act

Section 10 of the Rivers and Harbors Act is a federal law that was enacted to protect navigable waters in the development of harbors and other construction and excavation. Under section 10 of the Act, authorization from the U.S. Army Corps of Engineers (USACE) is required for the construction of any structure in or over any navigable waters of the United States, the excavation and dredging or deposition of material, or any obstruction or alteration to a navigable water.⁷⁰

In addition to the Rivers and Harbors Act, Section 404 of the Clean Water Act can also apply to coastal development. The Clean Water Act establishes a basic structure for regulating discharges of pollutants into United States Waters. For developments which involve the discharge of dredged or fill material, an approval must be sought through the USACE, and any dredge or fill material must meet wetland-specific water quality standards (Section 401 of Clean Water Act). In this instance, a developer seeking both Section 404 and Section 10 permits from the USACE are permitted to file a single application.

Application for such permits take approximately 60 days, however more complex project may take considerably longer. The application requires the project proponent to submit the projects purpose, reasons for the proposed discharge of dredged/fill material, type and amount of material being discharged, surface areas of wetlands/waters filled, and abutter information.⁷¹

As resiliency becomes more and more prevalent for development along Boston's coastline, alteration of landfill along the shoreline is highly likely, especially with shore-based flood

prevention. As such, any fill along the shoreline or restoration of current water dependent structures (piers, bulkheads) would require a Section 10 and/or Section 404 permit from the USACE.

Current laws make any such approval challenging with respect to sea level rise. This is primarily because most resiliency measures that come about are based on future sea level rise as opposed to current conditions. While the USACE has recognized the importance of sea level rise, it is not a clear focus as part of its permitting approval process and creates additional hurdles for developers to overcome.

Cost Implications

When evaluating potential development sites, private developers must consider a myriad of factors that will impact a project. Site conditions, underlying zoning and a wide array of market factors all impact the feasibility of a project. While every development has its unique characteristics, the following is an assessment of the increased risk and cost that developers face when choosing to build along Boston's waterfront vs. further inland.

Time to Market and Entitlement Risk

One of the most impactful challenges that developers face along Boston's waterfront is the sheer time it takes to entitle a large-scale development. As mentioned earlier in this paper, additional layers of development approvals at different jurisdictional levels increase complexity and length of time for a project to go from inception to breaking ground. Permitting and planning along the waterfront can take many months or even years. Changing information, constant reviews and iterative periods can extend projects well past initially projected timeframes.

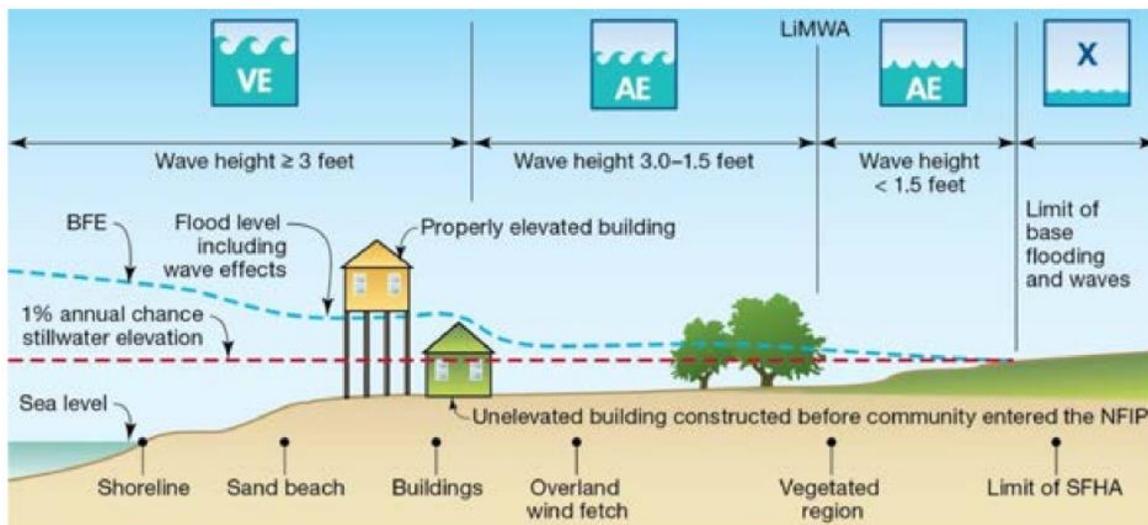
Extending a development timeline increases the market risk of the project. In most cases, developers are seeking to achieve target return thresholds to justify the cost of the project. Like many industries, real estate is known for market cyclicalities. The longer a project takes to get approved, the higher the possibility that market conditions may change. These market conditions can impact a financial pro-forma in a multitude of ways, primarily effecting the ability to lease the project at desired rental rates or increasing costs to build the project. Abrupt changes in the market could also halt a project completely if it no longer makes financial sense.

There are several ways private developers can mitigate this risk. First, developers can be conservative when evaluating the future cash flows and costs of a project. By assuming extended lease-up periods, little-to-no rent growth, and growth in construction costs, developers are able to mitigate some of this financial risk and give themselves a cushion on returns if the market is not performing well. By setting conservative expectations, developers can mitigate unexpected outcomes.

Another way private developers are able to mitigate the entitlement and market risk is to deeply understand their site, the entitlement process and potential requirements that may come about through a permitting effort. To mitigate this uncertainty, private developers conduct extensive diligence and utilize third-party consultants. For large-scale developments, a development team may consist of the owner, owner's counsel, architectural team, civil engineers, general contractor, among others. Specific to achieving entitlements along Boston's waterfront, developers may seek additional, specialized consultants to help navigate this process. These include, but are not limited to, landscape architects, shoreline consultants, environmental consultants, and permitting consultants. Most large-scale projects that are currently built along the waterfront will incorporate some combination of these consultant types to help facilitate the permitting and planning process. These consultants are an upfront cost to the developer in an attempt to expedite the permitting process, mitigate future project delays and diminish unforeseen costs.

Insurance Costs

A growing cost for developers is insuring a property against losses due to flooding. Currently, a general practice of property insurance is established by FEMA and its National Flood Insurance Program (NFIP). Homes and businesses in high-risk flood areas with mortgages from government-backed lenders are required to have flood insurance. Currently, FEMA's flood maps are based upon the 1% annual chance of flood elevation. The below map is a visual explanation of the FEMA flood maps and its designations. Figure 13 is a visual representation of the varying FEMA flood level designations. Moderate to low-risk areas fall under "X" level designations and do not require flood insurance. Areas that fall within "A", "AE", "AO" or "AH" designations are classified as high-risk areas. Highest-risk areas are labeled "V" or "VE".



Source: FEMA, n.d.

Figure 13: Diagram of various FEMA flood levels⁷²

The FEMA flood risk map serves as a baseline for the rest of the real estate industry. Large-scale commercial development may not have government-backed lender on a project, however commercial insurers will often assign higher deductibles to properties located in high hazard flood zones. Lenders may require or owners may desire to effectively buy down the deductible with the purchase of NFIP insurance.⁷³

As information continues to evolve on the risks of climate change and rising sea levels, it is plausible that flood insurance rates will continue to climb for private developers. FEMA's flood risk map is a conservative measurement, primarily considering that the flood maps are backwards looking at historical data. Private insurers will look to a plethora of information that will inform risk and probability of losses. As developers seek flood insurance, costs will likely rise as information continues to evolve, especially if new flood mapping is adopted in the future.

Physical and Structural Constraints

Aside from the risks associated with permitting and execution, physical and structural constraints create additional costs unique to waterfront development in Boston. These include site grading, dimensional & density restrictions, and construction of coastal resilience design elements.

Site Grading

The first consideration is potentially the most impactful for developers. As referenced in the description of Article 37 of the Boston Zoning Code, developers are advised to elevate ground floors to a minimum elevation above BCB if they fall within a FEMA SFHA or the BPDA SLR-FHA. The advised elevation is part of the updated Resiliency Checklist in Article 37 and is referenced in **EXHIBIT C**.

Grading sites to conform with BCB elevations bring about two major costs, i) the physical grading of the site to proper elevation and ii) the landscape architecture and site planning to incorporate the site into its surrounding environment. Much of Boston's waterfront has been developed long before these elevation guidelines have been put in place. Depending on the site, extensive landscape planning may be required to allow for the site to integrate with adjacent sites without compromising accessibility.

Dimensional and Density Restrictions

Another costly physical constraint typical of coastal development are the height restrictions and public access requirements associated with obtaining a Chapter 91 license. In order to obtain a Chapter 91 Waterways license for a non-water dependent project, developers must follow the size and height requirements, as well as devote most of its ground floor to public

use if it lies within Commonwealth tidelands. The most common and costly Chapter 91 constraints for developers are listed below⁷⁴:

- **Open Space:** At least 50% of a project site must be dedicated to open space. Within Commonwealth tidelands, open space must always be accessible and usable by the public (unless specified by Mass DEP).
- **Height:** Buildings located within 100 feet of the shoreline are limited in height by 55 feet. A building's height may increase by 1 foot for every 2 feet further inland it is located. Figure 14 illustrates this restriction.
- **Waterfront Facilities of Public Accommodation (FPAs):** These are facilities where goods or services are available to or the space is open to the public and is not restricted to a limited group. FPAs can include hotels, retail shops, restaurants, museums, art galleries, convenience stores, and more. On Commonwealth tidelands, the ground level of any building must be mostly FPAs.



Figure 14: A theoretical massing of a waterfront development along the Fort Point Channel in South Boston demonstrating the Chapter 91 height restrictions relative to proximity to the shoreline.⁷⁵

Private developments along Boston's coastline are tailored to meet Chapter 91 requirements. These requirements compromise developable land and reduces density that could be otherwise built. While an argument can be made that open and public space can bring pedestrian traffic to a project, restricting density and use cases impede a developer's profit potential.

Coastal Resilience Design Elements

Another cost implication associated with waterfront development are the additional resiliency considerations that may arise from a particular site. As part of Climate Ready Boston’s neighborhood-scale reports, various flood-prevention tools are explored. Depending on the location of the site, these costs must be borne by the developer if the project is to get approved. Through Climate Ready Boston and subsequent research reports, the City is confident in the effectiveness of shore-based solutions to combat sea-level rise. While site grading is a given as part of the Article 37 resiliency checklist, several shore-based solutions have been explored with communities and would be incorporated into specific development design and landscape architecture of a project. The following is a summary of several coastal resilience design elements that may bear additional scope and cost to a developer. Although these resilience design elements were featured in the final Climate Ready South Boston Report, the technical approaches are applicable across the majority of Boston’s shoreline.

There are three technical elements that combine to form coastal resilience design strategy:

- Technical Approach
- Location, or alignment of, the technical approach (e.g., along the shoreline or at the mouth of a Channel)
- The look, feel, and experience of the technical approach

The relationship between these three elements can provide long-term protection from rising sea levels and coastal flooding, and create social, environmental, and economic benefits. The following are five examples of different technical approaches that can be used to increase coastal resilience which have been explored through Climate Ready Boston and may be required to construct as part of a future development:

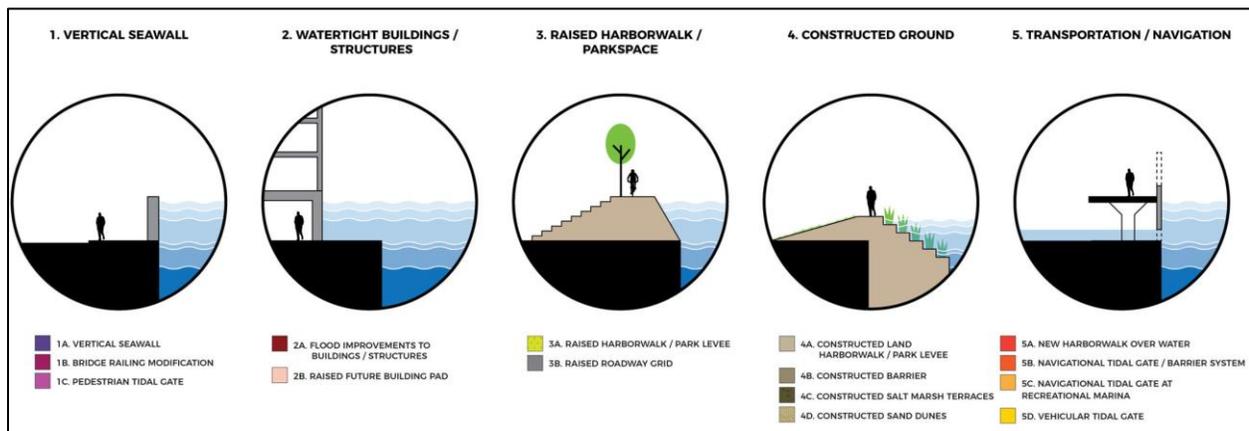


Figure 15: Technical Shore Based Solutions Highlighted in Climate Ready South Boston⁷⁶

Vertical Seawalls⁷⁷

Vertical seawalls are a viable resilience strategy across much of South Boston. Permitting requirements will vary by location. The following assumptions apply to coastal resilience design strategies that include vertical seawalls:

- All seawalls will be at least partially seaward of the high-water mark
- Existing seawalls may be able to be expanded or modified dimensionally (height raised) to meet resilience needs in some areas
- Some existing seawalls in South Boston are on the National Register of Historic Places
- Some South Boston seawalls may be wholly or partially on privately owned or leased property
- Seawalls are licensed structures and are required to be maintained. The licensee is required to maintain authorized fill
- The Massachusetts Department of Environmental Protection (MassDEP) may allow in some instances new seawalls/bulkheads outboard of old structures as part of maintenance procedures without being classified as new fill

Watertight Buildings and Structures⁷⁸

Buildings and structures that will be floodproofed will require engineering evaluation for structural soundness and must meet the building code. Alternate options include “tight or “sister” walls that are built immediately adjacent to structures and can provide additional reinforcement.

