Tufts University

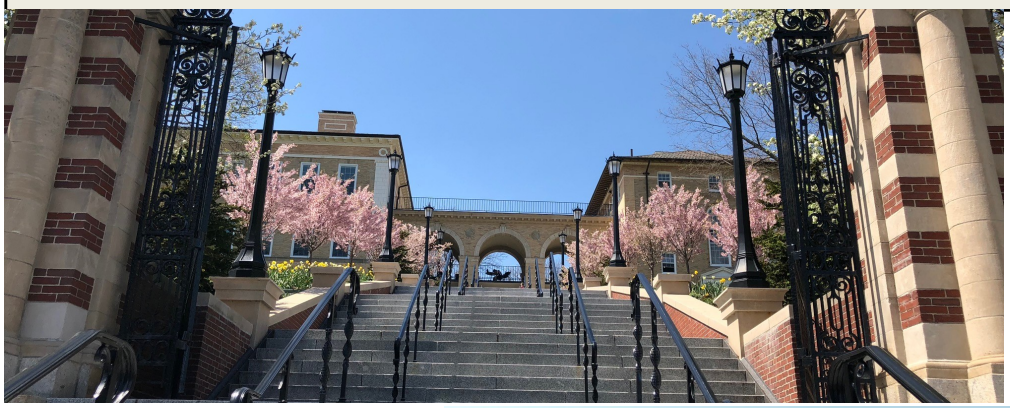


Photo Credits: Tufts University; Adam Whelchel/TNC

Community Resilience Building Workshop

Summary of Findings

May 2018

Tufts University
Community Resilience Building Workshop
Summary of Findings

Overview

The need for academic institutions, municipalities, regional planning organizations, states and federal agencies to increase resilience and adapt to extreme weather events and a changing climate is strikingly evident amongst the communities of the Commonwealth of Massachusetts. Recent events such as Tropical Storm Irene and Sandy have reinforced this urgency and compelled leading communities like Tufts University to proactively collaborate on planning and mitigating risks. Ultimately, this type of leadership is to be commended because it will reduce the vulnerability of faculty, staff, and students, infrastructure, and ecosystems and serve as a model for other communities in Massachusetts, New England, and the Nation.

In fall of 2017, the City of Medford joined the Commonwealth's Municipal Vulnerability Preparedness program, formed a core team including Tufts University students, and conducted a Community Resilience Building (CRB) Workshop facilitated by the Nature Conservancy in March 2018. This engagement lead to further community interest resulted in a CRB Workshop for Tufts University (May 2018). Prior to these engagements, Tufts University signed the Presidents' Climate Commitment (2016), which commits the University to increasing resilience to climate change through partnerships across the campus and community. The core directive of these effort was the engagement with and between community stakeholders to facilitate the education, planning and ultimately, implementation of priority resilient actions. The Workshop's central objectives were to:

- Clarify and advance comprehensive community resilience planning and hazard mitigation efforts.
- Propel action recommendations in Hazard Mitigation Plan and integrate resilience priorities into capital improvement budget.
- Complete an initial Campus Community Resilience Assessment to advance Tuft's Climate Commitment.
- Gain additional insights from community to better inform ongoing hazard mitigation efforts at Tufts University.

For the Workshop, Tufts University employed a unique "anywhere at any scale", community-driven process known as the Community Resilience Building (CRB) Workshop (www.CommunityResilienceBuilding.org). The CRB's Risk Matrix and various data and maps were integrated into the Workshop process to provide both decision-support and risk visualization around shared values and priorities across Tufts main campus. The principle data and maps used were previously compiled and/or generated as part of Tufts Hazard Mitigation Plan and Medford's Climate Vulnerability Assessment which were both in final draft at the time of this Workshop. Using the CRB process, rich with information, experience and dialogue, the participants produced findings which are outlined in this summary report. The following Summary of Findings provides an overview of the top hazards, current concerns and challenges, current strengths, and proposed action priorities to improve the resilience of Tufts University to natural and climate-related hazards today and in the future.

The workshop findings transcribed in this report, like any that concern the evolving nature of risk assessment and associated action, are proffered for comments, corrections and updates from workshop attendees and additional stakeholders alike. The leadership displayed by Tufts University with Community Resilience Building will benefit from the continuous and expanding participation of all those concerned.

Summary of Findings

Top Hazards and Vulnerable Areas for the Community

Extreme heat, extreme precipitation and flooding, hurricanes and nor'easters, and infectious diseases were predetermined as hazards of greatest concern for Tufts University based on the recently completed threat and hazard risk identification assessment. These hazards have direct and increasing impacts on Tufts faculty, staff, and students and resources such as its student housing and welfare, food supply and distribution, stormwater drainage systems, social network support for vulnerable populations on campus, utility and energy continuity, and other critical infrastructure and community assets.

Top Hazards and Areas of Concern for the Community

Top Hazards

- Extreme Heat
- Extreme Precipitation and Flooding
- Hurricanes and Nor'easters
- Infectious Disease

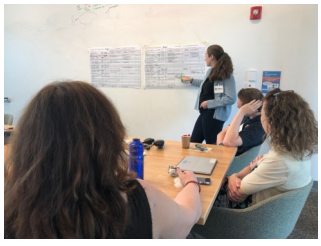
Areas of Concern

Infrastructure: Art Gallery loading dock and music building; gas boilers at Tilton + Cousins; food storage facilities in Dining Halls; Vivariums; IT networks in buildings; stormwater drainage system; Ballou Hall, Eaton Hall and East Hall flooding; Cousins area and lower campus flooding; aging residence halls; water supply system; day care center and preschool; commuter infrastructure (MBTA); Quarantine areas (Carmichael); Dewick; refrigeration for medicines and vaccines; outdated HVAC controls in residence halls; wood-frame houses; mechanical, electrical, and plumbing (MEP) system; Gantcher; boathouse on Malden River; sailing pavilion on Upper Mystic Lakes.

Roads: Powerhouse Boulevard; Route 16; Boston Avenue; Talbot Road.

Societal: International students; students from outside the New England area; faculty and students on campus; off campus students; elderly population in Tufts owned buildings; children at day care center and Elliot Pearson school; critical support staff; disabled/impaired/special needs community members; food supply and distribution for on campus community; emergency preparedness; contracted employees and summer residents.

Environment: Mystic River; aging trees; trees near buildings; stormwater retention capabilities; impervious surfaces; Vivarium animal populations; toxic chemicals in labs; open spaces on campus; heat absorbing roofs.



(Credit: Adam Whelchel/TNC)

Current Concerns and Challenges Presented by Hazards

Tufts University has several concerns and faces multiple challenges related to the impacts of natural hazards and climate change. In recent years, Tufts University has experienced a series of highly disruptive and damaging weather events including Tropical Storm Irene (August 2011), Tropical Storm Sandy, (October 2012), winter Nor'easter Juno (January 2015), and many other disruptive events. Impacts from Irene included heavy rain-induced, inland flooding and wind damage. Sandy caused extensive power outages across large portions of Somerville and Medford. Juno dropped nearly 36" of snow on campus, knocking out power and isolating residential halls and neighborhoods. The magnitude and intensity of these events and others across Massachusetts has increased awareness of natural hazards and climatic change, while motivating communities like Tufts University to comprehensively improve resilience.

