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Financing Climate Resilient Infrastructure for Boston's Waterfront: Leveraging land value uplift to floodproof the Raymond L. Flynn Marine Industrial Park

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Executive Summary

The South Boston Waterfront teems with life both on weekdays and weekends, being home to a myriad of life science and biotech companies, corporate headquarters, consulting firms, and tech startups. It has been one of the fastest growing urban neighborhoods in Massachusetts, with over 10 million square feet of office, retail, residential, and lab space added just between 2010-2013. Juxtaposed with this rapid growth is the reality that the South Boston Waterfront is also one of the most vulnerable neighborhoods to coastal flooding. Multiple storm events have flooded the district's main streets and walkways in recent years.

At the far east end of the Waterfront district, the City of Boston owns, operates, and leases out 190 acres of industrial land, referred to as the Raymond L. Flynn Marine Industrial Park. Given the recent flood events and imminent threats posed by sea level rise, the City conducted a planning study in 2018 to understand what it would take to floodproof the Industrial Park. The City's preliminary assessment of the infrastructure cost was over \$200 million dollars. The City started to consider a broad range of financing options to pay for the improvement. Traditional sources of capital, such as grants and municipal bonds, were considered. However, amidst the strong economic and development climate that has been in place since the 2010s, the City realized that this demand for growth could be leveraged to partially finance the infrastructure project. The basic idea is that the City would allow office, laboratory, and hotel developers to build on the city-owned parcels in the Industrial Park, and in return, these developers would be responsible for partially paying the infrastructure cost.

This case study documents how Boston's Climate Resiliency Infrastructure Contribution Program came about and analyzes its key design innovations. Given the nascency of the Program, its outcomes are difficult to measure. Nevertheless, there are lessons to be learned from turning a novel financing idea into a concrete policy solution. Boston's experience suggests that cities can leverage public land and land use regulation power to develop a novel financing mechanism and how to design such a financing mechanism to get stakeholders on board.

About the Author

Minjee Kim is an Assistant Professor in the Urban Planning department at UCLA. Her research is situated at the intersection of real estate development and urban planning. She writes about land use regulation, large-scale real estate developments, exactions, negotiated developments, and urban public finance. Her works have appeared in high impact academic journals such as the *Journal of the American Planning Association*, *Journal of Planning Education and Research*, *Journal of Planning Literature*, and *Urban Studies*. She has been recognized both nationally and internationally as an emerging expert in US land use regulation and zoning and has been working closely with the Lincoln Institute of Land Policy to promote land-based public financing. She earned her PhD and Master's degrees from the Massachusetts Institute of Technology and has multiple years of experience working in local governments, including the cities of Boston and Cambridge.

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Financing Climate Resilient Infrastructure for Boston’s Waterfront: Leveraging land value uplift to floodproof the Raymond L. Flynn Marine Industrial Park

Introduction

The South Boston Waterfront, sitting directly across the Fort Point Channel from Boston’s central business district, was a dormant parking lot for central business district workers as recently as the 1990s. This was for several reasons. First, the area did not have great transportation access prior to the completion of the Big Dig project. The Big Dig placed an intersection of two interstates (90 and 93) in the heart of the Waterfront district, making it a strategic and convenient location for accessing both downtown Boston and the airport. Second, the area was not connected to transit prior to the completion of the Silver Line in 2004. Third, the Boston Harbor Cleanup project began in the 1980s and was completed in the early 2000s, which made the waterfront properties desirable for development. Only after these significant public investments took place did the area become desirable for uses beyond parking lots and industrial. The district now boasts the shiniest, largest, and most expensive new buildings in the city of Boston, with more to be delivered in the future.

Figure 1: South Boston Waterfront aerial photography



Image credit: BPDA

To take advantage of the pace and scale of growth that began to take hold in the South Boston Waterfront, the Boston Planning and Development Agency (BPDA) began to think creatively about how best to leverage the properties it owned in the Marine Industrial Park, a 191-acre former Army and Naval base granted to the City in the 1970s and 80s. It comprises the eastern-most end of the Waterfront district and serves as the prime location for Boston's maritime industries.