Raised Harborwalk / Raised Park Space⁷⁹

Raised Harborwalk or raised park space requirements will vary by location. The following assumptions apply:

- Some Harborwalk may be all or partially seaward of the high-water mark
- Some Harborwalk may be built on new fill material
- Some existing Harborwalk may be expanded or elevated
- Harborwalk may be partially or wholly on privately owned or leased property

Constructed Ground⁸⁰

In areas where existing space is limited, options for new land constructed in the water demonstrate the potential for multi-purpose resilient infrastructure that provides co-benefits, such as open space for recreation, stormwater retention, and aesthetic value. Permitting requirements will vary based on location. The following assumptions apply:

- Volume and boundaries of landfill must still be determined
- Mitigation for filled land will be required
- A portion of the harbor/water will be filled to create a higher elevation and flood protection (as well as providing other benefits to the community). The primary purpose, however, is flood protection
- Landfill may be considered a flood protection water-dependent use, which includes: shore protection structures and associated fill necessary to protect an existing structure, and flood control facilities.

Transportation / Navigation⁸¹

This segment is specific to a flood/tidal gate and is specific to the Fort Point Channel and is not applicable to general coastal development in Boston.

The ultimate cost and type of permitting and regulatory timeframe for developers will depend on the following:

- The technical design solution
- Impact to the existing waterfront. Those strategies that are that interact directly with the shoreline, specifically those that aim to create land or build over water will require more extensive permitting

4. Current Approach

After assessing the City of Boston's approach to Climate Resiliency, the players involved with pushing policy forward, current policies and the impacts they have on the private development process, this thesis will now evaluate two different areas within South Boston that are in various stages of permitting approvals. First, this chapter will look at the Fort Point Channel and two high-profile projects that are being contemplated for adjacent sites. These projects are 5-15 Necco Street and 244-284 A Street. This chapter will then summarize 776 Summer Street, a project seeking approvals further in South Boston along a different waterway. Figure 16 highlights the current flood pathways for the South Boston neighborhood, and highlights the two areas that will be discussed.

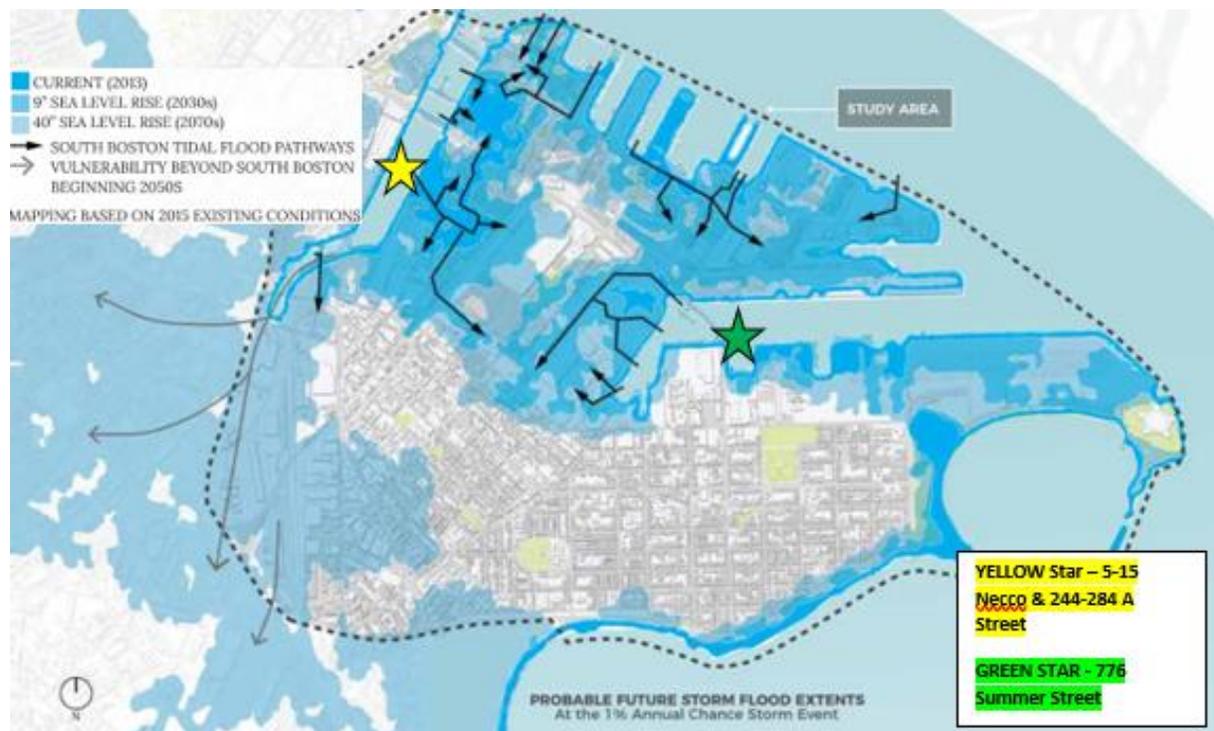


Figure 16: Diagram of probable future storm flood events for South Boston Neighborhood.⁸²

Fort Point Channel

Highlighted through Climate Ready Boston and subsequent South Boston Neighborhood study, the Fort Point Channel has been a major focus for the city as it is heavily exposed to potential flooding without intervention. As such, there has been significant vested interest from multiple stakeholders to find a solution to this threat to the city. “The significant losses from widespread flooding at such an early stage of sea level rise make Fort Point Channel an ideal location for implementation of near-term coastal resilience solutions.”⁸³ Concurrently, several sites along this flood path are owned by private developers seeking project approvals.

As part of Climate Ready South Boston, the City identified two possible flood resilience options for the Fort Point Channel. The first, or Option A, is to seek flood mitigation along the perimeter of the channel, while Option B is to explore flood protection along the mouth of the Fort Point Channel. Conceptual approach options for Option A included shore-based solutions along the east side of the channel. Climate Ready South Boston concluded its report that Option A was a necessity for long-term flood prevention, and that the project can be phased to address the most urgent flood pathways first.

Climate Ready South Boston then identified seven segments of the Fort Point Channel that will require sequenced flood mitigation. Each segment will require coordination to seamlessly integrate flood protection measures across the length of the channel. These segments are identified in Figure 17.

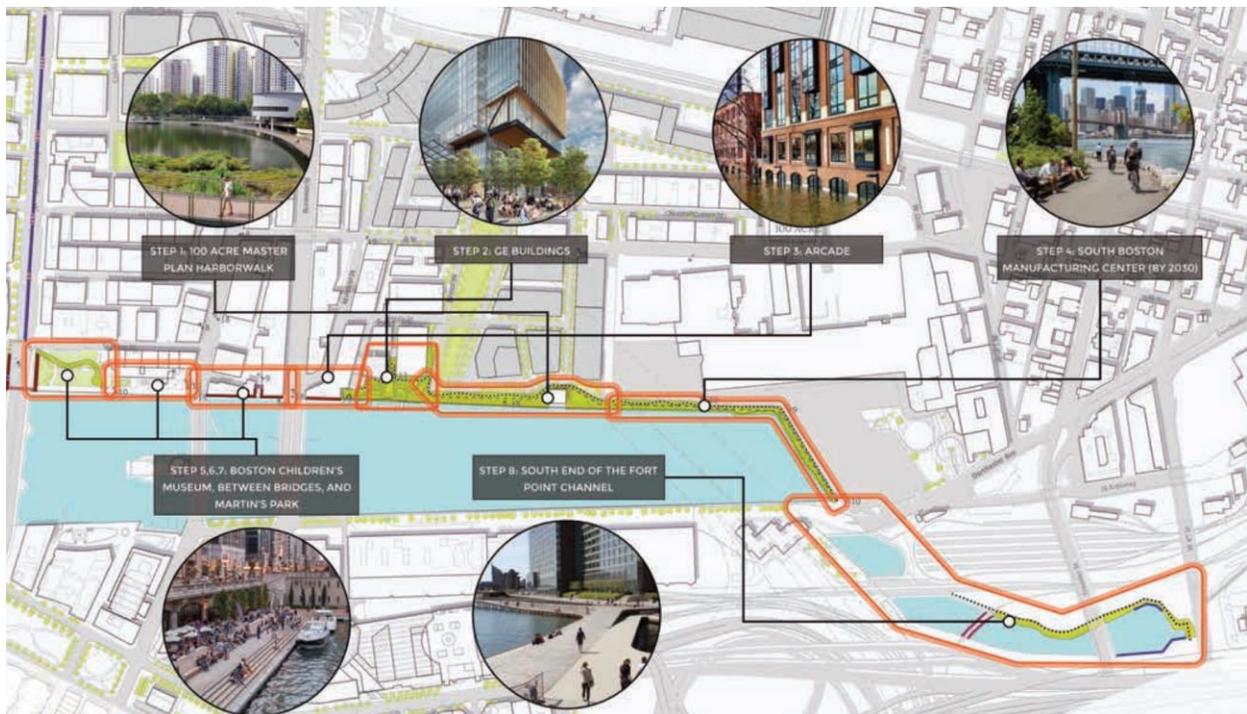


Figure 17: The seven segments of the Fort Point Channel that will require flood mitigation solutions.⁸⁴

The city of Boston has estimated costs for steps 1 - 7 in the range from \$37 - \$47 million. In an effort to support the costs of implementing this mitigation, the city of Boston has committed \$10 million in city funding for resiliency infrastructure and has also applied to FEMA for a Pre-Disaster Mitigation Grant, which would consist of approximately \$10 million in additional funding. Without additional funding sources identified, the remaining funding would come from private investment for design, permitting, construction and potential long-term maintenance.⁸⁵ The two Fort Point Project sites to be discussed fall within Steps 1 and 2 of the City's identified action plan.

100-Acre Master Plan

To put these projects into further context, the sites fall within the 100 Acres Masterplan, a comprehensive planning effort amongst community residents, other local stakeholders, public elected officials, and multiple City and State agencies. The shared goal of this planning effort was to redevelop this area with a wide array of residential, commercial, industrial, research and development, cultural, open space and other uses. This master plan was codified in 2007 and established height and density regulations for the area.

All sites have been codified though Planned Development Area No. 69. Given the highly negotiated process of Article 80 Large Project Review, this master plan serves as another guide for developers in this area and helps provide the framework for what the city expects for this area. Developers seeking approval in this area will undergo a Large Project Review Process to amend the current PDA.



Figure 18: 100 Acres Masterplan and Project Sites. The approximate site of 5-15 Necco is outlined in **BLUE**. The approximate site of 244-284 A Street is outlined in **RED**.⁸⁶

5-15 Necco Street

Project Overview⁸⁷



Figure 19: Rendering of 15 Necco Street from PDA Amendment dated 9/2020⁸⁸

5-15 Necco Street comprises approximately 2.7 acres along the Fort Point Channel consisting of two former Boston Wharf Company brick buildings formerly located at 5 and 6 Necco Court (“Brick Buildings”) as well as a vacant lot to the south that was formerly used for surface parking.

The site was previously owned by General Electric (“GE”). Under GE’s ownership, this project was approved in 2016 by the Boston Redevelopment Authority (now known as the BPDA) and underwent a PDA amendment of the preexisting 100 Acres Masterplan, which included an Article 80 Large Project Review. The proposed project at the time consisted of the rehabilitation of the Brick Buildings and the development of a new building (15 Necco) to serve as the corporate headquarters for GE. Under this approval, GE renovated the historic Brick Buildings, which included the restoration of the widening and reconstruction of the City’s Harborwalk adjacent to the project site.



Figure 20: Proposed Site Plan of 5-15 Necco Street⁸⁹

In 2019, the Brick Buildings and vacant site were sold to a joint venture between Alexandria Real Estate Equities (“ARE”) and National Development. In November 2019, new ownership submitted a Notice of Project Change to the BPDA. A Notice of Project Change is a document which may be filed by a project proponent with the BPDA if the project scope undergoes changes that are substantial enough to call for additional review and approval. Changes to the original scope included a new architectural design for 15 Necco, changes in use on the ground floor of both buildings, and changes to the landscape, site and streetscape improvements.

ARE and National Development achieved BPDA Board Approval on September 10th, 2020.

The approved project elements include:

- The rehabilitation of the Brick Buildings (completed).
- The construction of a new, approximately 316,750 square foot, twelve-story building, including a plaza between 5 Necco Street and 15 Necco Street that will be open to the public. This will be a multi-tenanted office / life-science / research and development building with active ground floor uses.
- The construction of approximately 60,650 square feet of open space at that will be privately owned and maintained but available for public use.
- The widening and reconstruction of the City’s Harborwalk along the entire length of the Fort Point Channel adjacent to the Project Site, which as noted above, has been completed in concert with the rehabilitation of the 5 Necco Street building.

