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Protecting the Big Apple: Why One Giant Band-Aid Is Not Enough

On October 26, 2012, New York Governor Andrew Cuomo declared a statewide state of emergency in preparation for Hurricane Sandy, a Category 3 storm projected to make landfall in New York City three days later. The massive storm wreaked havoc across much of the Northeastern portion of the United States, and unofficially became the second-costliest hurricane in U.S. history. One of the major areas of damage was New York City, which was drastically underprepared for the storm, and the city's aging infrastructure showed signs of vulnerability. Hurricane Sandy brought the New York City Subway System to its knees, closing much of the system for nearly a week. In order to commute between Brooklyn and Manhattan, riders had to take the Subway Shuttle bus across the East River. During this time, severe traffic gridlock took hold of the city, largely because of flooding in the Battery, Holland, and Midtown Tunnels (Kaufman et al. 8). If another major natural disaster were to hit New York City, it is likely that the current infrastructure would not withstand the storm, and could cause far more severe problems for the people of New York. We have all witnessed Hurricane Sandy's devastating effects on New York City's infrastructure, and while this enormous problem should clearly be addressed, its solution does not necessarily need to rival Hurricane Sandy in magnitude. This paper will examine several proposed solutions to combat the threats to New York City's infrastructure caused by natural disasters and climate change.

Infrastructure is what keeps a city like New York functioning on a day-to-day basis. For New Yorkers, the subway is their lifeblood. Workers use the rails to commute to work, students use them to go to school, and tourists use them to jump from destination to destination. A report on transportation in New York City throughout Hurricane Sandy and its aftermath by Sarah Kaufman, Carson Qing, Nolan Levinson and Melinda Hanson from the Rudin Center for Transportation at New York University detailed how Hurricane Sandy took out the entire subway for two days, and left parts of the system out of service for over a month (Kaufman et al. 10). Fortunately, 80% of the subway was operational less than a week after the storm hit, but this was nothing short of a miracle as the system experienced the most extensive damage in its history (Kaufman et al. 10). Hurricane Irene was a smaller storm that hit New York City fourteen months prior to Hurricane Sandy, and at the time, Klaus H. Jacob, a research scientist at Columbia University, estimated that a larger storm would take out the subway tunnels under the Harlem and East Rivers for nearly a month (qtd. in Kaufman et al. 5). The chokehold that these two rivers have on Manhattan requires two things in order for New Yorkers to successfully navigate the next natural disaster: a dependable alternative to traversing the rivers and an effective way to limit the effects of flooding on the tunnels below the rivers.

One of the more popular solutions among members of the media following Hurricane Sandy was the idea of building massive floodgates in the New York Harbor. Floodgates are a major investment that may or may not be the right solution for New York City, but the problem is that they are a single point of failure, and if the city that lies beyond them remains unprotected, the true value of floodgates becomes even more unclear. In a report drafted by the New York State 2100 (NYS 2100) Commission, at the request of Governor Cuomo in response to Hurricane Sandy, a multitude of suggestions are laid out in an effort to better prepare the State of New York for future natural disasters. The idea of floodgates in the New York Harbor is something that is thrown around after nearly every major storm in the New York Metropolitan Area, but the NYS 2100 Commission specifically suggests further exploring the issue. According to the report, floodgates are "large moveable gates that close during storm events to protect coastal areas from flooding…" and "involve engineered systems that mechanically move gates into place several hours prior to the arrival of a storm to hold back the storm surge entirely and protect the area behind the barrier" (NYS 2100 Commission 121). The report suggests that two or three floodgates would be required on the ocean side of the harbor and another at the entrance of the East River and estimates the total cost of installation at "$7 to $29 billion" (NYS 2100 Commission 121). With such a high cost disparity, it is clear that a more specific study is needed to adequately assess the true cost of installing floodgates, but do the benefits of floodgates really outweigh their costs?

