Route 44 and Route 104 in Taunton
Photo Credit: National Weather Service

Massachusetts Department of Public Health

INLAND FLOODING

CLIMATE HAZARD ASSESSMENT PROFILES

2016

OVERVIEW

Flooding is a common event in Massachusetts. Some floods develop slowly, while flash floods can occur within minutes or hours after a storm. Over 400,000 Massachusetts residents live in a 100 year flood zone – greater than a 1 in 4 chance of flooding during a 30-year mortgage.

HOW ARE PEOPLE EXPOSED?

Inland flooding may result in exposure to dangerous flood water and debris. Disruption of infrastructure (e.g., septic/sewage/wastewater treatment facilities, electric grid, transportation, and communication systems) may result in exposure to extreme cold or heat, unsafe food and drinking water, loss of access to medical services, and mold growth in homes and buildings. Individuals may also be exposed to waterborne pathogens (e.g., bacteria) and/or toxic chemicals that contaminate food and drinking water sources, or by wading through contaminated flood water.

WHAT ARE THE HEALTH EFFECTS?

The most serious health effects associated with exposure to inland flooding are injury and death. Flooded streets and roadblocks can make it difficult for emergency vehicles to respond to calls for service. Property damage and displacement of homes and businesses can lead to loss of livelihood and long-term mental stress for those facing relocation. Individuals may develop post-traumatic stress, anxiety and depression following inland flooding. Health effects also include increases in food- and water-borne illnesses, exacerbation of pre-existing diseases, and increases in respiratory illnesses from exposure to mold.

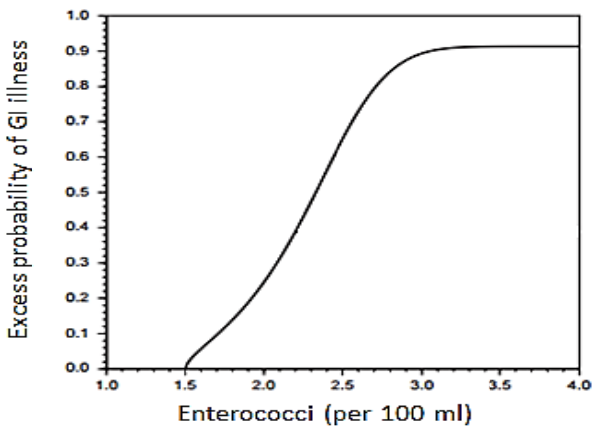
HOW WILL CLIMATE CHANGE MAKE THINGS WORSE?

Many Massachusetts communities are supported by infrastructure more than 100 years old that is in need of repair or replacement and designed using outdated estimates of precipitation and flooding. From 1958 to 2010, there was a 70% increase in the amount of precipitation that fell on the heaviest precipitation days. Heavy rainfall events are projected to increase during this century and lead to increased inland flooding. Increases in the frequency of major hurricanes and stronger storms are also predicted.

WHAT ARE THE EXPOSURE AND RELATED HEALTH RISKS FROM EXTREME WEATHER EVENTS?

Below is a conceptual approach to assess climate-related health risk based on exposure to the climate hazard. First, the relationship between the levels or exposure to the hazard that elicits a health response is derived from scientific literature. For example, below illustrates the relationship or exposure-response function between bacterial (Enterococci) concentrations that are often elevated in flood waters [exposure] and risk of gastrointestinal (GI) illness [response].

Figure 1: Relationship Between Bacterial (Enterococci) Concentrations and Risk of Gastrointestinal (GI) Illness*



Second, potential health risks can be estimated by applying the exposure-response function derived from Figure 1 to varying levels of exposure across the community. For example, the table below illustrates that as the magnitude of exposure to contaminated drinking water increases from low to high, the risk of GI Illness increases from low to critical.

Exposure to Contaminated Water	Pathogen Concentration: Low		Pathogen Concentration: High
	Moderate	Severe	Critical
	Low	Moderate	Severe
	Low	Low	Moderate

WHAT ARE THE FACTORS THAT INFLUENCE HEALTH RISKS FROM INLAND FLOODING?

Below are examples of factors that may increase vulnerability to health risks from inland flooding. These factors need to be considered in adaptation planning to reduce vulnerability to the health impacts of climate change.

SOCIODEMOGRAPHIC

- Individuals over 65
- Individuals over 65 and living alone
- Children under 5
- People of Color
- People living in poverty
- The homeless
- People with limited English proficiency
- Renters

PRE-EXISTNG HEALTH CONDITIONS

- Adults with respiratory disease (e.g., asthma, COPD) and cardiovascular disease
- Children with respiratory disease (e.g., asthma)
- Individuals using electricity dependent medical equipment and/or medications that need refrigeration.
- Individuals with disabilities or mobility problems
- Individuals with mental health challenges

ENVIRONMENT

- Degraded water quality
- River and stream bank erosion
- Ecosystem damage
- Damage to waterways and aquatic resources
- Damage to parks and recreational land

INFRASTRUCTURE

- Interruption of utilities (e.g., electricity, phone, cable)
- Failure of wastewater treatment systems
- Loss of safe drinking water
- Disruption of transportation and communication systems
- Loss of access to medical services
- Food and supply shortages

What Intervention Strategies Can Increase Adaptive Capacity for Inland Flooding?

DPH's Bureau of Environmental Health (BEH) is providing support to local health departments to increase their capacity to address the additional health burden associated with climate change at the local level. We also coordinate with other DPH programs and state agencies engaged in responding to the aftermath of inland flooding. As part of this effort, we are also promoting local adaptation strategies to reduce harm from inland flooding identified in the Massachusetts Climate Change Adaptation Report http://www.mass.gov/eea/waste-mgnt-recycling/air-quality/climate-change-adaptation/climate-change-adaptation-report.html including:

Short-term

- Increase the use of climate and weather information in managing storm water/flood risk and individual events
- Identify critical facilities and infrastructure at risk from flooding, such as water and sewer facilities susceptible to intrusion and implement modifications that decrease potential flood damage, and/or removing of critical infrastructure from vulnerable areas
- Assess capability to deploy power generators and water pumps to medical facilities
- Encourage preparedness in the home, in schools, in the work place, and at healthcare facilities
- Develop communication and outreach plans to raise public awareness of evacuation routes, flood zones, and response plans
- Support implementation of DPH's Mass in Motion and other Wellness programs to increase community resilience http://www.mass.gov/eohhs/gov/departments/dph/programs/community-health/mass-in-motion/
- Implement actions to prepare for storms from BEH's Community Sanitation Program http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/comm-sanitation and the Office of Preparedness and Emergency Management (OPEM) emergency preparedness program http://www.mass.gov/eohhs/gov/departments/dph/programs/emergency-prep/
- Implement actions to address mold from the aftermath of a storm http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/iaq/pollution/mold/

Long-term

- Incorporate information on projected increases in precipitation into community planning, transportation, and public works projects
- Promote workforce development to train public health staff to respond to climate change-related health threats

*Reference for Figure 1: Kay, David, et al. "Derivation of numerical values for the World Health Organization guidelines for recreational waters." Water Research 38.5 (2004): 1296-1304.

For more information about the health impacts of climate change contact the MDPH Climate and Health Staff
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