2019 – 2024
Capitol Region Natural Hazard Mitigation Plan Update

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Acknowledgements

Representatives from the 38 member municipalities of the Capitol Region Council of Governments contributed to the development of this Plan Update. The following individuals served as the primary project contacts and led the efforts in each community during the planning process, although some retired or moved to other positions in 2019. Numerous other municipal staff assisted them in the update. We thank all contributors for their input and work.

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Acronyms and Abbreviations

Acronym	Definition
BCR	Benefit-Cost Ratio
BFE	Base Flood Elevation
BOCA	Building Officials and Code Administration
CGS	Connecticut General Statute
CAO	Chief Administrative Officer
CEO	Chief Elected Official
CEQ	Connecticut Council on Environmental Quality
CIP	Capital Improvements Program
CIRCA	Connecticut Institute for Resilience and Climate Adaptation
CLEAR	Center for Land Use Education and Research
CRCOG	Capitol Region Council of Governments
CRS	Community Rating System
CSO	Combined Sewer Overflow
DEMHS	Connecticut Division of Emergency Management and Homeland Security
DEEP	Connecticut Department of Energy & Environmental Protection
DESPP	Connecticut Department of Emergency Services and Public Protection
DMA 2000	Disaster Mitigation Act of 2000
DOT	Connecticut Department of Transportation
DPH	Connecticut Department of Public Health
DPW	Department of Public Works (or Director of Public Works)
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
ESF	Emergency Support Function
FEMA	Federal Emergency Management Agency
FHBM	Flood Hazard Boundary Map
FHMP	Flood Hazard Management Plan
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance
FMP	Flood Management Program
FPMS	Floodplain Management Studies
GIS	Geographic Information System
GPS	Global Positioning System
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
IA	Individual Assistance
IBC	International Building Code
ICC	International Code Council
IT	Information Technology

Acronym	Definition
LID	Low Impact Development
LOMA	Letter of Map Amendment
MDC	Metropolitan District Commission of Connecticut
MOU	Memorandum of Understanding
MS4	Municipal Separate Storm Sewer System
NCDC	National Climatic Data Center
NCEI	National Centers for Environmental Information
NDDB	Natural Diversity Data Base
NEMO	Nonpoint Education for Municipal Officials
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NGVD	National Geodetic Vertical Datum of 1929
NHMP	Natural Hazard Mitigation Plan
NOAA	National Oceanic & Atmospheric Administration
NRCC	Northeast Regional Climate Center
NRCS	National Resources Conservation Service
NU	Northeast Utilities
OEM	Office of Emergency Management
OPM	Connecticut Office of Policy and Management
NIMS	National Incident Management System
PA	Public Assistance
PDM	Pre-Disaster Mitigation Program
POCD	Plan of Conservation and Development
RCC	Regional Coordinating Center
RESP	Regional Emergency Support Plan
RPA	Regional Planning Agencies
RPO	Regional Planning Organization
SBA	U.S. Small Business Administration
SCEL	Stream Channel Encroachment Line
SHMO	State Hazard Mitigation Officer
SHPO	State Historic Preservation Office
SHSGP	State Homeland Security Grant Program
STAPLEE	Social, Technical, Administrative, Political, Legal, Economic, Environmental
SSO	Sanitary Sewer Overflow
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDHS	U.S. Department of Homeland Security
USGS	U.S. Geological Survey
WUI	Wildland/Urban Interface

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Changes to Planning Process and Plan Document

Modifications to the Capitol Region's structure, the planning process, and the plan document were incorporated into the update of the Capitol Region Natural Hazard Mitigation Plan. The following is a list of the major changes. Each is addressed in the appropriate section of the document.

- Four towns each from the former Central Connecticut Regional Planning Area (CCRPA) and Windham Region Council of Governments (WINCOG) joined the Capitol Region and thereby joined the plan.
- The current version of HAZUS was utilized.
- The plan incorporates loss estimates from the Connecticut Natural Hazard Mitigation Plan Update (2014) which was not available during the prior planning process.
- The plan incorporates additional critical facilities into the GIS (and these are depicted on the maps) based on meetings with the municipalities.
- The plan adds a new appendix, "Critical Facilities" (Appendix A) to provide a starting point for municipalities to check and amend every 5 years. Critical facility information is often vital for developing mitigation actions and completing FEMA benefit-cost analysis (BCA).
- The plan adds a new appendix, "Historic Resources" (Appendix B) to provide a starting point for municipalities to understand where to focus resources on risk assessments and new historic resource surveys in accordance with new mitigation actions about historic resources.
- The plan adds a list of the 38 community Plans of Conservation and Development with notes regarding whether (and how) hazard mitigation is already incorporated or needs to be incorporated.
- The plan adds "fact sheets" to make the document livelier and give community planners the flexibility to pull stand-alone pages out of the plan document when pursuing specific projects, grants, etc.:
    - Mitigation Successes: Property Acquisitions
    - Mitigation Successes: Microgrids
    - Mitigation Successes: Public Information
    - Mitigation Successes: Drainage Improvements
    - Mitigation Successes: Code Plus Design
    - Mitigation Successes: Low Impact Development
    - Mitigation Successes: Culvert Replacement
    - Mitigation Successes: Floodproofing
    - Impacts of Climate Change: Precipitation and Riverine Floods
    - Impacts of Climate Change: Sea Level Rise
    - Impacts of Climate Change: Drought
    - Public Outreach and Engagement: Survey
    - Public Outreach and Engagement: Meetings
    - New Initiative: Hartford Climate Action Plan
    - New Initiative: Hartford Green Infrastructure and Zoning Regulations
    - New Initiative: Hazardous Spills at Businesses
    - New Initiative: Risks to Historic Resources
    - New Initiative: Municipal Separate Stormwater System (MS4)
    - New Initiative: Low Impact Development (LID) for Rural Resiliency
    - New Initiative: Sustainable CT

    - Regional Challenges: Crumbling Foundations
    - Regional Challenges: Critical Facilities of Regional Significance
    - Regional Challenges: Repetitive Loss Properties
- The planning process and document streamline the individual community goals into nine primary goals to help the eight new communities and 30 existing Capitol Region communities propose similar actions and revisit actions in 5 years while allowing for unique circumstances and identity. The nine goals were fashioned from the numerous municipal goals in the 2014-2019 plan:
    1. Minimize the impact of natural hazards on physical buildings and infrastructure.
    2. Ensure municipal codes and regulations support hazard mitigation.
    3. Improve institutional awareness and understanding of natural hazard impacts and mitigation within municipal governments and other decision-making bodies.
    4. Increase the use of natural, "green," or "soft" hazard mitigation measures such as open space preservation and green infrastructure.
    5. Improve the resilience of local and regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies.
    6. Improve public outreach, education, and warning systems.
    7. Improve the emergency response capabilities of the region and its communities.
    8. Ensure community character and social equity are addressed in mitigation activities.
    9. Minimize the economic impact of hazard damages.
- The planning process and the document develop new region-wide mitigation strategies for communities to choose from:
    - Risks to historic resources
    - Hazardous spills that occur at small businesses during floods and other events
    - Using Low Impact Development (LID) to build resilience in rural towns
    - Presence of the new *Sustainable CT* program
    - U.S. Environmental Protection Agency (EPA) municipal separate storm sewer system (MS4) permit compliance
    - Listing Metropolitan District Commission of Connecticut (MDC) facilities as critical facilities in the eight MDC member towns and five additional towns served by MDC water and sewer utilities

Organizational changes were made to Section II. Specifically, the portion of the Risk Assessment that describes each hazard has been divided into subsections as follows: *Location, Extent, Previous Occurrences, Probability of Future Events, and Impacts to Community Assets.*

Organizational changes were made to each community annex. Each annex was previously organized into sections called "Challenges" and "Goals, Objectives, and Strategies." Each annex has been expanded into new sections:

- Community Overview
- Critical Facilities
- Capabilities
    - New Capabilities
- Challenges
    - Challenges Overview
    - Hazard Losses
- Mitigation Strategies and Actions
    - Noted Hazard Mitigation Needs
    - Status of Previous Mitigation Strategies and Actions
    - Active Mitigation Strategies and Actions

Within that structure, the sections that reflect changes at the community level since the previous plan are:

- New Capabilities
- Status of Previous Mitigation Strategies and Actions

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Executive Summary

Introduction

Connecticut's Capitol Region encompasses the City of Hartford and 37 surrounding urban, suburban, and rural communities. The Capitol Region Council of Governments (CRCOG) received Federal Emergency Management Agency (FEMA) funds through the Connecticut Department of Emergency Services and Public Protection (DESPP) to develop a Natural Hazard Mitigation Plan (HMP) Update for the 38 municipalities comprising the region:

Town of Andover	Town of East Windsor	Town of Marlborough	Town of Suffield
Town of Avon	Town of Ellington	City of New Britain	Town of Tolland
Town of Berlin	Town of Enfield	Town of Newington	Town of Vernon
Town of Bloomfield	Town of Farmington	Town of Plainville	Town of West Hartford
Town of Bolton	Town of Glastonbury	Town of Rocky Hill	Town of Wethersfield
Town of Canton	Town of Granby	Town of Simsbury	Town of Willington
Town of Columbia	City of Hartford	Town of Somers	Town of Windsor
Town of Coventry	Town of Hebron	Town of South Windsor	Town of Windsor Locks
Town of East Granby	Town of Manchester	Town of Southington	
Town of East Hartford	Town of Mansfield	Town of Stafford	

CRCOG staff and municipal officials from each community contributed to this planning project. The Capitol Region Emergency Planning Committee (CREPC) ESF-5 Emergency Management subcommittee was expanded to provide guidance to the update process. This plan update builds on the existing Capitol Region Natural Hazard Mitigation Plan of 2014 and incorporates information from the former Central Connecticut Region Hazard Mitigation Plan Update (2016) and the former Windham Regional Hazard Mitigation Plan Update (2015). Berlin, New Britain, Plainville, and Southington were previously included in the former Central Connecticut Region Hazard Mitigation Plan. Columbia, Coventry, Mansfield, and Willington were previously included in the former Windham Regional Hazard Mitigation Plan. The other 30 communities listed above were included in the previous Capitol Region Natural Hazard Mitigation Plan (2014).

The purpose of this plan is to identify natural hazards likely to affect the Capitol Region and its nearly one million residents, assess vulnerabilities to these hazards, and set forth mitigation strategies that will reduce the loss of life and property, economic disruptions, and the cost of post-disaster recovery for the region's communities. The benefits of preparing a Hazard Mitigation Plan include:

- Improving the region's ability to deal with natural disasters and reduce losses
- Reducing the need for emergency response to natural disasters
- Enabling municipalities to access FEMA Hazard Mitigation Assistance Grants upon formal adoption of an approved plan
- Improving post-disaster recovery implementation

The plan considers the following natural hazards that affect the region:

- Dam Failure
- Drought
- Earthquake
- Flooding
- Forest and Wildland Fires
- Hurricanes and Tropical Storms
- Tornadoes and High Winds
- Severe Winter Storms

The impacts of these natural hazards were evaluated as well as the locations and groups of people particularly vulnerable to the effects of these hazards. Mitigation goals and strategies were developed at both the regional and local levels to reduce or prevent the damages to life and property that can result from these natural hazards. CRCOG and CREPC, in addition to local and other partners, are responsible for implementation of the regional goals contained in this plan. Each participating municipality identified its own mitigation goals and strategies and assumes responsibility for implementation of those measures.

Hazards Impacting the Capitol Region

The Capitol Region is vulnerable to the numerous natural hazards with flooding, winter storms, and high wind events being the natural hazards that most frequently occur with enough severity to cause loss of life or property. To evaluate the impacts of these hazards on our region, we looked at historical accounts of major storms and other events; examined flood insurance claims data and public assistance provided after federally declared disasters; analyzed demographic data and physical features; and used HAZUS-MH, a computer model, to estimate losses due to flooding, hurricanes, and earthquakes.

Loss estimates for each hazard are summarized for each community in Table ES-1 below and range from approximately $247,000 per year in Andover to nearly $11,093,000 in Hartford. Details regarding these loss estimates are provided in Section II and each municipal annex of this plan. The annualized loss estimate for the Capitol Region due to natural hazards is estimated at $84.1 million. The following is a brief summary of the natural hazards affecting the region and our communities.