Resiliency Considerations

As part of the Developer's planning process, there are several design considerations and requirements that came about for this project.

5 Necco was a rehabilitation of two existing, historic, former Boston Wharf buildings. As part of the restoration, GE committed to increase the base building elevation of both sites to 19.5' above Boston City Base (BCB). The existing first floor of the Brick Buildings were at approximately 15' above BCB. In order to comply with BRA recommendations at the time, GE agreed to compromise the lower level of the Brick Buildings and raised the finished floor to 19.5'+ BCB. This permitting process occurred in 2016, and therefore elevation heights were not yet incorporated into the Article 37 process.

Moving to the current process, National Development and ARE ("Proponents") underwent a PDA amendment process starting in 2019 that concluded in September 2020. Throughout this process, the Proponents were asked to increase the base building elevation of the New Building to 21.5' above BCB. In addition to this, the project incorporates a series of grade changes, landscaping and walls to provide continuous flood protection at 21.5' above BCB. Figure 21 outlines the approved resiliency planning for the project and various grading changes. To provide public access to the waterfront and Harborwalk, there are several breaks in the flood protection (identified by the dotted orange line in the image). Upon flooding events, ownership will use deployable flood protection at these areas. Additionally, the landscaped flood barriers are also designed to be modular, allowing for adaptability in flood protection elevation if required.⁹⁰

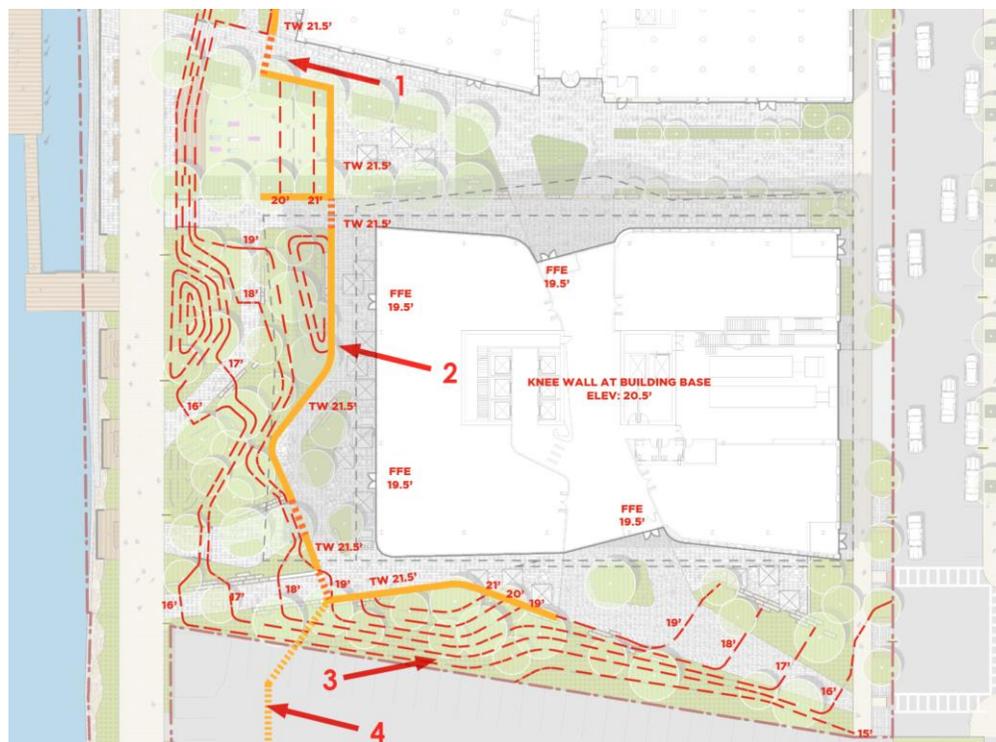


Figure 21: 15 Necco Resiliency Planning. Image identifies grade changes and BCB elevation grades for flood protection. This plan was later adapted to a Finished Floor Elevation of 21.5'+ BCB.⁹¹

There are two major considerations that the proponents faced when designing these resiliency measures. First was public access and integration into the existing landscape. Unique to this site are the physical constraints of providing access from the street level (15'+ BCB) up to the project site (21.5'+ BCB) and back down to the Harborwalk. Creating a welcoming site for pedestrians and ensuring ADA (Americans with Disabilities Act) compliance within a shallow site proved difficult in the planning process. Further, providing public access to the waterfront was a critical component to the planning process and weighs heavily on Chapter 91 approvals.

The other major consideration is the connection of flood protection along the Fort Point Channel. The Proponents must consider the sites to the north and south to ensure that flood protection measures are consistent and effective across sites. This requires coordination with abutters and the City of Boston. The flood protection is designed to connect with the FEMA flood barrier that has been proposed by the BPDA for the site.

A final consideration that came about through the site's waterfront location is its ground level uses. Per Chapter 91 regulations, it is expected that at least 75% of the ground floor space in both 15 Necco and 5 Necco Street will comprise facilities of public accommodation (FPAs). Further, approximately 5,000 SF of ground floor space in 5 Necco will be dedicated for Non-Profit FPA space and will be leased at below-market rental rates.

244-284 A Street



Figure 22: Rendering of 244-284 A Street⁹²

244-284 A Street was acquired by Channelside Acquisitions, LLC, an affiliate of Related Beal ("Related Beal") in May 2019 from the Gillette Company, LLC. The approximately 6.5-acre site is located directly adjacent to 15 Necco to the south along the Fort Point Channel.

In November 2019, Related Beal submitted a Letter of Intent with the BPDA and subsequently submitted a Project Notification Form in July 2020. The initial PNF comment period ended in November 2020. The project has not yet reached BPDA board approval. Given where this project is in the permitting process, the following information is based on the original Project Notification Form dated July 27, 2020 and subsequent public meetings.

The proposed redevelopment will include approximately 1.1 million square feet of residential, office, lab and mixed-use space, including but not limited to retail, restaurant and civic space. The project will consist of three buildings with below-grade parking, improvements to the Harborwalk, and extensive new open space. The proposed buildings include:

- Residential Building: Approximately 366,100 SF of residential space and mixed-use space with approximately 370 residential units
- Office Building: Approximately 332,192 SF of office and mixed-use space
- Lab/R&D Building: Approximately 400,000 SF of lab/R&D and mixed-use space

Incorporated within the mixed-use space, all three-buildings will contain FPA uses consistent with Chapter 91 requirements.

Resiliency Considerations



Figure 23: 244-284 A Street Resiliency Elevations⁹³

Figure 23 outlines the proposed elevation and grading of the site. The current base flood elevation of the site is 16.5' above BCB. Related Beal is proposing finished floor elevations of 21.5'+ BCB for the buildings closest to the Fort Point Channel. All inhabitable floors of the remaining buildings will be built to a minimum of 19.3'+ BCB. Per the resiliency checklist in accordance with Article 37, the recommended BCB finished floor elevation for the entire site is 19.5'+ BCB.

As referenced in the project's initial PNF: "The Project will include a section of the flood defense system, likely an earthen berm, proposed by the City of Boston for the Fort Point Channel area as part of the City's Climate Ready Boston plan. Once the City's plan is completed, the flood defense system will provide significant coastal flood risk reduction for a large portion of the South Boston community. The berm will be integral to the site design to meet the intent of Boston's ongoing resiliency efforts and protect existing neighborhoods around the site from stormwater surge and projected sea level rise. It is proposed that the Project Site be graded such that visual obstructions from the community to the water are minimally affected by the new resiliency infrastructure. Improvements to the Harborwalk will be made to enhance waterfront access and to provide integration with the berm."⁹⁴

Similar to the challenges that ARE and National Development are facing at 5-15 Necco, extensive coordination is required to achieve continuous flood protection along the Fort Point Channel consistent with the BPDA's desired design guidelines.

The current harborwalk and resiliency design incorporates an earthen berm which is covering a sheet-pile wall at 21.5'+ BCB elevation. The sheet piling is designed to prevent ground water penetration through the berm. This berm will be designed to connect to a seawall that would protect the adjacent parcel to the south. Figure 24 outlines the original proposed berm design, and current modifications as proposed by Related Beal.

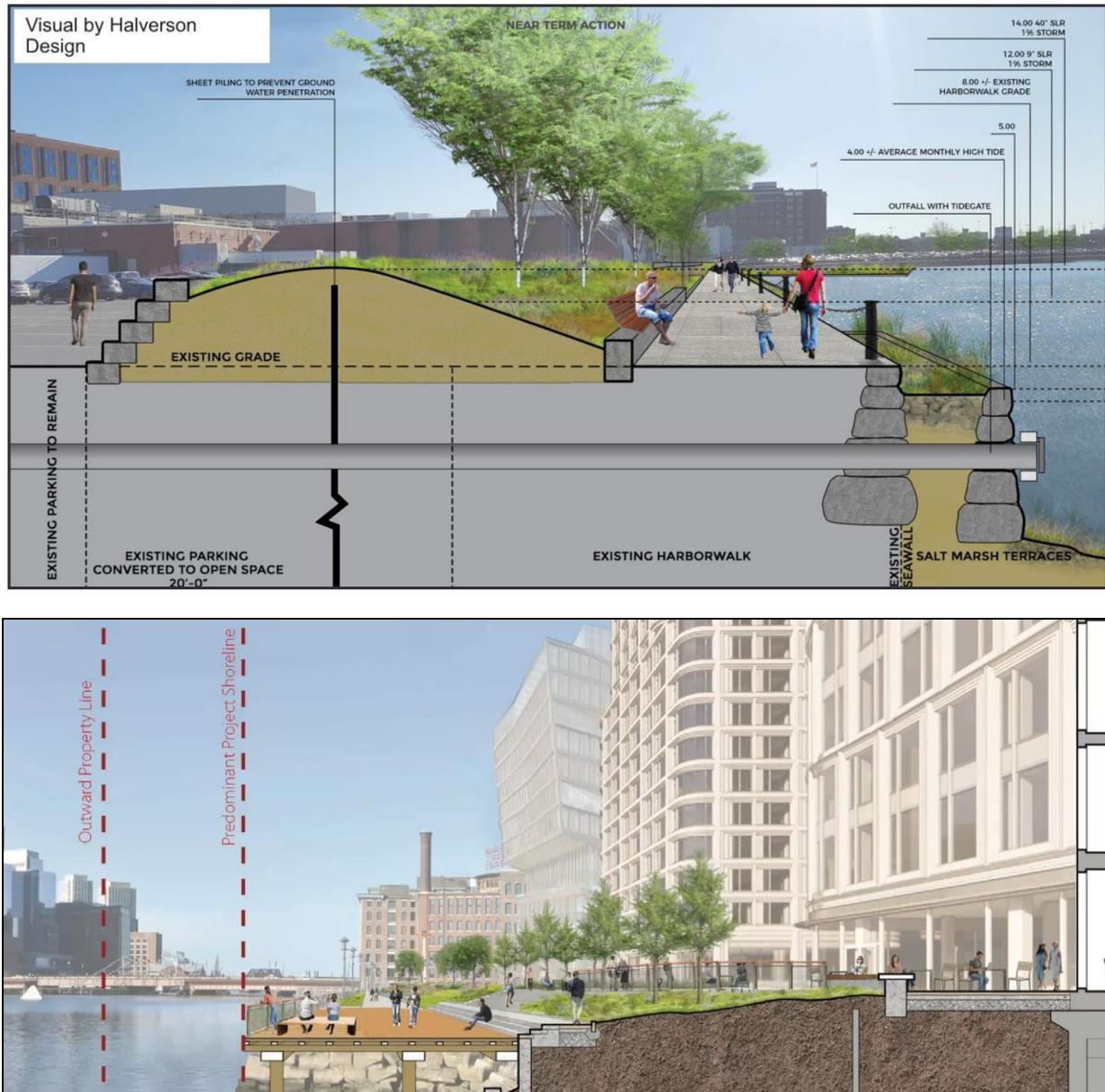


Figure 24: BPDA proposed Berm; Newly Proposed berm along 244-284 A Street⁹⁵

Related Beal faces similar grading issues to those encountered at 15 Necco Street. While this site is considerably larger and provides for a much more gradual grading back down to A Street, significant landscape design must go into the project to allow access to the waterfront (as opposed to a wall that prevents access). As such, Related Beal is designing the site to be at 21.5'+ BCB grade, only to grade down to the waterfront at the site of the berm. Figure 24 depicts the proposed design solution to give continued waterfront access.

776 Summer Street

Unlike the previous two projects, 776 Summer Street is not located along the Fort Point Channel. Rather, the site is located much closer to the residential neighborhood of South Boston, bound to the west by Summer Street, on the south by East 1st Street, on the east by a land parcel owned by the Massachusetts Bay Transportation Authority (“MBTA”) and to the north by the Reserved Channel and the Thomas J. Butler Dedicated Freight Corridor.