This series of extreme weather events highlights that for Tufts the impacts from hazards are diverse; they range from flooding of surface streets and low-lying facilities during heavy precipitation events to property damage from trees, wind, snow, and ice. Longer periods of elevated heat, particularly during July into September, have raised concerns about vulnerable groups like students living in older residence halls without air conditioning. The combination of these issues presents a challenge to preparedness, response and mitigation priorities and requires comprehensive yet tailored actions for particular locations and/or areas across Tufts University.

The workshop participants were generally in agreement that Tufts University and the surrounding communities of Somerville and Medford are experiencing more intense and frequent storms events and heat waves. Additionally, there was a general recommendation that staff, faculty, and students prepare with contingency plans for worst case scenarios during different times of the year particularly in the fall/winter due to more intense storms.

(Credit: Adam Whelchel/TNC)

(Credit: Adam Whelchel/TNC)

(Credit: Adam Whelchel/TNC)

Specific Categories of Concerns and Challenges

Food Systems

Universally, across all workshop groups the issue of food storage, supply, and distribution was raised. Much of the focus was directed to the two dining halls on campus that currently do not have the backup generators needed to safely extend the food storage capabilities and prevent spoilage during power outages. Concerns also surfaced around the availability of the dining workforce to safely get to campus and distribute food to the community during major events.

Stormwater Drainage Management

There was a concern raised about the current need to accelerate comprehensive planning and implementation of a stormwater drainage management across Tufts University. Universally, participants recognized that greater resources and capacity should be directed to improving the ability to maximize infiltration across campus via an increase in pervious pavement and green stormwater infrastructure (rain gardens, bioswales, green roofs, etc.). Increasing localized infiltration was identified as a solution to reduce nuisance flooding and standing water (which can harbor disease vectors) around routinely impacted buildings and walkways on campus. In addition, there was discussion of increasing the storage or detention capacity on campus as a contingency for more intense and frequent rain and snow events in the future. Recommendations also focused on connecting a stormwater plan with campus-wide forestry/landscaping/hardscape plans and future upgrades.

Quarantine Facilities/Protocols

Infectious disease is a serious concern given the high density and demographics of the student body and opportunities to make improvements in current response facilities and protocols were surfaced. These included improving the ventilation and HVAC capacity for the existing quarantine rooms in Tilton, Hodgdon, and Carmichael Halls. In addition, there is a general lack of awareness about basic hygiene and disease prevention among the student body that could be rectified via educational outreach. Finally, there was a recommendation for greater protocols or guidance (in coordination with municipal and state) on how to manage and contain outbreaks that would enable uninfected faculty and students to participate in courses remotely to avoid contact with infected population that are not quarantined.

Student Housing and Wellbeing

Many participants surfaced concerns about the 43 different buildings being used for student housing which largely revolved around updating HVAC and improving ventilation. In addition, there was a call for the health services to be responsive to student needs 24 hours a day - particularly during winter months. Also, an increased emphasis on handicapped and disabled students and faculty, international students, and quarantined students, as it relates to shelter, safety, and mobility during disasters was identified. These concerns expanded off campus given the large population of undergraduate students living in the surrounding neighborhoods.

Staff and Faculty Support and Services

Challenges around access to campus by staff and faculty during extreme events were voiced along with a request for flexibility to work remotely in order to be responsive to the needs of their own families' safety. Clearly, there is a need for clarity as to which campus functions and support staff are considered essential (i.e. select Facilities and Dining, Operations, etc.) to ensure rapid recovery and continuity of services.

Current Strengths and Assets

Because of the recent experiences with extreme weather, Tufts University is well acquainted with existing and shared strengths across their community and with the municipalities of Somerville and Medford. Reinforcing best practices and enhancing available assets will generate greater benefits to the University through increased resiliency to more frequent and intense storms, as well as to long term impacts from the ongoing increases in air temperature, precipitation, and drought.

- Clearly, the responsive and committed leadership exhibited by top administrators and staff at Tufts is a very appreciated strength by the workshop participants. Ongoing collaboration between faculty, staff, and students along with the public safety, emergency management, and sustainability personnel in Somerville and Medford on the priorities identified by the community herein will help to advance comprehensive, cost-effective approaches to resilience.
- The University has solid, highly experienced, emergency management and public safety staff with access to adequate, but limited, resources for shorter duration events. The overarching coordination amongst various departments including Facilitates and Operations, Public and Environmental Health and Safety, Sustainability, Emergency Management, Police, Fire, and EMS was cited as an ongoing, and highly valued community strength including the recent update of the Hazard Mitigation Plan for all four campuses.
- Recent construction and completion of the CoGen Plant on campus coupled with a limited number of generators to efficiently meet current demands, maintain power continuity during disruptions, and reduce dependency on a multi-source electrical grid.
- Mental and health care services and centers present on campus including the chaplaincy and interfaith center, student health center, staff wellness center, quarantine rooms used during infectious disease outbreak and attention to disabled community members are solid and reliable strengths on campus.
- Opportunities to further cultivate partnership between Tufts University. Somerville, and Medford to accelerate mutual resiliency.

Credit: Adam Whelchel/TNC

- Highly active and engaged student group community on campus..
- High concentration of well-educated individuals (built-in knowledge base) and facilities were identified as an existing strength worth cultivating and applying more directly to improve the overall resilience of the surrounding areas.

Top Recommendations to Improve Resilience

A common thread throughout the workshop discussions was the recognition that Tufts University will benefit from better preparedness through longer term, comprehensive planning across all areas of concern. This need and additional core highlights surfaced by the Workshop participants are addressed below.

Highest Priority

- (1) For the two dining facilities there is a need to secure back-up generators to minimize impacts during power outages, and to explore the use of battery storage to increase access to and redundancy of power. This will help to ensure the storage and availability of food for faculty, staff, and students that remain in campus during major events (i.e. food supply, distribution, storage).
- (2) Work to make improvements to the mechanical, electric, and plumbing (MEP) systems on campus. This should include, where appropriate, updating HVAC systems in preparation for extreme temperature situations and providing ventilation to prevent infectious disease spread; installing backflow preventers to protect from extreme precipitation-based flooding risks; and running wires underground to protect utilities from hurricanes and nor'easters.
- (3) Enhance human welfare for faculty, staff, students during disruptive events.
- (4) Ensure that non-critical, support staff have plans in place to enable the establishment of remote work options in the event of an emergency that closes campus.
- (5) For international students, establish liaisons via International Center to help students find safe places to stay during and after an emergency as needed.
- (6) Develop long-term forestry and landscaping master plan (locations, priorities, funding) to include a tree assessment (550 trees on campus currently) of all trees susceptible to damage from strong winds, a treatment plan and/or replacement component that favors installation of native, drought resistant species, and prioritization of drought resilient landscaping for campus.

