



IMPACT HUMAN

HURRICANE SANDY: A RETROSPECTIVE

RESEARCH BRIEF | NOV 2017 | WRITTEN BY: MARTHA MOLFETAS



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This Brief has been launched in conjunction with Impact Human’s project, ‘Sandy: A Retrospective’. Information provided here is intended to provide additional insight on hurricanes, coastal resiliency, climate impacts, and environmental justice in the NYC area in particular. For more media from us on this topic, including podcasts, photography, and interviews, please see our project webpage.

Hurricane Sandy – What Happened?

After moving through the Caribbean, Hurricane Sandy made its way northwards with tropical storm force winds spanning 1,000 miles in diameter – three times the size of Hurricane Katrina. Sandy made landfall at 7:30 pm on October 29, 2012, seven miles north of Atlantic City, at Brigantine, NJ. But before Sandy hit New Jersey, she ran into two other weather systems that steered her course, a high-pressure system in the north and a low-pressure system that pushed her east – reenergizing the storm and steering her sharply west with 80 MPH winds at landfall.

Two and a half hours prior to making landfall, Sandy was demoted by the National Hurricane Center to a ‘post-tropical cyclone’, as it lacked a strong centralized eye and since it relied on jet streams for its energy.⁴ That point of fact mattered little. Sandy retained her wide radius and low-pressure – which created the perfect calculus for an epic storm surge on any other day, except October 29th, 2012 was not just any other day. Sandy’s arrival to New Jersey and the NYC area coincided with high tide and a ‘spring’ tide – when the moon is full and the tide is at the peak of its monthly cycle; meaning that water levels were already higher than usual.

As Sandy came through, NYC-area bays, rivers, inlets and creeks all became inundated, with water rushing over beaches, sea walls and boardwalks. Fifty-one square miles of NYC flooded, accounting for 17% of the city’s land mass. According to FEMA^{*} maps at that time, 33-square miles of NYC were considered a part of the ‘100-year’ flood zone, or an area with a 1% chance of flooding on any given year. Sandy exceeded those expectations by 53% across the city, inundating areas beyond existing FEMA maps. But it wasn’t just the fact that Sandy caused flooding, the depth of flooding was staggering – in Sea Gate, Brooklyn; water reached 11 feet above ground level. At Tottenville, Staten Island, the water rose to 14 feet above ground level. Across the board, the impact of flooding was staggering and unprecedented in the city’s history.⁵

QUICK FACTS^{1, 2,3}

- Across N. America and the Caribbean, Sandy took 147 lives
- Sandy claimed 48 lives in NY-state, including 43 people in NYC alone
- 6,500 patients were evacuated from NYC nursing homes and hospitals
- 90,000 buildings were in the inundation zone in NYC
- 1.1 million NYC kids couldn’t go to school for 1 week
- 2 million people were without power at some point during and after the storm in the NYC-metro area
- 8.5 million households in 21 states lost power.
- 11 million travelers were affected by damages to the Subway, tunnels, ferry terminals, LIRR, PATH trains, and Amtrak
- \$19 billion in damages to the NYC area alone
- Across the US, Sandy caused a total of \$50 billion in damages
- Highest storm surge ever recorded in Battery Park of 13.88 ft
- NY Harbor recorded a 32.5-ft wave, 6.5 feet taller than the last record
- The NY Stock Exchange closed for two consecutive days due to weather, the first time since 1888

^{*} FEMA is the United State’s Federal Emergency Management Agency. They primarily respond to disasters and aid communities affected. They also assess risks, like flooding. To see if your area is at risk for flooding, visit the FEMA Flood Map Service Center here: <https://msc.fema.gov/portal>.

