Vulnerability & Risk Assessments Technical Reports

Climate Change Vulnerability Assessment

November 2015

City of Cambridge, Massachusetts

Acknowledgments

City of Cambridge

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For more information on the project, please visit the City website at
http://www.cambridgema.gov/climateprep

Technical Reports

Ranking Reports Critical Infrastructure & Community Resources, Kleinfelder, 2015

Climate Change Vulnerability Assessment for the Urban Forest in Cambridge. U.S. Army Engineer Research and Development Center, Environmental Laboratory, March 2014

Vulnerable Population Ranking Memorandum, Kleinfelder, January 2015

Public Health Assessment, Patrick Kinney, Columbia University, May 2015

Economic Vulnerability Assessment, Catalysis Adaptation Partners, May 2015

Executive Summary

Climate change will impact our world in a variety of ways, creating more need than can adequately be borne by our current funding mechanisms. In the midst of such stressors, it becomes necessary that the City develop a process by which the most at-risk resources, assets and populations are identified. The vulnerability and risk assessment represents the core aspect of this work. It is the tool by which the City is able to sort through the numerous types of assets, resources and impacts to identify the most critical and urgent needs. Those elements identified as the most at-risk will become the primary focus of the *Climate Change Preparedness and Resilience Plan*. This assessment allows the City to prioritize its focus and funding on the most immediate and urgent needs while at the same time maintaining a close watch on other vulnerabilities that may become more critical in future years.

The key findings from the Vulnerability and Risk Assessments are as follows:

- Cambridge is more vulnerable to increasing heat and precipitation-driven flooding in the near future than to sea level rise and coastal storm surges. Part 2 of this report will address the risks of sea level rise and coastal storm surges based on modeling for 2070.
- Vulnerability will increase for key infrastructure – public transit, energy, roads and bridges, telecommunications, critical service facilities – due to greater precipitation-driven flooding in the near term and long term.
- Heat waves and poor indoor air quality will become increasingly challenging public health concerns in the near future.
- Vulnerability is not evenly distributed among neighborhoods or households. People who are more isolated due to infirmity, age, or language and those with lower incomes are more vulnerable.
- Economic losses from a flood event or an area-wide power loss would be significant. A citywide event shutting down Cambridge is estimated to cause at least $43 million (in current dollars) in daily economic losses. Losses from disruption of economic activity are greater than the costs of property damage.
- Climate change threatens regional systems that Cambridge depends on, such as public transit and electricity. An unprecedented level of coordination and cooperation among agencies, cities, the state, businesses, institutions, and residents will be required to prepare effectively for climate change.

Map 1: Planning Priority Areas Map (Source: Kleinfelder, November 2015)

The Priority Planning Areas Map (Map 1) summarizes the most at-risk services and populations, with respect to climate change within the boundaries of Cambridge. It represents a risk assessment that compares seemingly unrelated resources, such as public health and the transportation system, and compares the risks within each (e.g., what is the greatest public health concern?) as well as between them (e.g., how does the risk of an overheated school rate against the risk of a flooded MBTA station?).

The Priority Planning Areas Map clearly illustrates that risk from climate change, posed by flooding and increased heat, is not evenly distributed throughout the City. Northern Cambridge and eastern Cambridge have relatively more physical and social vulnerability. Risk does exist elsewhere, but from a citywide perspective, the at-risk resources shown here would cause impacts to large segments of the population, often accompanied by significant economic, public health, and social effects.

Flooding has obvious implications in causing physical damage to buildings and infrastructure, as well as making areas inaccessible and creating an immediate public safety concern. There are also public health consequences associated with flooding events. Flooding can carry contaminants into buildings and create conditions for indoor mold growth. This has significant

negative impacts on indoor air quality. This risk is exacerbated in buildings that have poorly sealed exterior windows and roofs and those that use forced hot air, which can become a conveyor of air from damp basement areas. Indoor dampness is well known to be a cause of adverse respiratory effects. Any residential or commercial structure that experiences flooding can face potential long-term challenges related to contamination and mold growth and their remediation if not prepared for this consequence.

Heat vulnerability, to both people and to infrastructure, is a major, possibly underappreciated, risk to the community. Factors that contribute to vulnerability in cities include:

- the urban heat island effect, which can amplify the impacts of rising temperatures;
- areas with minimal tree canopy;
- a relatively high proportion of older housing stock that may be poorly adapted to hot weather due to lack of adequate natural ventilation or air conditioning; and
- equipment not suited for higher temperatures.

From a public health perspective, heat has been the largest single weather-related cause of death in the U.S. since the National Oceanic and Atmospheric Administration (NOAA) began reporting data in 1988. Fortunately, heat impacts on health are the most well understood, measureable, and potentially preventable impacts of climate change.

The project team worked closely with public health scientists, critical service providers and social service professionals to develop a first-order assessment of social impacts. The results indicate that social vulnerability is not evenly distributed among the neighborhoods. Portions of North Cambridge, Area 4, and Alewife are relatively more vulnerable to flood and heat impacts compared to other parts of the city based on greater presence of elderly, young, and social isolation.

There are also economic repercussions associated with a significant climate change event, such as substantial flooding or power failure caused by extreme heat. Such an event could impact the City's 128,000 jobs and result in a loss of $43 million per day (in current dollars) within Cambridge alone. Such interruptions fall heaviest on minimum wage workers with dependents and jobs that cannot be performed from home.

The impacts of flooding and the urban heat island effect transcend municipal boundaries. Cambridge and neighboring municipalities rely on regional systems outside of their direct control for energy and transportation services, among others. When regional infrastructure outside of Cambridge is impacted, Cambridge may feel the effects. Similarly, impacts to infrastructure in

Cambridge can have ripple effects elsewhere in the region. Regional coordination among cities, agencies, and organizations on adaptation planning and implementation will be needed to address these systematic risks.

For additional details about the vulnerability and risk assessments, including how they were carried out and what they found, please refer to the following reports attached to this Appendix:

Ranking Reports Critical Infrastructure & Community Resources, Kleinfelder, 2015

Climate Change Vulnerability Assessment for the Urban Forest in Cambridge. U.S. Army Engineer Research and Development Center, Environmental Laboratory, March 2014

Vulnerable Population Ranking Memorandum, Kleinfelder, January 2015

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