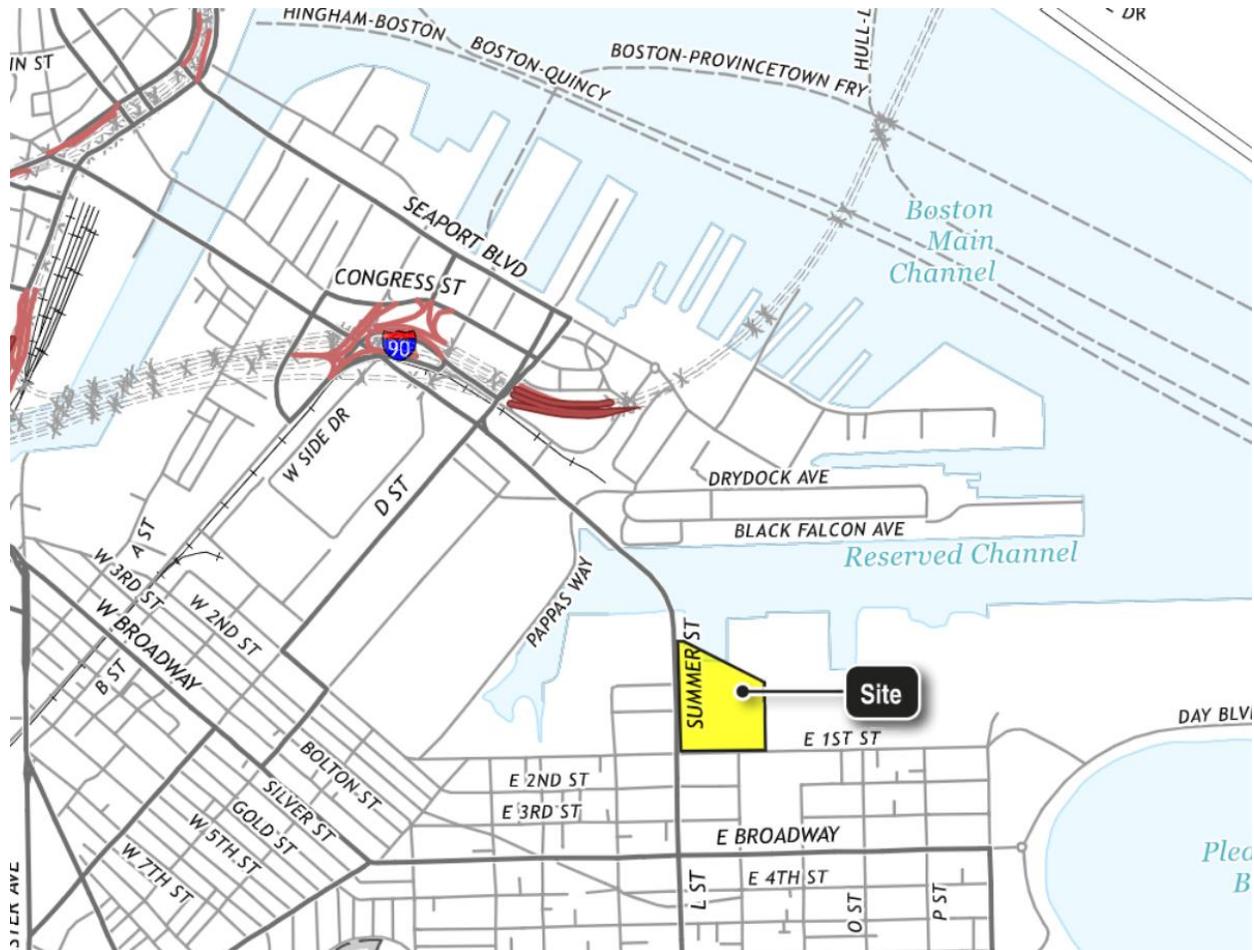


Figure 25: Site Location of 776 Summer Street⁹⁶

776 Summer Street (“The Project”) is an approximate 15.2-acre site owned by HRP 776 Summer Street LLC (“HRP”), a privately held partnership led by Hilco Redevelopment Partners and Redgate Capital Partners. The site was acquired in 2016, followed by the filing of an LOI and PNF in Q2 2017. HRP filed a PDA application in November 2019 following the end of the PNF Comment Period that same month. The project has not yet reached BPDA board approval.

The existing site contains a series of buildings and infrastructure related to its prior use as a Power Plant. Based on the PDA application dated November 2019, the proposed Project includes 2.1 million square feet of development situated along the Reserved Channel in

South Boston. The project includes the following key components highlighted in the original PNF filed in 2017⁹⁷:

- The clean-up and abatement of the project site and Power Plant buildings;
- The adaptive reuse of portions of the existing Power Plan Buildings and equipment to preserve their historical and architectural significance;
- The transformation of a previously fenced-off and inaccessible site into a public waterfront destination with new dining and retail, as well as community arts and business uses; and
- The provision of approximately 104,500 square feet of new outdoor public spaces with inviting landscaping, waterfront activation, programmable open areas, and amenities, including a new 1.15 acre publicly accessible waterfront open space.



Figure 26: Site plan of proposed Project from Presentation dated 9/9/20. "1898 BLDG" and "TURBINE"s 1-3 are existing structures to be redeveloped.⁹⁸

Resiliency Considerations

776 Summer Street's resiliency concerns relate to its connection to the Reserved Channel. In terms of resiliency, the project benefits as it does not fall along a critical flood pathway to other sites. Figure 27 highlights the site in context with the current FEMA SHFA zone.



Figure 27: Site Context Relevant to FEMA SHFA Flood Map⁹⁹

As outlined in Figure 27, approximately two-thirds of the Project site is historically upland, as the site naturally grades upwards in elevation moving North to South towards the South Boston neighborhood. Looking to the Article 37 resiliency checklist, the current site is approximately 16.5'+ BCB and falls within a recommended building elevation of 19.5'+ BCB. HRP intends to incorporate a series of stepped landscaping from the channel up to a minimum first floor elevation of 21.5'+ BCB for all buildings.

Today, the existing buildings on the site are set back from the waterfront approximately 100 – 120 feet. As part of HRP's urban planning efforts, there will not be any new buildings closer than this setback. This was not a set requirement by the City, however it allows for increased open space for the project and lessens the immediate burden of sea level rise protection for the buildings (allowing the open waterfront space to flood in the event of storm water flooding).

Unique to the site is that it currently has an existing Chapter 91 license and HRP must seek a new waterways license. The site is located on historically filled tidelands but also within a Designated Port Area or DPA. As part of the Chapter 91 regulations, the DPA program was created to protect water-dependent industrial uses in and along state waterways. HRP can make the argument that due to the lack of access to navigable water and the lack of feasible

water dependent development options, there is reason to work alongside the Commonwealth to appropriately revise the DPA for non-water dependent use.

Finally, the set back of the future planned buildings affords HRP some flexibility in its ground floor uses. Chapter 91 prohibits facilities of private tenancy on any filled tidelands within 100 feet of the shoreline. The current design does not anticipate any new non-water dependent buildings within this range. This clarification does not imply that all ground uses on the project will be private, however it does eliminate additional development hurdles and future use restrictions.

Observations

From these three case studies across varying stages in the permitting process, there are some themes that can be identified as well as observations to be made about the current regulatory framework surrounding climate resiliency.

Fluid Resiliency Requirements

First, it is evident that climate resiliency information is fluid and that approvals based on elevation grades can and will change. Evidence of this can be seen in all three projects, most notably with 5-15 Necco Street.

5-15 Necco Street was originally approved by the BPDA for finished floor elevations of 19.5'+ BCB in 2016, with the renovations to the existing brick buildings built to this elevation standard. When the project was later proposed again in 2019, the project elevation remained at 19.5'+ BCB. In following the public presentations, the project elevation for 15 Necco was increased to 20.5'+ BCB, and it was not until final approval when the finished floor elevations increased again to 21.5'+ BCB.

This is the most poignant example of fluidity with the given standard, however it can also be observed with 244-284 A Street and 776 Summer Street projects. When looking at the Climate Resiliency Checklist and BPDA Flood Hazard Map (Exhibit C), all three of these sites are suggested to be elevated to a minimum of 19.5'+ BCB. While 244-284 A Street and 776 Summer Street began their processes with this additional 2 feet of freeboard above the recommendation, it emphasizes how the current standard may not have been an acceptable elevation to begin with. Given the lack of concrete requirements in the current regulatory environment, longer permitting processes can prove costly and resiliency guidance will likely iterate until final BPDA Board Approval is met.

Design Consistency and Protecting Market Value

A second observation is the similarity in landscape design and base building elevations when comparing the Fort Point Channel and 776 Summer Street. This is especially interesting given the implications for flooding at the two different locations in the City of Boston. On one hand, the Fort Point Channel is one of the most vulnerable flood pathways in the city. As such, the resiliency infrastructure put in place will benefit many more sites than just those owned by the developer. On the other hand, 776 Summer Street sits along a site that is naturally graded and already prevents broader flood events to its surrounding area. Any resiliency measures would solely protect its project.

In all three examples, the developer group is agreeing to maintain its waterfront space and is building the appropriate resiliency measures to prevent coastal stormwater flooding for the projected lifetime of its project. In all three examples, landscape grading is utilized from the waterfront and base building elevations are being built to 21.5'+ BCB.

It is evident that developers are willing to bear the cost of resiliency design to protect their project and investment. At the Fort Point Channel, even though the City of Boston has committed \$10 million in funding and has applied for an additional \$10 million through FEMA, it is likely that the resiliency measures at 5-15 Necco and 244-284 A Street will be funded by the private developers who must protect their individual sites. Regardless of whether these improvements will protect a single project or an entire neighborhood from flooding, the specific project will require certain protections to preserve its market value at the end of its development life cycle.

Not All Projects are Created Equal

While there are some noted similarities between these projects, there are also clear differences between the process within the Fort Point Channel and the process underway at 776 Summer Street. The Fort Point Channel has been a major focus for the City of Boston, especially since the release of Climate Ready Boston. The City of Boston and several stakeholders are heavily invested in providing a comprehensive solution for this area, and the stakes are particularly high to properly establish continuous flood protection across multiple sites.

Given this involvement, developers in the Fort Point Channel have had both the benefit and challenge of integrating their site vision amidst the City's climate resiliency plan and research that is constantly evolving. This scenario benefits developers as extensive research, community outreach and published reports currently exist which all directly point to a resiliency framework for these sites. On the other hand, the high-profile nature of the site creates challenges for a developer to proceed with one set plan. There are many invested parties, and any resiliency measures will require wide-ranging coordination which could delay development.

776 Summer Street is quite the opposite in that it is an example of a project that must go through resiliency measures to protect its site and its site alone. This site does not fall within

one of the identified locations for flood prevention intervention by the City. Interestingly, many of the resiliency requirements seen for this project are consistent with what is seen in the Fort Point Channel. Approvals for this project remain a very public process with many interested stakeholders, however it is relatively isolated and lacks broader coordination with the City and adjacent sites for resiliency. A challenge that can arise from this scenario is that there lacks a clear resiliency design solution and therefore it must be proposed by the developer and subsequently approved. This gives the developer flexibility in design, however, risks a lengthy approval process amongst stakeholders.

These observations are merely tied to the two locations referenced in this chapter. As mentioned previously, each development site has a myriad of factors and considerations that must be addressed. Benefits and challenges of each site will vary by location, as the permitting and planning process today is left largely to bare minimum guidelines and successive negotiation.

5. Moving Forward

Over the last decade, coastal resiliency measures have become more and more relevant in the permitting and planning process in Boston, particularly since the release of Climate Ready Boston. Two project locations in South Boston helped to provide some context around the current requirements with regards to coastal resiliency. The following will explore changes in policy that developers may encounter in the future as this process continues to evolve.

Future Implications

Coastal Flood Resilience Overlay District (CFROD)

One of the major recommendations that came out of Climate Ready Boston was to create a zoning overlay district in the city to address coastal flood resiliency. Establishing a new overlay district was part of the fifth strategy in Climate Ready Boston: to create a coastal protection system to address flood risk.

The City of Boston is currently in the process of putting together a draft overlay policy with scheduled public meetings for review in January 2021. The new overlay district will provide new zoning definitions, dimensional and use standards for development projects to promote resilient design and better prepare new and existing buildings for future coastal storms and sea level rise.¹⁰⁰ The new zoning overlay will be an addendum to Article 25 of the existing zoning code.

The objectives of the new zoning overlay include¹⁰¹:

- Promoting resilient planning and design
- Providing consistent standards for the review of projects
- Maximizing the benefits of long-lived investments in coastal resilience
- Promoting the co-benefits of sustainable designs that address multiple climate impacts
- Advancing adaptation strategies that are future-looking and draw on best practices for long-term resilience
- Encouraging design that responds to the unique conditions of Boston’s building types, advancing resilience for individual buildings, district-scale resilience plans, and enhancing the public realm.

Unique to this overlay district, the jurisdiction of the zoning will capture sites that fall within future flood risk zones, up to the 1% annual flooding event by 2070. Figure 28 outlines the current flood map (what is captured through Article 25 & 37) against the new overlay boundary.

