

Water, Water, Everywhere:

The Increasing Threat

of Stormwater Flooding

in Greater Boston

Executive Summary



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*....How high's the water, mama?
Three feet high and risin'.
How high's the water, papa?
She said it's three feet and risin'...*

— Johnny Cash, Five Feet High and Rising

In March 2010, Eastern Massachusetts was deluged with several historic rainfall events. A series of three storms dropped a foot and a half of rain over a 19-day period, representing more than a third of the normal annual rainfall. The resulting flooding affecting thousands of homes, shutting down roads, parts of the MBTA, and entire downtowns, while also causing raw sewage to be released into our waterways. In the storms' aftermath, President Obama granted a major disaster declaration for seven counties in Eastern and Central Massachusetts. More than 27,000 flood claims were ultimately paid out, running to \$59 million in disaster assistance.

While sea level rise rightfully has garnered the attention of researchers, property owners, and municipal and state officials, stormwater flooding (sometimes referred to as inland or urban flooding) occurs when the volume of water on land exceeds the capacity of natural and built drainage systems and is devastating in its own right. Progress continues on developing models to assess the likely impacts of sea level rise, but no similar predictive tools exist for the widespread, and poorly understood, phenomenon of stormwater flooding. Unlike their coastal counterparts, inland property owners do not have access to a predictive flooding model, nor do the Federal Emergency Management Agency's (FEMA) flood maps capture much of the risk of stormwater flooding. With climate change increasing the frequency, intensity, and impacts of precipitation events in New England, greater understanding and more effective responses to stormwater flooding are imperative. For example, the number of intense two-day storms increased by 74% from 1901 to 2016, and the heaviest rain events of the year now drop 55% more precipitation than the rainiest days of the midcentury. An additional 40% increase is projected by the end of the century.

As part of the Metropolitan Area Planning Council's (MAPC) hazard mitigation planning efforts, we entered into an unprecedented data sharing agreement with FEMA and the Massachusetts Emergency Management Agency (MEMA) to access disaster claims records from the March 2010 storm. Due to federal privacy rules, the locational data of where the claims originated must remain confidential. These data, however, allowed a first-of-its kind analysis of stormwater flooding in Eastern Massachusetts.

Major Takeaways

The flooding caused by the March 2010 storms was widespread and distributed throughout the region. Unsurprisingly, areas that received higher rainfall totals tended to experience greater impacts.

However, we also learned that FEMA Flood Maps are poorly predictive of where stormwater flooding is most likely to occur. Ninety-six (96) percent of the disaster claims arose in areas outside of the FEMA Special Flood Hazard Areas (SFHAs), also known as the 1% chance flood zones. As the vast majority of claims were outside the SFHA, most residents were unaware of their risk. As a result, damages were much greater than they otherwise might have been. Of the flood claims granted, 87% were for flooding levels of less than one foot and 71% were for flood heights of less than six inches, indicating that even moderate levels of flooding can cause significant, widespread damage to properties.

A major part of our analysis looked at flooding indicators in relation to the location of flood claims. Indicators included presence within the FEMA SFHA, proximity to water and wetlands, slopes, soils, and the year a home was built. We found there is no factor that can easily predict susceptibility to stormwater flooding, though a number of indicators were “over-represented” in the flood claims. These included homes in the 1% (100-year) and .2% (500-year) chance flood zones, homes built between 1940 and 1980, those sited on relatively flat elevations or on sandy soils, and proximity to water and wetlands. Another potential factor is homes built on filled wetlands. Homes that were less likely to file claims were those built before 1940 and those on steeper slopes.

MAPC also explored the relationship between flood claims, flood zones, and equity factors like race, income, language, and places with high concentrations of renters. Our analysis did not find a relationship (e.g., flood claims were not any more likely to be found in low-income areas). There are a number of possible explanations for this, such as the widespread affected geography did not overly impact any particular populations, and low-income households may have been less likely to file disaster claims. Despite not finding a conclusive correlation, recovery for low-income households is likely to be more difficult. More research is needed to explore flooding risk for environmental justice (EJ) populations.

To better understand the human cost of stormwater flooding, we interviewed homeowners in Woburn who experienced flooding. Woburn was significantly impacted by the March 2010 storms and basements throughout the city flooded as a result. Through the interviews, we documented the financial and emotional toll that too

much water in the wrong place exacts on homeowners. A significant portion reported moderate to severe anxiety in responding to their flooded homes. Unlike prospective car buyers who have access to information about a vehicle's accident history, there is no similar disclosure requirement for properties with flood histories. In fact, disaster claims are considered confidential under federal privacy rules, benefiting the existing homeowner when it comes time to sell, but clearly disadvantaging a prospective buyer.

MAPC also investigated the potential relationship between filled wetlands and stormwater flooding using a historical 1892 map of wetlands in Newton and comparing the locations of flood claims. Many of those historical wetlands have been filled or drained for development over the last century, and some clusters of 2010 flood claims seem to be located on sites that were mapped as wetlands 100 years ago but have since been filled. However, this is considered a preliminary finding due to data limitations of the historical wetlands map. MAPC is continuing to conduct research to evaluate the connection between historic wetlands and stormwater flooding in a more robust way.

We recommend the following actionable recommendations for federal, state, and local measures:

- Enable more widespread access to flood claims data. Federal privacy requirements privilege the privacy rights of current property owners over the needs of municipalities to identify and respond to flood risk, and over the rights of the public to be informed of risk.
- Require flood history disclosure. Massachusetts is one of only 15 states that has no disclosure requirements for potential home buyers. Renters also need to be aware of risks to their properties.
- Finance property retrofits and repairs. MEMA should apply to the federal Storm Act that provides funding for hazard mitigation revolving loan funds. The state and municipalities can also set up programs that provide financial and technical assistance to property owners at risk of flooding.
- Provide more funding for stormwater management. Repairs to aging infrastructure and additional green and gray infrastructure is required to meet the increasing flood risks we face. This is especially important in highly urban locations that are home to environmental justice populations.
- Strengthen development and building regulations. Updated flood overlay districts and stormwater regulations, and common-sense building code improvements, like raising utilities by at least six inches, can help limit the disruption and financial impacts caused by stormwater flooding.

- Adopt innovative insurance strategies to assist low-income households. Many insurance programs are not affordable for low-income households and are slow to reimburse costs. Some places have started providing insurance funds up-front, addressing the gap of not having access to cash immediately after a flooding event.
- Continue to investigate the causes and impacts of stormwater flooding. Our analysis points to the need for additional research into groundwater and wetlands dynamics, as well as impacts on Environmental Justice populations. Ongoing study of flooding events, and interviews with affected residents, are needed to improve our capacity to reduce future flooding.

Through our policy and legislative work, MAPC will pursue the adoption of these mitigation measures, which would benefit not only our region, but also the entire state. These are critical actions needed to achieve the vision for an equitable and resilient region as called for in [MetroCommon 2050](#), our long-term regional plan.