Community Resilience Building Workshop Recommendations

Highest Priority (cont'd)

Credit: Adam Whelchel/TNC

- (7) While both Vivariums on campus have diesel generators that can run for about 24 hours on full tanks, there is a need to identify and secure an alternate energy source for longer-term needs beyond 24 hours to ensure the animals are properly cared for.
- (8) Conduct comprehensive inventory of surfaces and subsurface infrastructure across campus to identify specific opportunities to replace (or "depave") impermeable hardscaping with permeable pavement and/or green stormwater infrastructure to maximize local infiltration and alleviate stress on stormwater drainage infrastructure.
- (9) Look to secure a long-term stormwater drainage system plan that prevents standing water and helps to alleviate flooding on campus and maximizes the use of green infrastructure and localizes infiltration. This should include and help to strengthen a working partnership with municipalities to keep the system maintained and working routinely under all conditions, as well as reducing the impacts from man-holes popping out and damaging vehicles during major flooding events.
- (10) Look to augment a comprehensive energy supply/distribution system with generators for select locations/buildings and look to add battery storage capacity.
- (11) At Tisch Library, need to add cooling options and consider the ability to shelter residents from the surrounding community during major events.
- (12) City needs to develop through broad public outreach a coordinated and comprehensive evacuation plan. Plan should connect and help coordinate the availability/needs of sheltering and cooling facilities.
- (13) Ensure buildings and personnel can continue research projects that require power (i.e. refrigeration of samples) despite potential power interruptions during emergencies.

Community Resilience Building Workshop Recommendations

High Priority (cont'd)

- (14) For campus building that experience flooding, including Ballou need to incorporate solutions into the comprehensive stormwater drainage management plan.
- (15) Need to set up shelter in place policy for Elliot Pearson Children's School and the Bright Horizons childcare center in the event guardians are not able to reach school during emergencies. If emergency staff are single parents, ensure emergency shelter options are in place for dependents. In addition, identify most at-risk populations and have emergency plan in place related to children and guardians as well as preschool staff.
- (16) Reduce load demand to campus to help minimize strain and need for electricity provided from the Medford grid by increasing the number of back-up generators and adding renewable energy (solar) and battery storage.
- (17) For on campus health care (Health Services Clinic, Wellness Center) reevaluate medical personnel needs during emergencies. In addition, review and update protocols related to infectious diseases management across campus.
- (18) Strengthen outreach to area hospitals to better understand collaboration and co-support options in the larger health care community in Somerville and Medford.
- (19) For residential halls (43 buildings on campus) enhance cooling and heating capacity where needed as well as plant additional trees around circumference of building to reduce ambient air temperatures.
- (20) Run annual preparedness drills for infectious disease outbreaks and define capacity to secure and house vaccines under refrigeration in response to outbreaks.
- (21) Conduct risk assessment of IT infrastructure to determine ability to support the campus at all times under any condition and the ability to support functions remotely.
- (22) Establish work from home options and stay on campus options as needed and required and assurances for job security if an employee can't stay at or get to work.

Community Resilience Building Workshop Recommendations

High Priority (cont'd)

- (23) At the CoGen Plant continue to maintain and improve performance as able, ensure supply of gas (propane, natural gas, CNG) after extreme events, prioritize buildings on campus/create a list of buildings that require immediate energy recovery post disaster (dining/food storage, lab refrigeration) (there are 80 buildings on system); continue to storm harden plant, and consider options to reduce load and increase redundancy via solar projects on campus.
- (24) Conduct targeted outreach with Medford and Somerville administration and emergency management personnel about procedures to ensure students, staff, and faculty with special needs are properly identified for emergency management purposes within the municipalities, if needed.
- (25) Increase awareness and education about existing arbor plan and links to resilience.
- (26) Coordinate appropriate campus staff and offices to locate handicapped students and provide disability services before, during, and after emergency.
- (27) Consider 24 hour health services during major impactful events.
- (28) For campus emergency communications continue to maintain and test regularly via email, texts, and phone calls including the "Blue Lights" system.. Look to clarify who is responsible for communications and during what type of events.
- (29) Continue to strengthen communications and coordination between campus health care staff and staff at the three area hospitals.

Credit: Adam Whelchel/TNC

- (30) Enhance energy continuity at health care facilities on campus and generate plans to sustain isolation if needed during prolonged infectious disease outbreaks.

Community Resilience Building Workshop Recommendations

High Priority (cont'd)

- (31) For residential life staff continue to conduct regular training and enhance communications regarding emergency procedures and responses.
- (32) Enhance access and egress routes for dormitories that builds on the 8-10 buildings prioritized already.
- (33) Contract with snow removal contractor for additional services to ensure shuttle system routes are maintained during and after events.
- (34) Maintain and update as needed sheltering plan at Gantcher Field House with ability to shelter residents from community.
- (35) The Tufts Emergency Medical Services and the student run emergency ambulatory service should be maintained as a significant asset for campus.
- (36) Continue to conduct education tours and outreach regarding sustainability and resilience at Tufts to highlight advancements that serve as both motivator and model.

Moderate Priority

- (37) Establish hydration stations and additional cooling stations on campus and re-visit hand sanitation access.
- (38) Connect emergency management team with counseling staff at chaplaincy and strengthen partnerships with local community religious leaders in Somerville and Medford.
- (39) Elderly groups that use the Administrative Building owned by Tufts so campus may be responsible for their care during hazardous events.
- (40) Ensure there are volunteer leaders trained on emergency management and prevention plans during summer camps and conferences.
- (41) Need to strengthen building-based IT networks via Tufts Technology Services.

Community Resilience Building Workshop Recommendations

Moderate Priority (cont'd)

- (42) For contracted employees with language barriers, cultivate volunteer leaders with language knowledge within community that are trained on emergency management plans. In addition, secure language translation services for emergency communications and add additional languages to Tufts alerts.
- (43) Accelerate stormwater management planning effort to incorporate the location and extent of natural groundwater infiltration features in plans.
- (44) Increase the tree canopy in open spaces on campus.
- (45) Maintain existing and install additional rain gardens as suitable and as identified in master plan. Encourage adoption by student groups associated with proximate residence halls.
- (46) Update existing gas boilers to ensure continuity of heat to service Cousins and Tilton along with other buildings on this system.
- (47) Set up quarantine and health system that is not reliant on local hospitals and consider mobile housing for infected students in coordination with public health departments at local and state levels.

