Unto the Breach – Self-Funding Models for Urban Levees: Exploring Alternative Financing Models for Modern Storm Surge Management The Interesting Case of Eastern Staten Island

"Once more unto the breach, dear friends, once more... the game's afoot"
-- William Shakespeare, Henry V

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Acknowledgements

The authors acknowledge the support of a number of individuals and groups that have sustained this project. The Staten Island Board of Realtors provided financial support. Their sense of community stewardship and vision for a safer, sustainable Staten Island after Sandy is commendable. We are grateful for the insights and information they provided as well.

A number of key research partners at The College of Staten Island shared their experience and knowledge with the authors and therefore enriched the work. Dr. William Fritz is the President of the College of Staten Island and has been an important civic leader in the Sandy recovery effort as the hardest hit community in the region finds its way forward. But this is not the only hat President Fritz wears; he is a geologist with a research interest in flood surge and urban sustainability. With his unique combination of skills, he has emerged as a leader on the state and regional level on questions related to sustainability and resilience. We profited from the perspective both roles provide. President Fritz's research with Drs. Kress and Benimoff developed a remarkably prescient model of the impact of storm of Sandy's size and scope the summer before Sandy arrived.

Vice President for Information Technology and Economic Development Michael Kress led this project and provide the research team with guidance, coordination and technical oversight. Under his visionary leadership over the last six years, The College of Staten Island has built a multidisciplinary public policy research team with the technical skills and analytical capacity to tackle a myriad of policy challenges of importance to the borough, city and region. This assemblage of expertise is a vital resource as the borough finds its way forward post-Sandy. Dr. Kress also shared with us his considerable knowledge of computation models, hydrodynamics, and storm surge analysis.

Geologist Alan Benimoff shared his research perspective and knowledge about housing development history in the South Shore neighborhoods, and findings regarding field measurement of flood impacts and general flood risks. For years, he has warned of the dangers of uncoordinated development on the borough's South Shore. Sandy Sanchez provided superb administration and operational support for the report and the public policy research team.

This work would not have been completed without the dedicated support of the research team at the CUNY Social Policy Simulation Center based at the CUNY High Performance Computing Center. The team is led by GIS Specialist Nora Santiago, whose expertise in demographic and geospatial analysis informed our model and the visual representation of research. The team under her direction for this project--Adam Davidson, Hyoung Shim, Katherine Brigandi, Afrona Kazua, Jennifer Freund, Elisa Csorba, Ariana Zuberovic and Shenuque Tissera--contributed in many ways though their research, field analysis and modeling efforts. Their commitment to the spirit of inquiry and applied research is a source of inspiration for their senior colleagues.

The CUNY High Performance Computing Center at The College of Staten Island provided computational support, technical infrastructure and data storage. We acknowledge the support of the CUNY High Performance Computing Center under NSF Grants No. CNS-0855217 and No. CNS-0958379.

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INTRODUCTION

On 22 October 2012 a tropical storm formed in the Caribbean Sea. Gaining power in the warm seas, the storm made landfall in Jamaica and Cuba as Hurricane Sandy. The hurricane slowly traveled up the Eastern seaboard. The storm, downgraded to a post-tropical cyclone, made landfall in the U.S. at the town of Brigantine, NJ in the early evening of 29 October.[1]

Sandy was the deadliest storm on the East Coast since Hurricane Agnes in 1992 and the deadliest storm event in the U.S. since Hurricane Katrina in 2005. The U.S. death count from Sandy totaled 117. Sandy related deaths in New York [City?] totaled 44; approximately 10,000 New Yorkers were injured in the storm.[2]

Costs related to Sandy totaled $50 billion in twenty-four states including $19 billion in costs in New York City based on Mayor Bloomberg's late November 2012 estimate.[3] Sandy destroyed over 800 buildings, delivered severe damage to 1,700, and moderate damage to 16,000 in New York City.[4]

Within New York City, one area stands out as having sustained some of the most intense damage and loss of life: the borough of Staten Island. Over half of the City's deaths – 23 – were sustained on Staten Island and Staten Island deaths represented 37% of the U.S. total. Most died from drowning, including 22 of the 23 Staten Island victims.[5] 16% of Staten Island's population and 16.1% of the borough's housing units fell within the water inundation zone.

Staten Island neighborhoods ranked among the hardest hit in the city. New York City government identified three Staten Island neighborhoods of the ten "most-impacted neighborhoods" by Sandy storm surges. The combined neighborhoods of Dongan Hills/New Dorp Beach/Midland Beach and Oakwood accounted for 12% of all damaged single-family homes in the city and 18% of homes that required entire reconstruction. Only Breezy Point on the Rockaway Peninsula in Queens suffered greater levels of devastation.

Other Staten Island neighborhoods on city's most impacted neighborhoods included South Beach / Old Town and Bay Terrace.[6] North and West Shore communities were also flooded, but the most damage and fatality fell on coastal neighborhoods south of the Verrazano Narrows Bridge below the major commercial corridor of Hyland Boulevard including South Beach, Midland Beach, New Dorp Beach and Oakwood Beach and Great Kills Harbor.[7]

Sadly, the possibility of such an event, and the vulnerability of Staten Island to it, was not unknown. And there is a strong possibility that severe weather events like this may unfortunately become much more common in the future. There is thus a need to explore the problems that occurred during the storm to understand development and planning alternatives that might have minimized deaths, property damage and economic impacts during this storm and potential future storms like it. 'Business as usual' in land use, development and infrastructure investment, is no longer an option.

To respond to the significant social impacts of Superstorm Sandy on New York City and the disproportionate level of deaths in the Borough of Staten Island, The College of Staten Island in partnership with the Staten Island Board of Realtors has issued this report to aid in the development of design standards, zoning changes, infrastructure investments and policy perspectives to help Staten Island rebuild in sustainable and safe ways.

This report is organized as follows:

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CHAPTER 1: PLANNING AND POLICY PRE-SANDY

1.1. Hurricane vulnerability of New York City: what did we know?

The vulnerability of New York City to a major hurricane event was hidden in plain sight. The threat was understood in intellectual terms. But the last major hurricanes to hit the Northeastern United States were in 1938 and 1955 (REF) and these fortunately bypassed the City, although they ravaged places like Long Island and Hartford, Connecticut. Complacency was an obvious factor in lack of active planning and preparedness when Sandy ultimately did hit.

Nonetheless, a lot was known if such information had been chosen to be paid attention to. A research team at the College of Staten Island modeled storm surge impact on the Staten Island coastline that closely matched what occurred when Superstorm Sandy hit.[8] They warned that dense, unprotected residential and commercial development on the low-lying areas on the coast would be devastated by a “left hook” storm moving up the East Coast and making landfall in New Jersey. Incremental development over decades had eliminated the marshlands and open spaces that could absorb the energy of the storm. By “hardscaping the sponge” with development (paving and building on water absorbing marshlands), geologist William Fritz noted that Staten Island became vulnerable to loss of life and property.[9]

The Storm Surge Research Group at Stony Brook University modeled storm surge impact in 2008. They wrote that their study “reemphasizes the vulnerability of NYC to storm surge flooding,” and urged policymakers to “begin exploring the feasibility of constructing European-style storm surge barriers across the major connections of New York Harbor to the ocean.”[10]

Experts clearly identified the problem of storm surge vulnerability with such clarity and authority that bureaucrats within the federal and municipal bureaucracy took note and integrated findings within their analysis and recommendations to policymakers. For example, Max Mayfield of the federal National Hurricane Center warned the U.S. Congress in 2005 that many cities on the East Coast, including New York, were vulnerable to storm surge.[11] The New York City Office of Emergency Management, formed by Mayor Rudy Giuliani in 1996 and established as an independent agency in 2001, had long recognized the danger of hurricane storm surge and developed various maps, shelters and evacuation plans. A long series of reports from the New York State Disaster Preparedness Commission and the State Legislature issued warnings that were largely ignored.

However, all this pre-Sandy work was not tightly integrated into the planning and operation process of other city agencies, and even on its own terms, was not up to the task of managing the magnitude of the Sandy incident. Offering something of an apology, Governor Andrew Cuomo said "We had never seen a storm like this. So it is very hard to anticipate something that you have never experienced."[12]

A key issue, of course, was money. There was no political will to spend dollars on the recommendations of the experts. “As your budget shrinks, the first thing that goes out the door is emergency management,” remarked Michael Balboni, a former state homeland security.”[13] This is said not necessarily to impugn policy and political decisions made at the time. After all, budgets are always limited while community wants and needs are unlimited. Priorities have to be set and choices have to be made. It does, however, point to the need to consider financing options earlier rather than later. This will be a point developed later on in this report.

It must be said that some individual agencies were more prepared for an event like Sandy. The Metropolitan Transit Authority of New York was thinking seriously about questions related to climate change and sustainability with the formation of a special agency commission in 2007, and had the foresight to halt bus and subway operations before Sandy made landfall, thus protecting rolling stock from water and wind damage.

However, while the NYC Department of Planning’s ambitious blueprint for residential and recreational development of the waterfront, *Vision 2020*, discussed “soft” approaches to coastal protection as part of a sustainability approach to manage climate change, the report made no mention of the “hard” engineering of the NYC coastline that might be required to defend the city against storms and rising seas. Indeed, residential development along the East River in Brooklyn and Queens in the last decade, devoid of either hard or soft defenses, has made New York City more vulnerable to storm surge.[14]

For observers of the policy process, the management of the problem of hurricane vulnerability is no surprise. Anthony Downs wrote a seminal article about the politics of the “issue attention cycle” in 1972.[15] A disaster is a focusing event that brings public attention to a sub-optimal condition that has long existed. Press coverage, and government and academic investigations about the matter, bring reform ideas to the attention of elected officials. However, as memories of the disaster fade, press and public attention moves elsewhere. As mentioned above, the region had not experienced a major hurricane in decades and this took place when there was much less settlement and activity in many storm-vulnerable areas .

1.2 Staten Island’s unique vulnerabilities: not-so-benign neglect?

Being the smallest borough (in terms of population) in a City where boroughs no longer have strong policy influence since the elimination of the Board of Estimate, the Downs “issue attention cycle” has been particularly acute. The East Shore of Staten Island stretching from Midland Beach to Great Kills had a long reputation for flooding during storm events. In 1992, a *Staten Island Advance* reporter stated flatly that “the dearth of effective flood-protection devices on the Island's East Shore is well-known” after a December 1992 nor'easter flooded the borough’s East Shore. [16] An *ad hoc* collection of berms and tidal gates were easily overwhelmed by the storm. The storm damaged 1,000 homes and caused $5 million in damage.[17] While the disaster focused attention on the danger of coastal flooding for a few years, little more was done

to fortify the shore other than replace the protections that had been wiped out by the winter 1992 nor'easter.