Nevertheless, looming in the back of this tremendous growth has been the undeniable fact that the South Boston Waterfront is one of the most vulnerable areas in the city to climate change and the accompanying risk of coastal flooding. The starkest alarm came about in January of 2018 when high tides caused by winter storm Grayson completely flooded the key streets of the district and the Harborwalk. Needless to say, one of the most pressing problems that the City needs to address if it wants to foster more growth is to floodproof the Waterfront by building climate resilient infrastructure.

In response to the urgent need to floodproof the Marine Industrial Park, the BPDA devised a new mechanism to finance the infrastructure costs. This case study documents how this mechanism came about and its key design features. Given its nascency, the efficacy of the mechanism cannot be evaluated at the time of writing this case study, but the policy design details that were sorted and ironed out in the development of the financing strategy is a story that holds broad implications for national and international communities faced with similar infrastructure financing gaps in response to climate change-induced risks.

Description of the Problem

South Boston, and its Waterfront district in particular, is a neighborhood that faces “the greatest or near greatest exposure and potential losses to coastal flooding across all sea level rise conditions and flood events” (City of Boston 2016, p.282). It sits on land largely created by landfill, a project that began in the early 1800s, making it naturally vulnerable to coastal flooding and sea level rise. Illustratively, the 2016 report noted that “South Boston is the most exposed neighborhood in Boston, with nearly 25 percent of its land area exposed under 9 inches of sea level rise, 50 percent under 21 inches, and 60 percent under 36 inches at the 1 percent annual chance [storm] event” (City of Boston 2016, p.286). Under the 36 inches of sea level rise scenario, expected in 2070 or later, between 10,000 to 20,000 people are expected to face displacement at the 1 percent annual chance storm event (City of Boston 2016, p.288), with close to \$80 million annualized lost economic output and 600 job losses anticipated due to flood damage to structure (City of Boston, 2016, p.294). The total expected annualized loss from flood damage under the same scenario totaled \$530 million (City of Boston 2016, p. 296).

In 2023, the Boston Globe, the oldest and largest daily newspaper in Boston, premiered a documentary titled *Inundation District* to bring attention to the risks and costs associated with climate change. The documentary uses South Boston Waterfront as a case in point. The title of the documentary is a twist on the “Innovation District,” a label that the City pursued to market the Waterfront. It was an initiative launched by former Mayor Menino (in office from 1993 to 2014), which he first announced during his inaugural address on January 4, 2010. He then

declared: “Together, we should develop these thousand acres (of the South Boston Waterfront District) into a hub for knowledge works and creative jobs.” Later that year, the mayor’s new initiative was officially named the Innovation District. The Globe’s new documentary questions the city’s decision to choose this flood-prone area as the hub for economic growth and expansion and discusses the implications of such a decision.

The development boom of the South Boston Waterfront has been in full swing since the recovery from the Great Recession, while threats posed by climate change continue to worsen. The area has been one of the fastest growing urban neighborhoods in Massachusetts, adding over 10 million square feet of office, retail, residential, and lab space just between 2010-2013 (City of Boston 2016, p.282). The district boasts a multitude of life science and biotech companies, corporate headquarters, consulting firms, and tech startups, which in turn support a large selection of well-curated and sought-after restaurants, retail businesses, and parks. The Waterfront’s population grew by 195%, and its housing units grew by 327% from 2010 to 2020, according to the U.S. Census. The district essentially has gone from a sparsely developed, barren area predominantly comprising surface parking and industrial properties to a new urban neighborhood teeming with life on both weekdays and weekends. The number of square footages approved and under review with the city indicates that the pace and scale of growth of the district will only continue to strengthen in the coming years.

Located at the far east end of the South Boston Waterfront district, the BPDA owns approximately 190 acres of industrial land referred to as the Raymond L. Flynn Marine Industrial Park. In 1977, the City of Boston created the Economic Development and Industrial Corporation of Boston (EDIC) to secure the ownership of a 167-acre South Boston Naval Annex from the U.S. Department of Defense and subsequently added 24 acres of a U.S. Army Base (City of Boston 2022, p.334). The primary reason that the City created the Park was to preserve urban industrial base and blue-collar jobs. EDIC was later merged with BPDA in 1993 and since then, the Park has remained under BPDA ownership. Today, the Park is still home to a strong industrial economy, including active ports that accommodate cruise and cargo ships, offer ship repair functions, and house a seafood processing and distribution cluster, small-scale manufacturing firms, and design wholesale.