Table ES-1. Annualized Loss Estimate by Community (in $1,000s)

Town	Dam Failure	Drought	Earthquakes	Flooding	Hurricanes and Tropical Storms	Severe Winter Storms	Thunderstorms	Tornadoes	Wildfires	Total
Andover	$0	$0	$8	$1	$223	$11	$1	$1	$2	$247
Avon	$0	$0	$72	$4	$1,135	$163	$2	$266	$4	$1,646
Berlin	$0	$0	$76	$11	$1,245	$83	$3	$291	$5	$1,714
Bloomfield	$0	$0	$79	$15	$1,284	$181	$3	$301	$5	$1,868
Bolton	$0	$0	$13	$0	$337	$19	$2	$1	$2	$374
Canton	$0	$0	$28	$10	$645	$48	$1	$151	$5	$888
Columbia	$0	$0	$14	$1	$372	$9	$2	$2	$3	$403
Coventry	$1	$0	$25	$4	$843	$33	$5	$4	$5	$920
East Granby	$0	$0	$18	$2	$323	$41	$1	$76	$3	$464
East Hartford	$0	$0	$150	$14	$3,213	$188	$7	$752	$3	$4,327
East Windsor	$0	$0	$37	$8	$700	$30	$1	$164	$5	$945

Town	Dam Failure	Drought	Earthquakes	Flooding	Hurricanes and Tropical Storms	Severe Winter Storms	Thunderstorms	Tornadoes	Wildfires	Total
Ellington	$1	$0	$34	$2	$1,057	$67	$6	$5	$4	$1,176
Enfield	$0	$0	$121	$24	$2,799	$385	$6	$655	$6	$3,996
Farmington	$0	$0	$106	$39	$1,589	$192	$3	$372	$5	$2,306
Glastonbury	$0	$0	$150	$5	$2,158	$216	$5	$505	$10	$3,049
Granby	$0	$0	$23	$3	$707	$117	$1	$166	$8	$1,025
Hartford	$0	$0	$478	$32	$7,822	$910	$17	$1,831	$3	$11,093
Hebron	$1	$0	$22	$0	$656	$27	$4	$3	$5	$718
Manchester	$0	$0	$186	$7	$3,651	$381	$8	$855	$5	$5,093
Mansfield	$2	$0	$79	$21	$1,799	$115	$10	$8	$6	$2,040
Marlborough	$0	$0	$17	$3	$401	$18	$1	$94	$4	$538
New Britain	$0	$0	$196	$26	$4,589	$187	$10	$1,074	$2	$6,084
Newington	$0	$0	$110	$18	$1,916	$153	$4	$448	$2	$2,651
Plainville	$0	$0	$63	$28	$1,111	$55	$2	$260	$2	$1,521
Rocky Hill	$0	$0	$76	$4	$1,236	$83	$3	$289	$3	$1,694
Simsbury	$0	$0	$68	$16	$1,474	$225	$3	$345	$6	$2,137
Somers	$1	$0	$24	$13	$776	$93	$4	$3	$4	$918
South Windsor	$0	$0	$128	$6	$1,612	$408	$3	$377	$5	$2,539
Southington	$0	$0	$87	$21	$2,700	$127	$6	$632	$7	$3,580
Stafford	$1	$0	$30	$22	$819	$32	$4	$4	$8	$920
Suffield	$0	$0	$37	$1	$986	$103	$2	$231	$8	$1,368
Tolland	$1	$0	$34	$6	$1,020	$141	$5	$4	$5	$1,216
Vernon	$2	$0	$82	$6	$1,977	$259	$11	$8	$2	$2,347
West Hartford	$0	$0	$221	$38	$3,966	$670	$8	$928	$4	$5,835
Wethersfield	$0	$0	$75	$11	$1,672	$132	$4	$391	$2	$2,287
Willington	$0	$0	$12	$6	$409	$24	$2	$2	$4	$459
Windsor	$0	$0	$95	$3	$1,821	$100	$4	$426	$5	$2,454
Windsor Locks	$0	$0	$43	$9	$783	$320	$2	$183	$2	$1,342
Total	**$9**	**$0**	**$3,116**	**$444**	**$61,827**	**$6,345**	**$164**	**$12,106**	**$170**	**$84,181**

Hurricanes and Tropical Storms

The Atlantic hurricane season extends from June 1 through November 30 each year. While the Capitol Region is spared the coastal storm surges associated with hurricanes, it is not immune from damaging winds and rain. According to the state's Hazard Mitigation Plan, a moderate Category II hurricane can be expected to hit Connecticut once every 23 to 30 years. A major Category III or IV hurricane may occur before 2040 based on 20th century trends.

In August 2011, Hurricane Irene, which was downgraded to a tropical storm before hitting Connecticut, caused widespread damage to the region and state. Irene was responsible for three deaths associated with flooding and downed wires from falling trees. According to *The Hartford Courant*, insurance companies paid out $235 million on more than 60,000 claims in Connecticut related to damage from Irene. However, this figure does not include hundreds of millions more in uncovered expenses and cleanup costs for Connecticut's largest electric utility at the time, Connecticut Light and Power (now Eversource). At the height of the storm, some 754,000 residents were without power. Capitol Region

cities and towns were widely affected by downed trees, flooding, and power outages as a result of Irene. Many residents and businesses were without power for over a week. According to the Connecticut Division of Emergency Management and Homeland Security (DEMHS), municipalities, and other local and private nonprofit agencies incurred expenses of over $3.18 million due to Irene. The municipalities and agencies are eligible for reimbursement of 75% of these costs under FEMA's Public Assistance program.

CRCOG used FEMA's HAZUS-MH software to estimate the extent of physical damage and the economic losses to the region and our communities if we were hit with another hurricane with a 1% annual chance recurrence interval. The HAZUS-MH hurricane model primarily considers wind damage for inland areas such as the Capitol Region, which is not subject to storm surges. The model predicts the region could face economic losses of approximately $512 million.

Floods

Flooding can occur as a result of other natural hazards such as heavy precipitation, hurricanes, winter storms, snow melt, ice jams, or dam failures. The Capitol Region's numerous rivers and streams, as well as its urbanized areas, make floods and flash floods a regular risk. Individuals and local governments face significant economic loss, risks to public safety, and degraded waterways from flooding. There is not a "flood season" per se in Connecticut; however, waterways are normally higher during spring and are thus especially vulnerable to flooding from intense precipitation. Significant flooding can also occur as a result of hurricanes and tropical storms. According to the 2014 Connecticut Natural Hazard Mitigation Plan, major flooding of small rivers and loss of life can be expected every 5 to 10 years throughout the state. Major flooding of larger rivers, such as the Connecticut and Farmington, with loss of life and structural damage can be expected once every 30 years. Historic and widespread floods occurred in 1936, 1938, 1955, and 1982.

An analysis of claims filed under the National Flood Insurance Program (NFIP) in the Capitol Region demonstrates the potential for losses due to flooding. Since the program's inception, over 1,860 claims resulting in payments of nearly $15.1 million have been filed in the Capitol Region as of January 2018. West Hartford has had the highest number of overall flood loss claims, followed by Farmington, New Britain, and Simsbury. Farmington and West Hartford have also had the highest overall flood loss payments.

Of these claims, 436 were repetitive loss claims (i.e., more than one claim over $1,000 has been filed for flood damages to an insured building over a 10-year period). Approximately 144 properties have experienced repetitive losses in the Capitol Region. These losses have resulted in payments of approximately $5.5 million. West Hartford has the highest number of repetitive flood claims, followed by Simsbury. Farmington, West Hartford, and Newington have had the highest repetitive flood loss payments.

To help assess the risks we face from major flooding, CRCOG used FEMA's HAZUS-MH loss estimation program to model the effects of flooding at the local level. The following table shows the damages each town in the region might face from a flood with a 1% probability of occurring in any given year (i.e., the 100-year flood) and the average annualized losses from a flood in any given year. As can be seen, losses due to a 1% annual chance flood could be particularly high for the communities of East Hartford and Vernon. Farmington and West Hartford are at the highest risk of receiving flood damage based on the annualized losses.

Significant areas of the Capitol Region are vulnerable to flooding. About 8.5%, or 56,827 acres, of the Capitol Region is located in floodplains. Over half of this land is zoned residential. Without restrictions on development in floodplains, lives and property are at risk.

Table ES-2. HAZUS-MH 1% Annual Chance Event and Annualized Losses due to Flood

Town	Total Losses (1% Annual Chance Flood)	Annualized Loss	Town	Total Losses (1% Annual Chance Flood)	Annualized Loss
Andover	$7,873,000	$604	Mansfield	$30,104,000	$21,012
Avon	$69,855,000	$4,336	Marlborough	$9,538,000	$3,072
Berlin	$64,802,000	$11,056	New Britain	$33,351,000	$25,570
Bloomfield	$51,811,000	$15,468	Newington	$43,598,000	$18,126
Bolton	$1,193,000	$319	Plainville	$44,482,000	$28,279
Canton	$34,106,000	$10,062	Rocky Hill	$9,069,000	$4,308
Columbia	$23,278,000	$817	Simsbury	$48,070,000	$16,181
Coventry	$20,206,000	$4,003	Somers	$7,719,000	$13,384
East Granby	$7,882,000	$1,892	South Windsor	$67,123,000	$6,145
East Hartford	$141,861,000	$14,434	Southington	$64,141,000	$20,510
East Windsor	$35,996,000	$7,939	Stafford	$57,649,000	$22,378
Ellington	$14,633,000	$2,197	Suffield	$10,683,000	$829
Enfield	$57,001,000	$24,479	Tolland	$9,139,000	$5,873
Farmington	$78,659,000	$39,353	Vernon	$118,795,000	$6,336
Glastonbury	$94,366,000	$5,044	West Hartford	$88,125,000	$38,288
Granby	$11,670,000	$3,231	Wethersfield	$93,308,000	$11,181
Hartford	$60,966,000	$31,832	Willington	$3,971,000	$6,145
Hebron	$3,709,000	$207	Windsor	$89,805,000	$2,991
Manchester	$32,957,000	$7,035	Windsor Locks	$8,716,000	$9,355

Dam Failure

Dams provide vital benefits to our region such as water supply, power generation, flood control, and recreation, but in the event of failure, they can pose a threat to lives and property. Dam failure can happen for a number of reasons including as a result of natural disasters such as structural failure due to earthquakes or overtopping due to heavy precipitation. Dams in Connecticut are regulated by the Department of Energy & Environmental Protection (DEEP).

According to the DEEP, there are hundreds of dams in the Capitol Region. The majority of these are either Class A (low hazard) or Class AA (negligible hazard); failure of a Class A dam would lead to minimal economic loss and may cause damage to agricultural land or unpaved roadways while failure of a Class AA dam would cause negligible loss or damage. Dams of concern for hazard mitigation are those in classes BB, B, and C. In the Capitol Region, 61 dams are Class C, or high hazard, dams. Failure of a Class C dam would result in probable loss of life, major damage to habitable structures, damage to major highways, and great economic loss. There are 53 Class B, or significant hazard, dams in the Region. Failure in these dams would result in similar but less severe damage. Finally, there are 146 Class BB, or moderate hazard, dams in the region. Failure of one of these dams would result in damage to normally unoccupied structures or local roadways or would cause moderate economic loss; no loss of life would be expected. The state estimates there are nearly 12,000 people in Hartford County and 4,150 people in Tolland County within the mapped dam inundation areas of high and significant hazard dams. The

Capitol Region includes most of, although not all, the municipalities in Hartford and Tolland Counties, thus the regional population exposed to this risk is likely less than 2 percent.