The federal Army Corp of Engineers had devised a plan in the 1970s to protect the entire east and south shore that called for the construction of berms, 100 feet wide and 15 feet high, and other flood control features at a cost estimated from $22 to $30 million.[18] But these plans were not at the top of the borough agenda. The city refused to meet the 10% local share contribution to the project, somewhere in the range of $2-3 million. The combined pressure of the fiscal crisis of the 1970s and objections to elements of the plan by local residents and environmentalists resulted in inaction. In the aftermath of the 1992 nor'easter, stakeholders and politicians squabbled about next steps. There was little coordination among the various government agencies responsible for functions or pieces along the shoreline. A city interagency taskforce examined questions related to recovery from the nor'easter while a state taskforce covered the matter of long-term coastal protection. The state task force was criticized by some Staten Islanders for being too focused on Long Island issues.[19]

Local residents in the hardest hit neighborhood in the 1992 storm from Oakwood Beach formed a community group – the Flood Victims Committee of the Oakwood Beach Civic Association -- that kept the pressure up to rebuild the berm that protected their neighborhood that had washed away in the storm. In the years after the storm, residents complained that the berm's protection was insufficient, and that the federal government's management of its property at Great Kills Park, a critical link in shore protection, was inadequate.[20] Provision of a better layer of protection for the shoreline stalled because of interagency and intergovernmental inertia.

In 1995, for example, the Clinton White House floated a plan that the federal government would not cover the cost of beach erosion or coastal protection projects that were fundamentally local in nature.[21] Congress scuttled this idea and the Congresswoman from Staten Island at the time, Susan Molinari, secured $300,000 in federal funds for planning coastal protections that year.[22] A cursory study by the Army Corps concluded that a robust system of coastal protection would cost $50 million.

But it was not until 1998 that the city and state agreed to contribute to a more comprehensive three-year study.[23] In 2001, the Army Corps was still very much in the planning stages, holding a public meeting about coastal protection plans at New Dorp High School. So few people showed up that the formal presentation was cancelled and experts from the Corps and city and state agencies informally answered questions. The Corps intended to deliver a full report with recommendations by 2004. The report was subsequently pushed back to 2006.[24]

However, the Bush White House stripped funding from the bill in 2006 and Congress did not fight to restore it despite the objections led by members who represented neighborhoods on the New York shore, including Congressmen Anthony Weiner (Queens) and Vito Fossella (Staten Island). Funding for the planning process was rebooted in 2010 with a stimulus spending

appropriation secured by Congressman Michael McMahon, with additional money added from the state and city government. Under this restart, a final report was to be issued in 2012.[25] The report was not finalized by the time Sandy struck.

Although a comprehensive vision for shore protection was certainly needed, the storm and flooding threat was handled incrementally with a neighborhood-centered approach. Better organized neighborhoods, and the most vulnerable neighborhoods, got better layers of protection. In the 1992 to 2013 period (between the nor'easter and Sandy) Midland Beach added basins to manage rainfall; the Army Corp accelerated plans for smaller projects such as earthworks at Crescent Beach to protect Great Kills and the partial restoration of berms. The plan to protect Midland Beach was left unfinished. There were steady improvements in sewage and tidal gate management. The city also expanded its holding of undeveloped land as part of the New Creek Bluebelt to guide storm water through creeks into the Raritan Bay. But the incremental work was insufficient to meet the requirements of sustainability in the face of generational storms like Sandy.

As to the politics of land use in this period, there was general awareness among civic and political leaders that development in flood-prone areas was dangerous. There were a number of pitched battles to stop or at least scale down the construction of high profile, bigger developments. Smaller development on parcels often slipped under the radar, and developers were often granted variances to facilitate construction. In addition, the tangle of federal and state law, and city code was difficult to interpret and enforce.

This pattern of neighborhood-centered storm defense was a risky proposition as it turned out. One lesson from Sandy seems to be that commitment to a full plan of coastal protection, accompanied by a single-purpose, mission-centered local institution to finance, maintain and enforce costal protection, is the best guarantee of safety of persons and property against the risk of future storms in an era of rising seas and climate change. As a recent update of policy analysis noted, "funding uncertainty" is a major risk for the success of the program of making Staten Island safe from future storms.[26]

CHAPTER 2: SANDY AND ITS IMMEDIATE AFTERMATH

2.1 After Sandy hits: New York City's immediate and short-term response

New York City after Sandy was a city in shock. But it was not a city in disarray. Almost immediately local authorities, planners, the business community and policy analysts were thinking about what had happened, the adequacy of emergency response, and implications for the future.

The New York City government's official account of the Sandy response, cataloged in its report to the federal government, noted that: "The City of New York's immediate preparation and response to Hurricane Sandy was one of the largest mobilizations of City services in the City's history."[27]

The foundation of that response was contained within the City's existing Costal Storm Plan. The plan noted that relatively slow moving storms and hurricanes give a good amount of warning, but are unpredictable as to impact. Mayor Bloomberg met with officials at the Office of Emergency Management (OEM) days before the storm hit, and OEM established operations centers to manage storm related logistics and health evacuation.

A general evacuation order was issued the morning of Sunday, October 28. The management of the emergency was structured by the varying planning efforts and institutional capacities of the city and state agencies involved. While the transit system took appropriate steps to protect its trains and buses, the Housing Authority (NYCHA) seemed particularly unprepared for the storm when it had no supply chain in place to quickly replace destroyed elements of its boiler systems.

State-regulated private utility companies also did not fare well in the restoration of power (800,000 lost power in the storm). The magnitude of the storm required massive emergency operation efforts, and particularly burdened communications systems. In the hours and days during and after the storm, the New York Police Department rescued 1,200 people and the Fire Department, 500.[28]

Once the immediate danger was past, the focus of City, State and national policy shifted to recovery focusing on two major programs, **Rapid Repair** and **Build It Back**. **Rapid Repair** was a city program initiated a few weeks after the storm that sought to make flooded homes habitable as quickly as possible. In a dense metropolitan area with high housing costs, New York has little inventory to spare to accommodate those displaced by the storm. Thus, a "shelter in place" program was adopted. New York City built on a template that the Federal Emergency Management Agency (FEMA) used in previous disasters. Teams of contractors focused on the restoration of power, heat and water in damaged homes and apartments. $500 million was expended in five months that brought aid to those living in over 11,500 homes and 20,000

housing units.[29] Under the oversight of the Department of Environmental Protection, Rapid Repair program aided 3,000 homes on Staten Island.[30]

The program was not without critics – repairs were often imperfect, were slow to be completed, and often used vendors who were not trained in residential repair and restoration techniques. Knowledgeable local contractors were often excluded from participating because they lacked city-required credentials. Despite some of these issues, FEMA will likely use Rapid Repair as a model for future emergency response efforts to improve its Sheltering and Temporary Essential Power (STEP) program of which Rapid Repair was the City's version. By an emergency appropriation of Congress, federal Community Development Block Grant funding covered the city outlay.

Build It Back is a city program initiated in recent months after a long period of delay from Congress regarding emergency appropriation of funding. $648 million has been allocated for Build It Back from the Department of Housing Development. Through the month of September 2013, 22,000 had registered for the program, including 5,000 Staten Islanders. The deadline was then extended to the end of October.

The long delay in aid has bred cynicism among victims of the storm, and fewer citizens than eligible registered for it (full registration is estimated to be 6,000 on Staten Island). Under the terms of the program, after registration, storm victims will be contacted by representatives from the Office of Housing Recovery with the possibility of further repair, including home elevation to meet flood standards, full reconstruction of homes to flood standards, or acquisition of homes for those that choose to move. Build It Back is conceived as a program of gap coverage intended to backstop public and private insurance dollars provided since the storm.[31]

2.2. Current longer-term response plans – a focus on Staten Island

Given the recency of the storm, longer-term plans and policies are still being formulated but some policy ideas have nonetheless emerged. On contingency plans for the next emergency, the City government's after-action report, chaired by two deputy mayors, provides early thinking based on a review of response to Sandy. Among the fifty recommendations in the report were better plans for health care facility evacuation; a public education campaign to highlight the difference between the 311 and 911 systems; a more comprehensive sheltering system; and development of an emergency plan of a duration of longer than three days.

Another element of current policy thinking for the longer-term is also contained implicitly within the final component of the State of New York government plan for residents in the most vulnerable and severely water inundated locations which is a state buyout program. In other words, The State has offered funding to remove storm vulnerability by removing people from storm-vulnerable areas through purchase of their homes at market value, allowing them to buy new homes in less vulnerable areas.

Staten Island is a particular focus of the State program as are other hard-hit communities in the Rockaways and Long Island. Homes in the Oakwood Beach and Fox Beach neighborhoods could sell their properties to the state government at pre-storm market value. The state will hold the properties as open space resources, "returning them to nature," in the words of New York State governor Andrew Cuomo, or building a new structure up to storm surge and flood standards and selling it on the open market. The precise details of this program are uncertain, but the number of properties falling in this category is anticipated to be very small because of the costs involved with acquisition (a range of 300 to 500 eligible homes on Staten Island). A recent policy change in mid-October calls for the state to pay for and manage the process of home acquisition. The city government will be responsible for repair and rebuilding of homes. This intergovernmental sorting makes sense, and harmonizes the slightly different policy objectives of political and bureaucratic leaders in Albany and City Hall.[32]

There is little question that Staten Island is a location that requires special attention and the State buyout plan is one option. Whether it is the best or only option is considered in more detail below.

An important step forward was Mayor Bloomberg's recognition of the threat of storm surge and his ambitious plan for coastal protection documented in the report "A Stronger, More Resilient New York." The section on Staten Island offers a solid foundation for coastal defense, and the allocation of $50 million as the city match for the levee on the East Shore is an important first step.[33] However, there are gaps in funding for the full slate of city projects. The full citywide package of improvements has an estimated cost of $20 billion. The Bloomberg administration identified $15 billion in funds from city, state and federal sources. There is a $5 billion gap and in the plan, and the financial estimate assumes that the federal government will deliver on funds promised.[34] In an era of political polarization in Washington that is an optimistic presumption. Many cities and metropolitan regions are adopting "go it alone" strategies since the federal government has become an uncertain and unreliable partner.[35]

CHAPTER 3: A SCAN OF THE EASTERN SHORE OF STATEN ISLAND AND ITS CURRENT STORM VULNERABILITY

3.1 Physical and natural vulnerabilities

Before discussing Staten Island policy options further, a review of the Island's current and probable future vulnerabilities is in order.

A community's vulnerability to storms is determined by a number of factors. These include:

- Probability of storm events in the area
- Offshore and onshore topography
- Oceanographic environment (e.g. tide intensity and schedule)
- Natural ecosystem characteristics (e.g. nature of flora and fauna)
- Human settlement patterns
- Built and constructed environment characteristics

The first four factors pertain to the natural environment. Along all these dimensions, Staten Island, and its Eastern Shore in particular, is highly vulnerable to storms and other similar extreme weather events like Sandy. The following figures demonstrate this.