Jennifer Weeks, a freelance writer with an extensive background in environment and science, published a *CQ Researcher* report on the risks of densely populated coastal regions and specifically addresses the pros and cons of floodgates. In her report, Radley Horton, a research scientist at Columbia University's Center for Climate Systems Research discusses his skepticism of the merits of floodgates. He believes that many key questions still need to be answered, such as "How do you test a system like this? How do you minimize the risk that it will fail? ... What happens to people who live just outside of the barrier, where flood risks will increase?" (qtd. in Weeks 1). The NYS 2100 Commission report does not hold many answers. In fact, the report admits that floodgates have many shortcomings. They would not "mitigate the effects of freshwater flooding caused by extreme precipitation," and, since they must remain open unless a storm is imminent, they would not protect against "coastal inundation" as a result of sea-level rise due to climate change (NYS 2100 Commission 122). The report also admits that floodgates would likely worsen the impacts of flooding outside the barriers, and that additional environmental and economic studies should be conducted to determine the size of their impact (NYS 2100 Commission 122). New York City Mayor Michael Bloomberg finds the idea of floodgates impractical, and claimed, “Even if you spent a fortune, it’s not clear to me that you would get much value for it” (qtd. in Weeks 1). If the city’s mayor is unconvinced, it is surprising that this idea is receiving so much attention. It makes sense that people unfamiliar with the issue of natural disasters in New York City could believe that building a gigantic wall might solve the problem, but similar to immigration reform along the U.S. – Mexico border, the issue is far more complicated than what meets the eye. It is unlikely that there is just one overarching solution for such a complex problem, but there must be a more feasible, cost-effective solution that can provide more certainty of protection for New York City’s precious infrastructure.

When the subway tunnels were underwater after Hurricane Sandy, traffic became a nightmare, hampering commutes to and from Manhattan, and paralyzing the ability to move precious recovery materials into the city. To combat this, the NYS 2100 Commission recommends creating a “transportation lifeline network” that would identify primary and secondary avenues of transportation into and out of the city (48). The report recommends selecting routes that link people from one core area to another, allow for the movement of essential goods, first responders, and operational equipment, carry multiple transportation modes, are part of an established evacuation route, and have been designed to withstand extreme weather conditions (48-49). In the case of Hurricane Sandy, this type of system could have ensured that some of the tunnels under the East or Harlem Rivers stayed intact, which would have eased congestion while the rest of the system was being repaired. In addition to creating primary and secondary routes, the Metropolitan Transportation Authority (MTA) could prioritize subway routes based on ridership and strategically place pump trains near the tunnels on these lines in preparation for an imminent storm. This would allow service to be restored to the most vital lines first, which would further ameliorate the problem of prolonged commute times.

Prioritizing transportation routes is a step in the right direction, but it will only prove useful if those routes are hardened to the point where they can survive during natural disasters. In response to a 2007 flood that affected much of the subway system, the MTA invested over $30 million to prevent flooding by raising entrances at 30 subway stations, replacing pumps throughout the system, and closing nearly 1,500 ventilation grates (Kaufman et al. 5). There is no way to measure the impact of these improvements, but it is clear that there is still work to be done. For example, in a scaled down version of the floodgate model, the NYS 2100 Commission recommends the installation of waterproof roll-down doors at the foot of each subway stair entrance to ensure that water from the streets cannot penetrate the system (51). The report also recommends sealing electrical equipment off from water infiltration and installing mechanical vent closures to prevent water from entering the tunnels through the ventilation system (51). In the event that floodwater still finds its way into the system, the ability to contain it could be the difference between repairing one line and losing the entire system due to flooding. Researchers at the Department of Homeland Security's Science and Technology Directorate have developed a way to do this without having to install thousands of watertight doors. The Resilient Tunnel Project has yielded "an enormous inflatable cylinder that can be filled in minutes to seal off a section of tunnel before flooding gets out of control" (see Figure 1) ("35,000 Gallons of Prevention…" 1). By locating these at strategic locations throughout the subway system, not only could flooding be contained, but the MTA could save millions of dollars over installing thousands of conventional waterproof doors.