Low-lying Areas & Coastal Flooding

At times, it's easy to forget that all five boroughs of NYC are essentially islands surrounded by water. Coastal areas in Staten Island, Manhattan, Brooklyn, Queens and the Bronx saw flooding, but none saw flooding as severe as Staten Island, the Rockaways, and Long Beach. NYC-commuter areas were also devastated by flooding; like Hoboken in New Jersey, and cities like Freeport, NY and Seaford, NY out in southern Long Island.⁶ Overall, the ocean-facing, southern half of NYC saw the most devastation, faced with 12 feet-plus waves and flooding. In all, New York's beaches lost 3 million cubic yards of sand – with 1.5 million cubic yards of sand lost in the Rockaway Peninsula alone. After the storm hit and the surge flushed streets and homes with salt water, many homes experienced fires, since salt water conducts electricity.⁷

In the United States, NYC is the most at risk city for coastal flooding for present and future projected flooding due to sea level rise by 2050; and has the highest population at risk for coastal inundation. That's more so than Miami or Miami Beach. In fact, in a recent analysis of most at risk cities, NYC and Atlantic City were the only non-Florida communities ranked in the top-25; with NYC ranked in first place, and Atlantic City, NJ ranked at number 23. To put that in perspective, Miami Beach, FL with its porous limestone bedrock and sunny-day flooding ranked at number eight.^{8,9} NYC and the surrounding areas are estimated to see 1.7 – 2.0 feet of sea level rise by 2050, based on current climate models that take into account warming oceans and glacial loss.¹⁰

Climate Change & Sandy

Near where Sandy made landfall, sea levels have risen one-foot since the mid-1800s when modern records began. Further sea level rise expected for this century will make storms like Sandy all the more devastating; along with warming ocean trends which will add more precipitation and energy to storms and hurricanes.¹¹ We've recently seen this play out in the 2017 hurricane season with an unprecedented number of category five hurricanes leaving devastation in their wake.¹²

Across the globe, climate change has made rising seas a reality for coastal communities everywhere. Unfortunately, the northeastern United States has four-times the average global rate of sea level rise. Sandy's storm surge is what caused the most damage to communities, more than the tropical storm force winds or rain. Sea level rise played a role in increasing that damage, along with the unique tidal factors that day. As climate change continues to warm oceans, we will see more intense storms. As climate change forces oceans to rise, we will see more severe storm surges. Sadly, hurricanes like Sandy will be our future, rather than an outlier from our past.¹³

Damage Done & Recovery, 5 Years Later

Sandy took 43 lives and caused \$19 billion worth of damages in just the NYC area alone. Leaving 2 million people without power and 11 million travelers stranded due to inundation and damage to: commuter trains, the Subway, key tunnels, and ferry terminals.^{14,15}

Transit Woes

Many Subway lines and stations were severely damaged and have taken years to come back to life. In particular, the new South Ferry station had 15 million gallons of water flood into it, and

only recently reopened after \$340 million worth of post-Sandy repairs. Uniquely, the new South Ferry Station was only three years old when Sandy hit; thanks to \$545 million in post 9/11 recovery funds that aimed to increase transit capacity. Prior to Sandy, MTA[†] tried to protect the new station with barricades; but it could not stop the sheer force of the surge.^{16,17} Other arteries in the Rockaways saw whole strips of aboveground rail consumed by the storm surge. Costing \$200 million to repair, MTA managed to get the A-line back up and running within a year and with new defenses like sea walls to protect vulnerable rail lines.¹⁸ Many rail lines, tunnels and stations saw severe damage and have been by and large repaired, but some remain under construction or un-repaired:

- The entire NJ PATH[‡] train system saw \$300 million in post-Sandy repairs, with Hoboken station reopening with limited services three months after Sandy.
- Amtrak saw an estimated \$689 million in damages to just the East and Hudson River tunnels; repair work is still underway. This doesn't include recent track work done at Penn Station this summer.^{19,20}
- The LIRR[§] also saw an estimated \$300 million in damages to pumps, tunnels and bridges, including \$65.3 million in damages to the LIRR's Long Beach Branch.²¹
- In 2014, MTA was granted \$886 million by the U.S. Department of Transportation to repair damages from Sandy, including vital Subway stations, repairs to the LIRR and Metro-North lines, and repair key tunnels, signals, and the like.²²
- MTA has launched a 'Fix & Fortify' initiative that aims to add resiliency to the Subway network and coordinate efforts with the Port Authority of NY & NJ to ensure that stations, equipment and tunnels are all prepared for the next Sandy-type event.²³
- In all, the entire MTA network experienced **\$4.75 billion in Sandy damages**.²⁴

