The Boston Harbor Association
A Voice for the Harbor

To: Imagine Boston 2030 project team
CC: Julie Wormser, TBHA
From: WPI Climate Research Team
Date: October 6th, 2015
Re: Methods and recommendations to prioritize and manage coastal flood risks

Introduction

We are a team of engineering majors from Worcester Polytechnic Institute working with The Boston Harbor Association on a research project designed to identify, prioritize and reduce the risk of coastal flood damage along Boston's waterfront.

We used the results of the MassDOT hydrodynamic model to identify buildings at risk of coastal flooding in the Columbia Point neighborhood of Dorchester. We came up with a method of assessing and prioritizing risk based on both the likelihood of flooding and the severity of consequences if a property does flood. Finally, we interviewed experts from New York, New Orleans, The Netherlands and Germany to develop policy recommendations that could be incorporated into Imagine Boston 2030 to reduce Boston's risk of coastal flood damage. Our results are summarized below. We would be glad to provide you with greater detail.

Identifying and prioritizing community assets at risk of coastal flooding

Scientists from UMass Boston and the Woods Hole Group developed a hydrodynamic model of the likelihood of coastal flooding based on the interactions of predicted extreme weather events, sea level rise and tides. They developed projected flood risk maps (both depth and probability of flooding) for the years 2013, 2030, 2070, and 2100. Future maps included predictions of both higher and lower increases in sea level.

We used the 2030 maps that predicted higher increases in sea level for our research (see Figure 1). We conducted site visits to visually inspect properties and assets in the area identified in the MassDOT study as being at risk of flooding in 2030. We found that that multiple structures in the current and future flood zones are currently at risk of flood damage due to the location of windows, doorways, electrical equipment, gas tanks and ventilation systems below the height of projected flooding.

Figure 2 compares the likelihood of flooding in 2030 to a simple ranking of consequences of flooding for the assets we surveyed in the Columbia Point neighborhood. In this case, we based "consequences" on the relative number of people that would be affected by flood damage. An actual assessment would likely use a more sophisticated measure of consequence.

The National Flood Insurance Program (NFIP) does not currently differentiate the risk of flood damage based on either flood depths or the severity of consequences of flooding. All structures—from warehouses to schools, hospitals and nursing homes—are required to prepare for a current annual flood risk of 1% (the "100-year flood"). The MassDOT model data allow decision makers to prioritize vulnerable assets based on consequences, either to require higher preparedness standards for critical regional resources or vulnerable populations, or to prioritize structures for public investment.

Figure 2 shows how one can create a measure of “tolerable” versus “intolerable” risk and require assets within “intolerable” risk levels to prepare at higher levels. We believe that Boston can and should require assets with greater consequences (e.g., number of vulnerable people at risk, number of people using a public asset, residences vs. other building types) to be prepared for more extreme flooding than assets with lower consequences.

Because our measure of consequence is simple and subjective, the line in this graphic is for illustrative purposes only. Even in our simple example, however, two resources jump out as being at intolerable risk: the First Community Health Center and the JFK/UMass MBTA station. Both are at higher risk of flooding, and both are critical public resources. As mentioned before, this simple exercise can readily identify critical resources needing additional resources and/or stricter codes to decrease their—and Boston’s—risk of crippling flood damage

Figure 1: Satellite Overview of Case Study Area.