Figure 2: Aerial photography of the Marine Industrial Park



Image credit: BPDA

Amidst the strong economic and development contexts of the 2010s and onwards, the idea of creating a new land-based financing strategy, dubbed the Climate Resiliency Infrastructure Contribution Program, germinated. The City of Boston took notice of the strong demand for real estate in the broader Waterfront District and decided to leverage this demand to finance an infrastructure project that would protect the properties in the Marine Industrial Park from future coastal flood events and sea level rise.

Possible Strategies and Solutions

As a follow up to the 2016 Climate Ready Boston study, the City of Boston developed a climate resilience plan for South Boston between 2017 and 2018 (City of Boston 2018). This planning effort was led by the City of Boston Environment Department and the BPDA, funded by a grant from the Barr Foundation with additional support from the City. The purpose of this study was to develop near- and long-term strategies for mitigating the coastal flooding risks for South Boston, propose conceptual design options for infrastructure improvement, and evaluate technical feasibilities and the regulatory context for implementing the proposed solutions. An extensive community engagement process took place during the planning process, with over 650 people participating through meetings, open houses, and other community events, one-on-one interviews, focus groups, and an online survey (City of Boston 2018, p.27). Residents, property

owners, office workers, community organizations, public officials, and other stakeholders were consulted and invited to participate in developing climate resilient solutions for each subdistrict.

The 2018 planning study divided South Boston into four subdistricts and developed climate resilient solutions for each subdistrict. The focus of this case study is on the Marine Industrial Park subdistrict and the financing strategy devised for it. For the Park, two conceptual design options were proposed. Option A contemplated flood protection infrastructure along the perimeter of the Park, expected to cost between \$197 to \$228 million (in 2018 dollars). Option B contemplated infrastructure along interior roadways to cut off the flood pathway, expected to cost between \$132 to \$193 million (City of Boston 2018, p.116). While slightly more affordable, Option B would require additional floodproofing at the building level as a first line of defense. Accordingly, the study recommended Option A as the preferred strategy.

Figure 3: Option A vs Option B shown in the coastal resilience solutions for South Boston