Post Sandy Recovery

While the transit costs are staggering, so too are the costs to us individually. Many households are still displaced and rebuilding, five years after Sandy. In the immediate aftermath of Sandy, many were left stranded for days in high-rise buildings, with no electricity, gas, or water – unable to replenish supplies or cook. Elderly people and those with reduced mobility were unable to leave their homes without the aid of an elevator.²⁵ 80,000 residents in NYC's public housing were left without power, heat, and hot water for up to two weeks, with many of the NYCHA^{**} buildings reaching 20 stories; those least fortunate were trapped.²⁶ Meanwhile others faced the horror of water rushing into their homes, even knocking some structures off their foundations.²⁷ Even if homes were not damaged, many were left for weeks without pay due to office closures, setting them back on bills.²⁸

FEMA & Flood Zones

Largely, the areas still recuperating post-Sandy are the areas most gravely struck, like the Rockaways, Staten Island and Long Beach. Areas in Lower Manhattan appear to be completely rehabilitated. Seventy-percent of buildings structurally damaged by Sandy were low-rise, one to two family structures. Most were constructed prior to 1961 and were built with materials like

[†] MTA is the Metropolitan Transportation Authority. They manage and operate NYC's Subway and LIRR, and Metro North Trains. While the Subway serves the City of New York, it is actually managed by the state government.

[‡] NJ PATH is the New Jersey Port Authority Trans-Hudson, offering commuter rail services to NY Penn Station and within New Jersey.

[§] LIRR is the Long Island Rail Road, a commuter rail network managed and operated by MTA.

^{**} New York City Housing Authority.

wood, and without consideration for the type of flooding Sandy caused.²⁹ Before ‘Superstorm Sandy’, many affected by flooding were not required to have flood insurance. Typically, if you hold a mortgage the bank will determine whether or not you are required to obtain flood insurance based on FEMA maps, leaving many who have lived in homes for decades, or had properties passed down to them potentially lacking in coverage for the very thing impacting them. Many others whose homes were not considered within the flood zone did not opt for flood insurance, but were still affected by flooding. Leaving all those without adequate coverage left paying out of pocket for any and all repairs.

FEMA flood maps at that time excluded many of the areas that were inundated. Today, FEMA has expanded their flood map zones to include an additional 35,000 structures, making the total at about 67,000 structures within NYC at risk. With these new inclusions come other requirements, homeowners in flood zones must now elevate their homes three to six feet depending on which zone they are in to get flood insurance. Homeowners are left with the bill to raise their homes or the choice of relocating. After Sandy, FEMA’s National Flood Insurance Program paid out \$21 billion in claims. Even if you do not have flood insurance via FEMA directly, chances are the National Flood Insurance Program subsidizes your policy in some way.^{30,31}

New York State & NYC Initiatives

Post-Sandy, some homeowners in Staten Island have opted to sell their properties to the state. After the state buys these properties, storm-damaged homes are demolished to provide coastal ‘buffer zones’ or preserve wetlands – adding to coastal resiliency.³² In Oakwood Beach, Staten Island, the Governor’s Office of Storm Recovery has bought 299 homes for a whopping \$122 million. As of last year, the state has torn down 196 structures and created a wildlife haven in this one area.³³

Since 2013, the NYC government has taken steps to help people rebuild their homes post-Sandy through the ‘NYC Build it Back’ initiative. This program aims to help families rebuild their homes but also add resiliency for future storms and climate impacts after all other types of disaster assistance has been exhausted. Build it Back has focused primarily on waterfront areas and has utilized funding from the U.S. Department of Housing and Urban Development to aid 8,300 landlords and homeowners – helping roughly 12,500 families – get back into their homes. This includes the raising of 1,400 homes to be compliant with new FEMA regulations.³⁴ As of October 2017, 10,334 Sandy-damaged homes have completed construction via Build it Back.³⁵