Source: http://admissions.tufts.edu/visit/parking-and-directions/

Community Resilience Building Workshop Recommendations

Moderate Priority (cont'd)

- (48) Need to have education about basic hygiene and infectious disease prevention among student body.
- (49) Need to establish a resilience plan for campus buildings with carbon credits cost/benefit analysis.
- (50) Provide online classes and encourage remote learning during infectious disease outbreak events on campus. In addition, cancellation of large events/group gathering during infectious disease outbreaks.
- (51) For the stormwater detention infrastructure assess potential of increasing current overflow storage detention capacity (1 million gallons) at Tufts Athletic Fields to help reduce impact to Medford drainage system and to create more connections to existing retention system.
- (52) Conduct study to determine optimal use of green, white, blue roofs options across buildings on Campus (i.e. Barnum and Dana redevelopment). Study should take into account wind, precipitation, and heat.
- (53) For Memorial Steps continue to maintain the reduction of ponding due to smart engineering and heated steps.
- (54) Continue to support alternative transportation options including - zipcar, bike racks, hubway (now Blue Bikes), 2 parking garages, and T pass deductions (i.e. 35%).
- (55) For the critical laboratories on campus check that Haz/Mat and power continuity prioritization plans exist and are up to date. In addition, conduct education sessions with lab directors, support staff, and students to ensure readiness.
- (56) Need to continue to work to connect buildings south of Boston Avenue to the central plant or provide alternative power sources.
- (57) Registration faculty, staff, and alumni in an "I am willing to help/host" and increase preparedness training for these key members of the campus community of various situations (hurricane, snow storms, heat waves, etc.).
- (58) Allow faculty and staff to bring children to work when municipal elementary schools close.

Moderate Priority (cont'd)

- (59) For off-campus students coordinate with municipalities and students to tie into emergency management services. Tufts should coordinate with cities to help encourage landlords of students to improve the resilience of their buildings in low lying, flood-prone areas.
- (60) Continue Community Days at Tufts and look to strengthen connections through community meetings and activities with surrounding neighborhoods. Invite community members to use facilities at Tufts and hold listening sessions between community members and campus community focused on improving overall resilience.

Lower Priority

- (61) Seek ways to utilize gray water from MWRA for landscape irrigation.
- (62) Consider shifting academic calendar to avoid excessive heat late summer/ early fall.
- (63) Establish emergency contact plan for guardians associated with on campus day care facility and have facility keep children inside during major events.
- (64) Extend dialogue with MBTA to communicate needs and expectations of Tufts community and increase education and situational awareness for Tufts community related to transportation options.
- (65) Monitor risk of flooding over time from the Mystic River to campus facilities.

Credit: http://now.tufts.edu/articles/planning-worst

Credit: Adam Whelchel/TNC

Community Resilience Building Workshop Recommendations

Lower Priority (cont'd)

- (66) Identify which students are EMS/EMTs and engage them in campus planning for emergencies.
- (67) Connect with student groups including Graduate student council, Eco Reps, and Residential Life student staff to activate a broader and deeper communication strategy for emergency communications.
- (68) Work to increase the use of green infrastructure on roofs across campus.
- (69) Incorporate ways to increase the biodiversity on campus through installation and maintenance of native landscaping and smart uses of spaces and water.
- (70) Promote education on solutions that using Campus as a living laboratory; Involve multi-disciplinary teams from OOS, UEP, Wellness, Health, Sciences.
- (71) Need to determine accessibility of chaplains during emergencies. Inter-faith center on campus is in fact a smaller, tight-knit community that can be utilized for communications and outreach.

Credit: Adam Whelchel/TNC

Credit: Adam Whelchel/TNC

CRB Workshop Participants: Department/Authority/Organization/Business

Tufts University - Office of the Executive Vice President
Tufts University - Facilities Services (Arborist, Campus Services, Building Operations, Engineering, Controls, Residential Facilities)
Tufts University - Office of Sustainability
Tufts University – Environmental Health and Safety
Tufts University – Police Department
Tufts University - Undergraduate Students
Tufts University - Health and Wellness Services
Tufts University - Office for Campus Life
Tufts University - Graduate Students (Urban and Environmental Policy and Planning)
Tufts University - Faculty (Urban and Environmental Policy and Planning)
Tufts University - Construction
Tufts University - Strategic Capital Programs
Tufts University - Campus Planning
Tufts University - Dining & Business Services
Tufts University - Faculty (Environmental Studies)
Tufts University - Faculty (Earth and Ocean Sciences)
Tufts University - University Counsel
Tufts University - Finance Department
Tufts University - Technology Services (TTS)
Tufts University - Emergency Medical Services (TEMS)
Tufts University – Faculty (Environmental Studies and Anthropology)
Tufts University - Art Gallery
Tufts University – Provost's Office
City of Medford - Office of Energy and Environment
City of Somerville - Office of Sustainability and Environment
Massachusetts Emergency Management Agency

Recommended Citation

Woolston T., Bartlett G., Conroy E., Lehrenbaum S., Woodside R., and A. W. Whelchel (2018). Tufts University Community Resilience Building Workshop Summary of Findings. Tufts University, The Nature Conservancy, Second Nature. Medford/Somerville, Massachusetts.

CRB Workshop Project Team: Organization and Role

Tufts University Core Team

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Sophie Lehrenbaum - Tufts University Student

Facilitation Team

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Second Nature – Ruby Woodside (Facilitator)
The Nature Conservancy - Kristie Giannetto (Facilitator)
The Nature Conservancy - Sara Burns (Facilitator)
A Better City (and Medford resident) - Yve Torrie (Facilitator)
Julie Wormser (Facilitator)

Scribes (Tufts University Students)

Darya Mattes, Ivy Mlsna, Paulina Muratore, Tyler Stotland, Reed Collins

Acknowledgements

Special thanks to Tufts University leadership, staff, faculty, and students for their willingness to embrace this process in hopes of a more resilient future for University. Additional thanks to the City of Somerville and Medford staff as well as representation from the Massachusetts Emergency Management Agency for their contributions during the workshop. Thanks as well to Tufts University for providing convening space on campus and for providing refreshments and food. Finally, thanks to the scribes that recorded the workshop dialogue.

This project was made possible in part through the generous contribution of the facilitation team by The Nature Conservancy and Second Nature (and other friends listed above) to conduct Tufts University's Community Resilience Building Workshop in close partnership with the Tufts Core Team.