Severe Winter Storms

Connecticut is subject to blizzards, ice storms, and nor'easters - storms characterized by strong, possibly damaging northeasterly winds. The Capitol Region receives an average annual snowfall of about 40" although snowfall amounts vary widely from year to year and can vary dramatically across the region in any given storm. Severe winter storms can result in damage to buildings and infrastructure, loss of life, and disruptions to regional transportation and communication systems. Half of all federal disaster declarations for Connecticut since 1954 have followed major winter or snowstorms. Federal assistance is frequently used to offset the snow/ice removal costs that the state and municipalities incur. For example, a federal emergency was declared for the February 11-12, 2006, snowstorm in several counties in Connecticut (including Hartford and Tolland) to help share the costs of snow removal. In 2011, FEMA obligated over $74 million in Public Assistance funds to the State of Connecticut to reimburse state agencies, local governments, and eligible private nonprofit organizations for costs associated with the January 11-12, 2011, snowstorm and Storm Alfred in October. The frequency, intensity, and timing of winter storms dramatically impacts snow removal budgets. Storm Alfred was particularly costly for municipalities because of the heavy debris loads resulting from the high number of fully leafed trees downed in this storm. Municipalities also incur higher labor costs for snow removal on weekends and holidays.

Tornadoes/High Winds

Connecticut averages approximately three tornadoes every 2 years; however, in the first week and a half of July 2013 four tornadoes hit the state including three that touched down in the Capitol Region. Hartford and Litchfield Counties are at the highest risk for tornadoes within the state based on historical patterns and locations of their occurrence. Between 1950 and 2003, Hartford County experienced 14 tornadoes, and Tolland County experienced 10. Between 2006 and 2018, Connecticut experienced 23 tornadoes. Three of these were in Hartford County and two in Tolland County. The Capitol Region experienced three tornadoes in 2013. Four tornadoes severely impacted Connecticut during one storm in May 2018 although none were located in the Capitol Region. On October 2, 2018, an EF1 tornado touched down in New Canaan, and an EF-0 was reported in the Capitol Region in Mansfield.

Typically, tornadoes occur between April and October. High winds and microbursts (strong straight-line downburst winds) can also inflict damage to property and result in injuries.

One of the country's most destructive tornadoes touched down in Windsor Locks and Windsor on October 3, 1979. The F4 tornado had winds in excess of 200 miles per hour (mph) and tore an 11-mile path from Windsor to Suffield. The tornado killed 3 people, injured 500, and caused an estimated $250 million ($776,385,000 in 2011 dollars) in damage, in part because it struck the New England Air Museum, destroying several planes and hangars.

Earthquake

Connecticut has a moderate risk of earthquakes based on the frequency of their occurrence, not the intensity of individual earthquakes. Between 1568 and 1989, the state had 137 recorded earthquakes. The Capitol Region experienced 17 between 1837 and 2018. Of those where the magnitude was known, all were under magnitude 4.0. A strong earthquake centered in central Connecticut and thought to be 3.8 magnitude occurred on August 9, 1840.

Magnitude 3.0 to 3.9 earthquakes are often felt by people up to 100 miles away from the epicenter but rarely cause damage. Magnitude 4.0 to 4.9 earthquakes cause shaking of objects indoors but generally cause none to slight damage. Magnitude 5.0 to 5.9 earthquakes can cause moderate to major damage to poorly constructed buildings but none to slight damage to other buildings. Connecticut incorporated building codes for seismic activity into the state building code in 1992. There were no requirements prior to that. So, while the risk for a very damaging earthquake is relatively low in the region, some structures may be impacted by less intense earthquakes depending on the soil and integrity of the structure.

Using FEMA's HAZUS-MH software, CRCOG analyzed a probabilistic suite of earthquake scenarios to estimate the potential loss to property and life. Based on these scenarios, the annualized loss estimate for the region is $3.1 million, with Hartford and West Hartford having the highest annualized losses based on their built-up environments.

These simulations highlight the significance of the location of the epicenter to the damages that could be expected. A moderately strong earthquake centered near a more populated, built-up area would be expected to result in considerably more damage than one located in a more remote area. Based on our history and geology, the Capitol Region's vulnerability to damaging earthquakes is low. The damages we are likely to face here from earthquakes are much lower than in other parts of the nation and world.

Drought

Droughts periodically occur in Connecticut and can have serious consequences. While a drought does not pose immediate threats to life and property, it can have severe economic, environmental and social consequences. A lack of precipitation can affect not only agricultural production but also tourism, water utilities, residential wells, businesses, and more. Connecticut experienced notable droughts in 1957, 1964-67, 1980-81, 2002, 2012, and 2015-16. The 2012 drought affected Hartford, Tolland, and Windham Counties from April 12 through April 24. According to the National Oceanic & Atmospheric Association (NOAA) Storm Events Database, rivers and streams were most affected as most ran at record low levels during the spring runoff season. The main impact of this meteorological drought was periods of very high fire danger.

A meteorological drought was most recently declared for 2015-16. During the 2015-16 drought, many water utilities imposed voluntary or mandatory water conservation and restriction measures on their customers. Such restrictions can impact customers including businesses. As the state's 2014 Natural Hazard Mitigation Plan notes, predicting the future occurrences of drought within any given time period is difficult.

Forest and Wildland Fires

Forest or wildland fires can cause not only long-term damage to vegetation and ecosystems but also damage to developments, especially as residential development has increased in woodland areas. In the last 25 years, a few forest fires have occurred in the Capitol Region including a brush fire in April 1999 in Vernon, which burned about 40 acres and came within 100 feet of homes in a nearby neighborhood, and a fire in April 2005, which burned 8 acres along the Farmington River in Avon. The scale of these fires is much less than those experienced in the western and midwestern United States; nonetheless, forest fires here pose a risk to lives and property, especially at the urban/woodland interface.

Mitigation Strategy

To address the impacts of these natural hazards, the planning committee and local and regional staff reexamined the goals, objectives, and strategic mitigation activities proposed in the 2014 Plan as well as assessed our experiences with natural disasters of the last 5 years and considered input from the public and other stakeholders in order to develop a blueprint for better protecting our region over the next 5 years. Each mitigation action was prioritized, and responsible agencies, potential funding sources, and time frames for implementing the projects were identified. What follows is a brief outline of the regional and local strategies proposed.

Regional Goals, Objectives, and Mitigation Actions

Because of the regional nature of natural hazards and common concerns, some mitigation activities are better addressed at the regional level by CRCOG; however, the means to carry out certain activities may not be available to regional agencies but are available to municipalities. For example, CRCOG cannot enact laws and regulations, levy taxes, or enter into construction contracts. This section establishes our regional strategy for addressing natural hazards and sets out the mitigation actions that may best be undertaken by CRCOG on a regional level.

Goal: Minimize the loss of life and property and economic disruptions that can result from natural hazards.

Objective 1: Improve stormwater management and groundwater recharge throughout the region to prevent increased flooding and lessen the effects of drought.

Mitigation Actions:

1.1 Encourage all municipalities in the region to adopt regulations that incorporate or refer to recommended practices from the most current Connecticut *Stormwater Quality Manual*, Connecticut *Guidelines for Erosion and Sedimentation Control* and, in particular, those that promote low impact development and green infrastructure techniques. This will encourage development that is in harmony with natural drainage systems.

1.2 Foster improved understanding of the importance of stream management, maintenance of natural drainage channels, and use of green infrastructure practices among municipal staff, inland wetlands commissions, and planning and zoning commissions through education.

Objective 2: Assist municipalities in implementing hazard mitigation strategies.

Mitigation Actions:

2.1 Work with member municipalities to maintain this regional Natural Hazard Mitigation Plan with updates at least every 5 years.

2.2 Annually notify communities of the opportunities to apply for mitigation funds under the PDM and FMA programs and notify communities of HMGP opportunities as applicable. Provide letters of support when appropriate.

2.3 Incorporate additional natural hazard mitigation concerns into the regional Plan of Conservation and Development if it is updated in 2019-2024, and provide specific instructions to municipalities to address natural hazard mitigation in local Plans of Conservation and Development as they are updated.

2.4 Encourage municipalities to participate in the National Flood Insurance Program's Community Rating System by hosting an information workshop.

Objective 3: Assist municipalities in minimizing risks associated with power disruptions.

Mitigation Actions:

3.1 Encourage the installation of generators at critical facilities and in developments serving the elderly or special need populations, or development of microgrids to serve the same purpose, through outreach and associated work with local officials to determine which facilities still do not possess standby power but require it.

Objective 4: Assist municipalities in minimizing risks associated with droughts.

Mitigation Actions:

4.1 Assist municipalities that do not currently have drought ordinances in enacting such ordinances to enable the enforcement of water conservation, and assist with messaging and notifications regarding droughts. These actions should be consistent with guidance resulting from implementation of the State Water Plan (2018) and the Coordinated Water System Plan (2018) as well as the updated Connecticut Drought Preparedness and Response Plan.

Municipal Goals, Objectives, and Mitigation Actions

Each of the 38 municipalities in the Capitol Region also reassessed its goals, objectives, and strategic mitigation actions from the 2014 Plan and developed a new strategic course of action for the upcoming 5 years. While many are unique to the individual communities, there are commonalities among the actions proposed, and most communities have proposed a range of activities including public education and awareness; natural resource protection; plans, studies, and regulatory actions; structural projects and modifications to buildings, facilities, and infrastructure; as well as measures to improve preparedness and emergency response.

Table ES-3: Summary of Types of Mitigation Projects Proposed by Community

Mitigation Project Type	Education & Awareness	Natural Resources Protection	Preparedness & Emergency Response	Prevention	Structural Projects	Property Protection
Andover	5	1	7	3	2	1
Avon	2	1	5	4	1	3

Mitigation Project Type	Education & Awareness	Natural Resources Protection	Preparedness & Emergency Response	Prevention	Structural Projects	Property Protection
Berlin	2	1	2	3	2	4
Bloomfield	7	2	5	5	0	4
Bolton	5	1	8	5	7	1
Canton	3	1	4	2	1	4
Columbia	3	2	2	1	4	2
Coventry	3	1	7	11	8	2
East Granby	3	2	5	4	0	2
East Hartford	4	1	4	6	1	4
East Windsor	4	2	5	3	3	2
Ellington	2	1	2	3	1	1
Enfield	3	1	1	2	1	3
Farmington	3	1	3	3	2	4
Glastonbury	5	1	0	5	2	3
Granby	7	4	5	9	3	2
Hartford	3	1	3	2	2	3
Hebron	2	1	1	5	1	1
Manchester	4	1	1	1	2	5
Mansfield	8	1	7	6	3	3
Marlborough	2	1	3	2	1	2
New Britain	6	1	3	4	5	3
Newington	2	1	2	5	0	3
Plainville	6	2	9	12	6	3
Rocky Hill	2	0	0	1	1	3
Simsbury	4	2	2	7	8	4
Somers	5	1	5	2	3	2
South Windsor	4	1	7	3	1	4
Southington	4	1	5	3	1	3
Stafford	2	1	6	1	3	1
Suffield	4	1	1	4	0	1
Tolland	6	1	4	3	6	1
Vernon	2	1	3	1	2	4
West Hartford	4	1	10	6	3	5
Wethersfield	2	1	3	3	11	5
Willington	4	1	5	7	2	1

Mitigation Project Type	Education & Awareness	Natural Resources Protection	Preparedness & Emergency Response	Prevention	Structural Projects	Property Protection
Windsor	3	0	4	5	2	4
Windsor Locks	5	1	3	3	10	3

Table ES-4: Summary by Community of Mitigation Projects for Each Goal

Hazard Mitigation Goal	Minimize the impact of natural hazards on physical buildings and infrastructure.	Ensure Municipal Codes and Regulations support hazard mitigation.	Improve institutional awareness and understanding of natural hazard impacts and mitigation within municipal governments and other decision-making bodies.	Increase the use of natural, "green," or "soft" hazard mitigation measures such as open space preservation and green infrastructure.	Improve the resilience of local and regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies.	Improve public outreach, education, and warning systems.	Improve the emergency response capabilities of the region and its communities.	Ensure community character and social equity are addressed in mitigation activities.	Minimize the economic impact of hazard damages.
Andover	2	0	3	1	2	3	6	2	0
Avon	2	0	1	1	4	2	4	2	0
Berlin	4	2	1	1	2	1	2	1	0
Bloomfield	3	1	3	2	2	6	5	1	0
Bolton	12	0	1	1	4	5	4	1	0
Canton	6	0	1	1	0	2	4	1	0
Columbia	6	0	1	1	1	2	2	1	0
Coventry	6	0	4	2	8	1	8	3	0
East Granby	1	0	3	2	3	1	5	1	0
East Hartford	6	0	5	1	1	2	4	1	0
East Windsor	4	0	2	3	0	2	6	2	0
Ellington	1	0	2	1	2	1	2	1	0