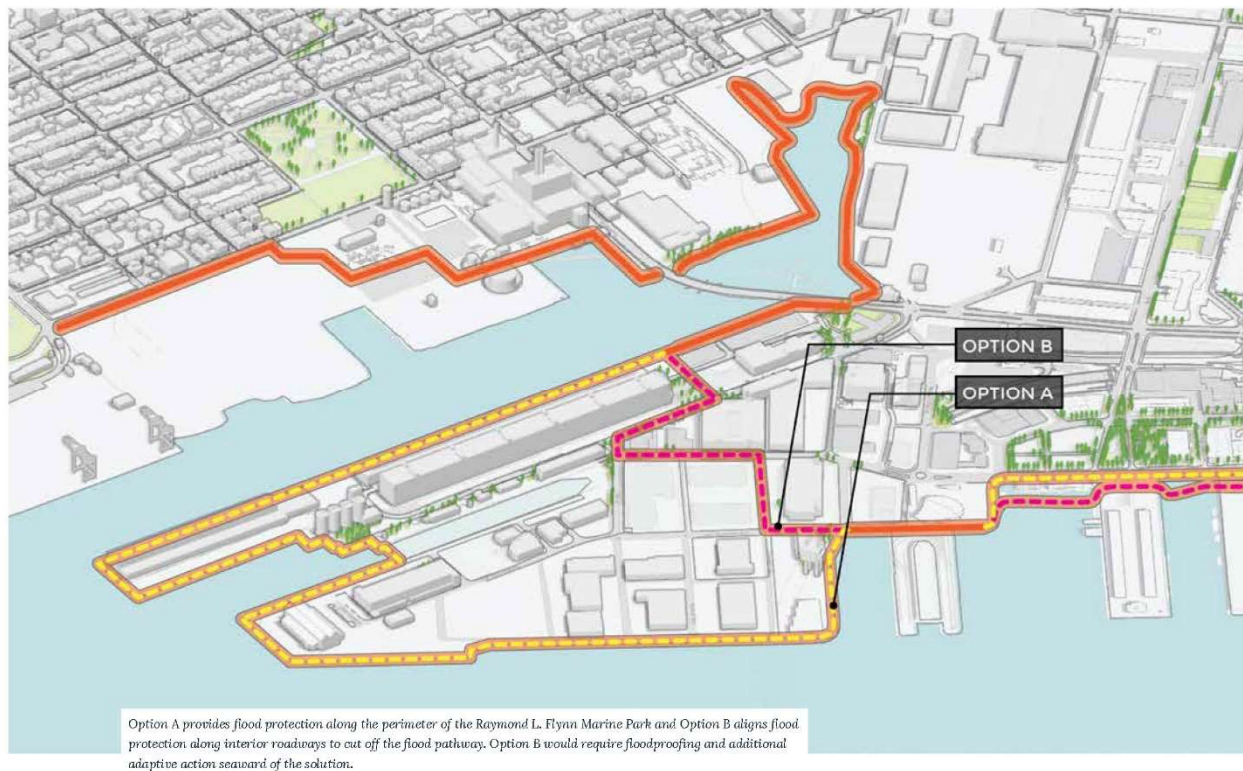


Image credit: City of Boston. (2018). *Coastal Resilience Solution for South Boston*: 131

With the expected infrastructure cost ranging from \$197 to \$228 in 2018 dollars, BPDA started to consider a broad range of financing options to pay for the improvement. The first obvious source of capital was the traditional grants from local, state, and federal governments. BPDA considered sources such as the City of Boston’s capital fund, MassWorks infrastructure program, and other relevant grant programs offered by the Federal Emergency Management Agency (FEMA), Federal Transit Administration (FTA), Federal Highway Administration (FHWA), Maritime Administration (MARAD), American Rescue Plan Act (ARPA), and United States Department of Transportation (USDOT) (City of Boston 2022, p.31). Traditional municipal bonds, both general obligation and revenue, were also considered.

Concurrent with the planning study for developing flood protection strategies, BPDA was also undertaking a comprehensive update to the Master Plan for the Marine Industrial Park, which was originally written in 1999. The purpose of this Master Plan Update was to harness the scale and pace of growth of the broader Waterfront district that began in the 2010s. BPDA wished to create opportunities to accommodate new office, lab, and industrial spaces in the Marine Industrial Park while preserving its commitment to maritime industrial activities. As part of this Master Plan Update, BPDA evaluated the development potential for every site in the Park and how adding additional development capacity would impact the environment and existing infrastructure capacity. As a result of this Master Plan Update, the Agency increased allowable Floor Area Ratio (FAR) for most of its parcels from 2.0 to 4.0 for non-maritime uses, while lower FARs were assigned for parcels used for maritime uses to keep redevelopment pressure at bay for these parcels. Approximately 4.3 million square feet of additional development capacity has been added (City of Boston, 2022, p.44).

Going through the multi-year exercise of envisioning how the City may increase allowable development capacities for its land and contemplate what benefits should be generated from this increased growth, BPDA realized that the potential to capture this land value uplift existed for financing climate resilient infrastructure. The basic idea was that BPDA, as a landowner, would negotiate each lease so that the long-term leaseholders would be asked to pay for the infrastructure improvement costs for floodproofing the district. The following section delves deeper into the policy design, regulatory framework, and implementation of the financing mechanism.

The Solution

The Climate Resiliency Infrastructure Contribution Program

Ultimately, the Agency arrived at the idea of creating a Climate Resiliency Infrastructure Contribution Program to help finance a district-wide floodproofing infrastructure project. The Program will comprise of contributions from the current and future long-term leaseholders, i.e., tenants, of the BPDA-owned land in the Marine Industrial Park. The BPDA is in an exceptionally strong position to ask for developer contributions for the infrastructure due to its unique landowner status. Real estate developers who want to develop properties in the Marine Park must negotiate and enter long-term ground leases with the BPDA. When such opportunities arise, BPDA can add stipulations about the developer's obligations as conditions for their use of publicly owned land. This is the leverage BPDA is using to ask for developer contributions for the infrastructure project.