Appendix

Base Map

Participatory Mapping - Base Maps

Tufts University Base Map

Group #1


CURTIS STREET
HOLLAND STREET
FAIRMOUNT AVENUE
WARE STREET
HARDAN ROAD
RAYMOND AVENUE
CONWELL AVENUE
CURTIS AVENUE
CHETWYND ROAD
ADAMS STREET
QUINCY STREET
HILLSDALE ROAD
OSGOOD STREET
TESLA AVENUE
WESTMINSTER STREET
ELECTRIC AVENUE
POWDER HOUSE BOULEVARD
OSSIPEE ROAD
BROADWAY
LOVELL STREET
SUNSET ROAD
UPLAND ROAD
EDISON AVENUE
CAPEN STREET
EMERY STREET
PACKARD AVENUE
TEELE AVENUE
WHITFIELD ROAD
SAWYER AVENUE
PROFESSORS ROW
WINTHROP STREET
MASON STREET
WHITMAN STREET
TILTON LANE
TALBOT AVENUE
LATIN WAY
HOUSTON FIRE LANE
MILLER LANE
BELLEVUE STREET
FAIRMOUNT STREET
BURNHAM STREET
LEONARD STREET
CAPEN STREET EAST
UNIVERSITY AVENUE
BOSTON AVENUE
UPPER CAMPUS ROAD
NORTH HILL ROAD
WALKER STREET
LOWER CAMPUS ROAD
CHARNWOOD ROAD
BENHAM STREET
BROOKINGS STREET
BURGET AVENUE
HUME AVENUE
SUNSET AVENUE
GREENLEAF AVENUE
COLLEGE AVENUE
DEARBORN ROAD
BROMFIELD ROAD
PEARSON ROAD
WARNER STREET
SAINT CLEMENTS ROAD
KNOLLWOOD ROAD
WOODBINE
WEDGEMERE ROAD
COLBY STREET
BOWDOIN STREET
WINDSOR ROAD
BRISTOL ROAD
HARVARD STREET
WINCHESTER STREET
BERWICK ROAD
BRADFORD AVENUE
PRINCETON STREET
YALE STREET
RADCLIFFE STREET
BENTON ROAD
WELLESLEY STREET
FLEMING STREET
BUZZELL LANE
RENFREW STREET
STERLING STREET
FREDERICK AVENUE
STANLEY AVENUE
STEARNS AVENUE
PEARL STREET
CHARLTON STREET
DARTMOUTH STREET
VASSAR STREET
WAREHAM STREET
MARION STREET
GRANVILLE AVENUE
MAIN STREET
HANCOCK STREET
HANCOCK AVENUE
ELIOT STREET
KENWAY STREET
BILLINGS AVENUE
Tisch Library
Eaton Hall
Cousens Gym Complex
Gantcher Field House
Bello Field
Dewick-MacPhie Dining Hall
Cohen Auditorium
Kraft Field
TUFTS UNIVERSITY POLICE DEPARTMENT
S
S
S
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S
S
V
V

Group #2


Legend
Fire Station
Police Station
Municipal Boundary
Other
Academic
Administrative
Athletic
Auxiliary
Courts
Parcel Owner
Fields
Greek
Housing, large
Housing, small
Research
Vacant
Parking
Walnut Hill
Fraternity
Flooding
Flooding

Group #3


TUFTS
VULNERABLE STUDENTS
EXPERTISE/COMMUNITY
VULNERABLE STREET
RESILIENT
WELL PREPARED
HOUSING DENSITY
NEIGHBOR NEEDS SUPPORT
FOOD STORAGE NEED
FLOOD
SEWER VILLE
NEDHAM
Legend
Fire Station
Police Station
Municipal Boundary
Other
Academic
Administrative
Athletic
Auxiliary
Courts
Fields
Greek
Housing, large
Housing, small
Parcel
Parking
Research
Vacant
Walnut Hill

Group #4

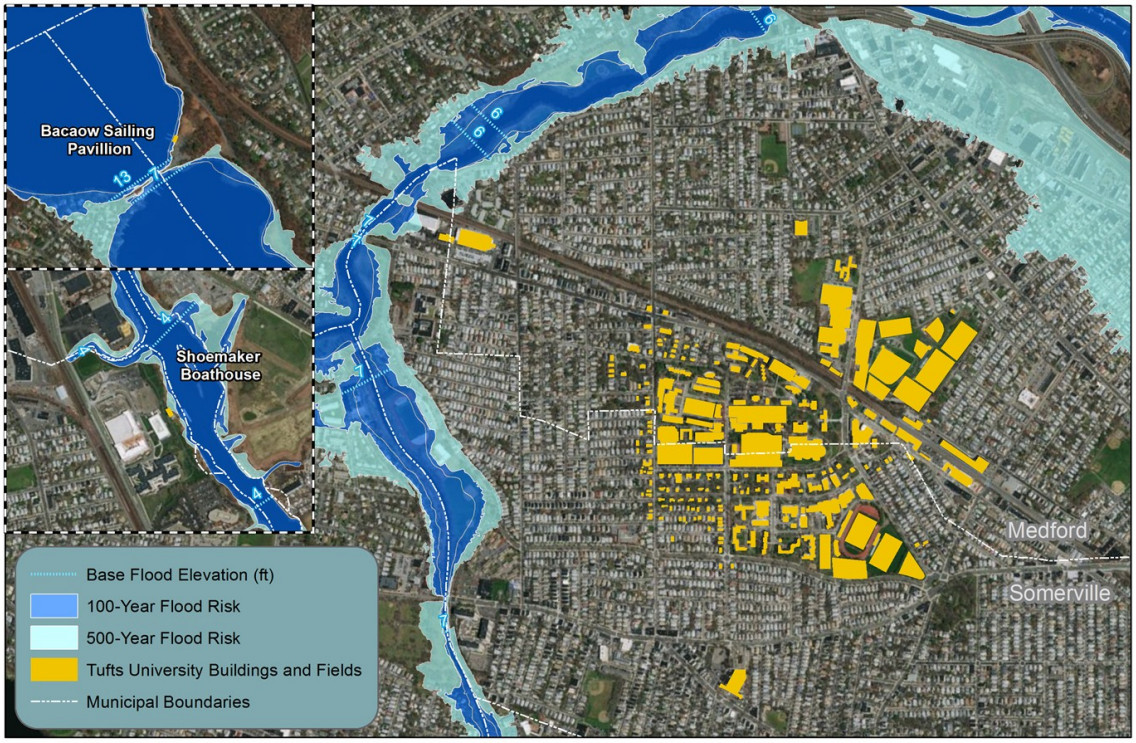

Legend
Fire Station
Police Station
Municipal Boundary
Other
Academic
Administrative
Auxiliary
Athletic
Courts
Parcel Ownership
Fields
Greek
Housing, large
Housing, small
Research
Vacant
Parking
Walnut Hill
Fraternity Hou
Tufts Universi
Walnut Hill Pa
Group #5
Flooded areas
Spiritual Communities
Green = Infrastructure
daycare
Dining= light orange
LABS=
Undergr
Cogen =
Boston Ave

Group #5

Resources and Maps Used During Workshop

Flood Risk for Medford-Somerville Campus
Medford-Somerville Hurricane-Induced Storm Surge
Medford-Somerville Cat-4 Hurricane Maximum Inundation
Great New England Hurricane
Heat: Days above 90 degrees
Medford-Average Daytime Temperature
Medford-Tree Canopy
Cambridge: Precipitation Totals
Medford-Somerville Earthquake Economic Loss Model
Tufts University Hazard Mitigation Plan (2017) – Hazard Priority Summary