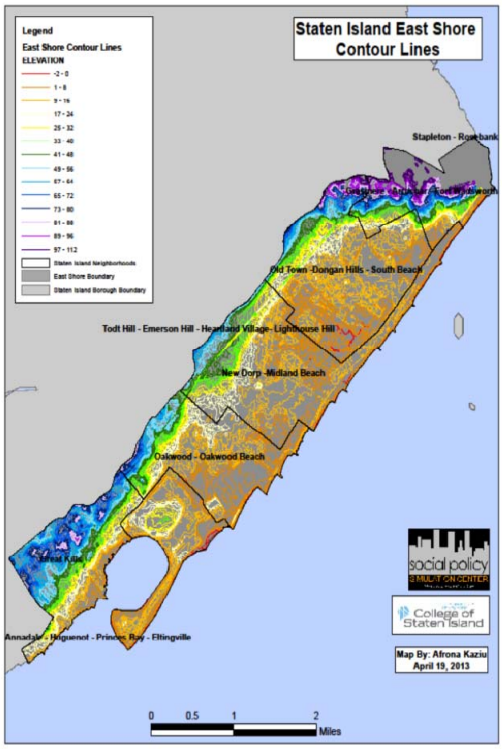

Staten Island East Shore
Contour Lines
Legend
East Shore Contour Lines
ELEVATION
-2 - 0
1 - 8
9 - 16
17 - 24
25 - 32
33 - 40
41 - 48
49 - 56
57 - 64
65 - 72
73 - 80
81 - 88
89 - 96
97 - 112
Staten Island Neighborhoods
East Shore Boundary
Staten Island Borough Boundary
Stapleton - Rosebank
Old Town -Dongan Hills - South Beach
Todt Hill - Emerson Hill - Heartland Village- Lighthouse Hill
New Dorp -Midland Beach
Oakwood - Oakwood Beach
Annadale - Huguenot - Prince's Bay - Eltingville
social policy
College of Staten Island
Map By: Afrona Kaziu
April 19, 2013
0
0.5
1
2
Miles

Figure 1

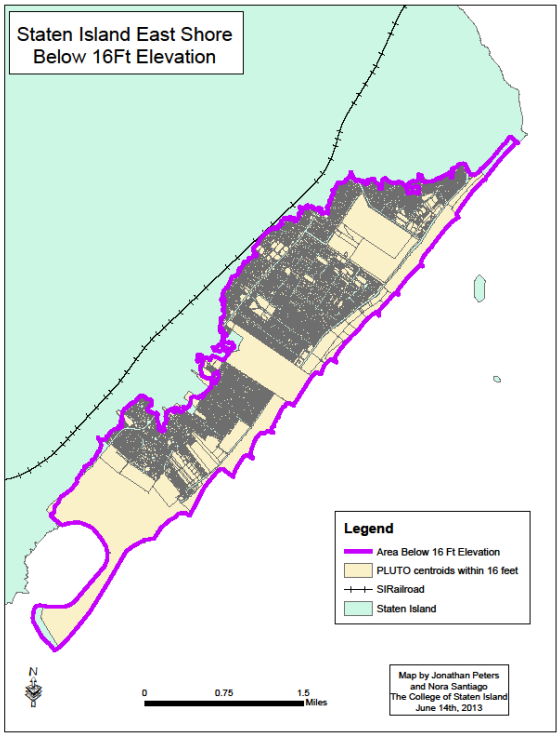


Figure 2

Figure 3 – Low Elevation Districts on Staten Island

Figures 1 and 2 show detailed elevations for the neighborhoods worst hit on Staten Island, those along the South and East Shores. Figure 2 in particular highlights the fact that most of this area is at or below 16 feet above sea level. Figure 3 outlines the areas of storm surge on the island. Hurricane Sandy brought an average surge of 14 feet. Simple arithmetic shows that most of the South Shore and East Shore were going to be under water for some period. Coastal storm surges are endemic to the area, of greater or lesser magnitude depending upon the timing of a particular storm and the tides. Hurricanes, of course, bring catastrophic surges. Additionally, coastal erosion, as with most beachfronts, is an ongoing issue for the Island.

Average exposure to flood surge is only part of the picture. The Island's onshore topography most exposed to this marine environment will flood to a much more widespread extent because any ocean surge is met in many areas with areas with little elevation, allowing for even a relatively small overtopping to travel over a large distance. This is the reason why Hylan Boulevard flooded, even though it is more than a half-mile away from frontline beach communities.

Moreover some areas had an unfortunate "bowl" topography of in which low oceanfront elevation was met by a sharp higher elevation further back which trapped water coming in over that elevation after the surge receded. Some of this is due to built structures, in particular Father Capodanno Boulevard in which some neighborhoods behind the Boulevard, with their ground now saturated by rain and tidewaters, sat in water at significant depths, for several days in some cases.

Much of the area also contains marshlands. This could be a good thing long-term for capturing surge and storm waters. However, during the storm itself Staten Island the marshes tended to flood more quickly, held water longer, and were sprinkled in relatively small strips throughout populated areas rather than being buffer zones between these areas and the sea.

3.2 Human and built environment vulnerabilities

The human and built environment exacerbates these natural hazards. The population of the East and South Shore currently totals approximately 70,000 residents. Between 2000 and 2010, the areas together saw population growth of 11 percent, and growth over the past fifty years has been extremely strong. Figure 4 shows a map of population densities across Staten Island and a few major transport corridors.

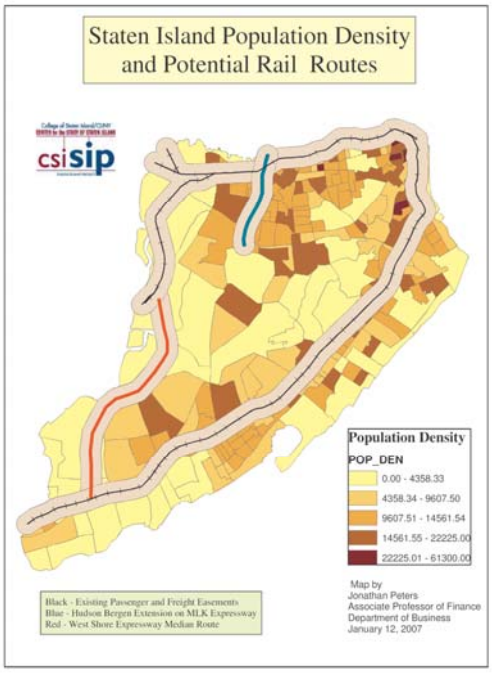


Figure 4

People on the South and East Shores originally lived in beach cottages, often without proper foundations, that gradually became winterized for year-round occupancy. Now, generally, housing in the area is freestanding, or detached, consisting predominantly of 1- and 2-family homes. These account for 90 percent of all area buildings; 59 percent of 1- and 2-family homes were built before 1983, and before current flood-protection standards.

It is bad enough that this environment is exposed to major flooding during storms, but worse that so much of the existing housing stock is incapable of withstanding it. In fact some equally bad storm surges occurred along parts of Staten Island's West Shore. Loss of life there, however, was much lower because that area is more industrial, less populated, and with comparatively less in the way of outmoded housing stock. (Figure 5 shows concentrations of housing damage). On the East and South shores a number of winterized bungalows in that were not properly anchored were washed off of their foundations during the storm. 61 percent of the buildings in the inundated areas there were pre-1983, and pre current flood code construction.

Critical infrastructure in the area does not look much better. The area's drainage infrastructure is designed to, not coastal surges and the system effectively failed during the storm. At times floodwaters overflowed catch basins into roadway drainage and sewer systems and several tide and floodgates were damaged during the storm. Of course a storm of Sandy's magnitude is

going to cause damage, but systems need to be robust enough so as not to fail as they largely did in this case.

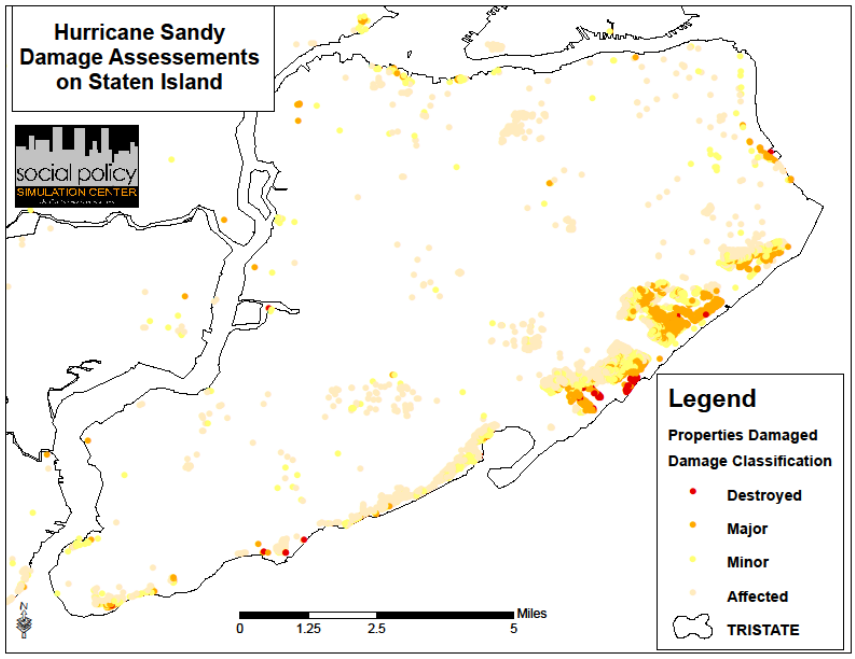


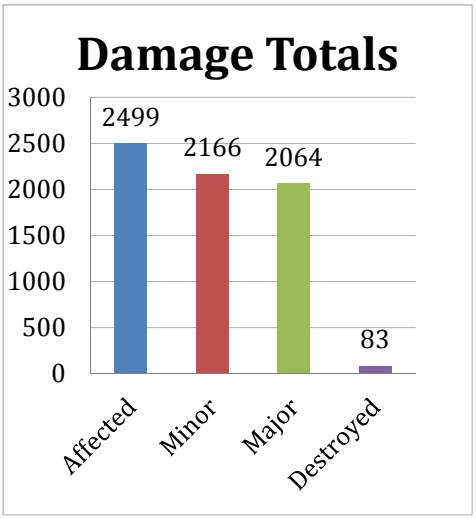
Figure 5

Roads and streets, principal means of egress, are stressed under normal conditions. In the event the narrow alleys and streets in many of the worst affected areas quickly became impassable and in some cases, especially behind Father Capodanno Boulevard, death traps. Many fleeing residents could not get out in time and rescue personnel had trouble getting in on a timely basis. Larger streets, such as Hylan Boulevard, were flooded and damaged. It did not help that Island's major hospital, SIUH, is in the area and served by these same roads. The Hospital transferred its most vulnerable patients offsite before the storm, sustained considerable damage during it, and had no power days afterwards. During those same days it had to be serviced by helicopter via its heliport.