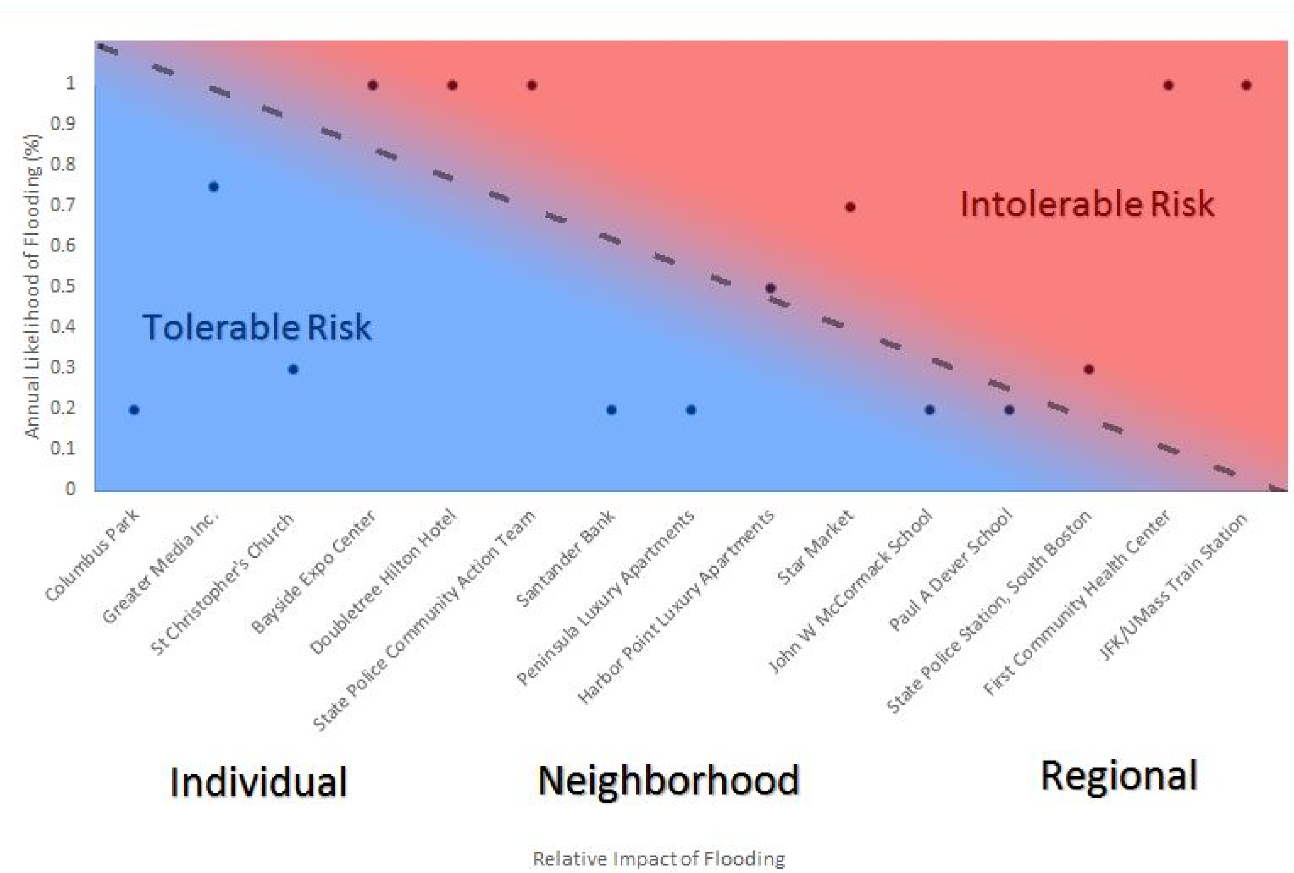

Figure 2: Likelihood versus Consequence of Coastal Flooding

Possible Policy Solutions to Reduce Vulnerability:

Our literature review and interviews led to a collection of insights from flood resilience around the world. We collected possible actions the government could take to create a resilient city. The results of our findings are summarized in the table below:

Category	Specific Example
Mandatory Actions	
Tie Insurance Premiums to Resilience	Increased premiums for buildings that do not submit plan for retrofitting building by X date
	If building owners do not comply with retrofitting, they cannot be insured or aided by government
	Decrease premiums and provide funding for buildings that develop plan for retrofitting that adheres to all new standards and can be complete within X years
Tie Property Taxes to Resilience	Create resilience funding pool/loan (“Green Bank”)
	Provide tax breaks for investments in resilience
	Taxes increase if building and property owners do not comply with implementing flood resilience strategies
	Interest free loans to protect homes
	Build a seawall along coastline in areas of high risk
	Protective dikes under Harbor Walk
	Ensure subway stations and routes are protected from water
	Fortify the Central Artery and Tunnel system
Tie Building Codes to Environmental Conditions	Require buildings to be resilient for entire lifespan of structure
	Require specific improvements (e.g. mechanicals, entry points) above flood zone
	Measure building relative to height of flood at end of lifespan,not absolute elevation; allow increased height of building/space for mechanicals to be safely stored
	Immediate requirement for new buildings, before 2030 for existing buildings
	Instill new department that ensures flood resilience safety standards are upheld annually similarly to fire inspections/codes
	Receive government benefits if buildings are retrofit to minimum resilience code
	Abandon first floor and convert to floodable space that is usable by the public
	Important utilities raised from basement or first floor level to a level above flood level
	Point of entry must be above floodable height (i.e. second floor)
	Important assets are not to be permitted to be built in flood zones (i.e. hospitals)

Voluntary Actions	
Tie Community to Resilient Redevelopment	Provide vulnerability checklist framework to community leaders to assess their own vulnerability
	Community leaders can submit findings along with their own recommendations for community to government to analyze and decide to fund
	Brochures to explain possible resilience strategies
	Inform residents of likelihood and consequences of flooding in their area (i.e. climate preparedness kits, programs, workshops)
Tie Community to Emergency Preparedness	Establish shelters for Emergency Flood Situations
	Develop action plan in place similar to emergency practices for blizzards

Conclusion

Coastal flooding will play an increasingly important role in the development of Boston's waterfront property. The recent 1000 year flooding event in South Carolina demonstrated that climate change may have wider reaching effects than previously thought (USA Today, 2015). It is important to recognize that policies and resilience strategies should be implemented as preventative measures before the floodwaters inundate properties and cause damage. New York was not prepared for Hurricane Sandy, resulting in a considerable amount of damage and a rush to take reactive measures that proved to be very costly. Considering how narrowly Boston avoided similar damages from Sandy, we propose the city implements preventative measures and resilience strategies.

Thank you for considering our input. We hope our research is helpful. It was a pleasure to work on this analysis.

Best Regards,

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