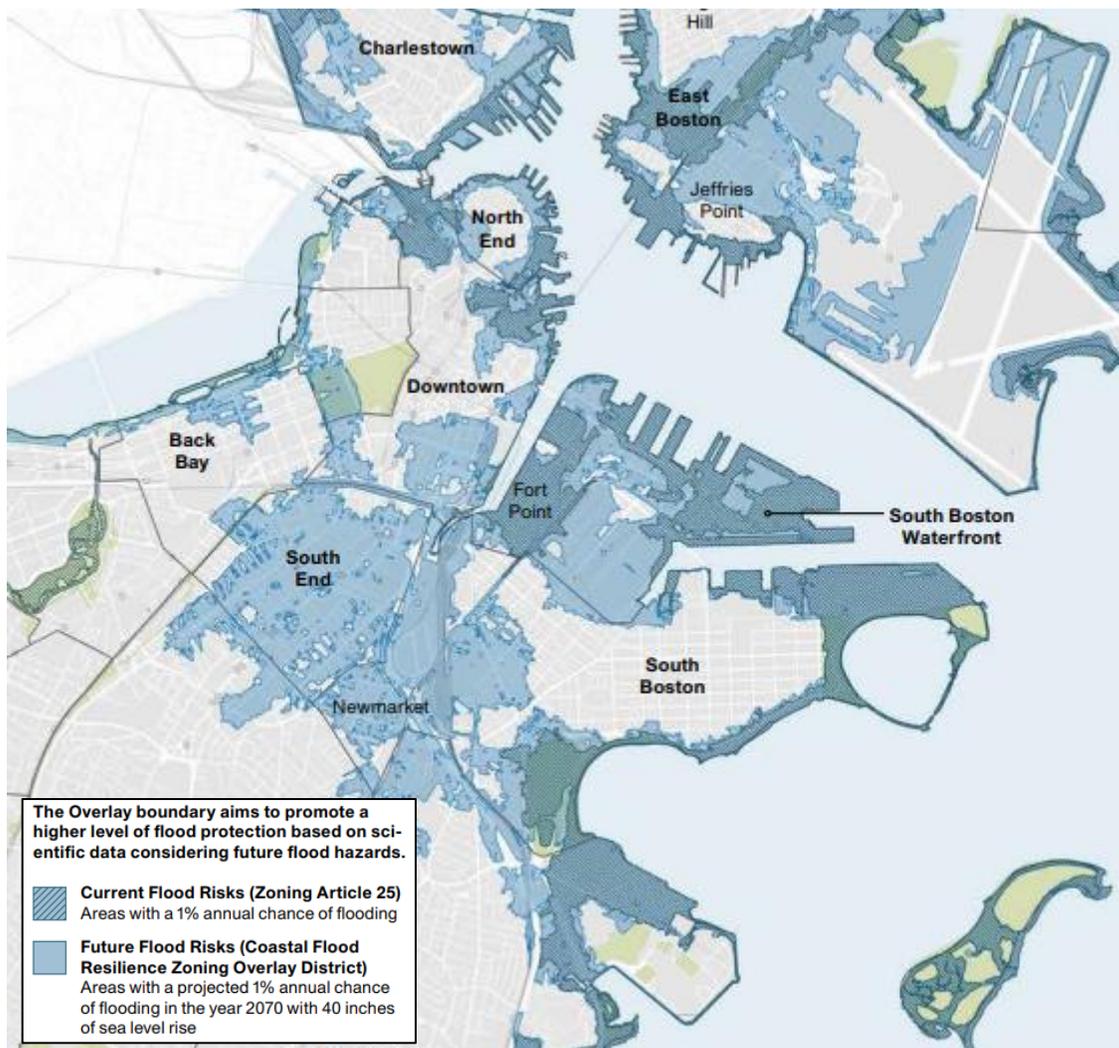


Figure 28: Current vs. Future Flood Risks. Expansion of Flood Resiliency Jurisdiction

This overlay district will have a significant impact on inland sites that could be exposed to future flooding, particularly in Boston's South End, which has historically had no flood resiliency protocols for development and redevelopment. One of the focuses with the overlay is to promote retrofitting of existing structures in vulnerable areas. "These standards are intended to prevent flood damage to buildings by elevating building occupiable space, flood proofing areas beneath flood elevations and promoting health and safety by preventing sensitive uses, such as living space below the flood elevation."¹⁰²

While this overlay will have significant implications for smaller-scale developments and retrofits, the new SFROD will also have future implications for large-scale developers. Per the proposed zoning, all projects subject to Large and Small Project review (any project in excess of 20,000 SF) will have to undergo an official Resilience Review. This process will be administered by the BPDA Urban Design Staff and will focus on the resiliency design considerations of proposed projects.

Modification of Existing Tools

There are several existing policy and regulatory tools that help to ensure private developers adhere to desired guidelines and build for future flood events. In a report published by Arcadis and the Boston Green Ribbon Commission in April 2020, titled *Expanding Boston's Capacity to Build Coastal Resilience Infrastructure*, Boston's existing regulatory framework was assessed to identify where policies can be strengthened and modified in the future. This report was specific to implementation efforts along the Fort Point Channel, however much of its findings can be applied to other focus areas throughout the City of Boston.

Codify Neighborhood-Scale Resiliency Plans

One of the most important recommendations in this report was for the City of Boston to formally adopt coastal mitigation plans. Through interviews with various property owners along the Fort Point Channel, many of the existing property owners "expressed uncertainty about the City's plan for flood mitigation".¹⁰³ While the City has published reports on coastal mitigation efforts, alignment and target elevations have not been officially codified. This recommendation is to formalize the findings of the neighborhood scale Climate Ready Boston Reports into some stages of the existing regulatory process.

A formal adoption of neighborhood-scale plans will create broader awareness and adherence to the recommendations released over the past 5 years. Once official neighborhood plans are adopted by the City, there are opportunities for existing policy to be amended and adapt to these plans. Figure 29 highlights the strengths, weaknesses, and potential opportunities for the future of the Article 80, Article 37 and Chapter 91 process.¹⁰⁴

Policy vehicle	Strengths	Weaknesses	Opportunities
Boston Planning and Development Agency, Article 80 Development Review and Article 37 Green Building and Climate Resiliency Policy and Checklist	<ul style="list-style-type: none"> Established development review process Enforceable mechanism for advancing coastal resilience Creates requirement for consideration of climate change and adaptation through development approvals process 	<ul style="list-style-type: none"> Non-Prescriptive; requires consideration of resilience, but does not provide standards or design criteria Applies only to new development subject to certain types of Article 80 review Relies on a site-by-site approach 	<ul style="list-style-type: none"> Potential to advance and enforce district-scale strategies in the near-term site-by-site if coastal mitigation plans and performance standards are established
State of Massachusetts 310 CMR 9.00 (Chapter 91 regulations) and 301 CMR 23 (Municipal Harbor Planning)	<ul style="list-style-type: none"> Established regulatory process 	<ul style="list-style-type: none"> Base regulations do not incorporate best available climate projection data Policy objectives may be interpreted as conflicting with coastal resilience solutions in some cases Relies on site-by-site approval process Applies only to properties within Chapter 91 jurisdiction 	<ul style="list-style-type: none"> Municipal Harbor Planning (MHP) (301 CMR 23) provides vehicle for localities to amend base Chapter 91 regulations MHP could include or refer to climate projections, target elevations, tie-in specs, etc. and requirements for district investments Chapter 91 enforcement power may incent property owner action (as discussed in greater detail under Track 2)

Figure 29: Identified Strengths, Weaknesses and Opportunities for Article 80, Article 37, and Chapter 91 Regulations.¹⁰⁴

As seen in Figure 29, much of the recommended modification will be focused towards helping the City provide district-scale flood protection for its various focus areas. Existing tools may be modified in the future to allow for private adoption and appropriate tie-in of these broader planning efforts. Depending on the detail behind a neighborhood scale report, the resiliency review will largely have to continue on a site-by-site basis as projects enter these processes.

District for Resilience Improvements (DRI)

District for Resilience Improvements or DRI is a concept that has been explored in several reports published since Climate Ready Boston. The idea stems from the original Climate Ready Boston report within its fourth strategy, outlining an initiative to establish “local climate resilience committees to serve as long-term community partners for climate adaptation.”¹⁰⁵

As contemplated in the GRC and Arcadis report, a DRI would be the creation of a new governance entity which would be responsible for the management and implementation of district-wide flood protection measures. Potential key functions of this entity could include¹⁰⁶:

- Coordinating Property Owners
- Taking on Debt
- Establishing Public-Private Partnerships
- Pursuing Grants
- Procuring Contractors and Consultants
- Planning Capital Improvements
- Operating and Maintaining Resilience Solutions

The creation of a public entity provides a direct focus towards implementation of resilience improvements. These DRIs can range from being district-specific to a single entity with

jurisdiction across the city. Unlike the BPDA, a DRP group will be able to engage and oversee various publicly backed projects, which in-turn will help implement district-wide resiliency plans and establish partnerships along the waterfront.

Conclusions

The permitting and planning process for large-scale development in Boston can prove long and arduous for private developers. To add to these challenges, climate change and coastal resiliency considerations have poised additional hurdles for developers seeking to build along Boston's waterfront. By analyzing the current permitting landscape with regards to coastal resiliency, several themes can be identified, and potential future changes can be posited moving forward.

- Large-scale permitting and planning in Boston will continue to be highly negotiated and evaluated on a case-by-case basis
- The City of Boston is still in early stages of implementation, with new regulations and entities yet to be formed
- High-risk flood pathways will remain the City's focus, and neighborhood-scale plans must be adopted to establish consensus across stakeholders
- Equitable funding will drive the discussion moving forward, and the City of Boston must take action to define how neighborhood-scale protection will be financed

As evidenced through case studies, the resiliency planning process for private developers remains a highly negotiated and non-prescriptive process. Notwithstanding numerous reports and a plethora of research since Climate Ready Boston, a lack of concrete resiliency guidance dictates no "right" answer for developers along the coastline. The result is a constantly iterative approach to climate resiliency, primarily negotiated through Article 80 Project Review and Chapter 91 approvals process.

Despite the lack of tangible direction, the City of Boston is still merely in its near-term stages since the establishment of Climate Ready Boston. A new zoning overlay is to be established which will create a forward-looking approach to flood risks, while a new resiliency review board in the Article 80 / Article 37 review process will begin to streamline various design requirements and approaches.

Moving forward, developers can expect the City of Boston and other stakeholders to remain heavily invested in Boston's highest risk areas. Several recommendations have pointed towards codifying the Climate Ready Boston Neighborhood reports to establish more concrete direction in some of these areas. As these expectations become stronger, funding and collaboration will become essential to implementing such wide-scale flood protection.

The proposed CFROD language is currently under a public review period and provides the City of Boston with an opportunity to take a step towards establishing funding expectations for district-wide flood protection. Within this overlay zoning, there is a possibility that projects under small or large project review must contribute to any district-scale flood protection that

they benefit from. This requirement would establish an equitable funding expectation from those that benefit from broader flood protection projects. This language is not in the current draft zoning, but it presents an opportunity to codify funding requirements for district-scale flood protection efforts borne by public entities.

As the City of Boston progresses into its next steps of climate resiliency regulation, it is important to note that information on climate change and coastal flood risk can and will evolve over time. Changing information was evident in the current case studies, and there has been a rapid advancement of information and perspectives over the past five years alone. It is unknown how this information will change, but expectations for increased scrutiny of coastal resilience measures is in-line with what we have seen to date.

Coastal development in Boston will continue to be a highly public and negotiated process for the foreseeable future. Additional regulations for coastal resiliency are forthcoming; however, uniqueness of location and changing perspectives on flood protection measures will prevent implementation of prescriptive zoning codes. Ultimately, the future of Boston's coastline is dependent on public-private cooperation and will continue to unfold as the state of the climate evolves.