Overall damage to structures alone was horrific. Figure 6 shows that close to 5000 homes were impacted, around half of which sustained major damage or were destroyed completely. Many of these neighborhoods and facilities have not yet completely recovered, even these many months after the storm. Most businesses in beachfront communities have yet to reopen and many houses are wiped away or uninhabitable. Some residents are understandably reticent to return at all. It is expected that the likelihood of storms such as Sandy is increasing and even without storm, sea level rise is a long-term threat to the area.

Clearly the policies and practices of the past are no longer adequate. But what should replace them? The next chapters turn to a discussion of some potential options.

Figure 6 – Staten Island Housing Damaged In Sandy by Damage Class



CHAPTER 4: A FRAMEWORK FOR POLICY OPTIONS FOR A STORM-RESILIENT STATEN ISLAND

4.1. The basic elements of storm resilience and risk mitigation

Before considering possible options for Staten Island, it is worth noting that there are other communities in the U.S. and around the world that are facing similar challenges. A lot of thought has been given to the basic 'moving pieces' of building storm and climate change resilience into the natural, human and built environments. The August 2013 report of the US Federal interagency Hurricane Sandy Rebuilding Task Force contains a basic outline of such pieces:

"**Sustainability:** … Sustainability involves providing for the long-term viability of the people and economy of the region and its natural ecosystems, which requires consideration of the risks posed by a changing climate, the practicality of maintaining a long-term presence in the most vulnerable areas, and the need to protect and restore the natural ecosystems.

Resilience: The ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions.

Risk Assessment and Risk Management: Risk assessment is evaluating and prioritizing known risks and their effects; risk management is making a decision and setting policy based on that knowledge.

Hazard Mitigation: An effort using non-structural measures to reduce loss of life and property by lessening the impact of a major storm.

Vulnerable Populations: Groups of people especially at risk to impacts of a major storm due to their location or because they are overburdened and lack resources or have less access to services."[36]

The key aspects of policies to prepare for the next storm on Staten Island would thus begin with a sound knowledge of the risks and the penalties for ignoring those risks (the 'Risk Assessment and Risk Management' category above). Policy responses thus could be simplified down to the following two broad types of strategies:

1. Remove vulnerable populations and activities from the hazard. The most severe impacts of Sandy on Staten Island arose from the fact that significant numbers of people lived and worked in coastal areas subject to storm surges and sea level rise. One possibility is to simply move residences, businesses and infrastructure further inland. This does not protect from all storm hazards, such as high winds, but it does limit exposure the major source of hurricane damage on Staten Island. This approach is most fully captured by the 'sustainability' and 'vulnerable populations' categories above.

2. Make populations, structures, and systems more able to withstand and recover from the hazard. A great deal of physical damage and loss of life on Staten Island occurred because physical structures such as housing, and infrastructure systems, such as roads, were not designed to withstand severe storm conditions and could not 'bounce back' to serviceable condition after the storm had passed. If the homes in the area had been raised above sea level and designed to higher standards much property damage and loss of life would have been avoided. A similar point could be made about road and street design, which in some cases created conditions that exacerbated flooding and made egress of people away from the storm area and ingress of emergency personnel into it more difficult than it needed to be. Changes such as these fit most closely into the 'resilience' and 'hazard mitigation' categories.

Interestingly, the mass transit infrastructure on Staten Island was well designed to avoid significant damage – as the MTA's reliance on bus services in the most vulnerable areas allowed the agency to remove their major assets and relocate them to higher ground during the evacuation. This is in sharp contrast to the MTA's subway tunnels and stations in the flood zone who sustained significant damage. Even worse was New Jersey Transit, who lost about 1/3 of their rolling stock due to a poor decision to park those assets in flood prone areas. Further consideration of the value and risks of various transportation technologies is warranted as we move forward with our disaster planning.

Of course there is overlap across these two broad strategies, and across the categories provided in the Hurricane Sandy Rebuilding task force, and none of these are mutually exclusive.

4.2. Policy alternatives for Staten Island

The question for stakeholders and policymakers is what steps are they willing to take to "break the cycle" and mitigate damage from future storm events? These decisions have to be made against the backdrop of risk management of "knowns" and "known unknowns". Staten Island's risk of being hit by a left hook hurricane in any given year is estimated at .7%. Over twenty years, the recurrence interval (the odds of being hit once in that time period) is 14% - and that represents a significant long term risk. The "unknown known" is how rising seas and climate change impact the yearly risk model estimates. This is difficult to predict. There is some consensus that warmer water in the Atlantic will create more frequent, violent storms. An optimistic prediction would be to assert that the recurrence interval is at the lower bound of risk.

With regards to physical capital in areas that are prone to flooding, one could consider the various options to remove or minimize the risk of flooding in the region. This report looks to examine the potential to develop various flood mitigation strategies to address the risk in the Eastern Shore of Staten Island.

A number of choices exist as to how to address these risks. In particular, public capital can be modified or moved to improve storm resiliency. Correspondingly, private capital could also be improved to reduce storm damage and/or relocated to alternative locations to avoid risk.

There is thus a range of policy options for defending Staten Island against the ravages of sea level rise and extreme weather events. These range from 'soft' measures focused on changing incentives to 'hard' engineering solutions. Although presented individually below, these options can be mixed and matched with one another. They also are scaleable. For example, storm surge barriers can be local and small or regional and large. The menu of options falls into the general categories and line items:

'Soft' approaches

1. Sustainable Building Plans and Codes
2. Alternative Land Uses
3. Zoning Initiatives
4. Active Reuse

'Hard' approaches

5. Barrier Protection
6. Infrastructure Relocation and Redundancy

These options are briefly detailed in the next chapter and considered in the context of the local social and economic development Impacts on Staten Island. The economic viability and the impact on Staten Island's economy that any new land use or other measures will potentially have are compared to a 'minimal change' approach. In particular there is a consideration of policy changes and their effect on local development and economic business models.

This analysis does not seek to do a 'zero-sum' calculation but instead explores the potential to redevelop the South, Midland and Oakwood Beach areas of Staten Island to achieve adequate storm surge protection and enhances and improves the local economy and social fabric. Given the various land uses that are currently in place, the authors seek to examine how a more consolidated plan of land use as well as coordination of land use and development with proposals that relate to storm surge protection such as barriers or levees.

4.3. Self-funding possibilities

A critical aspect of any policy option is money. Many of these options require expenditures of additional sums above 'normal' budgets, in some cases in substantial amounts. Yet money is something that is in short supply. Fiscal capacity is a dimension that must be considered explicitly in developing future storm preparedness and resilience. Otherwise paper plans will

end up being nothing more than paper tigers, of little use in defense against the next event. This seems to be precisely what happened prior to Sandy in which many plans were available but funding constraints kept them on the back burner, with tragic results.

The options below, especially with respect to the most expensive option of a levee, are discussed in terms of the current fiscal capacity on Staten Island (and the City more broadly), assuming that any option will in the first instance largely be 'self-funded', i.e. without a major infusion of cash from higher levels of government. In particular, constructing a levee along the shore of any area provides direct benefits to certain households and may or may not provide all levels of protection. This report proposes to explore the potential to develop a self-funding authority that can provide the levee with a high level of protection in an expedient way. This will be the planning assumption for all the options considered, though the most detail will be provided for the levee option. While it is always beneficial to receive outside infusions of capital, relying on them is a potentially dangerous planning assumption, an assumption this report will avoid.

Economic Impacts of Post Sandy Development

Regarding Economic Development, we can examine both the potential jobs impact of reducing the development levels of the Eastern Shore as well as the potential for job creation in a sustainable plan for the Eastern and North Shore.

As an option, one could consider the potential value of the flood mitigation on existing and future jobs in the region. Migrating the use of the vast bulk of property in the flood prone zones to public use or open space would have a major impact on local jobs. First, one would have to consider the appropriate use for the land as open space and then then potential for those uses to sustain various types of jobs. If we are migrating to an economy where a large section of the land is used for parks and recreation services, we must examine the potential for the recreational services job market to provide long term employment.

Alternatively, the redevelopment of the properties in question as well as the structural development of additional housing and commercial enterprise in this region would result in both temporary construction jobs as well as ongoing retail and service employment. In addition, the construction of the levee facilities and their operations would create additional construction and permanent operational jobs. The construction jobs, given the public nature of the project would be created as prevailing wage and likely union positions for the construction. Therefore, redevelopment and levee construction will result in a significant increase in local employment. These investments also will support the long term job base from the existing firms that should be retained in the local job markets.

On a net basis:

Preservation of Existing Land Use
1) Construction Jobs – Home Restoration
2) Construction Jobs – Commercial Restoration
3) Construction Jobs – Levee and Flood Control
4) Flood Control Operations - Ongoing
5) Retail Jobs – Ongoing
6) Manufacturing/Other - Ongoing

Abandonment to Open Space
1) Construction Jobs - Demolition Jobs
2) Recreational/Ecotourism Jobs - Ongoing

Providing for structural migration of land use to open space would require significant public capital outlays. Governor Andrew Cuomo has proposed a buyout of the most flood prone areas – but this represents roughly 300 houses in the most at risk areas. This program has a net cost in the range of 120-140 million dollars – using the promised Pre-Sandy price levels. A total buyout of all homeowners in the zone below 16 feet on the Eastern Shore of Staten Island would cost in the range of 8-11 billion dollars – or roughly 75 times the cost of the current program. The ability of New York State to shoulder this kind of costs in all at-risk regions is extremely uncertain.

Removing land from tax paying status and moving it into park usage will create a significant loss in tax revenue for New York City. With 11,932 properties in the Eastern Shore at risk, these properties produce roughly $49,187,568 per year in property tax revenue – based on current tax rates and with 47% of the parcels tax exempt. In addition, this region produces 12,000 in jobs with corresponding income and wage taxes generated as well. It seems unlikely that Staten Island's Eastern Shore will become a major center of eco-tourism or recreational employment. As such, we must consider the tax loss and job base loss when we explore these various options.

CHAPTER 5: 'SOFT' RESILIENCE OPTIONS FOR STATEN ISLAND

5.1. Sustainable Building Plans and Codes

Of course, an immediate and obvious policy presents itself on Staten Island (and region-wide). That is to consider the scale and location of housing in the flood zone and how might future building plans account for potential risks in this zone.