Now that flooding in the subway can be kept under control and transportation routes into and out of the city have been prioritized, New Yorkers are ensured mobility in the event of another major storm, but the city as a whole is far from protected. Steps should also be taken to prevent flooding in the first place. According to a report by Lauren Coleman in the William &

Mary Environmental Law and Policy Review, the sea level in the New York Harbor is expected to rise nearly one foot due to global warming (530). This increases the risk of flooding as a result of smaller storms while increasing the likelihood of larger storms causing even more damage. To combat this, it is impractical to implement a change in the building code to require floodproofing the first floor of all buildings in New York City, as some experts have suggested, because it would be nearly impossible to enforce and extremely costly. A more feasible approach is through the use of soft infrastructure, which is "a land use design technique that incorporates both natural and man-made landscape features to 'provide new ground to eroded areas, remediation to polluted areas, and protection to areas at high risk of storm surge damage'" (Coleman 531). The report specifies three main techniques that could help New York City battle rising tides: the construction of "barrier islands" along the shoreline to absorb some of the surge, the buildup of new wetlands where marshes used to lie, and the implementation of the Palisade Bay Project which "incorporates the use of piers and slips to reduce the intensity of wave velocities" (Coleman 532). Some of these ideas are being seriously considered by city officials. In a New York Times article, Mireya Navarro, an environmental writer focused on the New York City region, points out that Mayor Bloomberg's administration has already begun "expanding wetlands to accommodate surging tides" (1). City agencies have laid down rock and salt-resistant grass to protect against storm surges at Brooklyn Bridge Park, and city officials are hoping to spend over $2 billion on environmental projects through 2030 (Navarro 1). Soft infrastructure solutions are not only effective, but feasible as well.

While soft infrastructure techniques could hold off many major storms, if another storm decimates New York City, the case for floodgates will rise again. While citizens of New Orleans can try to convince them that even levees fail, floodgate proponents will continue to argue that they offer absolute protection from storms. Either way, supporters of floodgates are correct in saying that large storm surges cannot be stopped by many soft infrastructure techniques, but they *can* slow them down. If sand dunes along the shoreline slow an imminent flood from a storm surge by just a few minutes, it would give city officials ample time to activate their storm action plans, which could include locking down primary travel routes, closing waterproof doors at subway station entrances, preparing pump trains, and arming inflatable cylinders in the tunnels. Floodgates may provide New Yorkers with exactly the protection they need from the next big hurricane, but the there is no way to tell without extensive research that could take years to complete. Furthermore, city officials worry that floodgates "could interfere with aquatic ecosystems and with the flushing out of pollutants, and may eventually fail as sea levels keep rising" (Navarro 1). By implementing soft infrastructure techniques, prioritizing transportation routes, and making improvements to the city's subway system, New York will be capable of withstanding the many threats to its infrastructure system from natural disasters and global warming.

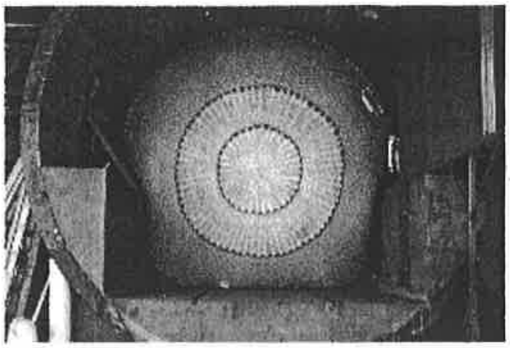

Figure 1

Inflatable stoppers, designed by the Department of Homeland Security's Science and Technology Directorate, can be filled with water or air to seal off tunnels to contain flooding ("35,000 Gallons of Prevention…" 1).

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