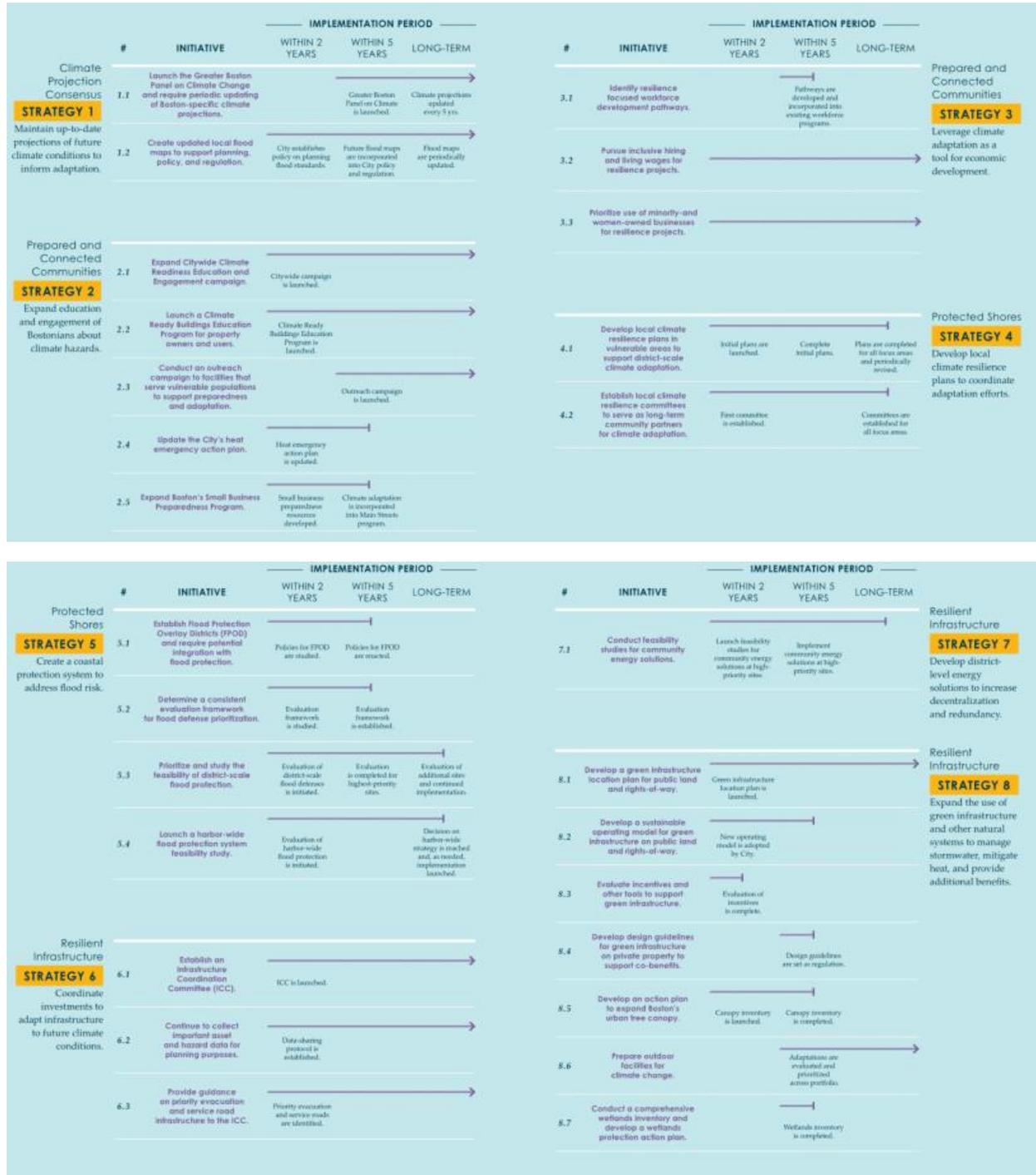
Glossary & Acronyms

% Annual Coastal Flood Risk	The probability of a flood event occurring in any single year.
ABC	A Better City
AD	Adequacy Determination
ADA	Americans with Disabilities Act
BCB	Boston City Base: a city-wide datum that can be converted to NAVD88 by using a conversion factor of BCB-6.46 feet
BPDA	Boston Planning and Development Agency (formerly BRA)
BPDA Flood Hazard Area	See SLR-FHA
BRA	Boston Redevelopment Authority (now known as BPDA)
BRAG	Boston Research and Advisory Group
CFEP	Coastal Flood Event Probability
CFROD	Coastal Flood Resilience Overlay District
CLF	Conservation Law Foundation
CRB	Climate Ready Boston
CZM	Massachusetts Office of Coastal Zone Management
DOA	Determination of Applicability (in relation to the Wetlands Protection Act)
DPA	Designated Port Area
DPIR	Draft Project Impact Report (Article 80 process)
DRI	District for Resilience Improvement
EENF	Expanded Environmental Notification Form
EIR	Environmental Impact Report
ENF	Environmental Notification Form
FEMA	Federal Emergency Management Agency
FPA	Facilities of Public Accommodation (in accordance with Chapter 91 Laws)
FPIR	Final Project Impact Report
GRC	Green Ribbon Commission
IMP	Institutional Master Plan (Article 80 Process)
IPCC	Intergovernmental Panel on Climate Change
LEED	US Green Building Council Leadership in Environment and Energy Design
LOI	Letter of Intent (Article 80 process)

LSCSF	Land Subject to Coastal Storm Flowage (in relation to the Wetlands Protection Act)
MassDEP	Massachusetts Department of Environmental Protection
MCZM	Massachusetts Coastal Zone Management
MEPA	Massachusetts Environmental Policy Act
MHW	Mean High Water: A Tidal Datum representing the average of all the daily tidal high-water heights observed over a period of several years. In the United States this period spans 19 years and is referred to as the National Tidal Datum Epoch.
NFIP	National Flood Insurance Program
OOC	Order of Conditions (in relation to the Wetlands Protection Act)
ORAD	Order of Resource Area Delineation (in relation to the Wetlands Protection Act)
PDA	Planned Development Area (Article 80 Process)
PNF	Project Notification Form (Article 80 Process)
SFHA	Special Flood Hazard Area: Area where the National Flood Insurance program's (NFIP's) floodplain management regulations must be enforced
SLR	Sea-Level Rise
SLR-FHA	A BPDA term that delineates the extent of flooding projected in the BH-FRM for the 1% CFEP in 2070 scenario.
USACE	U.S. Army Corps of Engineers
WPA	Wetlands Protection Act

Exhibits

Exhibit A - Climate Ready Boston Initiatives



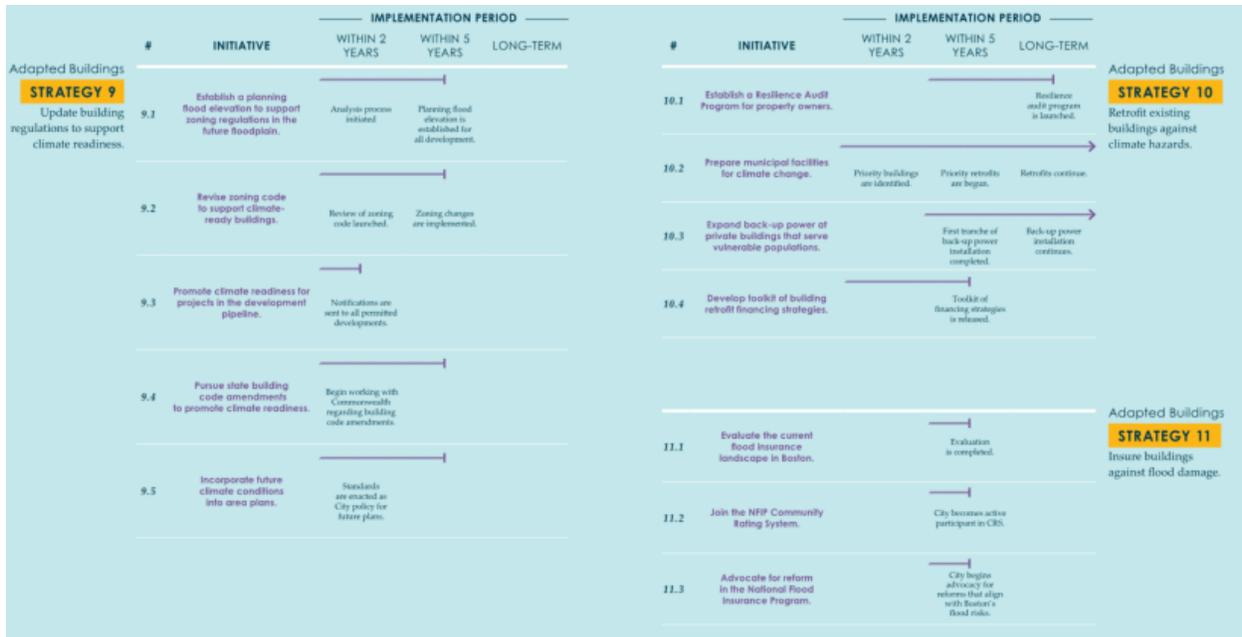
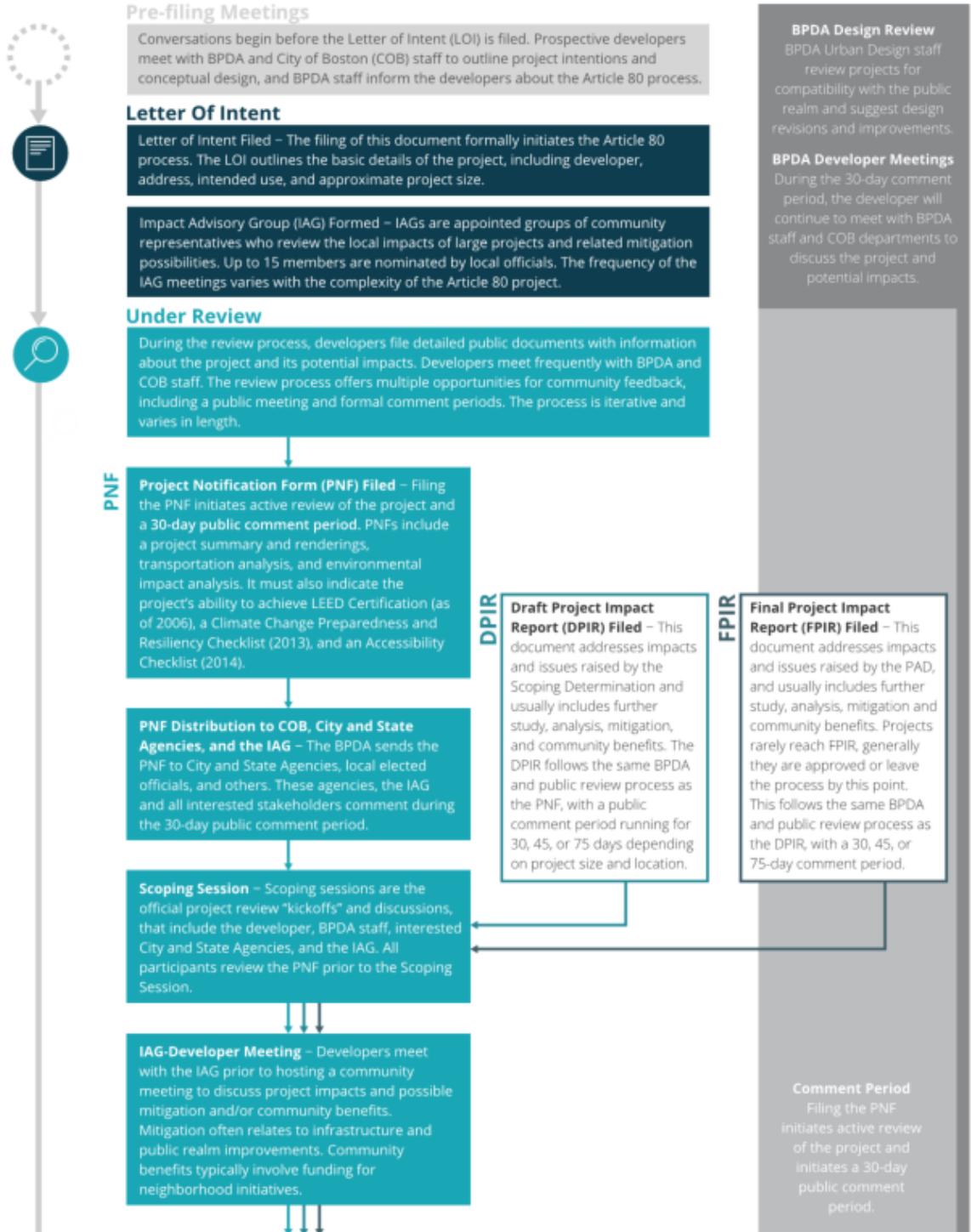


Exhibit B - Article 80 Large Project Review Stages (BPDA)

Development Review Stages



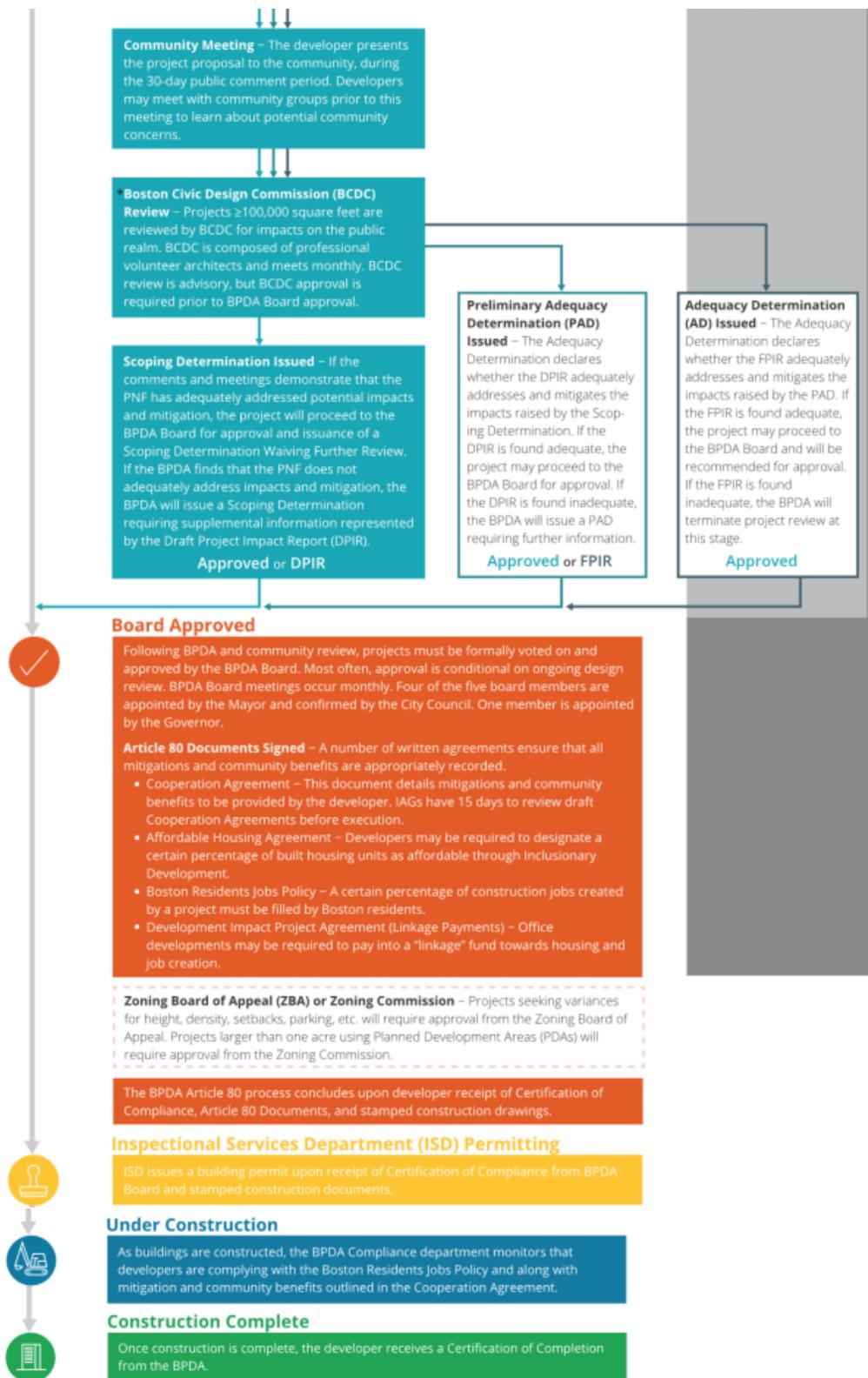


Exhibit C - Article 37 Sea Level Rise Survey & BPDA Flood Hazard Map

E - Sea Level Rise and Storms

Under any plausible greenhouse gas emissions scenario, sea levels in Boston will continue to rise throughout the century. This will increase the number of buildings in Boston susceptible to coastal flooding and the likely frequency of flooding for those already in the floodplain.