Hazard Mitigation Goal	Minimize the impact of natural hazards on physical buildings and infrastructure.	Ensure Municipal Codes and Regulations support hazard mitigation.	Improve institutional awareness and understanding of natural hazard impacts and mitigation within municipal governments and other decision-making bodies.	Increase the use of natural, "green," or "soft" hazard mitigation measures such as open space preservation and green infrastructure.	Improve the resilience of local and regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies.	Improve public outreach, education, and warning systems.	Improve the emergency response capabilities of the region and its communities.	Ensure community character and social equity are addressed in mitigation activities.	Minimize the economic impact of hazard damages.
Enfield	4	0	1	1	1	2	1	1	0
Farmington	5	0	3	1	1	1	3	2	0
Glastonbury	3	4	1	2	1	4	0	1	0
Granby	5	5	3	3	3	4	5	2	0
Hartford	5	0	1	1	1	1	3	2	0
Hebron	3	1	1	1	0	1	3	1	0
Manchester	4	1	2	1	2	3	0	1	0
Mansfield	6	1	3	3	3	8	3	1	0
Marlborough	3	0	1	1	1	1	3	1	0
New Britain	8	1	2	2	2	4	1	2	0
Newington	3	0	1	1	2	1	4	1	0
Plainville	8	4	4	4	4	5	8	1	0
Rocky Hill	2	0	1	0	2	1	0	1	0
Simsbury	10	3	2	2	3	1	2	2	2
Somers	2	2	1	1	2	5	3	1	1
South Windsor	4	0	2	1	4	3	5	1	0
Southington	3	2	1	1	0	2	6	2	0
Stafford	2	0	1	2	1	3	4	1	0
Suffield	2	1	1	1	1	3	1	1	0
Tolland	4	1	2	1	3	4	5	1	0
Vernon	5	0	1	1	0	1	3	1	1
West Hartford	7	1	3	1	2	2	10	2	1
Wethersfield	16	0	1	1	1	1	3	1	1
Willington	5	2	2	2	2	2	4	1	0

Hazard Mitigation Goal	Minimize the impact of natural hazards on physical buildings and infrastructure.	Ensure Municipal Codes and Regulations support hazard mitigation.	Improve institutional awareness and understanding of natural hazard impacts and mitigation within municipal governments and other decision-making bodies.	Increase the use of natural, "green," or "soft" hazard mitigation measures such as open space preservation and green infrastructure.	Improve the resilience of local and regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies.	Improve public outreach, education, and warning systems.	Improve the emergency response capabilities of the region and its communities.	Ensure community character and social equity are addressed in mitigation activities.	Minimize the economic impact of hazard damages.
Windsor	4	2	2	0	4	2	4	0	0
Windsor Locks	2	1	1	1	12	3	4	1	0

Planning Process

The update planning process began in 2017 when FEMA awarded CRCOG a Pre-Disaster Mitigation Planning Grant to update its multi-jurisdictional natural hazard mitigation plan. This Plan Update was developed in collaboration with CREPC, the region's 38 municipalities, and DESPP/DEMHS. As in 2013-2014, ESF-5 Emergency Management served as the planning committee for the update process and provided guidance to the project. A consultant (Milone & MacBroom, Inc. of Cheshire, Connecticut) was retained to provide technical support and coordinate efforts to involve officials from each town. Milone & MacBroom, Inc. assembled a team of subconsultants (Dewberry, Jamie Caplan Consulting, and Punchard Consulting) working on state and local hazard mitigation plans in Connecticut in parallel with the CRCOG planning process to provide its expertise and input. Finally, members of the public were provided opportunities to provide input throughout the development of the Plan Update.

The hazards included in the planning process in 2017-2018 were those profiled and analyzed 5 years earlier. Importantly, they were the same as the hazards included in the 2014 Connecticut Natural Hazard Mitigation Plan and its update (to be adopted in 2019).

As the hazards analyses were undertaken, the consultant team led meetings with municipal officials to initiate updates to individual city and town plans. These meetings were held in each of the 38 municipalities and included local staff from a variety of departments including administration, planning, emergency management, police, fire, public health, public works, and engineering. In some towns, citizens and elected officials also participated. The consultant team conducted the following meetings locally over a 5-month period (November 2017 through March 2018) with municipal officials to conduct the local update process:

Table ES-5: Summary of Local Planning Meeting Dates and Attendance

Municipality	Local Planning Meeting Date
Andover	3/29/2018
Avon	1/16/2018
Berlin	11/9/2017
Bloomfield	12/20/2017
Bolton	2/16/2018
Canton	12/6/2017
Columbia	2/16/2018
Coventry	12/18/2017
East Granby	12/14/2017
East Hartford	1/18/2018
East Windsor	11/28/2017
Ellington	1/16/2018
Enfield	2/26/2018
Farmington	1/12/2018
Glastonbury	12/20/2017
Granby	12/14/2017
Hartford	12/13/2017
Hebron	2/13/2018
Manchester	12/20/2017
Mansfield	12/13/2017
Marlborough	2/6/2018
New Britain	11/27/2017
Newington	11/9/2017
Plainville	11/6/2017
Rocky Hill	11/10/2017
Simsbury	12/19/2017
Somers	11/20/2017
South Windsor	12/20/2017
Southington	11/14/2017
Stafford	3/29/2018
Suffield	11/28/2017
Tolland	1/10/2018
Vernon	1/11/2018
West Hartford	11/29/2017
Wethersfield	12/5/2017
Willington	2/13/2018
Windsor	12/18/2017
Windsor Locks	12/11/2017

To review prior goals, objectives, and actions and to strategize about new mitigation initiatives, CRCOG and the consultant team sought the advice of the CREPC planning committee at workshops held on January 23, March 27, and September 12, 2018. The meetings were attended by municipal officials from most of the Capitol Region communities as well as representatives from DEEP, the State Historic Preservation Office (SHPO), and the Connecticut Institute for Resilience and Climate Adaptation (CIRCA). The consultant team presented and described mitigation success stories; a number of proposed mitigation initiatives with assistance from DEEP, SHPO, and CIRCA; and reported on additional strategies/actions based on our findings and discussions with local officials at the individual municipal meetings. These meetings led to the new initiatives described in this update such as the historic resources resiliency, addressing spills from small businesses, Municipal Separate Storm Sewer System (MS4) stormwater registration compliance, regional critical facilities, etc.

A variety of means were used to inform the public of the planning process and to gain public input on hazards, areas and issues of concern, and mitigation measures. These specific outreach efforts include public meetings, web postings, and an internet-based public survey. From the survey and public meetings, we found there is strong support for: 1) activities that will mitigate and accelerate recovery from, damage to utilities, infrastructure, and critical facilities (especially the power grid); 2) providing assistance to vulnerable populations; and 3) public education and outreach, public warning system improvements, and emergency response trainings. There is less support for mitigation actions involving floodproofing, drought ordinances, and building-earthquake analysis. Natural and recreational resource recovery, as well as tourism and business recovery, are the lowest priorities for most respondents.

Plan Implementation and Maintenance

Upon approval of the Plan Update by FEMA, each municipality's governing body as well as CRCOG's Policy Board will need to formally adopt the Plan Update. CREPC will also be asked to append this plan to the Regional Emergency Support Plan (RESP).

Implementation of the strategies contained within this plan will depend largely on the availability of resources. Each municipality and CRCOG will have to consider the costs, availability of funding, and impacts of each strategy individually. The CRCOG Policy Development & Planning Department will be responsible for regional strategies and coordination with CRCOG Public Safety staff. The planning subcommittee of CREPC (ESF-5), which provided guidance to this project, will monitor progress on its implementation with assistance from CRCOG staff. The subcommittee will conduct annual outreach to municipalities to ascertain progress on proposed mitigation actions.

For more information on natural hazard mitigation planning, please visit CRCOG's website – http://crcog.org/2016/05/30/natural-hazards-mitigation-planning/.

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Municipal Annexes

Details on the hazard risks and vulnerabilities, mitigation capabilities, and planned mitigation strategies and actions of each municipality in the Capitol Region are included in the Municipal Annexes section of this document. That section is formatted to be viewed as a separate document, but is not intended as a stand-alone planning document.

Appendices

(Please note: Appendices are formatted to be able to be printed as a separate document.)

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Section I: Introduction and Overview of the Region

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Introduction

The Capitol Region Council of Governments (CRCOG) received Federal Emergency Management Agency (FEMA) funds through the Connecticut Department of Emergency Services and Public Protection (DESPP) to develop a Natural Hazard Mitigation Plan Update for the 38 municipalities comprising the region:

Town of Andover	Town of East Windsor	Town of Marlborough	Town of Suffield
Town of Avon	Town of Ellington	City of New Britain	Town of Tolland
Town of Berlin	Town of Enfield	Town of Newington	Town of Vernon
Town of Bloomfield	Town of Farmington	Town of Plainville	Town of West Hartford
Town of Bolton	Town of Glastonbury	Town of Rocky Hill	Town of Wethersfield
Town of Canton	Town of Granby	Town of Simsbury	Town of Willington
Town of Columbia	City of Hartford	Town of Somers	Town of Windsor
Town of Coventry	Town of Hebron	Town of South Windsor	Town of Windsor Locks
Town of East Granby	Town of Manchester	Town of Southington	
Town of East Hartford	Town of Mansfield	Town of Stafford	

CRCOG staff and municipal officials from each community contributed to this planning project.

Plan

This plan update builds on the existing Capitol Region Natural Hazard Mitigation Plan of 2014 and incorporates information from the former Central Connecticut Region Hazard Mitigation Plan Update (2016) and the former Windham Regional Hazard Mitigation Plan Update (2015). Berlin, New Britain, Plainville, and Southington were previously included in the former Central Connecticut Region Hazard Mitigation Plan. Columbia, Coventry, Mansfield, and Willington were previously included in the former Windham Regional Hazard Mitigation Plan. The other 30 communities listed above were included in the previous Capitol Region Natural Hazard Mitigation Plan.

This introductory section contains a brief overview of the plan's purpose and an introduction to the region and its current conditions. It describes who we are and what we have at stake. Section II profiles and evaluates the natural hazards that affect the Capitol Region. Section III assesses regional and local capabilities, summarizes the local and regional mitigation actions, and describes the regional mitigation goals and strategies in more detail. Section IV describes each participating community, their vulnerabilities to natural hazards, and their mitigation strategies. Section V describes the planning process undertaken by CRCOG and its member municipalities to complete this plan. Section VI outlines the process for implementing, monitoring, and updating the plan as well as summarizing the adoption process. Section VII documents the sources we used. Finally, the appendices provide further details on our planning process, critical facilities, historic and cultural resources, and loss estimates.

Authority

The Federal Disaster Mitigation Act of 2000 (DMA 2000) amended Section 322, "Mitigation Planning" and other sections of the Robert T. Stafford Disaster Relief and Emergency Assistance Act to promote natural hazard mitigation planning. DMA 2000 requires local governments to have an approved Natural

Hazard Mitigation Plan to be eligible to receive Hazard Mitigation Grant Program project funding. Once approved by FEMA and adopted locally, this regional plan will fulfill that requirement.

Purpose

The purpose of this plan is to identify natural hazards likely to affect the Capitol Region, assess our vulnerabilities to these hazards, and set forth mitigation strategies that will reduce the loss of life and property, economic disruptions, and the cost of post-disaster recovery for the region's communities. Unlike other emergency plans already adopted for the region, this Hazard Mitigation Plan focuses on reducing or eliminating the impacts of natural hazards. Nevertheless, as mitigation measures are only a part of emergency preparedness, this plan will be incorporated into future editions of the Regional Emergency Support Plan (RESP) after adoption. The Capitol Region's communities recognize their responsibility to protect the health, safety, and welfare of their citizens and will strive to implement the mitigation strategies they propose. However, while this plan provides a blueprint for local and regional efforts to reduce or eliminate risk to life and property from natural hazards, it does not constitute a mandate, specification, or regulation.