Development and implementation of such an option is already well underway. New York City itself has issued guidance on new building codes and zoning standards for both future development to better withstand and avoid storm damage and, perhaps more importantly, for making current 'non-complying' structures more capable of this as well.[37]

The definition of 'sustainable' is a key point here. New flood zone maps and revised flood insurance rates along with Federal Sandy aid payments flowing through to region households are leading to a boom in the simple practice of raising existing homes, damaged or otherwise, on stilts to be above future storm surges[38]. The figure below, taken from NYC zoning guidance for non-compliant homes, shows a schematic current transitional City policy governing this practice.

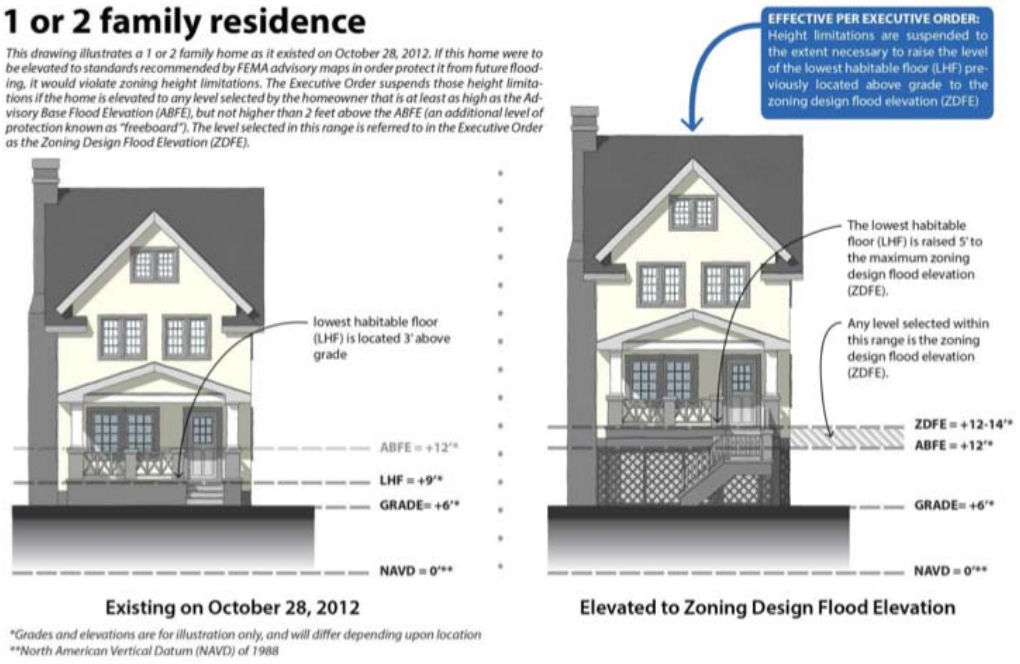


Figure 6

Simple as this strategy is, it is not cheap, costing as much as $100,000 or more depending upon the size of the house and the nature of the site the house is being lifted from and then being placed back down on (sites with soft soil or clay, for example, require extra hardening and

evening to for the new raised foundation and to avoid damage when the house is placed on that new foundation). And the height the house is to be raised is another consideration. 8 feet is one figure that is often offered as a benchmark, but this may not provide enough protection for storm surges of 14 feet or more (although it certainly will be more than adequate for sea-level rise).

There are also hazards other than storm surge that building codes need to consider. Increased precipitation, high winds (storm-related and other-wise) and higher temperatures and fire risk all must be taken into account. These are all affected by the interaction of the structure design with the risks inherent at its location that arise from both natural and built environments.

The distribution of these risks varies quite a lot across Staten Island. While the most attention has been paid to storm surge and flooding on the South and East shores, the North Shore of Staten Island also sustained substantial damage, much of it wind knocking down trees and damaging houses[39]. Flooding was also an issue; though its extent was less, the high business and residential densities interacted with vulnerable marine infrastructure to cause major disruption and destruction. Floodwaters reached beyond Bay Street in Clifton, Stapleton and Tompkinsville, and the John B. Caddell tanker ran aground in Stapleton, closing down Front Street. Piers were driven ashore blocking the Bay Street landing in St. George and many docks and landside facilities were destroyed along the Kill Van Kull. Floodwaters also crossed Richmond Terrace in parts of West Brighton, Port Richmond and Mariners Harbor [40]. There was also damage to both Staten Island Ferry terminals, though the greatest damage was sustained to the Lower Manhattan facility.

Changes in flood maps, to be followed by changes in flood insurance rates and applicability (to say nothing of changes in private insurance policies) are driving both local policy changes and market forces. As the figure below shows, Sandy storm surges went well past the 1983 designated flood zones all across the City. For both commercial and single and two household residential uses the major interim change has been to require raising of structures. For multistory structures, planned changes focus on hardening and sealing to withstand winds and flooding, and movement of critical building systems, such as water and heating/cooling, from basement or ground floor locations.

Zoning changes such as these will be privately financed in the sense that the costs will be borne by the property owner or developer through expenditure on compliance. The requirement to attain flood insurance and an increase in flood insurance rates will lead to changes in location decisions. If such changes are made without considering the broader economy the necessary protection against future storms may be achieved at the expense of optimal local economic development. For Staten Island it is clear that differences in housing stock, local natural conditions and economic patterns should perhaps dictate some allowances for differences in local zoning and other policies. However a baseline level of structural upgrade is arguably the right thing to do across the city. Changes above such a baseline are where variations should be considered. This will be discussed in section 5.3 below.

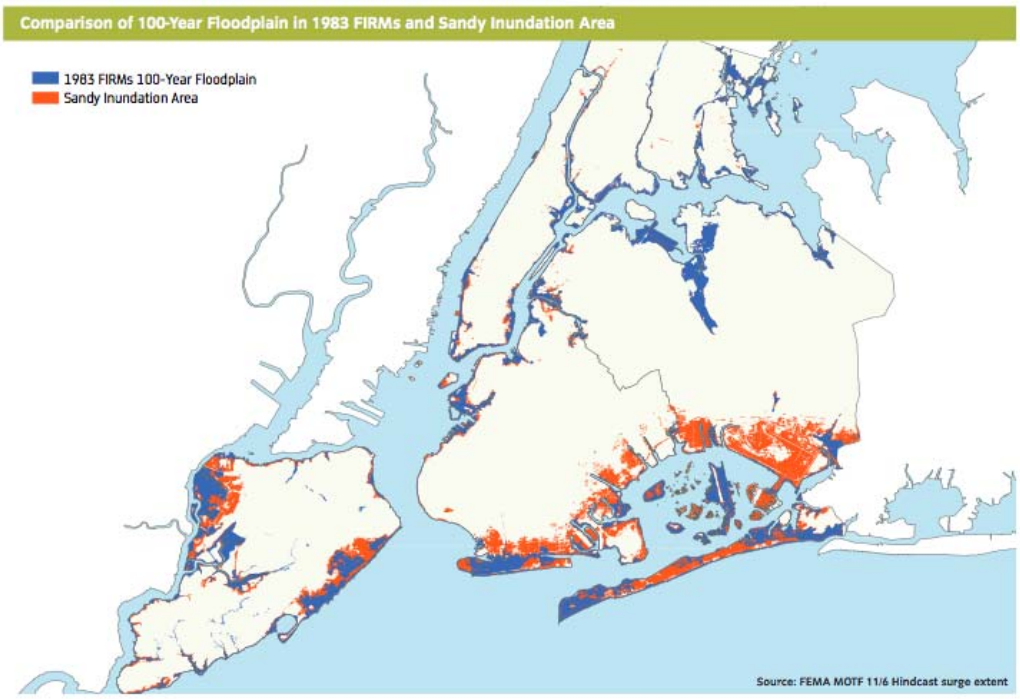


Figure 7 (source: page 69 – Towards a More Resilient New York)

5.2. Alternative Land Uses

The aftermath of Sandy has shown that past patterns of land use need to be changed on Staten Island. What areas of potential development might provide resources for building a more sustainable Staten Island?

On the East and South Shores there is a good argument that low-density residential development of any sort is not particularly sensible going forward, even if structures are raised and/or protected by a flood barrier (considered in more detail in Chapter 6). The West Shore, which currently has relatively little residential development but which experienced surges similar to that witnessed on the East and South Shores, should probably not be zoned for much residential development now. Changes to land use on the North Shore will probably not need to be as needed from a storm-resiliency point of view, although some intensification of existing land uses might be desirable to redistribute some activities across the Island (along with some modest rezoning to move activities out of relatively narrow flood prone areas). One thing is clear, as the figure below shows: low-rise structures were much more prone to hurricane damage than large ones.

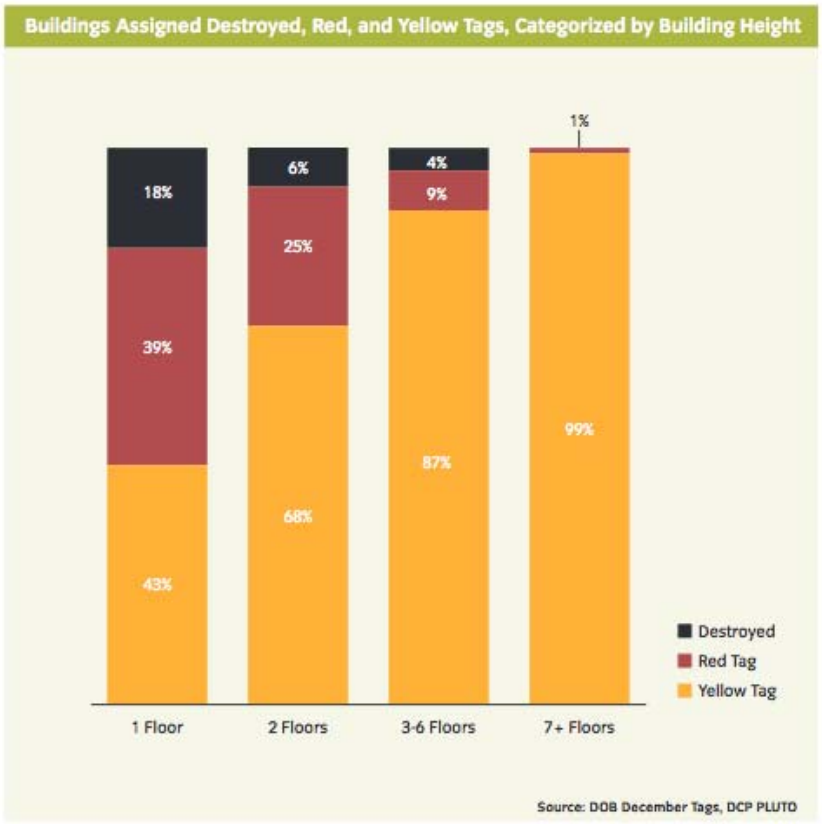


Figure 8 (source: Towards a More Resilient New York, p. 75)

What would such land use changes look like if it is to be both resilient and economically viable? A definitive answer to this is not possible without detailed research, but a preliminary idea is to pull back all residential development to at least 8 feet above sea level Island-wide and raise single-and two-family homes until a 16-foot elevation is reached. Multi-family residential dwellings, suitably reinforced and redesigned (e.g. with critical systems raised above surge levels and with requisite amounts of water absorbing land adjacent) would be the preferred development pattern because overall footprint could be reduced allowing for more empty land to flood without serious consequence. This implies a substantial redevelopment of the East and South Shores and maintaining of the West Shore as a primarily industrial-commercial zone with some substantial open spaces kept. It also implies that some funneling of both residential and commercial activity might be to the North Shore to capture future growth.