The basic idea is that the owners of the buildings that will benefit from the infrastructure improvement should also pay for the cost. The district-wide floodproofing solution, as contemplated in the 2018 Coastal Resilience Solutions for South Boston, would prevent coastal floods from reaching individual buildings within the Park, significantly reducing the risks of structural and operational damages caused by flood events. The level of protective measures individual property owners must undertake is lowered as well, resulting in savings in construction and rehabilitation costs. These future cost savings are used as justifications for subjecting tenants to contribute to the cost of building climate resilient infrastructure.

The following is an excerpt from the actual negotiated term sheet between BPDA and a developer:

During the Term of the Lease, Tenant shall pay to Landlord its Pro Rata Share (as defined below) of the cost of Landlord's and/or City of Boston's capital investments in the RLFMP to mitigate the impacts of sea level rise and coastal flooding (each such investment being hereinafter referred to as a "Climate Resiliency Investment") for all RLFMP tenants and subtenants ("Climate Resiliency Payment"). Tenant shall have no obligation to pay a Climate Resiliency Payment for any Climate Resiliency Investments for any period prior to the Ground Lease Execution. For purposes of this amendment, Tenant's "Pro Rata Share" shall be a percentage equal to the ratio that the gross floor area of all building(s) constructed by Tenant on the Premises at the applicable time bears to the gross floor area of all buildings in the district where the investment is made, which at a minimum shall include the gross floor area of all buildings located in the RLFMP at the applicable time plus the gross floor area of the building(s) located at 88 Black Falcon and the gross floor area of the Black Falcon Cruise Terminal (collectively, the "Climate Resiliency Area"). Tenant's Pro Rata Share shall be recalculated from time to time as new buildings and improvements are constructed within the Climate Resiliency Area.

Land value creation, capture, and distribution

The Climate Resiliency Infrastructure Contribution Program is a land-based financing mechanism that leverages publicly owned land to capture value from for-profit real estate developments. Land value creation, in this context, originates from two different mechanisms. First, independent from the Climate Resiliency Infrastructure Contribution Program, significant land value uplift had already resulted from the broader economic growth of the South Boston Waterfront district. The development boom and population growth since 2010 rendered the Marine Industrial Park ripe and desirable for office and lab spaces. This has meant that the value of land owned by the Agency increased considerably. However, in order for this land value uplift to materialize, the BPDA had to be willing to release its land for the highest and best economic use. Without the City's authorization to use the land at a greater density and intensity of uses, the value uplift is locked with underutilized land and thus, does not materialize.

In other words, the BPDA, as the landowner, has held the key to "unlock" and capture the land value uplift of the land it owns in the Marine Industrial Park, and it has been employing a multitude of strategies to capture such value uplift. For example, BPDA has asked interested developers to offer competitive rent levels for leasing its land, sought non-monetary contributions from the developers, such as creating affordable housing or securing publicly accessible open space, and leveraged the land value uplift as a subsidy to offer below-market rents to support uses and users that may not be able to compete in the land market, such as the maritime industry tenants.

The Climate Resiliency Infrastructure Contribution Program adds another layer of land value capture mechanism to the suite of value capture tools already being employed by the City. This land-based financing strategy involves both creating additional land value and a capture

mechanism of the created value. Additional land value results from the anticipated future cost savings to the City and the property owners of the park in the form of reduced flood damages, which is captured in the form of contributions to fund the infrastructure. The funding mechanism is analogous to special assessment districts. Like special assessment districts, the direct beneficiaries of the land value captured through the Climate Resiliency Infrastructure Contribution Program will be those who are paying for the infrastructure improvement, namely, the property owners and long-term leaseholders, including the owners of the buildings in Marine Industrial Park, MassPort, and the City.