Flood Risk for Medford - Somerville Campus



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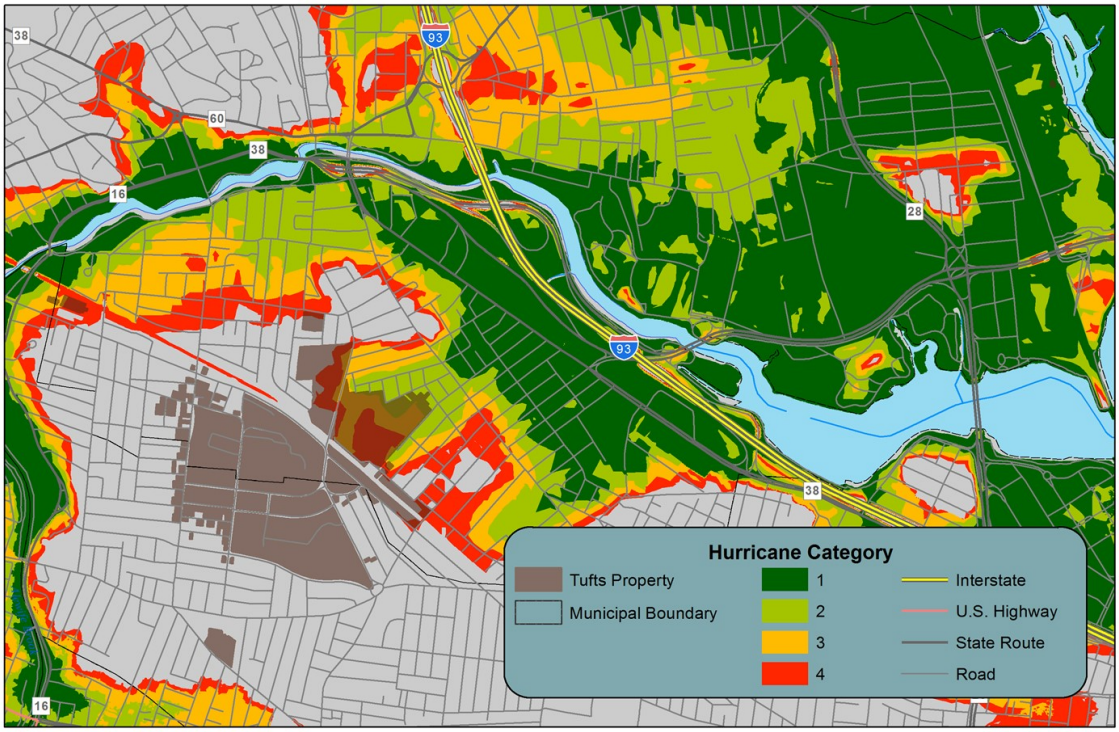
Flood Zones and Flood Base Elevations derived from Flood Insurance Rate Map

0 0.1 0.2 0.3 0.4 Miles

Medford - Somerville Hurricane-Induced Storm Surge



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Inundation Zones from MassGIS
worst-case SLOSH models for each hurricane category

0 0.15 0.3 0.45 0.6 Miles

Medford - Somerville Category 4 Hurricane
Maximum Potential Inundation

N

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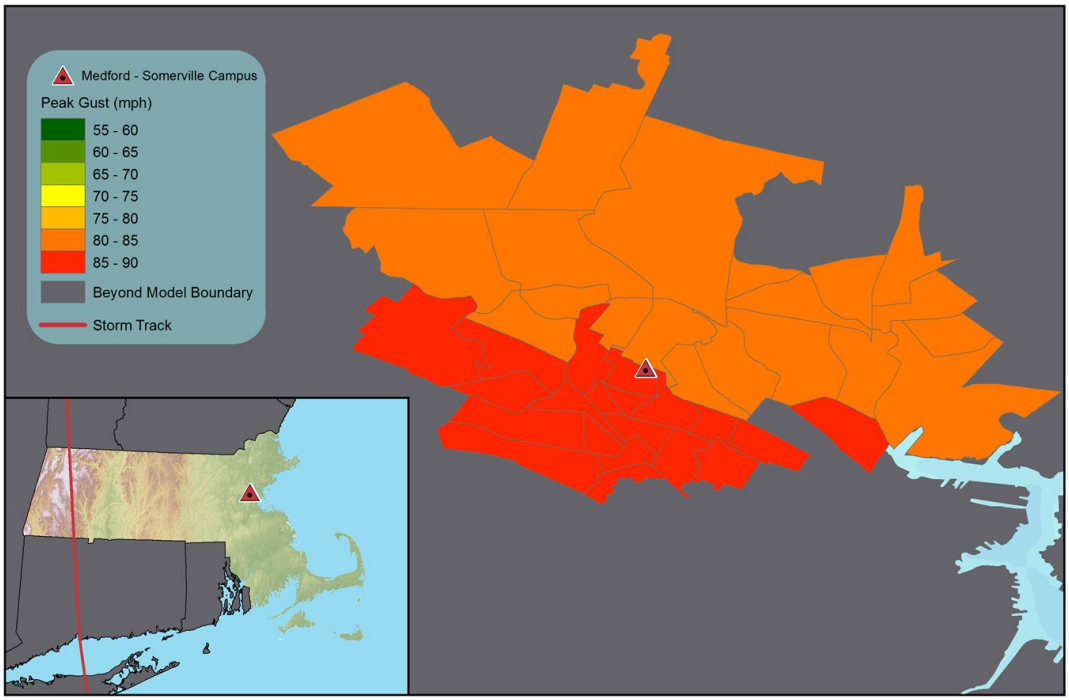
Hazus Modeled Inundation Depths (ft)
based on worst-case SLOSH models produced by
Army Corps of Engineers
<http://wsgw.mass.gov/data/gispub/shape/state/hurr_inun.zip>

0 0.075 0.15 0.225 0.3 Miles

Great New England Hurricane (1938)



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0 0.5 1 2 3 4 Miles

N

Data Source: National Hurricane Center,
Hazus Modeled Peak Gusts,
Tufts University, MassGIS

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Figure 0-1: Average Annual Snow Totals Across the Northeastern USA p. 83