Densification and intensification in some areas (away or out of flood zones) combined with low- or no-density uses in hazard prone catchments may well yield better economic development and business outcomes depending upon how it is done and combined with other policies and investments. For example 'eco-tourism' and 'green business' may be possible future attractions

for Staten Island in newly 'wild' beachfronts, grasslands or marsh parks if that is the desired pattern, which can then be surrounded with medium-density residential complexes and business or commercial parks and malls.

It should be noted that 'densification' does not necessarily imply high-rise or apartment building structures. Modern urban design concepts in neighborhoods like those on much of Staten Island often have free-standing townhouses, with one or two residences, facing in on each other across parks and green plazas (which can serve as water- absorption capacity during storms) and perhaps their own small individual backyards or patios. Much current development in Staten Island is town-home based, but located on street-fronts and prone to sprawl and often with little privacy from adjoining units. Even without the effects of Sandy, such patterns were no longer viable given scarce supplies of developable land and stresses on urban infrastructure, especially transportation. Sandy has simply magnified the need for new development plans that can achieve householder outcomes comparable to, or better than, existing models while planning for and absorbing the social costs that future weather risks entail.

Modified zoning that allows greater density in certain corridors and district may be desirable to fund flood protection measures. The greater density creates greater market value that could be taxed to provide for flood protection maintenance and repairs or to provide additional funds to improve levee structures in preparation for future sea level rise. These zoning changes could be contingent based on based on payment for key infrastructure investments and/or could be given in exchange for a given asset improvement or investment.

5.3. Zoning Initiatives

Understandably, zoning currently is reacting to needs identified through the effects of Sandy. This section considers initiatives through zoning that can change land use in the ways that potentially lead to the most stable and productive use of land in these zones. There are, of course, other ways to achieve changes in land use and consumer behavior, including changes in public finance (e.g. flood and private insurance requirements and charges) and infrastructure investments (e.g. opening a light rail system). Some of these are considered in chapter 6.

How should zoning be changed to allow not just for reactive changes but also 'proactive' changes going forward? This, too, is a very complex and subtle question with no obvious immediate single answer. One idea is to perhaps allow for some 'pilot' zoning initiatives in small areas to allow for controlled and responsible experimentation with innovative development models. Another is to think carefully about commercial, industrial and residential zoning categories and how some of these might have changed post-Sandy. This is not just about redistribution of such land uses away from flood zones, but perhaps refinement of uses into subcategories that are more resilient to specific hazards within hazard-prone areas (e.g. recreational commercial activities such as campgrounds that can be easily evacuated and that

will sustain little damage from storms as opposed to active recreational facilities such as sports parks).

Or perhaps having different allowances for types of activities depending upon their hazard vulnerability is another route. In a sense this has already been done with new codes that strengthen and raise structures, but one could perhaps also allow for certain activities only if they have minimal structural aspects, such as allowing only seasonal commercial enterprise that use tents or other temporary movable structures if they are to locate and operate in a place prone to storm surges or sea level rise. The basic message is to encourage flexibility and creativity within a risk minimization framework.

5.4. Active Reuse

The leads to a final point which relates to areas of potential development that may be located within the flood zone and how might these areas be safely developed and provide resources for further improvements in the community?

Some of these issues have already been touched upon above. A key aspect of active reuse is to design for quick and minimum cost demobilization and remobilization. This can be done through locating activities in very 'hard' structures, and this may be necessary in some cases, especially where a long-standing activity may be difficult and costly to relocate and which relies on substantially engineered infrastructure (e.g. a hospital).

But this is costly. An alternative is to pick reuses where service levels can be quickly adjusted or to redesign existing uses to achieve this capacity. The East and South Shores, for example, have a great deal of recreational businesses in the form of beach and marina activities. Integrating natural features to absorb wind and water shocks (in the form of more reed and marshlands, for example) with the active use is one obvious and widely employed resiliency measure; so is downsizing and down-designing structures where allowable; and emergency structures can be added. So the Great Kills Marina could be altered to allow for more natural absorptive capacity in the form of more green spaces (not necessarily with more trees, however, which can cause damage during high winds); to shift to more moveable marine structures such as pontoon docks; and to have ramps and emergency storage facilities in place so that boats can be moved to safety prior to a storm.

CHAPTER 6: 'HARD' RESILIENCE OPTIONS FOR STATEN ISLAND

6.1. Barrier Protection

The impact of Superstorm Sandy on the New York City region has had a multiple of effects on our region that warrant serious examination. In particular, one must consider the recovery and the appropriate flood mitigation strategies that need to be applied in various locations around the region to address these significant risks. With the highest fatality rate of any county in the region – 23 known deaths, the need to address the risk on Staten Island is particularly great. The authors consider here the potential to self-fund a set of levee structures to provide for enhanced flood protection in certain vulnerable areas.

With regards to physical capital in areas that are prone to flooding, one could consider the various options to remove or minimize the risk of flooding in our region. These include structured retreat, hardening of assets, elevation of assets and storm barrier protection. This report looks to examine the potential to develop and finance various flood mitigation strategies to address the risk in the Eastern Shore of Staten Island.

A number of choices exist as to how to address these risks. In particular, public capital can be modified or moved to improve storm resiliency. Correspondingly, private capital could also be improved to reduce storm damage and/or relocated to alternative locations to avoid risk.
One key aspect is the impact of a fixed, hard structure such as a levee on flood risk. The Federal Emergency Management Agency (FEMA) is charged with managing risks and assisting state and local government in disaster recovery. As such, FEMA has established protocols for evaluating the value and benefits of various flood control measures. FEMA will accredit a levee that meets certain minimum Federal standards and this will reduce the risk of flooding in a particular area.

Our project plan would utilize this concept of flood map revision and proposes to construct an approximately six mile levee stretching from Fort Wadsworth in Arrochar to Buffalo Street in Bay Terrace. The addition of appropriate storm water management interceptor sewers and pumping stations would be included in the project to manage any rainfall or water intrusion. Beach replenishment and stabilization would also be considered and managed through the project financing.

Additional areas of concern such as the North, South and West Shore of Staten Island can be considered and evaluate on an area by area basis. Their mitigation strategies are to some degree linked to the proposals that may address broader infrastructure plans for the New York Harbor Region. The Eastern Shore project is needed irrespective of the future plans for the Upper Bay area.

Figures10 & 11 provide an overview of the existing topography as well as the area of consideration for our plan of action. Figure 10 provides the location of the levee (blue boundary)

and the inner boundary (16 Foot Contour in purple) which establishes the area of protection and taxation for this project. Figure 11 provides the topography of the region – where one can clearly see the extensive low lying areas that are subject to storm surge damage.

Figure 9

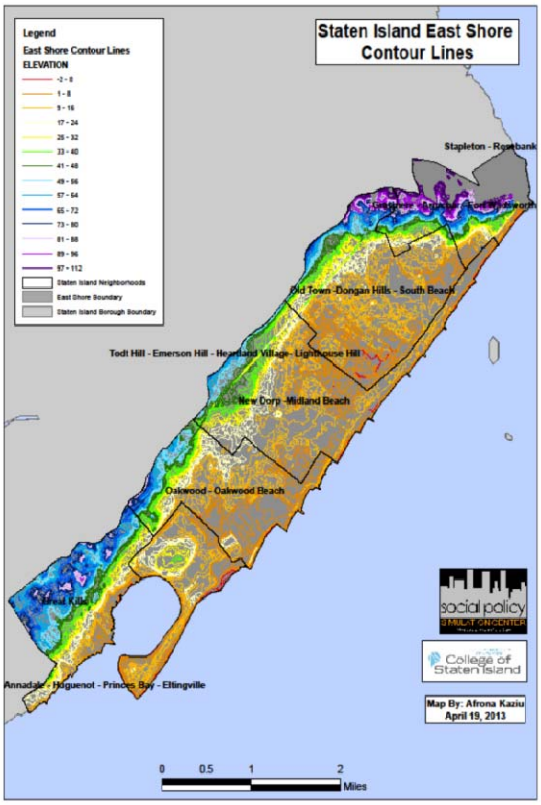


Figure 10

We suggest that the project could be funded using Tax Increment Financing (TIF) or Payment in Lieu of Taxes (PILOT). These funds would be allocated to a special agency created by state charter that would develop and managed the levee and other structures. The Staten Island Water Board (to use a potential name) would have taxing authority in the areas of the region protected by the levee (areas inside the levee perimeter that are less than 16 feet above sea level).
The SI Water Board would solicit federal and state funds that may be available for project development to contribute to construction and operational costs. They would also consider and encourage the use of low and favorable financing terms from other government entities or outside groups. These funds would be pooled with bond proceeds from a bond issue based upon the future tax collections from the region and these funds would be applied to construct the levee structures and any needed flood management infrastructure in the project area. Bonding would

be utilized to accelerate project completion and the agency may wish to establish an appropriate sinking fund for future levee capital projects.

Project Design Elements:

The project proposed would construct a levee that will provide a high degree of protection for the eastern shore of Staten Island. The engineering and operational aspects of this project would be established during the project planning process. Reference to appropriate agency documents and standards would be applied during the project development phase.

Key Project Elements include:

1) Utilize the Existing Boardwalk Right of Way and Public Parklands for Levee site
2) Use Earthen Levee technology with appropriate stabilization and scour protection
3) Levee at 1% Event Elevation - About 18 Feet above Sea Level
4) Final levee will meet Accredited Levee standards as set by FEMA
5) The Levee would be at about + 10 Feet above Ground Level in Most Areas
6) Minimal Land Acquisition Costs
7) Appropriate Flood Gates & Pumps for Storm Water Management
8) Appropriate management and maintenance of existing local water courses (Bluebelt)
9) Beach Replenishment as needed due to potential erosion.

These proposals appear to be consistent with the major aspects of the Army Corps of Engineers report “South Shore of Staten Island, NY – Hurricane and Storm Damage Reduction Project” dated November 2102. This report remains in the draft stage and is slated for final release in 2014. The report lays out a number of flood mitigation projects that would need to be completed and also outlined the funding gaps that exist to creating these projects. In particular, the report focuses on the potential risk that exists due to a delay in project funding and completing, in particular the potential for a significant storm to cause massive flooding and fatalities in this area. Our report looks to provide a funding mechanism to address that problem.