However, the beneficiaries of the infrastructure improvement will be broader than its direct payers. This is primarily because the flood protection measures contemplated as part of the improvement are intended to serve multiple functions, particularly for the enhancement of the public realm. For example, the proposed seawall that will surround the periphery of the Park is envisioned to serve as an elevated Harborwalk that would enhance the public realm. Towards the tip of the reserved channel, a salt marsh was proposed to serve as a soft, natural water's edge, along with a boardwalk. Residents of Boston are poised to benefit from these public realm enhancements for years to come.

Getting stakeholder buy-in

The interviewed BPDA staff remarked that developers were generally on board with the idea of creating a financing mechanism because they knew that floodproofing the district was a necessity at this point. Moreover, the BPDA and the City were able to convince the developers that collective action would be more economical and resilient in the long run compared to individual property owners undertaking extensive flood protection measures at the building level. The staff also noted that financial institutions are now unwilling to invest and lend money for development projects in flood prone areas unless there is a clear plan to protect the buildings from future flood events. This pressure from the financiers served as a motivation for developers to sign on to the Climate Resiliency Infrastructure Contribution Program.

Although the current and future developers and tenants of the Park were generally on board with the Program, the BPDA staff further pointed out that two unique features of the Program were instrumental in getting stakeholder buy-in. The most critical design feature, according to Devin Quirk, Deputy Chief for Development and Transformation, was that the Program is designed as a “reimbursement” mechanism. “This isn’t us collecting money in advance,” Quirk emphasized. “The idea is that... after we (i.e., the City, working through BPDA) have built the infrastructure and you are protected, you will pay us back your *pro rata* share (of the infrastructure cost).” In other words, the Climate Resiliency Infrastructure Contribution Program is not designed to collect money to pay for infrastructure cost upfront, but rather structured to reimburse the City for the costs incurred once the infrastructure is in place, providing guaranteed flood protection for the leaseholders before making any cash outlay.

Another “ticket to get people to say yes,” according to Quirk, was preventing the free rider problem. The BPDA staff wanted to provide assurance to the current and prospective tenants that they will not be the ones responsible for paying the lion’s share of the infrastructure cost simply because they are the first ones to sign the leases. Accordingly, the lease agreement was written in

a way that developer pledges to the Climate Resiliency Infrastructure Contribution Program don't become enforceable until BPDA secures commitments from tenants representing over 50% of the new development capacity. In other words, the first developer to agree to the Climate Resiliency Payment will not be responsible for making any payment until over half of those responsible for the Payment have agreed to do so. The following is an excerpt of a lease agreement:

To avoid unfairly penalizing Tenant and Tenant's Improvements when compared with other properties in the RLFMP, Landlord agrees to not require the Climate Resiliency Payment from Tenant unless, at the time of assessment, tenants occupying at least fifty percent (50%) of the gross floor area of the buildings located in the RLFMP and under Landlord control (i.e., 88 Black Falcon and the Black Falcon Cruise Terminal are not under Landlord control as of the Effective Date) have also committed to the Climate Resiliency Infrastructure Contribution program.

Finally, another element of the Resiliency Fund is that only the non-maritime tenants would be responsible for the infrastructure cost. When the Agency undertook the climate resilience study for South Boston, the participants of the community meetings, events, and surveys indicated that the continued and effective operation of the port, as well as the protection of existing jobs, should be paramount to the Park's flood protection strategy (City of Boston 2018, p.114). Accordingly, the Agency decided to either exempt the maritime tenants from the Resiliency Fund contribution or apply a reduced rate.

Calculating the pro rata share

To fairly distribute the cost of infrastructure, the BPDA decided that every tenant should be responsible for making a contribution that would be proportionate to the benefit they'll be receiving from flood protection. BPDA translated this principle into a formula that calculates the percentage, i.e., Pro Rata Ratio, of the square footage of the buildings owned by a tenant vis-à-vis the total developable square footage of the Marine Industrial Park. Each tenant's Pro Rata Ratio is multiplied by the total reimbursement amount to the City to determine a tenant's contribution.

$$\text{Pro Rata Ratio} = \frac{\text{Square footage of the building owned by the tenant}}{\text{Total non industrial square footage}}$$

$$\begin{aligned} \text{Developer's contribution amount} \\ = \text{Pro Rata Ratio} \times \text{Total investment made by the City} \end{aligned}$$