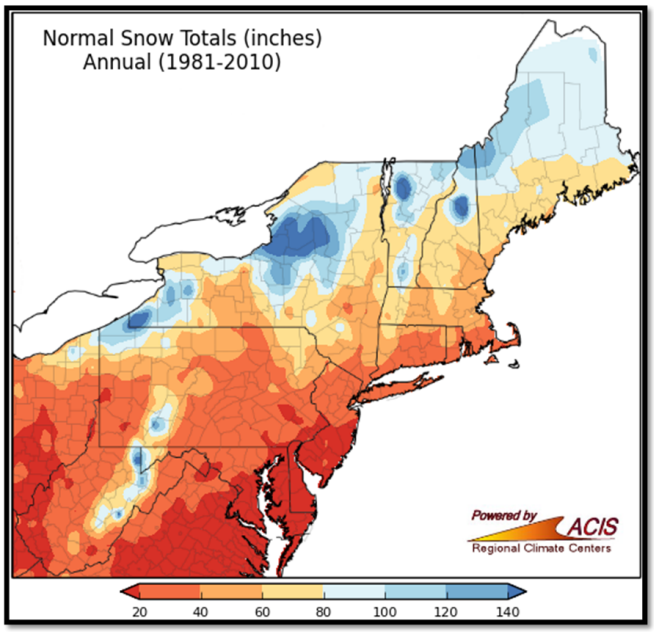

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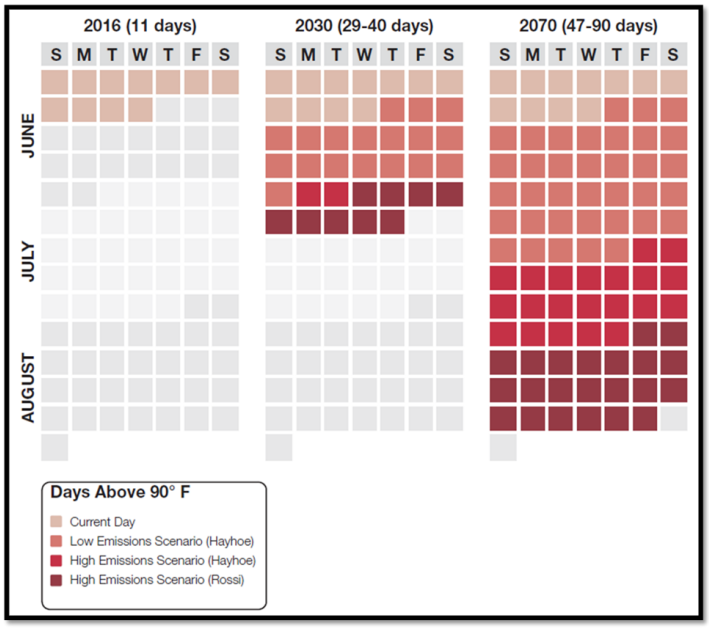
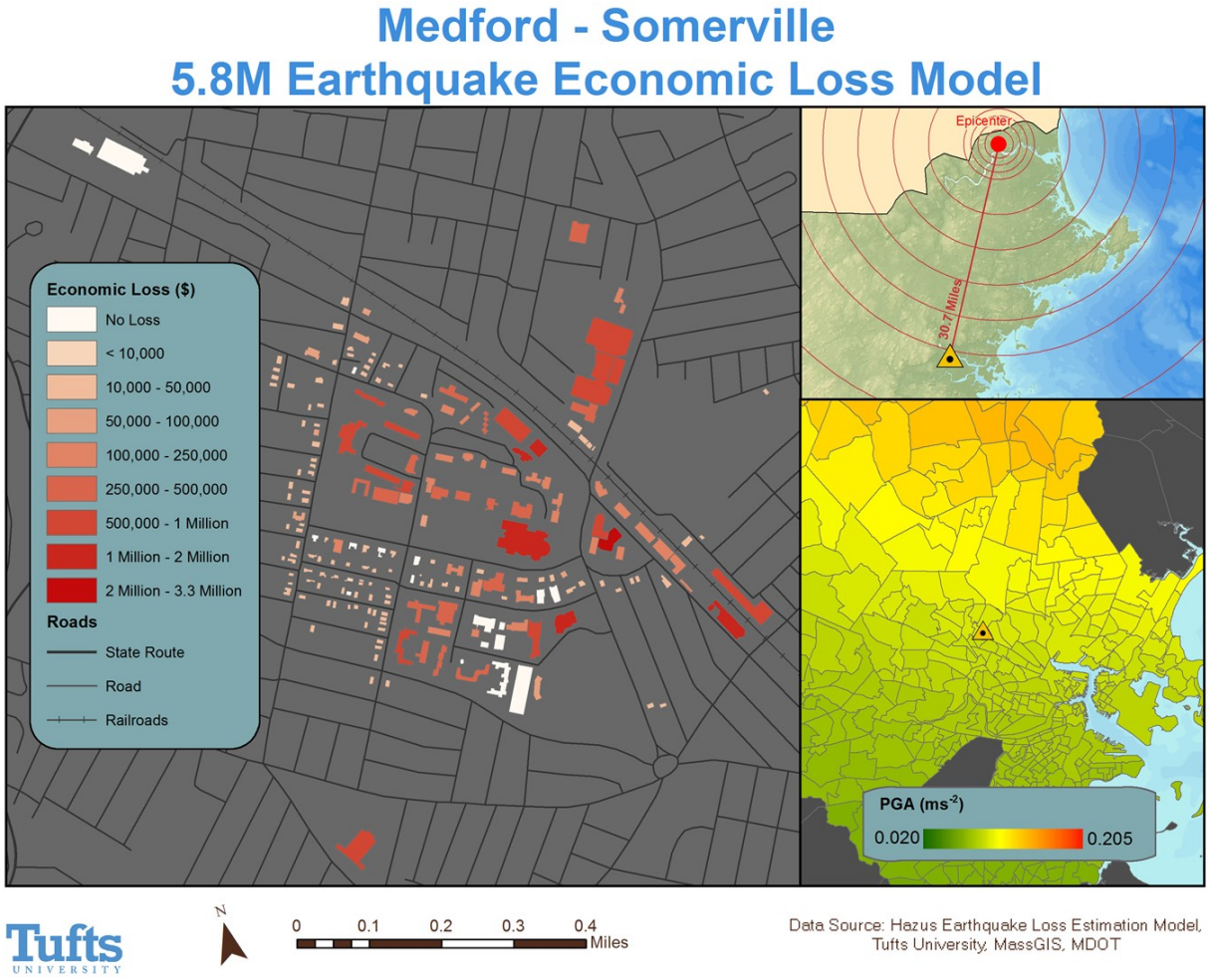
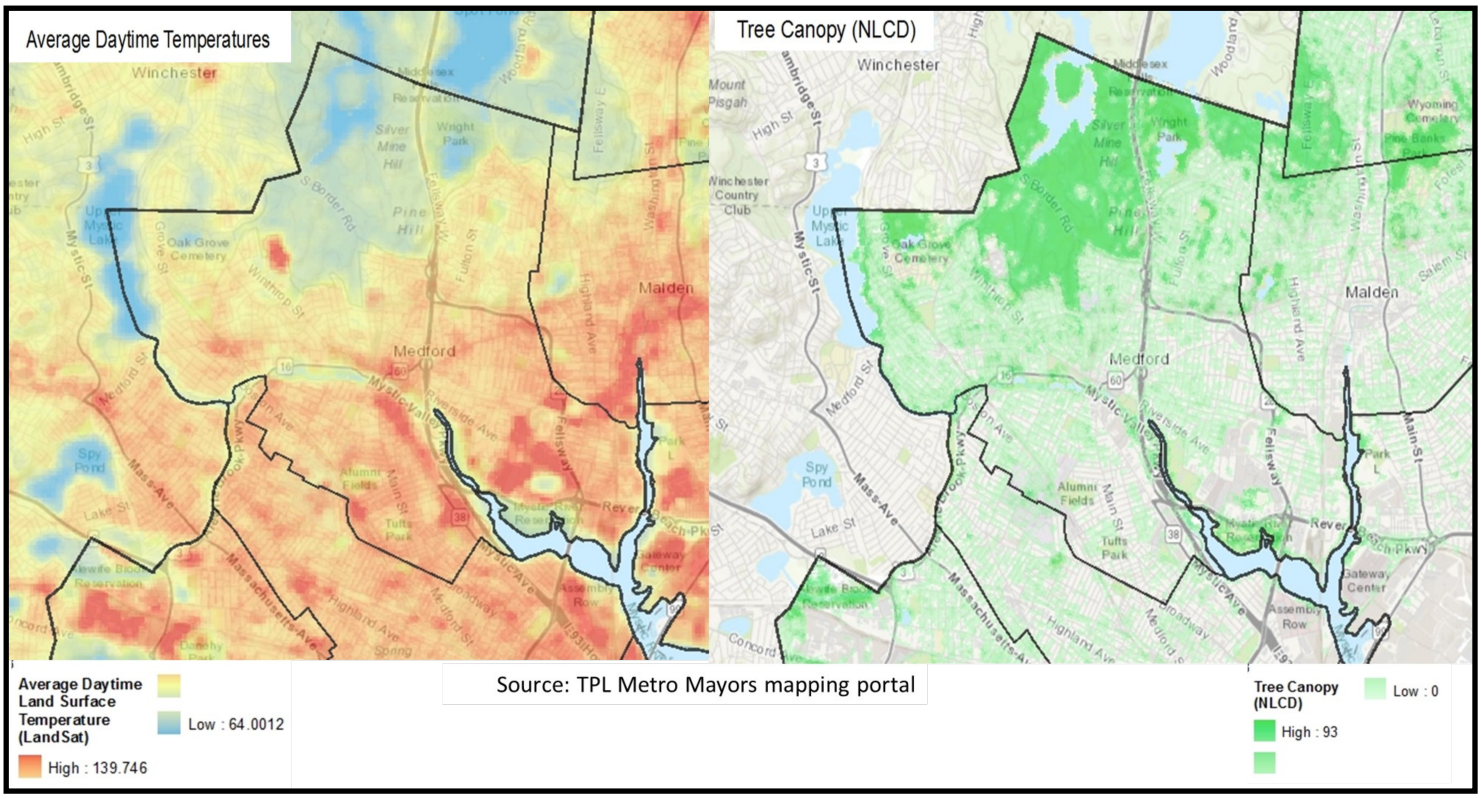
Figure 0-1: Comparison of Days Above 90°F for Low and High Emissions Scenarios for the City of Somerville and the Medford/Somerville Campus. (Source: City of Somerville Climate Change Vulnerability Assessment (2017)) p. 305