Is any portion of the site in a FEMA SFHA?

What Zone:

Current FEMA SFHA Zone Base Flood Elevation:

Is any portion of the site in a BPDA Sea Level Rise - Flood Hazard Area? Use the online [BPDA SLR-FHA Mapping Tool](#) to assess the susceptibility of the project site.

If you answered YES to either of the above questions, please complete the following questions. Otherwise you have completed the questionnaire; thank you!

E.1 - Sea Level Rise and Storms - Design Conditions

Proposed projects should identify immediate and future adaptation strategies for managing the flooding scenario represented on the BPDA Sea Level Rise - Flood Hazard Area (SLR-FHA) map, which depicts a modeled 1% annual chance coastal flood event with 40 inches of sea level rise (SLR). Use the online [BPDA SLR-FHA Mapping Tool](#) to identify the highest Sea Level Rise - Base Flood Elevation for the site. The Sea Level Rise - Design Flood Elevation is determined by adding either 24" of freeboard for critical facilities and infrastructure and any ground floor residential units OR 12" of freeboard for other buildings and uses.

Sea Level Rise - Base Flood Elevation:

Sea Level Rise - Design Flood Elevation:

Site Elevations at Building:

First Floor Elevation:

Accessible Route Elevation:

Describe site design strategies for adapting to sea level rise including building access during flood events, elevated site areas, hard and soft barriers, wave / velocity breaks, storm water systems, utility services, etc.:

Describe how the proposed Building Design Flood Elevation will be achieved including dry / wet flood proofing, critical systems protection, utility service protection, temporary flood barriers, waste and drain water back flow prevention, etc.:

Describe how occupants might shelter in place during a flooding event including any emergency power, water, and waste water provisions and the expected availability of any such measures:

Describe any strategies that would support rapid recovery after a weather event:

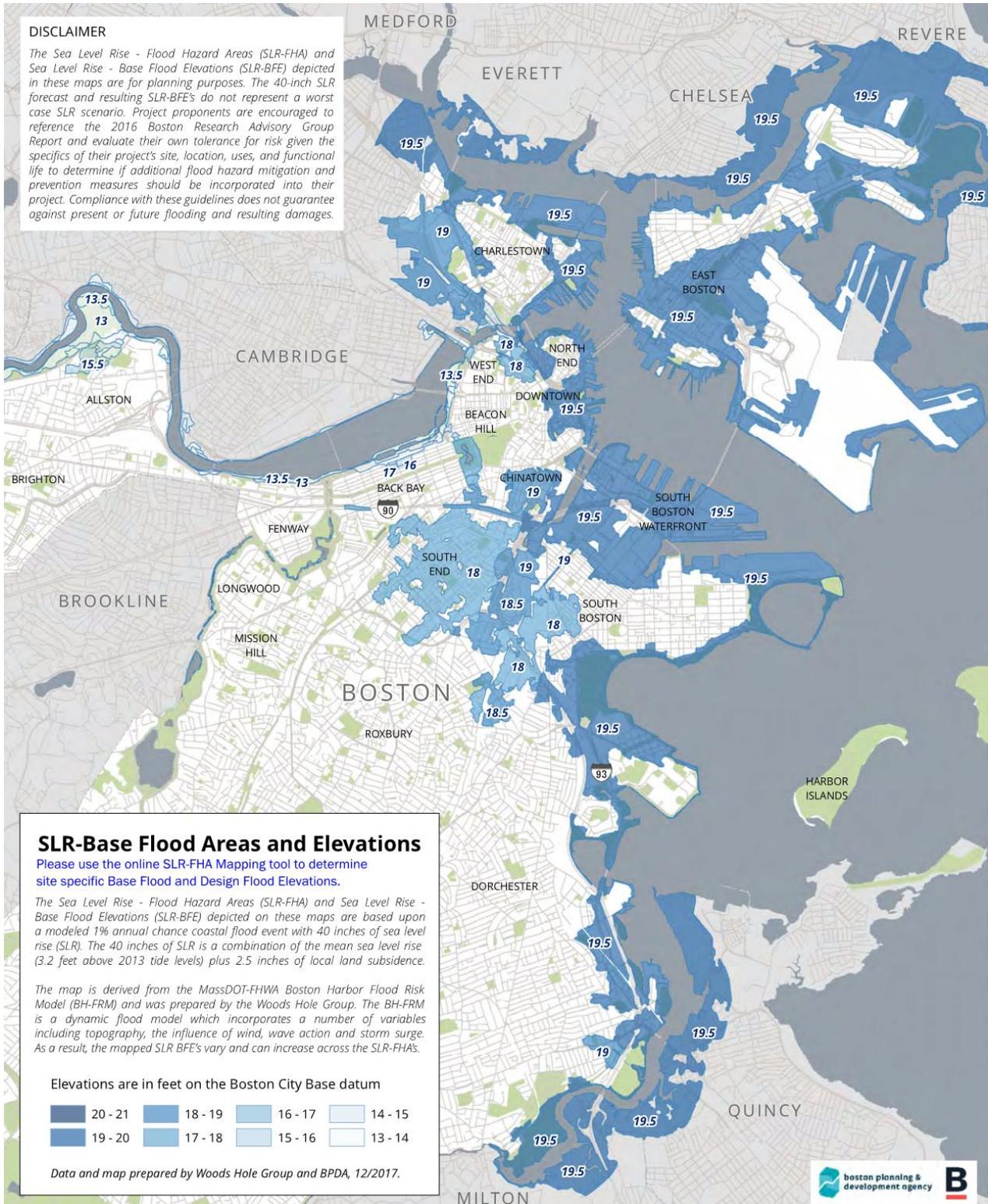
Describe future site design and or infrastructure adaptation strategies for responding to sea level rise including future elevating of site areas and access routes, barriers, wave / velocity breaks, storm water systems, utility services, etc.:

Describe future building adaptation strategies for raising the Sea Level Rise Design Flood Elevation and further protecting critical systems, including permanent and temporary measures:

A pdf and word version of the Climate Resiliency Checklist is provided for informational use and off-line preparation of a project submission. **NOTE: Project filings should be prepared and submitted using the online [Climate Resiliency Checklist](#).**

DISCLAIMER

The Sea Level Rise - Flood Hazard Areas (SLR-FHA) and Sea Level Rise - Base Flood Elevations (SLR-BFE) depicted in these maps are for planning purposes. The 40-inch SLR forecast and resulting SLR-BFE's do not represent a worst case SLR scenario. Project proponents are encouraged to reference the 2016 Boston Research Advisory Group Report and evaluate their own tolerance for risk given the specifics of their project's site, location, uses, and functional life to determine if additional flood hazard mitigation and prevention measures should be incorporated into their project. Compliance with these guidelines does not guarantee against present or future flooding and resulting damages.



SLR-Base Flood Areas and Elevations

Please use the [online SLR-FHA Mapping tool](#) to determine site specific Base Flood and Design Flood Elevations.

The Sea Level Rise - Flood Hazard Areas (SLR-FHA) and Sea Level Rise - Base Flood Elevations (SLR-BFE) depicted on these maps are based upon a modeled 1% annual chance coastal flood event with 40 inches of sea level rise (SLR). The 40 inches of SLR is a combination of the mean sea level rise (3.2 feet above 2013 tide levels) plus 2.5 inches of local land subsidence.

The map is derived from the MassDOT-FHWA Boston Harbor Flood Risk Model (BH-FRM) and was prepared by the Woods Hole Group. The BH-FRM is a dynamic flood model which incorporates a number of variables including topography, the influence of wind, wave action and storm surge. As a result, the mapped SLR BFE's vary and can increase across the SLR-FHAs.

Elevations are in feet on the Boston City Base datum

20 - 21	18 - 19	16 - 17	14 - 15
19 - 20	17 - 18	15 - 16	13 - 14

Data and map prepared by Woods Hole Group and BPDA, 12/2017.



Endnotes & Works Cited

- ¹ (Climate Ready Boston, n.d., p. 17)
- ² (AR5 Synthesis Report, n.d.)
- ³ Ibid.
- ⁴ The IPCC is planning to release its Sixth Assessment on Climate Change in 2022.
- ⁵ (AR5 Synthesis Report, n.d.)
- ⁶ (How Boston Made Itself Bigger, 2017)
- ⁷ Ibid.
- ⁸ (Climate Ready Boston, n.d.)
- ⁹ (Douglas et al., 2013)
- ¹⁰ (United Nations Framework Convention on Climate Change, n.d.)
- ¹¹ (*Article 37 Green Building Guidelines | Boston Planning & Development Agency*, n.d.)
- ¹² (Lubber, n.d., p. 11)
- ¹³ (Douglas et al., 2013)
- ¹⁴ Ibid.
- ¹⁵ (Conti, 2012)
- ¹⁶ (Boston Research Advisory Group, 2016)
- ¹⁷ (R. McGuinness, personal communication, October 2, 2020)
- ¹⁸ (Climate Ready Boston, n.d.)
- ¹⁹ Ibid.
- ²⁰ (Climate Ready Boston Map Explorer, n.d.)
- ²¹ (Climate Ready Boston, n.d.)
- ²² Ibid. 11
- ²³ Ibid. 17
- ²⁴ (*Governance-for-a-Changing-Climate-Full-Report-UMB-SSL-1.Pdf*, n.d.)
- ²⁵ (*Climate Ready Boston*, n.d.)
- ²⁶ Annualized values represent the potential total losses from a major event in any given year, based on each projected sea level rise condition, multiplied by its chance of occurring in that year
- ²⁷ (*Climate Ready Boston*, n.d., p. 17)
- ²⁸ (*Governance-for-a-Changing-Climate-Full-Report-UMB-SSL-1.Pdf*, n.d.)
- ²⁹ (*Governance-for-a-Changing-Climate-Full-Report-UMB-SSL-1.Pdf*, n.d., p. 24)
- ³⁰ Ibid. 19
- ³¹ Ibid. 20
- ³² (Foster et al., n.d.)
- ³³ Ibid.
- ³⁴ (BPDA, 2020)
- ³⁵ (*Governance-for-a-Changing-Climate-Full-Report-UMB-SSL-1.Pdf*, n.d., p. 73)
- ³⁶ (*Barr Foundation*, n.d.)
- ³⁷ (Boston Harbor Now, n.d.)
- ³⁸ (*Governance-for-a-Changing-Climate-Full-Report-UMB-SSL-1.Pdf*, n.d., p. 76)
- ³⁹ (*Home — A Better City*, n.d.)
- ⁴⁰ (*Conservation Law Foundation | For New England*, n.d.)
- ⁴¹ (*Governance-for-a-Changing-Climate-Full-Report-UMB-SSL-1.Pdf*, n.d., p. 80)
- ⁴² (*Boston Green Ribbon Commission*, n.d.)
- ⁴³ (*Massachusetts Office of Coastal Zone Management | Mass.Gov*, n.d.)
- ⁴⁴ (*Governance-for-a-Changing-Climate-Full-Report-UMB-SSL-1.Pdf*, n.d.)
- ⁴⁵ Ibid. 81
- ⁴⁶ (*ARTICLE 80 - DEVELOPMENT REVIEW AND APPROVAL | Redevelopment Authority | Boston, MA | Municode Library*, n.d.)
- ⁴⁷ (BPDA, 2014)
- ⁴⁸ (BPDA & City of Boston, 2014)