Although the formula has been determined, the exact dollar amount that each tenant will pay is still a moving target. This is due to a couple of reasons. First, the total cost of the district-wide floodproofing solution is still being estimated as of 2024. To understand the full-scale and current price tag of a district-wide solution, BPDA has allocated \$1 million to conduct a vulnerability analysis of the Park. Only when a more accurate and updated cost is known will the

City have a better idea about how much it will need to contribute to fill the financing gap. Next, both the denominator and numerator for calculating the Pro Rata Ratio are also not set in stone yet. “The denominator is set based on what we expect the full development potential to be, but it's at a point in time when we make the investments. That is when we'll know for sure,” noted Rebecca Hansen, Director of Real Estate at the BPDA.

Tenant's Pro Rata Share of the cost of each Climate Resiliency Investment shall be first assessed starting on the January 1st first occurring after Landlord or the City of Boston, as applicable, has commenced the construction of such Climate Resiliency Investment and the cost of such Climate Resiliency Investment shall be amortized over thirty (30) years at the interest rate available to Landlord and/or the City of Boston to finance such Climate Resiliency Investment. Notwithstanding the foregoing, the annual Climate Resiliency Payment owed by Tenant hereunder (after aggregating Tenant's Pro Rata Share of the cost of each Climate Resiliency Investment) shall in no event exceed \$XXX per year (the “Climate Resiliency Payment Cap”), provided that commencing on the first anniversary of the Effective Date of the First Amendment and each anniversary thereafter, such Climate Resiliency Payment Cap shall escalate annually at a rate of 3% per year.

Two other elements of the lease terms are noteworthy. First, the contributions are not envisioned to be a one-time, lumpsum payment, but contemplated to be paid over 30 years. Second, the lease agreements also impose a cap on each tenant's annual contribution, escalating at 3% per year. These measures further reduce the risk imposed on the tenants, rendering the financing strategy more palatable and acceptable to the interested developers and their financiers.

Figure 4: Picture of parcels O and P under construction



Image credit: Marcus Partners

Legal framework

Beginning around 2015, the BPDA began to capitalize on its Marine Industrial Park properties by ground leasing them to developers planning to build offices, labs, and other commercial spaces in the Park. Following the Massachusetts General Law Chapter 30B, the BPDA would issue a Request for Proposals (RFPs) for these long-term lease opportunities and select a winner from the proposals it receives. In the RFP, the Agency would specify an expected rent level, which would be based on the market-assessed value around the time of the RFP issuance. However, the Agency would indicate that it will consider below- or above-market rents depending on the specifics of the proposal. A typical duration of the ground lease has been 70 years during which the rent would escalate every five years (City of Boston 2019).

For any city-owned land, a typical ground lease between a developer and the City would specify a fixed rent and other conditions for the long-term use of public land. For the BPDA-owned land in the Marine Industrial Park, additional terms would apply to further the Park's mission, which is to support the maritime industry. For example, in the 24 Drydock RFP, the applicants were required to pay for a temporary relocation of the Boston Ship Repair company's office space and

to create a new 10,000-square-foot office space for the company at an affordable rent level. The RFP further specified that the BPDA reserves the right to negotiate any other terms of the lease and it is within this prerogative that the commitment to the Climate Resiliency Infrastructure Contribution Program has been imposed on the developers.

Results

At the point of writing this case study, in 2024, it is difficult to discuss the outcomes and impact of the Climate Resiliency Infrastructure Contribution Program. This is because, as pointed out earlier, monetary contributions from the developers will only be collected 1) once the City has disbursed money to fund the district-scale floodproofing infrastructure project and 2) when the developers of over 50% of the total developable floor area of the Park have committed to the Program. In other words, no money has been collected from developers at this point.

Moreover, the City is also in the process of assessing the feasibility and estimating the costs of the infrastructure project. Only when the City has a better understanding of the total scope and cost of the project would it be possible to line up possible funding sources and determine the funding gap that needs to be filled by the City. Since the Climate Resiliency Infrastructure Contribution Program has been designed to reimburse this City's contributions to the project, it has not been determined how much money the developers of the Marine Industrial Park will be collectively responsible for paying.