The plan considers the following natural hazards that affect the region:

- Dam Failure
- Drought
- Earthquake
- Flooding
- Forest and Wildland Fires
- Hurricanes and Tropical Storms
- Tornadoes and High Winds
- Severe Winter Storms

Mitigation goals and strategies were developed at both the regional and local levels. CRCOG and the Capitol Region Emergency Planning Committee (CREPC), in addition to local and other partners, are responsible for implementation of the regional goals contained in this plan. Each participating municipality identified its own mitigation goals and strategies and assumes responsibility for implementation of those measures.

Connecticut's Capitol Region

Geography and Climate

The Connecticut River valley bisects the Capitol Region from north to south. The western and eastern edges of the region contain more steep slopes and narrower tributary river valleys than the relatively flat, central valley (see the topography map at the end of this section). The region's climate, like the state's, is dominated by a relatively even distribution of precipitation across four seasons, a significant range in temperatures both seasonally and daily, and significant variability in weather over brief time spans as well as across years. Generally, the region has a moderate climate with maximum temperatures ranging from 35^{o} to 40^{o} in winter to 80^{o} to 85^{o} in summer. The average minimum temperature ranges from about 31^{o} in winter to 70^{o} in summer. Average annual precipitation is about 45 inches although this can vary widely, and the amount of precipitation may be changing as the climate changes. About 40 inches of snow can be expected per year, with wide variation across the hills and valleys of the region, and again, with wide variation from year to year. For example, in Stafford in the region's northeast,

snowfall amounts average just less than 40 inches in the southern area of the town but increase to nearly 60 inches in the northwest corner.

Population and Housing

Connecticut's Capitol Region encompasses the City of Hartford, Connecticut's capitol, and the 37 surrounding urban, suburban, and rural communities. It is a region rich in history as well as human and natural resources. Portions of the Farmington and Connecticut Rivers traverse the region, in addition to several regional river complexes, including the Hockanum, Park, Quinnipiac, Scantic, and Willimantic. The region contains urbanized and heavily developed areas as well as low-density suburbs and rural enclaves.

The total regional population according to the 2010 U.S. Census is 973,960. The estimated population of the region in 2016 was 970,790, or a 3% decrease. According to the Connecticut Department of Economic and Community Development (DECD), the region is estimated to grow to a population of 1,000,619 by 2023, or a 3% increase over the 2010 population. As Table 1 indicates, population density across the region varies dramatically, from a low of 207 people per square mile in Bolton to a high of 7,853 people per square mile in Hartford.

Table 1: Capitol Region 2010 to 2023 Population and Density

Municipality	Land Area (sq. mi.)	2010		2016 (estimated)			2023 (projected)		
		Census 2010 Population	Density (per sq. mi.)	2016 Population Estimates	Density (per sq. mi.)	Percent Change 2010 to 2016	2023 Population Estimates	Density (per sq. mi.)	Percent Change 2016 to 2023
Andover	15.7	3,303	210	3,252	207	-1.6%	3,069	196	-6.0%
Avon	23.6	18,098	1,153	18,364	1,170	1.4%	20,333	1,296	9.7%
Berlin	27.0	19,866	1,266	20,499	1,306	3.1%	20,311	1,294	-0.9%
Bloomfield	26.3	20,486	1,305	20,642	1,315	0.8%	20,521	1,308	-0.6%
Bolton	14.7	4,980	317	4,930	314	-1.0%	4,511	287	-9.3%
Canton	25.0	10,292	656	10,287	655	0.0%	10,966	699	6.2%
Columbia	22.0	5,485	349	5,433	346	-1.0%	5,471	349	0.7%
Coventry	38.2	12,435	792	12,433	792	0.0%	12,036	767	-3.3%
East Granby	17.7	5,148	328	5,170	329	0.4%	5,325	339	2.9%
East Hartford	18.7	51,252	3,266	50,237	3,201	-2.0%	54,147	3,450	7.2%
East Windsor	26.8	11,162	711	11,355	724	1.7%	13,193	841	13.9%
Ellington	34.6	15,602	994	16,071	1,024	2.9%	18,582	1,184	13.5%
Enfield	34.2	44,654	2,845	44,368	2,827	-0.6%	42,779	2,726	-3.7%
Farmington	28.8	25,340	1,615	25,524	1,626	0.7%	25,526	1,626	0.0%
Glastonbury	52.2	34,427	2,194	34,584	2,204	0.5%	34,676	2,209	0.3%
Granby	40.8	11,282	719	11,247	717	-0.3%	10,690	681	-5.2%
Hartford	18.1	124,775	7,950	123,243	7,853	-1.2%	127,205	8,105	3.1%
Hebron	37.3	9,686	617	9,529	607	-1.6%	9,239	589	-3.1%
Manchester	27.7	58,241	3,711	57,873	3,687	-0.6%	64,436	4,106	10.2%
Mansfield	45.6	26,543	1,691	25,969	1,655	-2.2%	27,338	1,742	5.0%
Marlborough	23.5	6,404	408	6,402	408	0.0%	6,113	390	-4.7%
New Britain	13.5	73,206	4,664	72,558	4,623	-0.9%	76,367	4,866	5.0%
Newington	13.1	30,562	1,947	30,423	1,938	-0.5%	31,603	2,014	3.7%
Plainville	9.8	17,716	1,129	17,677	1,126	-0.2%	17,738	1,130	0.3%

Municipality	Land Area (sq. mi.)	2010		2016 (estimated)			2023 (projected)		
		Census 2010 Population	Density (per sq. mi.)	2016 Population Estimates	Density (per sq. mi.)	Percent Change 2010 to 2016	2023 Population Estimates	Density (per sq. mi.)	Percent Change 2016 to 2023
Rocky Hill	13.8	19,709	1,256	20,119	1,282	2.0%	21,839	1,392	7.9%
Simsbury	34.3	23,511	1,498	24,407	1,555	3.7%	22,217	1,416	-9.9%
Somers	28.5	11,444	729	11,092	707	-3.2%	11,661	743	4.9%
South Windsor	28.7	25,709	1,638	25,737	1,640	0.1%	24,614	1,568	-4.6%
Southington	36.6	43,069	2,744	43,685	2,783	1.4%	43,602	2,778	-0.2%
Stafford	58.8	12,087	770	11,758	749	-2.8%	12,108	771	2.9%
Suffield	42.9	15,735	1,003	15,625	996	-0.7%	16,721	1,065	6.6%
Tolland	40.3	15,052	959	14,791	942	-1.8%	14,548	927	-1.7%
Vernon	18.1	29,179	1,859	29,148	1,857	-0.1%	30,372	1,935	4.0%
West Hartford	22.3	63,268	4,031	62,903	4,008	-0.6%	66,196	4,218	5.0%
Wethersfield	13.1	26,668	1,699	26,195	1,669	-1.8%	27,082	1,726	3.3%
Willington	33.5	6,041	385	5,872	374	-2.9%	6,467	412	9.2%
Windsor	31.0	29,044	1,851	28,875	1,840	-0.6%	28,399	1,809	-1.7%
Windsor Locks	9.4	12,498	796	12,512	797	0.1%	12,618	804	0.8%
Totals	**1,046**	**973,959**	**62,057**	**970,789**	**61,855**	**-0.3%**	**1,000,619**	**63,756**	**3.0%**

Source: U.S. Census, CT DECD – Connecticut Population Information, http://www.ct.gov/ecd/cwp/view.asp?a=1106&q=250666

Overall, the region contained an estimated 401,548 housing units in 2016, which is a 7% increase from 374,475 units in 2000. The majority of these units are single-family detached housing units as seen in Table 2. The region's rural and suburban towns account for most of the increase in housing units.

While the overall growth in housing units between 2000 and 2016 is estimated as 7%, growth between 2010 and 2016 was only 1% for single-family housing and an estimated 15% increase in multifamily housing over the 6-year period.

As shown in Table 2, between 2010 and 2016, new housing units in rural and suburban portions of the region increased by about 22%; in urbanized areas of the region (the cities of Hartford and New Britain and the towns of East Hartford, Enfield, Manchester, Newington, Rocky Hill, Vernon, West Hartford, Wethersfield, and Windsor Locks), the increase was about 11%. While there was limited growth in single-family housing, almost all the communities saw growth in multifamily units.

It is noted that Census data estimates indicate a decrease in single-family housing for some of the communities, which could be attributed to property conversions or demolition; however, there appear to be reporting anomalies for Bloomfield, Columbia, Farmington, Mansfield, and New Britain, which may be attributed to changes in reporting classifications of unit types.

Table 2: Capitol Region 2000 to 2016 Housing Counts

Municipality	Total Housing Units				Municipality	Total Housing Units			
	2000	2010	2016*	Percent change 2000 to 2016		2000	2010	2016*	Percent change 2000 to 2016
Andover	1,198	1,317	1,279	7%	Mansfield	5,481	6,017	6,078	11%
Avon	6,480	7,389	7,415	14%	Marlborough	2,057	2,389	2,296	12%
Berlin	6,955	8,140	8,427	21%	New Britain	31,164	31,226	31,616	1%
Bloomfield	8,195	9,019	8,807	7%	Newington	12,264	13,011	12,860	5%
Bolton	1,969	2,015	2,118	8%	Plainville	7,707	8,063	8,054	5%
Canton	3,616	4,339	4,340	20%	Rocky Hill	7,962	8,843	8,788	10%
Columbia	1,988	2,308	2,199	11%	Simsbury	8,739	9,123	9,428	8%
Coventry	4,486	5,099	5,082	13%	Somers	3,012	3,479	3,631	21%
East Granby	1,903	2,152	2,146	13%	South Windsor	9,071	10,243	10,378	14%
East Hartford	21,273	21,328	21,530	1%	Southington	15,557	17,447	17,747	14%
East Windsor	4,356	5,045	4,999	15%	Stafford	4,616	5,124	5,195	13%
Ellington	5,417	6,665	6,847	26%	Suffield	4,853	5,469	5,282	9%
Enfield	17,043	17,558	17,403	2%	Tolland	4,665	5,451	5,472	17%
Farmington	9,854	11,106	10,793	10%	Vernon	12,867	13,896	14,170	10%
Glastonbury	12,614	13,656	13,801	9%	West Hartford	25,332	26,396	25,987	3%
Granby	3,887	4,360	4,556	17%	Wethersfield	11,454	11,677	11,376	-1%
Hartford	50,644	51,822	53,297	5%	Willington	2,429	2,637	2,563	6%
Hebron	3,110	3,567	3,575	15%	Windsor	10,900	11,767	11,553	6%
Manchester	24,256	25,996	25,072	3%	Windsor Locks	5,101	5,429	5,424	6%
					Total	**374,475**	**400,568**	**401,584**	**7%**

Source: U.S. Census, American Community Survey, *Selected Housing Characteristics*, http://factfinder2.census.gov/

* 2016 totals do not reflect other types of housing units that are not in a permanent structure.