Net Financial Impact on Property Owners and Residents

In areas with accredited levees, the regional flood maps are redrawn to reflect a moderate level of risk in the levee protected areas. FEMA is quick to point out that a levee will not prevent all flood events and that levee protected areas still have moderate flood risk. Given the existing rates for flood insurance we expect the following movements in pricing with and without an accredited levee. FEMA states that the flood insurance rates are discounted by roughly 50% to 67% over the non-protected flood prone area rates.

Table 1 provides a sample of how the re-rating will be applied and the net impact on homeowners and commercial owners in the region. In this example – the current owners face either a higher cost of flood insurance or would be charged a levee fee. Pricing for flood insurance is based upon relative risk. In this example, the prices are based upon the existing rates based upon floodsmart.gov. For a low risk area, such as inland Great Kills, the quoted rate is available as a "rack" rate of roughly $129-$460 for the building and contents. For areas that are located in the high risk zones – such as the low lying areas of Midland and South Beach – rates are not available as a "rack" rate, but are subject to a review of the structure and location based on a composite of factors. In a low lying area, rates may fall in the $5,000 to $10,000 per property per year if no changes in existing levee protection occurred.

The authors propose that the by providing an accredited levee through a user fee, the exchange outlined below would occur. For properties located in the flood prone areas, properties would be moved in terms of flood map designation from high risk zones (say A or V) to a low to moderate risk zone (say B or C). This would reduce the flood insurance cost from $7,500 to $2,475. These same user would also be subject to a levee fee if Tax Increment Financing were applied – here at $3,500 per year. The net effect is that the levee package financing is less expensive for a given property owner than the unprotected flood insurance cost.

Table 1: Net Cost Impact

	Area		
Cost	High Risk	Low Risk	Post Levee
Flood Insurance	$ 7,500	$ 460	$ 2,475
Levee Fee	$ -	$ -	$ 3,500
Net	$ 7,500	$ 460	$ 5,975
Risk	High	Low	Moderate
Effective Flood Zone	A or V	X or Shaded X	B or C

In terms of total householder costs, the levee has the potential in this zone to produce less in total costs to property owners as compared to mandated national flood insurance (subject to significant re-rating) for owners with mortgage needs. Owners of properties that are free and clear of bank loans and lack flood insurance would face uninsured risks to their building and contents. Construction of the levee would raise the cost of the Water Board tax, but offset that (perhaps completely or more) through a reduction in flood insurance premiums.

Financial Proposals Details:

The project is structured to use the offset of flood insurance reduction to pay for the levee improvements. Two scenarios are detailed

1) Full load cost financing – no grant money, tax free bond funding
2) Full load cost financing – no grant money – but zero cost loan for projects from City, State or Federal Government.

The following assumptions and project parameters are consistent across scenarios:

1) Fifty Year Project Payoff
2) 4% Tax Free Municipal Bond interest rate
3) 11,932 Properties in the Flood Zone and protected by the proposed levee
4) Total estimated market value of these properties is 10.747 Billion in 2012

The projects are proposed and cost estimates developed based on the proposed levees on the Mississippi River south of New Orleans in Plaquemines Parish that are currently under construction. Based on their cost structure, it appears that 6 miles of levee will cost $2.15 Billion Dollars which has a 50 Year Payoff of roughly $100 million dollars per year. Adding in a maintenance and operational cost of $10 million dollars a year would result in a net total cost of $110 million dollars a year.

The authors then estimate the needed tax rate per homeowner based on the estimated market value for all properties in the protected zone. Utilizing the New York City PLUTO land use data and a Geographic Systems Analysis of the topography, we are able to get an estimate of the total properties impacted and their approximate market value. Based upon our evaluation, there are 11,932 properties on the Eastern Shore of Staten Island that would be protected by the levee. These properties have an estimated market value of $10.7 billion dollars in 2013.
Table 2 provides details on the calculations for Scenario 1.

Table 2 – Estimates of Levee Costs and Taxation – 4% Rate of Borrowing

Staten Island Eastern Shore Levee			
Factor	Assessed Land	Assessed Total	Building Value
Assessed Value	$ 268,381,828	$ 497,714,741	$ 229,332,913
Properties	11,932	11,932	11,932
Market to Assessed Ratio	21.59	21.59	21.59
Approximate Market Value	$ 5,795,464,032	$ 10,747,701,889	$ 4,952,237,857
Average Value of Proerty	$ 485,708	$ 900,746	$ 415,038
Rate per Dollar of Market Value		1.0250%	
Total Tax Revenue		$ 110,163,944	*
Annual Costs Per Property		$ 9,232.65	
*Capital Costs of $100 million per year and $10 million in operation costs per year			
All properties taxed on full market value based on a flat rate on market value			
Total Capital Costs	$ 2,150,000,000		
Local Share	100%		
Annual Operations	$ 10,000,000		
Interest Costs	4.00%		
Loan Duration to Payoff - Years	50		

Estimated cost impact per property per year for the levee tax was $9,232.65 in the impacted zone. This cost is based on no federal or state flood mitigation dollars. Further refinement of alternative subsidy or offsets could reduce these costs. From a property owner perspective, the offset of flood insurance reduction is not address in Table 2 – but is outlined in Table 1

Table 3 provides an analysis of the impact of a zero interest loan to the project from some source. If this was provided and appropriate financing structures were established as in our prior example, this cost change would reduce the annual levee tax from $9,232.65 to $4,413.16 per year per property.

Additional scenarios could be developed using this methodology for various patterns of funding. The project financing is designed to accept a mix of funding mechanism and could utilize grants, loans and self-funding methods. Higher and lower amounts of grant funding would alter the

annual cost to a property owner as would various options on time to retirement for the bonds. The project is designed to rely on the revenue bond aspect of the program and perhaps a backstop to the general fund to provide the highest bond rating possible given City & State finances. This will work to contain borrowing costs and annual impact per property owner.

The project would be funded through an initial bond issue with a private contracting company building the levee. We suggest that this project be let as a Design – Build – Operate – Maintain (DBOM) project, with the construction company providing operational services for an extended period – perhaps 20 years in exchange for an annual fee from the authority. Further, we suggest that the project have an incentive structure built into the funding to reward the contractor for early completion of the project – with the closing of the levee and support structures being the key completion point (the levee would hold back the ocean if a storm event occurred). In additional, a penalty clause for delayed completion should be considered.

Under our scenario outlined here, it is not unreasonable to suggest that this project could be completed in four years – with full storm protection to design standards in place by October 2017.

Table 3: Zero Cost Financing Estimates

Staten Island Eastern Shore Levee - 0% Interest Costs			
	Assessed Land	Assessed Total	Building Value
Value of Properties	$ 268,381,828	$ 497,714,741	$ 229,332,913
Number of Properties	11,932	11,932	11,932
Market to Assessed Value	21.59	21.59	21.59
Total Estimated Market Value	$ 5,795,464,032	$ 10,747,701,889	$ 4,952,237,857
Market Value Per Property	$ 485,708	$ 900,746	$ 415,038
Rate Per Dollar of Market Value		0.49%	
Total Tax Revenue		$ 52,663,739	*
Annual Costs Per Property		$ 4,413.66	
* Includes $42.6 Million in capital costs and $10 Million in operating costs per year			
All properties taxed on full market value based on a flat rate on market value			
Total Capital Costs	$ 2,150,000,000		
Local Share	100%		
Annual Operations	$ 10,000,000		
Interest Costs	0.00%		
Loan Duration to Payoff - Years	50		

The Politics and Public Finance of an East Shore Levee

As part of its Sandy emergency appropriation, the federal government pledged $50.7 billion to the states and cities along the Atlantic coast to recover and rebuilt from Sandy. But there is no clear line from Washington to the localities for the transmission of funds. One year after Sandy, only $5.2 billion of the federal pledge has been spent. Complaints about insufficient transparency and difficultly in accessing funds abound, although it appears that the balky intergovernmental bureaucracy is finally getting in gear, one year later.[41] While there seems to be some commitment among political leaders in New York to securing federal funding for the construction of a levee on the East Shore of Staten Island, the historical track record documented above regarding the neglect of coastal protection after major storms on Staten Island, and the more recent difficulties regarding the flow of funds from the federal government since Sandy, should give rise to some healthy skepticism regarding completion of the Staten Island project by the Army Corp. As noted earlier, Mayor Bloomberg's aggressive plan for coastal protection has

funding gaps, and estimated costs for infrastructure projects in New York are often underestimated (citiation here?). Changing political tides in Washington may jeopardize funding; indeed, federal Sandy appropriations were subject to a 5% reduction under the sequestration process. The Army Corp identified funding problems as one of two major risks to Staten Island's coastal projection (the other, the unpredictability of force of future storms and surge).[42] In short, an unsteady federal partner, and competition within New York City among neighborhoods funding, suggest that a "go it alone" plan may be in order. Staten Island should move forward with a self-financed seawall protection plan for the East Shore.

A go it alone strategy for the financing and management of an East Shore levee has two components—revenue generation and governance. A long-term revenue stream will be required to finance the bonded debt needed to pay for levee construction, and ongoing maintenance and operations as well. Residents and businesses within designated levee neighborhoods could pay a tax. Although residents certainly would not like the prospect of paying the freight on this big infrastructure project, a few issues have to be taken into account. First, whatever costs they may be ask to assume for the levee bonds will be less than the flood insurance costs they would assume individually. Second, the city and state governments could use finance tools such as Payment in Liu of Taxes (PILOTS) or Tax Increment Financing (TIFs) to manage costs for those in the levee district. PILOT programs allow recipients to make payment lower than the assessed property tax value. In New York, PILOTs have a poor reputation, usually because they are deployed to give tax breaks to big corporations. However, since this PILOT would assist beleaguered Sandy victims, it would easily attract support. Local political leaders could enter into negotiations with city officials to settle on an acceptable formula. Another financing possibility, and one not commonly used in New York, would be to use Tax Increment Financing (TIF) to pay for the levee. As a first step, TIFs freeze tax rolls. As the investment improvement generates economic activity and rising property values, the incremental increase in property tax revenue is dedicated to pay the cost of the capital improvement. Payoff could be accelerated with strategic, smart-growth oriented commercial and residential develop in the levee district concentrated around transportation hubs such as the Staten Island Railroad.[43]

A potential governance vehicle for the levee district would be a state authority. In New York, state authorities have the power to declare eminent domain, bond and make capital investments. There are over 640 public authorities in New York. If the levee district were organized as a public benefit corporation, the governing board could be composed of local officials.[44] The great disadvantage is that state authorities are often insulated from public pressure because their board members are appointed by members of the executive branch. Yet another option would be to create a single-purpose special district. New York is awash in special districts—more than 6,900 exist across the state. Under state law, special districts where established to assist towns; there is no provision for their establishment in cities, and New York City carries out most its functions though its line bureaucracies. While special districts have come under criticism for inefficiency and lack of transparency in recent years, the governance form seems a good fit for what is proposed here. There are approximately 100 special directs that exist outside of the typical town

structure and have a board elected directly by residents in the special district. A levee district could be created by special act of the state legislature and granted the bonding authority one might find at a state authority. Election of board members by residents of the district would also be provided for.[45] Yet another option is to administer the levee through a City agency.