It is possible that the City could benefit from the Program earlier than the timing of the developer contributions. The City could potentially issue revenue bonds backed by the financial commitments from the developers to borrow money upfront and plug the funding gap. In interviews, BPDA staff brought up this idea, but no concrete action has been taken to explore the feasibility and marketability of a bond.

Analysis, Evaluation, and Lessons Learned

A unique institutional context to note for the development of the Climate Resiliency Infrastructure Contribution Program is that the City of Boston is the owner of the 190 acres of land, with a sizable portion leased out to MassDOT for its port operations. This public ownership of the land puts the City in an extremely advantageous position for capturing land value uplift that has resulted from economic growth. While other communities around the globe may not be able to benefit from such unified and large publicly owned prime real estate, the policy innovations found in the Climate Resiliency Infrastructure Contribution Program have broader implications for land-based financing schemes in other contexts.

The most important and clear lesson that can be learned from the story of Boston is the use of its land use regulatory power. BPDA increased the development capacity to allow for additional growth and capture the land value uplift as a condition for the right to develop. If the City had not increased the allowable development capacity as part of the Master Plan Update in 2018, the value uplift that resulted from the economic growth of the South Boston Waterfront would simply be locked in the land. The government's power over land use and how much development

to accommodate is the key to unlocking land value uplift when there is a strong demand for real estate. It is a leverage that governments can use to secure concessions from real estate developers, even when the land is not publicly owned.

In addition, several policy designs of the Program are noteworthy and can be adopted by other communities contemplating a new land-based financing tool. First, designing the Program to be a reimbursement mechanism as opposed to an upfront cash outlay was the key to getting developers on board with the policy. For many reasons, land value capture tools often face opposition from those who are asked to pay, with a primary concern being that the project that they are supposed to benefit from simply may not get delivered or not delivered in time. The reimbursement structure removes such uncertainty, making the idea more attractive to these stakeholders.

Another common opposition to any infrastructure investment borne by private individuals and companies is the free rider problem. Those who are asked to pay for the infrastructure cost understandably raise the issue that they are unfairly burdened with the cost, and others who are not currently at the negotiation table may come later and enjoy the benefit without having to pay. To address this issue, the BPDA structured the terms of the Program so that developer pledges don't become enforceable until there is a guaranteed commitment from developers of over 50% of the total development capacity within the Park. With such a guarantee, those who are asked to commit early on can be assured that future developers would also be responsible for funding the infrastructure improvement.

Calculating each tenant's share of the infrastructure cost based on the square footage of their buildings is also an element that could inform land-based financing strategies elsewhere. Current and future developers of the Marine Industrial Park will be asked to make a contribution that is proportionate to the size of their building. The underlying assumption of this approach is that developers are being asked to pay an amount that is commensurate to the benefit that they will enjoy. Ensuring a fair distribution of the costs and benefits is key to a successful land-based financing strategy.

Although the City has yet to pursue this possibility seriously, the Climate Resiliency Infrastructure Contribution Program can also open a novel pathway for issuing municipal bonds backed by developer contributions. Backed by 30-year pledges of the leaseholders, the City could issue a municipal revenue bond to borrow a lump sum of money upfront to fund the infrastructure. If such bonds are issued and if there is market acceptance, this will open uncharted territory for bond financing that taps into revenue sources beyond property taxes and special assessments.

Lastly, the story of Boston is a testament to the importance of staying creative, attentive, and detail-oriented for devising innovative land-based financing solutions. Boston's planners were extremely attentive to the specific needs, motivations, risks, and concerns of the stakeholders and developed a financing mechanism that is hyper-tailored to these contexts. Such an approach was key to successfully securing stakeholder buy-in. Other communities contemplating new land-based financing solutions should start by developing a thorough understanding of the specific context in which land-based financing will apply and the interests of the stakeholders. The jury is

still out on whether this financing mechanism will succeed financially, but the hope is that this early investigation of Boston's Climate Resiliency Infrastructure Contribution Program inspires other communities worldwide to start thinking creatively and innovatively about solving the financing gap for building climate resilient infrastructure.

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