Table 3: Capitol Region 2000 to 2016 Housing By Type

Municipality	2010						2016						Single Family Change	Multi-Family Change
	2010 Total	Single-Family Detached	% Single Family	1-Unit Attached	2-4 Units	5 Units or More	2016 Total	Single-Family Detached	% Single Family	1-Unit Attached	2-4 Units	5 Units or More		
Andover	1,286	1,227	95%	15	11	33	1,279	1,198	94%	7	7	74	-2%	49%
Avon	7,056	4,999	71%	842	487	728	7,415	5,423	73%	934	1,360	632	8%	42%
Berlin	7,676	6,344	83%	216	612	504	8,427	6,420	76%	254	1,189	818	1%	70%
Bloomfield	9,099	6,135	67%	556	668	1,740	8,807	5,834	66%	542	1,325	1,648	-5%	19%
Bolton	2,254	1,937	86%	57	184	76	2,118	1,915	90%	36	125	78	-1%	-25%
Canton	4,159	3,023	73%	208	421	507	4,340	3,123	72%	322	859	358	3%	35%
Columbia	2,309	2,149	93%	72	80	8	2,199	1,966	89%	12	220	13	-9%	53%
Coventry	4,935	4,345	88%	204	199	187	5,082	4,673	92%	111	221	188	8%	-12%
East Granby	2,043	1,590	78%	56	144	253	2,146	1,712	80%	55	162	272	8%	8%
East Hartford	21,544	11,012	51%	936	4,195	5,401	21,530	11,104	52%	906	4,756	5,670	1%	8%
East Windsor	4,769	2,553	54%	353	361	1,502	4,999	2,845	57%	504	956	1,198	11%	20%
Ellington	6,271	3,890	62%	201	679	1,501	6,847	4,095	60%	381	1,187	1,565	5%	32%
Enfield	16,991	11,950	70%	969	2,190	1,882	17,403	12,166	70%	909	3,273	1,964	2%	22%
Farmington	10,917	7,111	65%	1,298	1,024	1,484	10,793	6,537	61%	1,253	2,447	1,809	-8%	45%
Glastonbury	13,421	10,208	76%	1,051	973	1,189	13,801	10,002	72%	1,185	2,468	1,331	-2%	55%
Granby	4,341	3,841	88%	182	159	159	4,556	4,052	89%	228	382	122	5%	46%
Hartford	54,902	8,164	15%	1,608	20,115	25,015	53,297	7,823	15%	2,359	21,724	23,750	-4%	2%
Hebron	3,441	3,127	91%	79	140	95	3,575	3,292	92%	68	255	28	5%	12%
Manchester	25,454	12,379	49%	1,726	4,670	6,679	25,072	11,587	46%	2,152	6,474	7,011	-6%	20%
Mansfield	6,558	3,874	59%	259	1,314	1,111	6,078	3,389	56%	407	1,610	1,079	-13%	15%
Marlborough	2,221	1,976	89%	109	103	33	2,296	2,043	89%	75	178	75	3%	34%
New Britain	32,917	10,033	30%	905	12,331	9,648	31,616	9,184	29%	929	13,275	9,157	-8%	2%
Newington	12,582	8,141	65%	1,616	1,000	1,825	12,860	8,188	64%	1,410	2,376	2,296	1%	37%
Plainville	7,798	4,892	63%	352	1,298	1,256	8,054	4,920	61%	392	1,702	1,432	1%	21%
Rocky Hill	8,567	3,945	46%	979	724	2,919	8,788	4,207	48%	929	1,967	2,614	7%	19%
Simsbury	8,709	7,027	81%	412	529	741	9,428	7,462	79%	472	1,022	944	6%	45%
Somers	3,465	3,301	95%	18	113	33	3,631	3,184	88%	98	329	118	-4%	232%
South Windsor	9,801	7,245	74%	1,051	240	1,265	10,378	7,430	72%	982	1,379	1,569	3%	54%
Southington	17,071	12,276	72%	1,065	1,287	2,443	17,747	12,593	71%	1,129	2,740	2,414	3%	31%
Stafford	5,118	3,830	75%	168	622	498	5,195	3,720	72%	166	951	524	-3%	27%
Suffield	5,365	4,339	81%	405	408	213	5,282	4,436	84%	391	604	242	2%	21%
Tolland	5,287	4,814	91%	113	194	166	5,472	5,190	95%	63	111	171	8%	-27%
Vernon	13,536	6,459	48%	452	2,484	4,141	14,170	6,431	45%	873	3,478	4,261	0%	22%
West Hartford	25,733	16,872	66%	831	3,040	4,990	25,987	17,148	66%	825	3,598	5,241	2%	9%
Wethersfield	11,374	8,431	74%	485	991	1,467	11,376	8,418	74%	523	1,618	1,340	0%	18%
Willington	2,381	1,622	68%	49	148	562	2,563	1,596	62%	135	411	556	-2%	45%
Windsor	11,405	8,666	76%	874	1,095	770	11,553	8,786	76%	598	1,827	940	1%	23%
Windsor Locks	5,415	3,851	71%	351	461	752	5,424	3,936	73%	351	883	605	2%	18%
Total	**398,171**	**227,578**	57%	**21,123**	**65,694**	**83,776**	**401,584**	**228,028**	57%	**22,966**	**89,449**	**84,107**	0%	15%

Source: U.S. Census, American Community Survey, *Selected Housing Characteristics*, http://factfinder2.census.gov/

Land Use

Like most inland areas in New England, the Capitol Region historically developed along its major rivers. That early settlement pattern is still evident in contemporary land uses, with more urbanized areas concentrated along the Connecticut, Farmington, and Hockanum Rivers. Less dense development and more significant forested and open space lands exist on the western and eastern edges of the region. Map 2 on page 14 of this section displays land cover across the region in 2006. As is evident from the map, more development has occurred in a rather diffuse pattern, away from the traditional urban core. This map was derived from the Center for Land Use Education and Research (CLEAR) at the University of Connecticut. Town-level land cover change maps for the same time period are available on CLEAR's website. These maps can help towns assess the vulnerability of new developments to natural hazard risks. The Capitol Region's current Plan of Conservation and Development's Land Use Policy Map is displayed on page 15 of this section (Map 3). The Land Use Policy Map represents the generalized land use plan for the region and the 30 municipalities that were members of CRCOG at the time the plan was prepared. It reflects existing and proposed regional priority areas of development and preservation and shows municipal focus areas for development and conservation.

The Capitol Region hosts significant commercial, industrial, and public properties ranging from the regional employment centers and state office buildings in Hartford, New Britain, Enfield, Suffield, Rocky Hill, Wethersfield, and Newington to Rentschler Field in East Hartford, Bradley International Airport in Windsor Locks, the commercial/industrial Day Hill Road area in Windsor, and the major retail developments in West Hartford, Manchester, and South Windsor. According to 2015 equalized net grand list data, the region contains $108.9 billion in taxable real, personal, and motor vehicle property (see Table 4 below). The previous Hazard Mitigation Plan reported a total of $64 billion in taxable real, personal, and motor vehicle property. A significant component of the increase is due to the addition of eight municipalities to the region.

Table 4: 2015 Grand List Data by Town

Municipality	2015 Total Equalized Net Grand List	Grand List Components			
		Residential	Commercial, Industrial, Utility	Personal Property	Other
Andover	$371,631,557	83%	2%	13%	2%
Avon	$3,687,550,800	77%	13%	10%	0%
Berlin	$3,282,737,376	64%	18%	16%	2%
Bloomfield	$3,020,013,610	55%	24%	20%	0%
Bolton	$623,371,566	81%	5%	11%	2%
Canton	$1,607,651,531	73%	15%	11%	1%
Columbia	$698,989,199	81%	4%	13%	2%
Coventry	$1,425,790,912	83%	4%	13%	0%
East Granby	$859,087,879	61%	16%	23%	0%
East Hartford	$3,903,976,521	58%	21%	19%	1%
East Windsor	$1,352,524,745	58%	24%	17%	1%
Ellington	$1,897,496,889	79%	7%	13%	1%
Enfield	$4,062,151,475	65%	17%	17%	1%
Farmington	$5,329,528,757	64%	23%	12%	1%
Glastonbury	$5,953,139,268	71%	17%	11%	1%
Granby	$1,448,556,777	83%	5%	11%	1%

Municipality	2015 Total Equalized Net Grand List	Grand List Components			
		Residential	Commercial, Industrial, Utility	Personal Property	Other
Hartford	$7,050,499,019	47%	30%	21%	1%
Hebron	$1,071,376,676	84%	3%	12%	1%
Manchester	$5,549,612,279	62%	21%	17%	0%
Mansfield	$1,536,756,457	67%	19%	14%	0%
Marlborough	$823,378,394	84%	5%	11%	0%
New Britain	$3,659,454,405	69%	13%	17%	0%
Newington	$3,732,257,306	65%	21%	14%	1%
Plainville	$1,903,145,342	61%	20%	17%	2%
Rocky Hill	$3,059,763,412	63%	24%	13%	0%
Simsbury	$3,600,147,476	77%	11%	11%	1%
Somers	$1,208,933,114	78%	5%	14%	3%
Southington	$5,582,080,126	72%	12%	14%	2%
South Windsor	$3,793,497,465	64%	18%	16%	2%
Stafford	$1,101,222,496	73%	8%	16%	3%
Suffield	$2,007,892,425	78%	7%	14%	1%
Tolland	$1,815,100,661	80%	7%	12%	0%
Vernon	$2,514,856,753	70%	15%	14%	1%
West Hartford	$9,251,991,620	75%	16%	9%	1%
Wethersfield	$3,174,823,747	80%	9%	11%	0%
Willington	$614,961,716	71%	12%	15%	3%
Windsor	$4,440,057,842	50%	28%	21%	1%
Windsor Locks	$1,902,931,359	47%	23%	29%	1%
Total	**$108,918,938,952**				

Source: Equalized Net Grand List by Town, 2015. CT Office of Policy and Management, http://www.ct.gov/opm/cwp/view.asp?a=2987&q=385970&opmNav_GID=1807

Not all properties are equally vulnerable to all natural hazards as location and building materials influence vulnerability; nevertheless, the region risks substantial financial losses from catastrophic natural hazards affecting not only property but also business and government operations.

Development Trends

The above discussion about building permits, housing units, and population change provides a somewhat uniform picture of development trends in the Capitol Region. The discussion noted that while there was limited growth in single-family housing, almost all the Capitol Region communities saw growth in multifamily units. Some of the increases in multifamily housing units are striking, with very large apartment complexes completed in Bloomfield and Simsbury since the previous edition of this plan was approved in 2014.

To provide a narrative characterization of development trends in the Capitol Region, each municipality was provided an opportunity during the planning process to comment on development within its borders. Almost every community reported small subdivisions and at least a few nominal single-parcel, nonresidential developments and redevelopments. Many communities also reported renovations or replacements of schools and other town-owned facilities. Some of the more significant developments noted by communities include the following:

Table 5: Notable Developments or Redevelopments

Municipality	Notable Developments or Redevelopments
Andover	None / individual properties only
Avon	The "Village Center" project is underway. Preliminary discussions about redevelopment of Fox Run Golf Course have occurred, but nothing specific has been proposed.
Berlin	None / individual properties only
Bloomfield	A new apartment complex was recently completed in the town center. 38 assisted-living units are in for permits/approvals; the site is next to a floodplain but not in the floodplain. A development in Blue Hills includes 20 duplexes, 40 townhouses, and multiple apartments.
Bolton	None / individual properties only
Canton	None / individual properties only
Columbia	None / individual properties only
Coventry	None / individual properties only
East Granby	Some growth in manufacturing and residential infill
East Hartford	The Silver Lane Corridor is being actively promoted for development. Rentschler Field has additional space for nonresidential development. The state's commodities distribution facility is moving from East Hartford to Manchester, which will open up space for development in the site it vacates.
East Windsor	Future development may include "Calamar," a 122-unit complex on Route 5 off Route 140; this will be elderly housing. Some talk of a 600-unit apartment complex on Phelps Road at Route 5 – but many years out Two roundabouts are planned; these are DOT projects in conjunction with train station improvements. Sixty homes in "West River Farms A casino (collaboration between Mohegan and Foxwoods) will break ground and open within 5 years.
Ellington	None / individual properties only
Enfield	Lego has several vacant buildings that can be used. Zero King Street – two flex buildings "Mayfield" is 34 buildings under construction, with 10 apartments in each. "Villages" is a subdivision with 34 houses.
Farmington	None / individual properties only
Glastonbury	A 250-unit apartment complex has been built recently off New London Turnpike A 145-unit apartment complex is under construction on Hebron Avenue. One hundred units on Glastonbury Boulevard will be under construction soon. A number of new renovations are underway downtown. 30,000 sf of commercial space is under construction near McDonalds. "Gateway" is new and open.
Granby	A 33-unit building was recently completed and undergoing occupancy. One hundred thirty apartment units in development with 50 homes plus additional 34 units approved.
Hartford	The Yard Goats baseball stadium was completed in 2017 and may spur some development activity.
Hebron	A large senior living facility is currently being completed in the downtown area behind the CVS.