One of the great advantages of the self-financing plan is that it could change the politics of recovery for Staten Islanders. To date, the neighborhoods of New York City and Staten Island have too often been passive recipients of government policies and largesse, waiting for the mayor, governor or the federal bureaucracy to deliver on vague promises of recovery and being made whole. A bold plan to self-finance the levee as described here will force policymakers to confront local demands for action. It very well might speed an entire program of intergovernmental financing that will make the self-financing plan unnecessary. It might also speed the project along with a hybrid plan of self-financing for construction and maintenance subsidized with intergovernmental dollars. Under any scenario, a full-court press with the self-finance plan will accelerate construction of costal defenses that will lower overall costs by reducing the flood insurance payout for individual homeowners. It deserves to be underscored—even without any intergovernmental aid, the cost of constructing a levee with costs spread among homeowners and businesses within a designated special district is lower than managing the risk of storm surge with individuals assuming the risk with home elevation plans and costly flood insurance premiums. A well-designed levee will provide the residents of the neighborhoods behind it with the sense of security necessary for the prosperity of the borough.

6.2. Infrastructure Hardening, Relocation and Redundancy

One thing that Sandy revealed strongly was that, from a storm-resilience perspective, key infrastructure systems were either poorly located, poorly designed or both. Sometimes the results were deadly. Other times the results were just disruptive. In some cases they were both.

There are small and large-scale aspects to this issue. The street plans in a few of the East Shore neighborhoods in particular were difficult to navigate with numerous dead-ends and circuitous routes. This can and should be changed, and could be done at relatively little cost, to allow for easier egress and ingress in the event of emergency. This can also have salutary economic effects in normal circumstances if it allows for easier and more efficient traffic flow through residential areas and commercial centers. New York City's own post-Sandy report calls for raising traffic light controllers in locations where signal control was knocked out by Sandy, an especially acute situation on the East and South Shores[46].

Some transportation infrastructure will require more investment. Father Cappadano Boulevard is especially problematic in the way it kept surge waters from flowing back out to sea and this should almost certainly be lowered back to the surrounding elevation. The City's Resilience report additionally identifies the need for "physical improvements to the floating infrastructure, loading bridges/gang- ways, pilings, and piers at both the Whitehall and St. George ferry

terminals and at additional ferry landings around the city" and commits NYCDOT to launching this expenditure "immediately." [47] The report also identifies Hylan Boulevard as in need of capital projects to improve stormwater management and traffic-flow along and near the corridor.

The City Resilience report spends a bit of time discussing The Richmond Valley SIR Station as one that already experiences chronic flooding and the closing of the Atlantic and Nassau stations in Tottenville leaving the Page Avenue commercial area without direct SIR service. The report recommends possible relocation of the Richmond Valley SIR station to Page Avenue and its reinvention as a rail and bus hub to both decrease future service disruptions in the event of another storm and also enhance local economic development.

Although the term 'Transit Oriented Development' (TOD) is not used, this particular proposal contains the germ of a potentially larger integrated infrastructure and development option that might simultaneously build redundancy and resilience into transport infrastructure while increasing economic activity. Increases in local economic output could, in turn, provide some or all of the financing for the initial investments and ongoing maintenance and operations.

TOD refers to the joint development of transit stations and land-use surrounding stations to concurrently create adjacent business and population density that creates a viable ridership base for transit service while increasing local economic productivity. A big problem across Staten Island is the limited capacity to local meet travel demand (resulting in chronic traffic congestion) and the generally low-density sprawl of economic activity that accompanies both automobile travel and poorly-designed transit service.

An integrated redevelopment of SIR, traffic corridors and bus service along the East and South Shores has been justifiable on economic and travel demand grounds for a long time. Hurricane Sandy has increased the justification for it on resilience grounds as well. The addition particularly of proper Bus Rapid Transit (BRT) along a strengthened Hylan Boulevard (quite different from the 'Select' service currently running there which is really just an Express bus) along with a similar redesign of SIR service would not only ease traffic congestion under normal conditions (and possibly serve currently underserved areas); it would also increase overall capacity and in so doing provide 'redundant' capacity to serve travel demand if some portion of the system was knocked out by another storm for some period. The same could be said of a redesigned transport corridor on the North and West shores, especially the additional of a light rail in those areas, projects of long-standing interest that have met prior benefit-cost assessments and which already have sufficient population densities to justify service provision.

Redundancy also could be well served, and at relatively little cost, by an expansion of ferry service on Staten Island. A mid-Island service to Manhattan did run temporarily after the storm. But there has been well-known demand for such a service on a permanent basis and probably to other areas around the City, and in New Jersey, as well. Staten Island has a number of locations where there is relatively little water distance between it and the rest of the City or New Jersey

and there have been historical services offered at some of these points, especially at Port Richmond and Tottenville. In both of these cases New Jersey offers substantial transit service at points just across from potential Staten Island ferry landings.

Regular ferry service at key points has two justifications. One is that there is very significant congestion on all travel modes on Staten Island and ferries offer extra capacity at key points. A second is that regular ferry service is more resilient in the event of storms because such service will have better landside facilities (which, of course, need to be designed properly to withstand or at least bounce back from storm danger) and operating vessels and because users can easily transition to and from them because they have already incorporated their schedules, locations and so forth into their personal knowledge and behavior.

The North Shore has some particular infrastructure issues. The preponderance of marine facilities, especially dry docks and other marine facilities along the Kill Van Kull, and the Staten Island Ferry Terminal, are by definition vulnerable to storms, major and minor, and sea level rise. A more systematic study of the location and design of these facilities has yet to be done. But clearly more 'floatable' facilities may be recommended and integration between marine structures and landside roads is obviously a priority given the damage that occurred from an unfortunate and unplanned mixing of these two during Sandy.

The other major categories of storm-affected infrastructure are health facilities and wastewater and water facilities. The City's Resilience report notes that all 14 of the City's wastewater treatment facilities were located along the waterfront, as was the case on the South and East Shores in the case of the Oakwood Beach Wastewater Treatment Plant. The report suggests, without providing detail, that treatment facilities possibly be raised or flood-proofed through the use of local barriers, and improved waterfront infrastructure. Redundant systems might also be another possibility. Regarding healthcare infrastructure, SIUH was also badly affected by virtue of its location. It is not clear what the best and most cost-effective options are at this point but a strategic relocation of some of these, if joined with other activity centers (e.g. locating SIUH near a SIR transit node) might offer some secondary benefits to offset costs.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS: A BUSINESS PERSPECTIVE

A review of the findings in this report can take many directions. In this case, the major cross-cutting dimension will be a business development perspective.

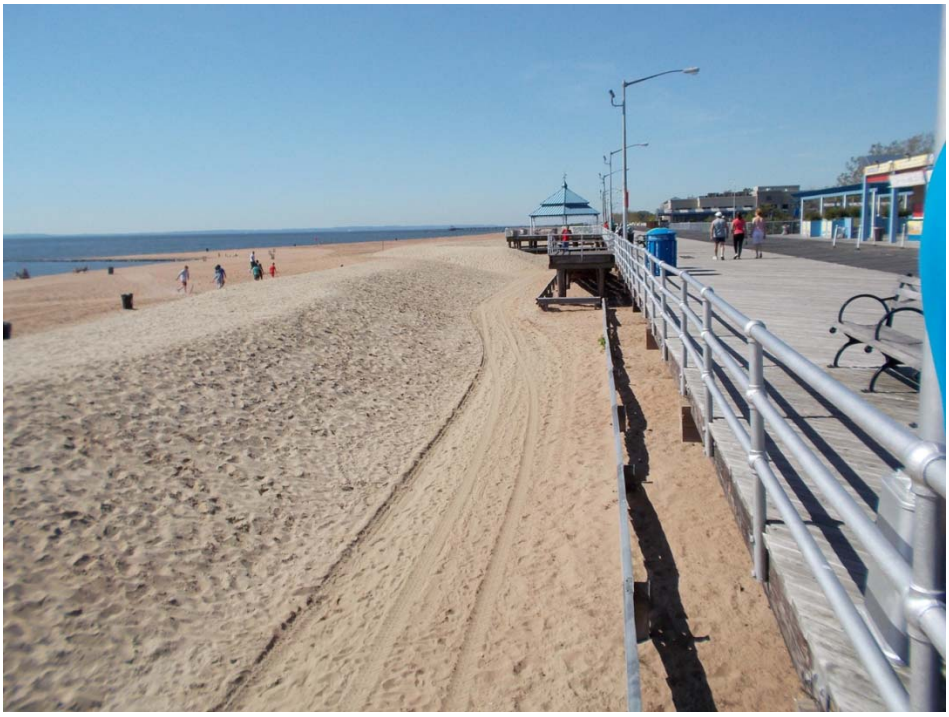
What is desirable from such a perspective? It would seem that any solutions to the problem of making Staten Island more storm-resilient would need to include considerations of costs to business, of predictability and certainty of policy, and of overall productivity impacts. The primary objective undoubtedly has to be the saving of lives and limiting of damage and disruption from the next storm and climate effects such as sea-level rise and this entails necessary additional costs to all sectors of the society. But there are many paths to such an objective. Which might be a way of minimizing overall costs while making Staten Island a more desirable place to do business and live and work in?

Our proposed core levee project is both affordable and reasonable given the existing flood risk in this area. The project has the potential to be self-financed under a number of scenarios and the costs are reasonable and sustainable. Offsets to local taxes could provide relief for these costs to existing property owners and would reduce the cost of this project to regional residents. The project would provide significantly enhanced protection to the region and would prevent events as opposed to attempting to repair or replace damaged structures after the storm surge event. Given a self-financing structure, the levee board could accelerate the project using the capital markets and should be able to deliver the project significantly sooner that waiting for capital appropriations from the Federal, State or City government. Existing and proposed flood government protection money could be used to offset costs and be folded into the project financing package to lower the cost of the project.

We envision a project that could be completed with swift governmental action by September 2017.

Property owners who are ineligible for flood insurance or who had properties with values in excess of existing flood insurance limits would benefit from this program. Loss of life would be minimized – and that cost is not fully accounted for by existing flood insurance programs. Might we be able to see a bright new day for Staten Island residents – such as was the case in Photo 1 taken in September 2013 by the authors when Sandy seemed a bad and distant memory.

Photo 1 – Existing Beachfront in South Beach – Fall 2013



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