Source: City of Cambridge Climate Vulnerability Assessment, p.8

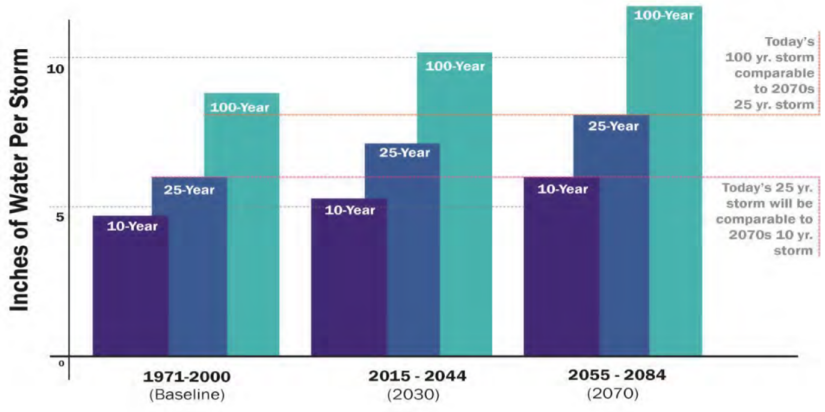
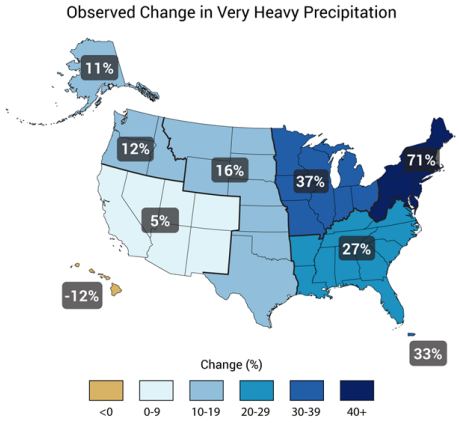


Figure 3: Precipitation projections (Source: Kleinfelder based on ATMOS projections November 2015)

Source: Figure 2.18, 2014 U.S. NCA



LIKELY YEARS OF INITIAL OCCURRENCE	VULNERABILITY ASSESSMENT SLR (ABOVE CURRENT TIDE LEVELS)	10-YEAR, 24-HOUR RAINFALL DEPTH
2030S–2050S[13]	9 INCHES	5.6 INCHES
2050S–2100S[14]	21 INCHES	5.8 INCHES
2070S OR LATER[15]	36 INCHES	6.0 INCHES

Source: Climate Ready Boston, Climate Vulnerability Assessment, p.19

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Table 4: Risk Assessment for Medford/Somerville Campus from p. 7

Hazard	Probability	Impact	Spatial Extent	Warning Time	Duration	Vulnerability	Overall Risk
Drought	2	1	4	1	4	1.9	**Moderate (2.1)**
Earthquakes	1	2	4	4	1	2.2	**Moderate (2.2)**
Extreme Temperatures	3	3	4	1	3	1.6	**High (2.7)**
Floods Including Extreme Precipitation	4	2	3	4	2	3.1	**High (3)**
Infectious Diseases	3	3	4	1	4	2.75	**High (3)**
Mid-Latitude Cyclones	3	3	4	1	4	3.55	**High (3.2)**
Severe Winter Weather	4	3	4	1	4	3.55	**High (3.4)**
Shoreline Change	1	1	1	1	4	1.45	**Low (1.3)**
Thunderstorms (Hail)	4	2	4	4	1	1.75	**High (2.7)**
Thunderstorms (Lightning)	4	2	1	4	1	1.75	**Moderate (2.3)**
Thunderstorms (Wind)	4	2	4	4	1	1.75	**High (2.7)**
Tornadoes	3	2	3	4	1	3.1	**High (2.7)**
Tropical Cyclones	3	2	4	1	3	3.55	**High (2.9)**
Wildfires/Brush Fires	1	1	1	4	1	2.6	**Low (1.6)**
Fire or Explosion	1	2	2	4	1	2.45	**Moderate (2)**
Hazardous Material Release	1	2	2	4	2	3.35	**Moderate (2.3)**
Transportation (Vehicular and Pedestrian)	2	2	1	4	1	1.65	**Low (1.8)**
Utility Failure	3	2	4	4	2	3.1	**High (2.9)**
Active Shooter	1	4	4	4	1	3	**High (2.9)**
Cyberattack	3	2	3	4	3	3	**High (2.8)**

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