Municipality	Notable Developments or Redevelopments
Manchester	None / individual properties only
Mansfield	Significant new development on the UCONN campus and in the downtown Storrs area was underway during the development of the 2014 plan update, and most has been completed. New water supply and sewer have been brought to the Mansfield Four Corners area of town, which is an area of interest for new development.
Marlborough	None / individual properties only
New Britain	Stanley Golf Course at the extreme northeastern corner of the city was developed with a new Costco since the adoption of the 2014 plan. Significant planning has been conducted toward redevelopment in the downtown area. The CT*fastrak* busway terminal and associated support services were completed since the adoption of the 2014 plan.
Newington	The CT*fastrak* busway station spurred some light development since the adoption of the 2014 plan.
Plainville	None / individual properties only
Rocky Hill	Mixed-use commercial and residential developments have been mostly completed but still underway along Cromwell Avenue near West Street.
Simsbury	Apartment construction has increased. About 1,200 new units have been constructed, 1,000 are coming soon, and 1,000 more are approved.
Somers	None / individual properties only
Southington	None / individual properties only
South Windsor	None / individual properties only
Stafford	None / individual properties only
Suffield	Several new subdivisions underway or approved.
Tolland	About 37 units of elderly housing have been added in Tolland since the 2014 plan update.
Vernon	Since the 2014 plan, the Amerbelle Mill Complex has undergone some redevelopment, including the removal of an on-site dam; the former Roosevelt Mill has been redeveloped into loft apartments; and the Talcottville Mill redevelopment occurred, including a riverbank stabilization project.
West Hartford	New Park Avenue is an area of continued interest for development. The new apartment complex on New Park Avenue is located near the CT*fastrak* busway; it is elevated above the 0.2% flood elevation. The UConn West Hartford campus is vacant and, after significant planning, will be redeveloped and occupied by a single large commercial enterprise. Development potential remains at the intersection of Park Road and Prospect Street at the old convent. This site is close to a stream that crosses into Hartford.
Wethersfield	A new CREC magnet school was built since the 2014 plan update.
Willington	None / individual properties only
Windsor	An Amazon logistics center and large Dollar Tree have located to the town since the 2014 plan update.
Windsor Locks	Montgomery Mill will be redeveloped into apartments. Several new residential neighborhoods, mostly single family, have been developed. Many attempts have been made to develop a 70-acre parcel along Route 20.

In summary, based on meetings with local planning teams, the communities of Avon, Bloomfield, East Hartford, East Windsor, Enfield, Glastonbury, Granby, Hartford, Mansfield, New Britain, Rocky Hill, Simsbury, Suffield, Vernon, West Hartford, Windsor, and Windsor Locks have experienced the most significant development in the last few years and have the most noteworthy projects approved or pending approval. The communities of Hebron, Newington, and Tolland have experienced a somewhat lesser level of development and redevelopment. All remaining Capitol Region communities have experienced at least nominal development or development of single properties and parcels.

Capitol Region communities are aware of the need to strictly regulate development in areas of risk. Each municipality enforces floodplain development regulations as noted in Section II, and none are actively promoting new construction in SFHAs.

In addition to those projects listed above, the State of Connecticut and the Capitol Region anticipate that transit-oriented development (TOD) will be spurred by the June 2018 startup of CT*rail*, the new commuter rail between New Haven and Springfield. Existing railroad stations in Berlin, Hartford, Windsor, and Windsor Locks and potential new stations in Newington, West Hartford, and Enfield may lead to TOD development in those communities. The CT*fastrak* busway has already spurred some development along its stations in New Britain, Newington, and West Hartford. [image courtesy of hartfordline.com]

Cultural and Natural Assets of the Region

The Capitol Region is rich in natural, historic, and cultural assets. Efforts have been taken by many to recognize, preserve, and protect these assets. These assets should be considered in our mitigation planning whether in efforts to further protect the assets from the impacts of natural disasters or to minimize potential adverse impacts that may affect these assets.

The Connecticut Department of Energy & Environmental Protection (DEEP) maintains a database of plant and animal species that are endangered, threatened, or of special concern. The list is lengthy and can be seen on DEEP's website[1]. In the Capitol Region, some of the species listed include the Barn Owl, Red-headed Woodpecker, Timber Rattlesnake, Wood Turtle, Short-nose Sturgeon, Ground Beetle, Sedge, Yellow Lady's-slipper, Red Pine, and Prickly Pear. Map 4 displays the approximate locations endangered, threatened, and special concern species and significant natural communities in the Capitol Region. These locations are taken from DEEP's Natural Diversity Data Base (NDDB) Maps. These maps are intended to be a pre-screening tool to identify potential impacts to state-listed species. The DEEP should be consulted regarding any mitigation projects that may be considered in these areas.

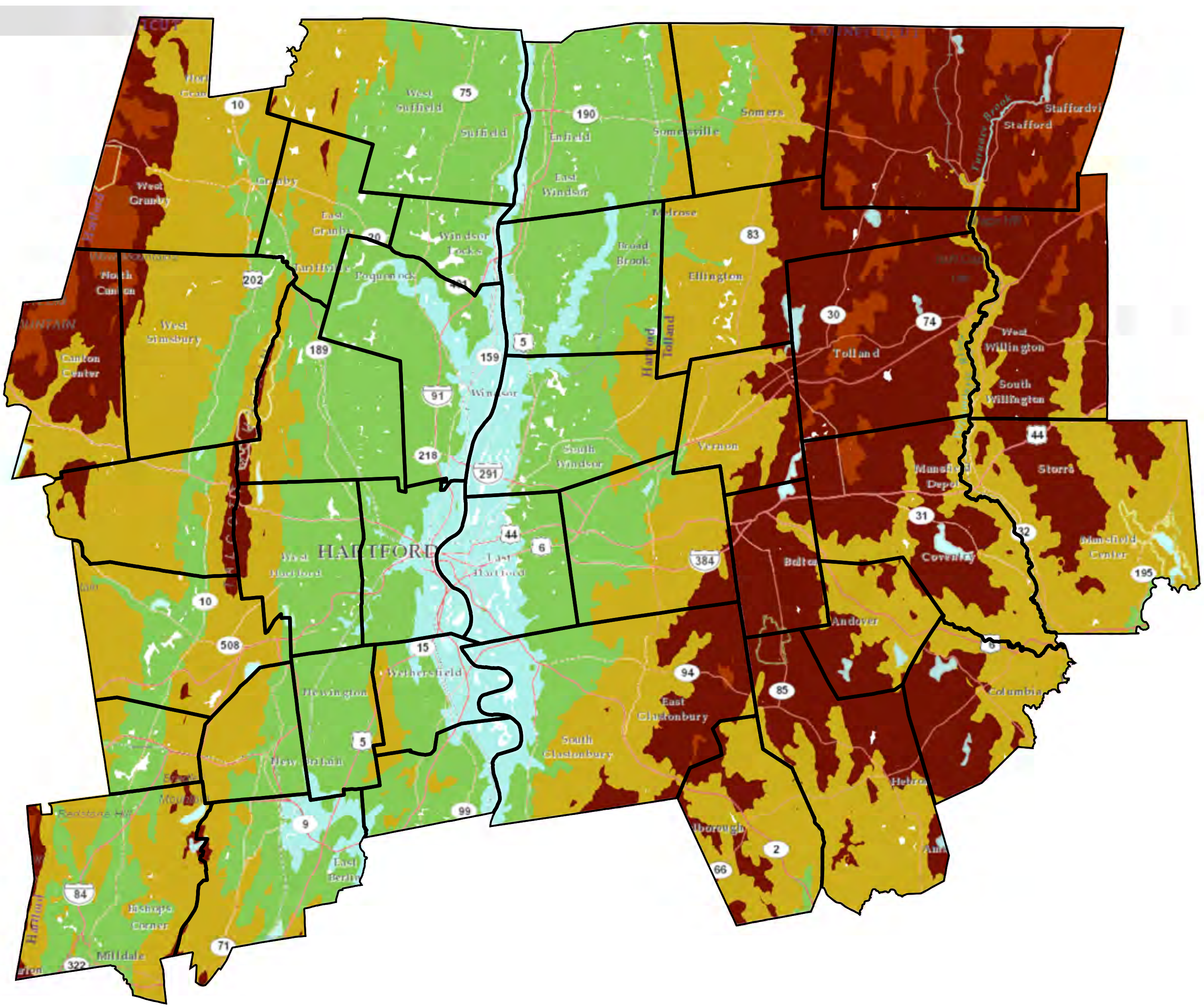
The numerous structures, sites, and districts listed on the State and National Registers of Historic Places in the Capitol Region attest to the importance of historic preservation to our communities. Sites on the

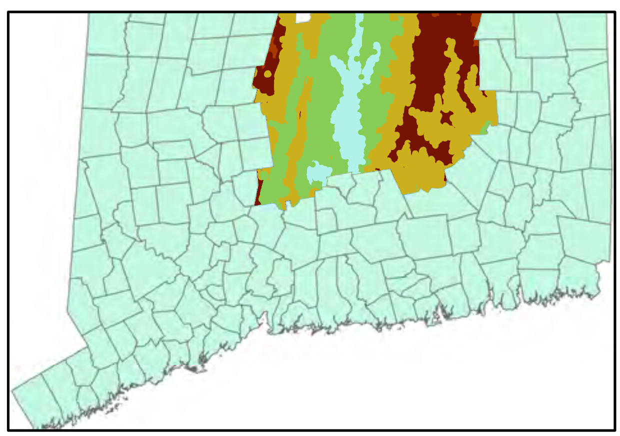
[1] http://www.ct.gov/dep/cwp/view.asp?a=2702&q=323474&depNav_GID=1628

Registers are significant to our culture. Map 5 displays sites on the National Register. An inventory of the sites and districts depicted on Map 5 can be found in Appendix B. SHPO maintains a list of State Archaeological Preserves. The Archaeological Preserves in the Capitol Region are:

- Dividend Brook Industrial Archaeological District, Rocky Hill
- Small Pox Hospital Rock, Farmington
- Newgate Prison and Copper Mine, East Granby
- Fifth Camp of Rochambeau's Infantry, Bolton

SHPO should be consulted regarding any mitigation projects that may be considered that could affect buildings or sites on the Registers. Risks to historic and cultural resources are discussed in Section II of this plan.





LEGEND

Elevation

- Below 50 Feet
- 50-200 Feet
- 200-500 Feet
- 500-800 Feet
- Over 800 Feet

SOURCE(S):		LOCATION:
USGS	Map 1: Topography	Capitol Region, CT

N

Capitol Region Natural Hazards Mitigation Plan Update

MXD: Y:\2020-16\Maps\Map_1_Topography_.mxd

Map By: MER
MMI#: 2020-16
Original: 10/11/2017
Revision: 10/11/2017
Scale: 1 inch = 30,000 feet