Climate Action

Aside from responding to the immediate impacts of Sandy, New York’s Governor Cuomo and NYC Mayor de Blasio have both committed to the goals of the Paris Agreement and have set emissions goals for both the City of New York and for New York State. NYC aims to cut emissions 80% from 2005 levels by 2050.³⁶ While New York State has some of the most ambitious climate targets, aiming to cut emissions to zero by 2050, and to get half of all electricity from clean energy by 2030.³⁷ After President Trump withdrew from the Paris Agreement on Climate Change, Governor Cuomo joined the US Climate Alliance, which aims to commit to actions that cut emissions and address climate change, within the stated goals of the Paris Agreement.³⁸ Together, the US Climate Alliance represents 36% of the US population and \$7 trillion in annual GDP.³⁹

Conclusion & Recommendations

The state of New York has made strides to act to prevent future climate impacts through strong emissions targets and to respond to the aftermath of Sandy. Locally, NYC's government has taken steps to fix damaged housing. Both have taken steps for coastal resiliency projects, which have included re-building beaches and boardwalks, and increasing coastal resiliency to storm surges by re-introducing sea grasses and building up dunes and wetlands. For example, in the Rockaways alone, the Army Corps of Engineers has spent \$400 million to rehabilitate the beach post-Sandy; with another \$3.6 billion planned to construct floodwalls and levees in Jamaica Bay.^{40,41}

One thing that is missing from all this is building resiliency for future projected climate impacts, rather than just what we are experiencing today. Currently, NYC is only planning for six feet of sea level rise, when current federal estimates from NOAA^{††} are that we could see beyond eight feet of sea level rise by the end of this century.^{42,43}

New York is not alone. In most parts of the U.S., we see coastal resiliency planning only for what we anticipate in the near term, as we saw with Miami Beach's coastal and flood resiliency initiatives.⁴⁴ What is important is that the local and state government are not just recognizing climate change as a threat to communities, they are putting forward policies and programs intended to build out emissions and shore up resiliency, post-Sandy. The problem with this last point is that the resiliency being planned is only in response to areas that were devastated by Sandy, not to all areas that are at threat to sea level rise, and therefore, higher storm surges.

The NYC-area has 600 miles of coastline.^{‡‡} There will be places we will have to leave behind and let go back to nature, like what is happening in Staten Island today. There will be other areas we will want to protect at all costs, due to population density and/or economic factors. Cities like NYC can learn a lot from the Netherlands, where instead of fighting against the inevitable fact of sea level rise; coastal communities are building structures that can float; and communities that can exist within this new reality. Cities like Amsterdam and Venice have long existed with the reality of water inundation.⁴⁵

Recommendations

This short brief recommends the following actions and policies for state and local governments:

- The local NYC government should require all new structures to take into account at least 10 feet of sea level rise, and take additional measures to build levees and coastal defenses to take into account the highest current anticipated sea level rise for 2100. Additionally, any and all projects should take into account not just projected sea level rise, but the potential future storm surge we can expect to experience after an additional 10 feet of sea level rise.
- Both the NYC and New York State governments should create a stronger hurricane response roadmap to help communities plan better for storms, and create an evacuation plan for future storms and hurricanes.
- New York State and NYC should continue to pursue ambitious climate targets on emissions, but should also stop all future oil, gas, and shale development and transport. This would include shutting down existing pipelines. Emissions cause climate change and

^{††} NOAA is the National Oceanic and Atmospheric Administration.

^{‡‡} Miles of coastline from Encyclopedia Britannica, <https://www.britannica.com/place/New-York-City>.

environmental pollution for local communities. Making pipelines and oil and gas wells an echo of the past is the only way to deter the worst impacts of climate change.

We are already paying for the impacts of climate change. Each year, in the United States we pay \$240 billion in response to extreme weather events fueled by climate change, and the health consequences of burning fossils.⁴⁶ We can continue to pay for climate impacts, or we can invest in climate solutions and resiliency.

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³ Deconcini, Christina and Forbes Tompkins. "Impacts of Hurricane Sandy and the Climate Change Connection." World Resources Institute (WRI). Accessed 21 November 2017 (2012).

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¹⁰ U.S. Global Change Research Program. "Projected Sea Level Rise and Flooding by 2050." Accessed 22 November 2017. <http://www.globalchange.gov/browse/multimedia/projected-sea-level-rise-and-flooding-2050>.

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