-
- ⁴⁹ Ibid.
- ⁵⁰ (*Mitigation & Impact Advisory Groups | Boston Planning & Development Agency*, n.d.)
- ⁵¹ (BPDA & City of Boston, 2014)
- ⁵² (BPDA & City of Boston, 2017)
- ⁵³ (*ARTICLE 25 - FLOOD HAZARD DISTRICTS | Redevelopment Authority | Boston, MA | Municode Library*, n.d.)
- ⁵⁴ (*Governance-for-a-Changing-Climate-Full-Report-UMB-SSL-1.Pdf*, n.d.)
- ⁵⁵ (*Chapter 91, The Massachusetts Public Waterfront Act | Mass.Gov*, n.d.)
- ⁵⁶ (*Boston Harborwalk - Boston Harbor Now*, n.d.)
- ⁵⁷ (*Chapter 91, The Massachusetts Public Waterfront Act | Mass.Gov*, n.d.)
- ⁵⁸ (*03-20-18-MASTER-Chapter-91-An-Advanced-Introduction.Pdf*, n.d.)
- ⁵⁹ (*Chapter 91, The Massachusetts Public Waterfront Act | Mass.Gov*, n.d.)
- ⁶⁰ (*301 CMR 11.00*, n.d.)
- ⁶¹ Ibid.
- ⁶² (*Environmental Notification Form (ENF) Preparation and Filing | Mass.Gov*, n.d.)
- ⁶³ (*Governance-for-a-Changing-Climate-Full-Report-UMB-SSL-1.Pdf*, n.d.)
- ⁶⁴ (*Chapter 91, The Massachusetts Public Waterfront Act | Mass.Gov*, n.d.)
- ⁶⁵ (*CLF-Peoples-Guide-Public-Waterfront-Act-Dec28.Pdf*, n.d.)
- ⁶⁶ (*Chapter 91, The Massachusetts Public Waterfront Act | Mass.Gov*, n.d.)
- ⁶⁷ (*Climatereadysouthboston_final_report_v11.1s_web.Pdf*, n.d.)
- ⁶⁸ (Massachusetts Department of Environmental Protection, 2014)
- ⁶⁹ (*Governance-for-a-Changing-Climate-Full-Report-UMB-SSL-1.Pdf*, n.d.)
- ⁷⁰ Ibid.
- ⁷¹ (Hockett, n.d.)
- ⁷² (*Home | FEMA.Gov*, n.d.)
- ⁷³ (J. Kerr, personal communication, December 11, 2020)
- ⁷⁴ (*CLF-Peoples-Guide-Public-Waterfront-Act-Dec28.Pdf*, n.d.)
- ⁷⁵ (McGuinness, 2020)
- ⁷⁶ (*Climatereadysouthboston_final_report_v11.1s_web.Pdf*, n.d.)
- ⁷⁷ Ibid.
- ⁷⁸ Ibid.
- ⁷⁹ Ibid.
- ⁸⁰ Ibid.
- ⁸¹ Ibid.
- ⁸² Ibid.
- ⁸³ Ibid.
- ⁸⁴ (*Climatereadysouthboston_final_report_v11.1s_web.Pdf*, n.d.)
- ⁸⁵ (Foster et al., n.d.)
- ⁸⁶ (McGuinness, 2020)
- ⁸⁷ (*Amended and Restated Development Plan for 5 and 15 Necco Street, South Boston, Massachusetts, 2020*)
- ⁸⁸ Ibid.
- ⁸⁹ Ibid.
- ⁹⁰ (National Development and Alexandria Real Estate Equities, 2020)
- ⁹¹ (National Development and Alexandria Real Estate Equities, 2020)
- ⁹² (ChannelSide Acquisitions, LLC, 2020)
- ⁹³ (ChannelSide Acquisitions LLC, 2020)
- ⁹⁴ (ChannelSide Acquisitions, LLC, 2020)
- ⁹⁵ (ChannelSide Acquisitions LLC, 2020)
- ⁹⁶ (HRP 776 Summer Street LLC, 2017)
- ⁹⁷ (HRP 776 Summer Street LLC, 2017)
- ⁹⁸ (HRP 776 Summer Street LLC, 2020)
- ⁹⁹ (*FEMA Flood Map Service Center | Search By Address*, n.d.)
- ¹⁰⁰ (*Coastal Flood Resilience Zoning Overlay Public Meeting | Boston Planning & Development Agency*, n.d.)
- ¹⁰¹ (*Flood Resiliency Building Guidelines & Zoning Overlay District | Boston Planning & Development Agency*, n.d.)

¹⁰² (*Flood Resiliency Building Guidelines & Zoning Overlay District* | Boston Planning & Development Agency, n.d.)

¹⁰³ (Foster et al., n.d.)

¹⁰⁴ (Foster et al., n.d.)

¹⁰⁵ (*Climate Ready Boston*, n.d.)

¹⁰⁶ (Foster et al., n.d.)

Works Cited

03-20-18-MASTER-Chapter-91-An-Advanced-Introduction.pdf. (n.d.). Retrieved December 2, 2020, from <https://ebcne.org/wp-content/uploads/2018/03/03-20-18-MASTER-Chapter-91-An-Advanced-Introduction.pdf>

301 CMR 11.00: MEPA Regulations | Mass.gov. (n.d.). Retrieved December 3, 2020, from <https://www.mass.gov/regulations/301-CMR-1100-mepa-regulations>

Amended and Restated Development Plan for 5 and 15 Necco Street, South Boston, Massachusetts. (2020).

AR5 Synthesis Report: Climate Change 2014 — IPCC. (n.d.). Retrieved October 26, 2020, from <https://www.ipcc.ch/report/ar5/syr/>

ARTICLE 25—FLOOD HAZARD DISTRICTS | Redevelopment Authority | Boston, MA | Municode Library. (n.d.). Retrieved December 1, 2020, from https://library.municode.com/ma/boston/codes/redevelopment_authority?nodeId=ART25FLHAD1

Article 37 Green Building Guidelines | Boston Planning & Development Agency. (n.d.). Retrieved October 7, 2020, from <http://www.bostonplans.org/planning/planning-initiatives/article-37-green-building-guidelines>

ARTICLE 80—DEVELOPMENT REVIEW AND APPROVAL | Redevelopment Authority | Boston, MA | Municode Library. (n.d.). Retrieved November 23, 2020, from https://library.municode.com/ma/boston/codes/redevelopment_authority?nodeId=ART80DEREAP

Barr Foundation. (n.d.). Barr Foundation. Retrieved November 22, 2020, from <https://www.barrfoundation.org/>

Boston Green Ribbon Commission. (n.d.). Boston Green Ribbon Commission. Retrieved November 23, 2020, from <https://www.greenribboncommission.org/>

Boston Harbor Now. (n.d.). Retrieved November 23, 2020, from <https://www.bostonharbornow.org/>

Boston Harborwalk—Boston Harbor Now. (n.d.). Retrieved December 3, 2020, from <https://www.bostonharbornow.org/what-we-do/explore/harborwalk/>

Boston Research Advisory Group. (2016, June 1). *Climate Ready Boston: Climate Change and Sea Level Rise Projections for Boston*. https://www.boston.gov/sites/default/files/document-file-12-2016/brag_report_-_final.pdf

BPDA. (2014). *Large Project Review (Infographic)*. <http://www.bostonplans.org/getattachment/1662c8d7-30bd-4704-96da-dc4bb3fc461c>

BPDA. (2020). *Boston Planning and Development Agency Annual Report 2018-2019*. <http://www.bostonplans.org/getattachment/4074ee8a-3433-49fe-b9e5-13e47293803d>

BPDA, & City of Boston. (2014). *A Citizen's Guide to Development Review under Article 80 of the Boston Zoning Code*. <http://www.bostonplans.org/getattachment/610ddaf1-a547-4eb9-bb22-4d0938f354f6>

BPDA, & City of Boston. (2017). *Climate Resiliency Guidance*.
<http://www.bostonplans.org/getattachment/5d668310-ffd1-4104-98fa-eef30424a9b3>

ChannelSide Acquisitions, LLC. (2020). *244-284 A Street Project Notification Form*.

ChannelSide Acquisitions LLC. (2020, August 26). *244-284 A Street Public Meeting 8/26/20*.

Chapter 91, The Massachusetts Public Waterfront Act | Mass.gov. (n.d.). Retrieved October 2, 2020, from <https://www.mass.gov/guides/chapter-91-the-massachusetts-public-waterfront-act>

CLF-Peoples-Guide-Public-Waterfront-Act-Dec28.pdf. (n.d.). Retrieved December 7, 2020, from <https://www.clf.org/wp-content/uploads/2018/12/CLF-Peoples-Guide-Public-Waterfront-Act-Dec28.pdf>

Climate Ready Boston. (n.d.). Retrieved October 5, 2020, from https://www.boston.gov/sites/default/files/embed/2/20161207_climate_ready_boston_digital2.pdf

Climate Ready Boston Map Explorer. (n.d.). Retrieved October 19, 2020, from <http://boston.maps.arcgis.com/apps/View/index.html?appid=7a599ab2ebad43d68adabc9a9e9bea0e6&extent=-71.1583,42.2897,-70.9309,42.4060>

Climatereadysouthboston_final_report_v11.1s_web.pdf. (n.d.). Retrieved September 10, 2020, from https://www.boston.gov/sites/default/files/embed/file/2018-10/climatereadysouthboston_final_report_v11.1s_web.pdf

Coastal Flood Resilience Zoning Overlay Public Meeting | Boston Planning & Development Agency. (n.d.). Retrieved December 15, 2020, from <http://www.bostonplans.org/news-calendar/calendar/2021/01/15/coastal-flood-resilience-zoning-overlay-public-mee>

Conservation Law Foundation | For New England. (n.d.). Conservation Law Foundation. Retrieved November 23, 2020, from <https://www.clf.org/>

Conti, M. (2012, October 29). *North End Waterfront Sees Flooding and Rising Sea Levels During Hurricane Sandy [Photos]*. NorthEndWaterfront.Com. <https://northendwaterfront.com/2012/10/north-end-waterfront-sees-flooding-and-rising-sea-levels-during-hurricane-sandy-photos/>

Douglas, E., Kirshen, P., Li, V., Watson, C., & Wormser, J. (2013). *Preparing for the Rising Tide*. The Boston Harbor Association.

Environmental Notification Form (ENF) Preparation and Filing | Mass.gov. (n.d.). Retrieved December 4, 2020, from <https://www.mass.gov/guides/environmental-notification-form-enf-preparation-and-filing>

FEMA Flood Map Service Center | Search By Address. (n.d.). Retrieved December 14, 2020, from <https://msc.fema.gov/portal/search?AddressQuery=776%20summer%20street%20boston#searchresultanchor>

Flood Resiliency Building Guidelines & Zoning Overlay District | Boston Planning & Development Agency. (n.d.). Retrieved December 15, 2020, from <http://www.bostonplans.org/planning/planning-initiatives/flood-resiliency-building-guidelines-zoning-over>

Foster, C. A., Johnson, T., & Cleveland, J. (n.d.). *EXPANDING BOSTON'S CAPACITY TO BUILD COASTAL RESILIENCE INFRASTRUCTURE LESSONS FROM THE SEAPORT DISTRICT*. 175.

Governance-for-a-Changing-Climate-Full-Report-UMB-SSL-1.pdf. (n.d.). Retrieved November 9, 2020, from <https://www.greenribboncommission.org/wp-content/uploads/2018/09/Governance-for-a-Changing-Climate-Full-Report-UMB-SSL-1.pdf>

Hockett, P. (n.d.). *Army Corps Section 404/Section 10*. 27.

Home | FEMA.gov. (n.d.). Retrieved December 17, 2020, from <https://www.fema.gov/>

Home—A Better City. (n.d.). Retrieved November 23, 2020, from <https://www.abettercity.org/>

How Boston Made Itself Bigger. (2017, June 13). National Geographic News. <https://www.nationalgeographic.com/news/2017/06/Boston-landfill-maps-history/>

HRP 776 Summer Street LLC. (2017). *L Street Station Redevelopment—Project Notification Form*.

HRP 776 Summer Street LLC. (2020, September 9). *776 Summer Street—Development Update*.

Kerr, J. (2020, December 11). *Flood Insurance Interview: Risk Management, Boston Properties* [Personal communication].

Lubber, M. (n.d.). *Climate Action Leadership Committee*. 24.

Massachusetts Department of Environmental Protection. (2014). *310 CMR: Wetlands Protection Act*. <https://www.mass.gov/doc/310-cmr-1000-the-wetlands-protection-act/download>

Massachusetts Office of Coastal Zone Management | Mass.gov. (n.d.). Retrieved November 23, 2020, from <https://www.mass.gov/orgs/massachusetts-office-of-coastal-zone-management>

McGuinness, R. (2020, March 4). *BPDA / MIT 100 Acres Studio Presentation*.

McGuinness, R. (2020, October 2). *Interview—Richard McGuinness—Boston Planning and Development Authority* [Personal communication].

Mitigation & Impact Advisory Groups | Boston Planning & Development Agency. (n.d.). Retrieved November 24, 2020, from <http://www.bostonplans.org/projects/development-review/mitigation-impact-advisory-groups>

National Development and Alexandria Real Estate Equities. (2020, September 2). *15 Necco Street Public Meeting 9/2/20*. <https://bpda.app.box.com/s/eytkn6qcoiusxoitu90rkek5sznkhqck>

United Nations Framework Convention on Climate Change. (n.d.). *Kyoto Protocol Reference Manual: On Accounting of Emissions and Assigned Amount*. Retrieved October 29, 2020, from https://unfccc.int/sites/default/files/08_unfccc_kp_ref_manual.pdf