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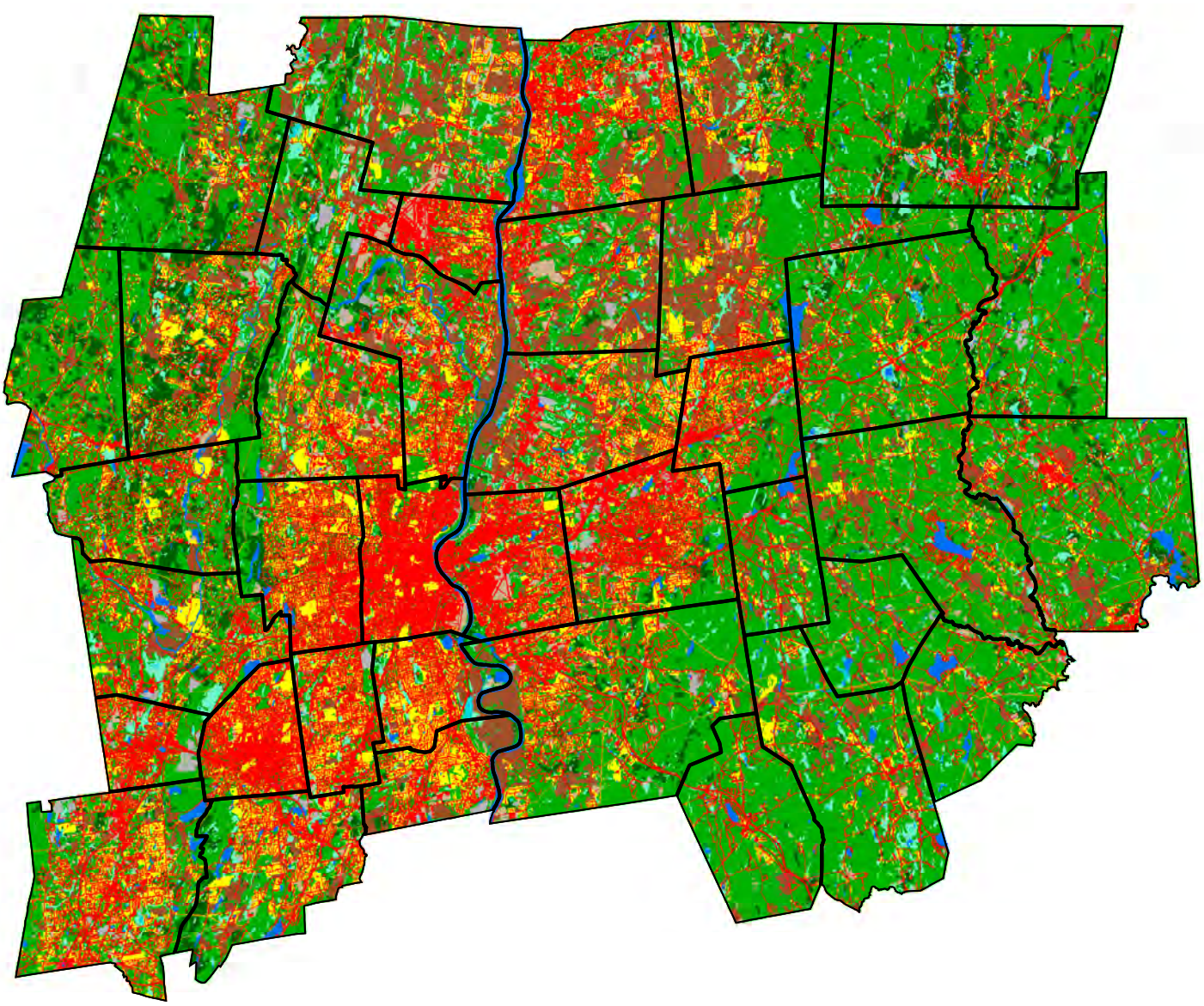
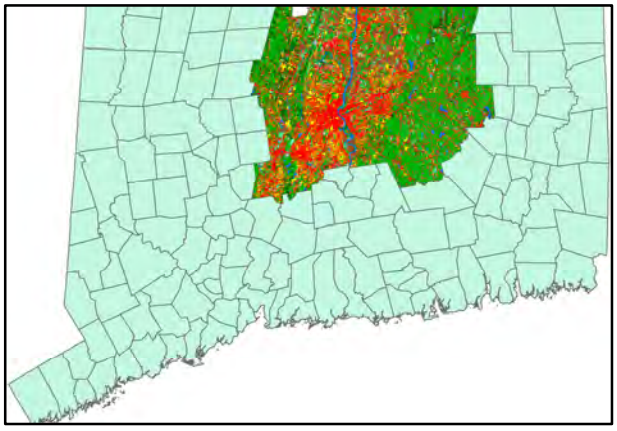


LEGEND

- Agriculture
- Barren Land
- Coniferous Forest
- Deciduous Forest
- Developed
- Forested Wetland
- Non-forested Wetland
- Other Grasses
- Tidal Wetland
- Turf & Grass
- Utility ROWs
- Water



SOURCE(S):
UConn CLEAR

Map 2: Land Cover

LOCATION:
Capitol Region, CT

N

Capitol Region Natural Hazards Mitigation Plan Update

MXD: Y:\2020-16\Maps\Map 2_Land Cover_.mxd

Map By: MER
MMI#: 2020-16
Original: 10/11/2017
Revision: 10/11/2017
Scale: 1 inch = 30,000 feet

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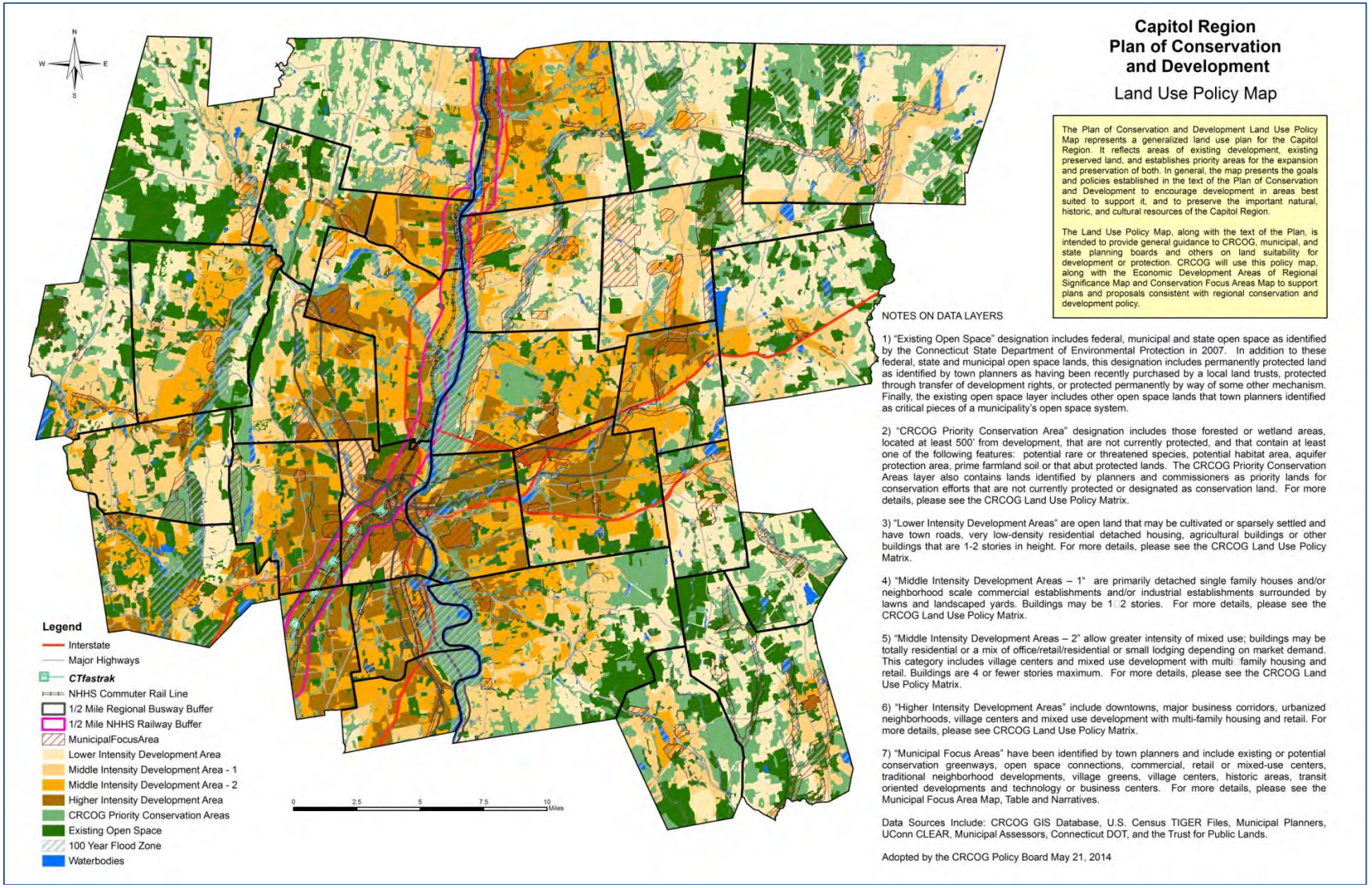
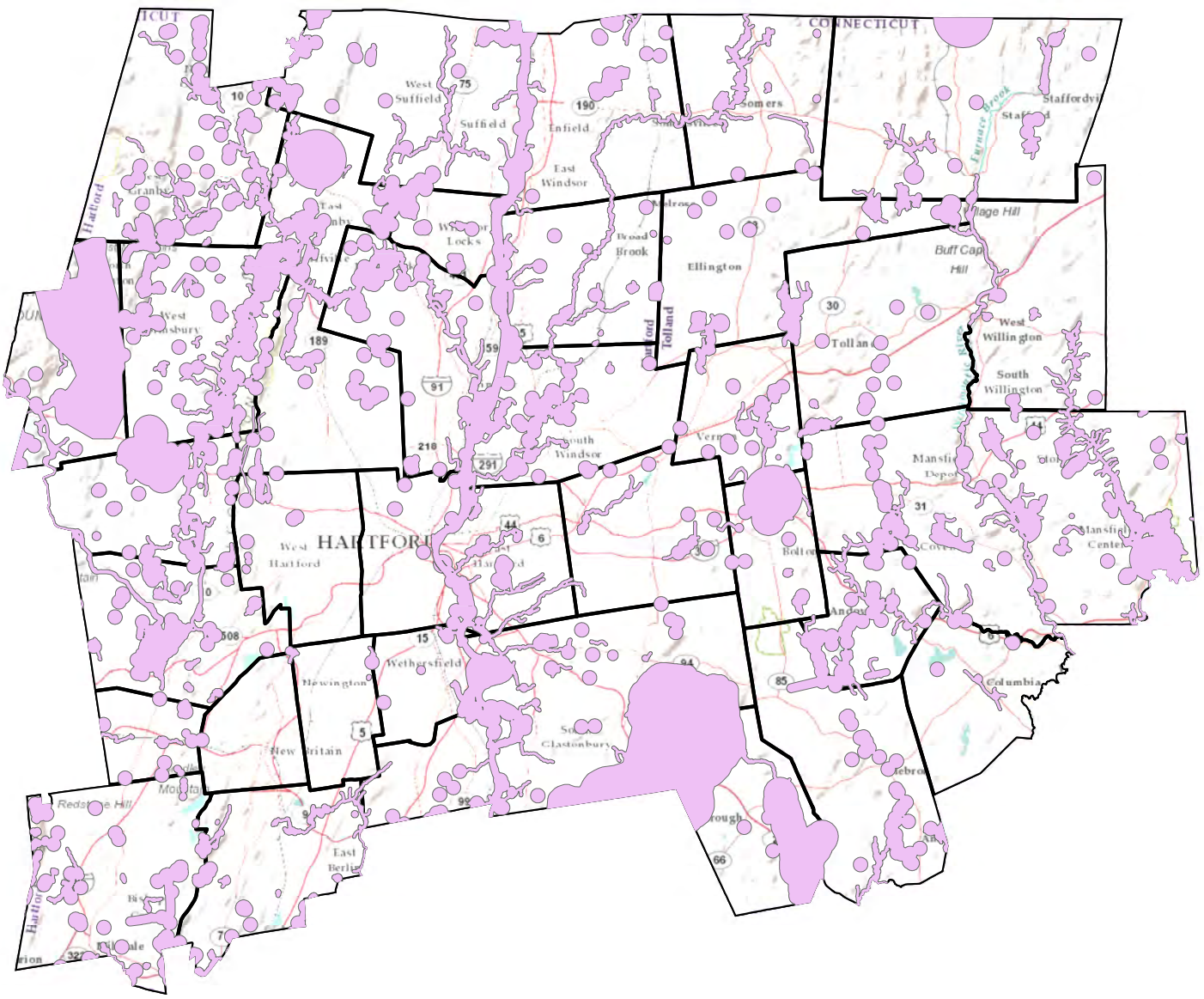
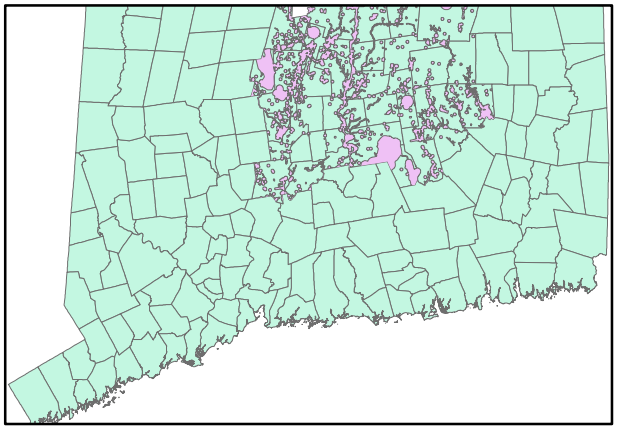
Map 3: Capitol Region Plan of Conservation and Development Land Use Policy Map



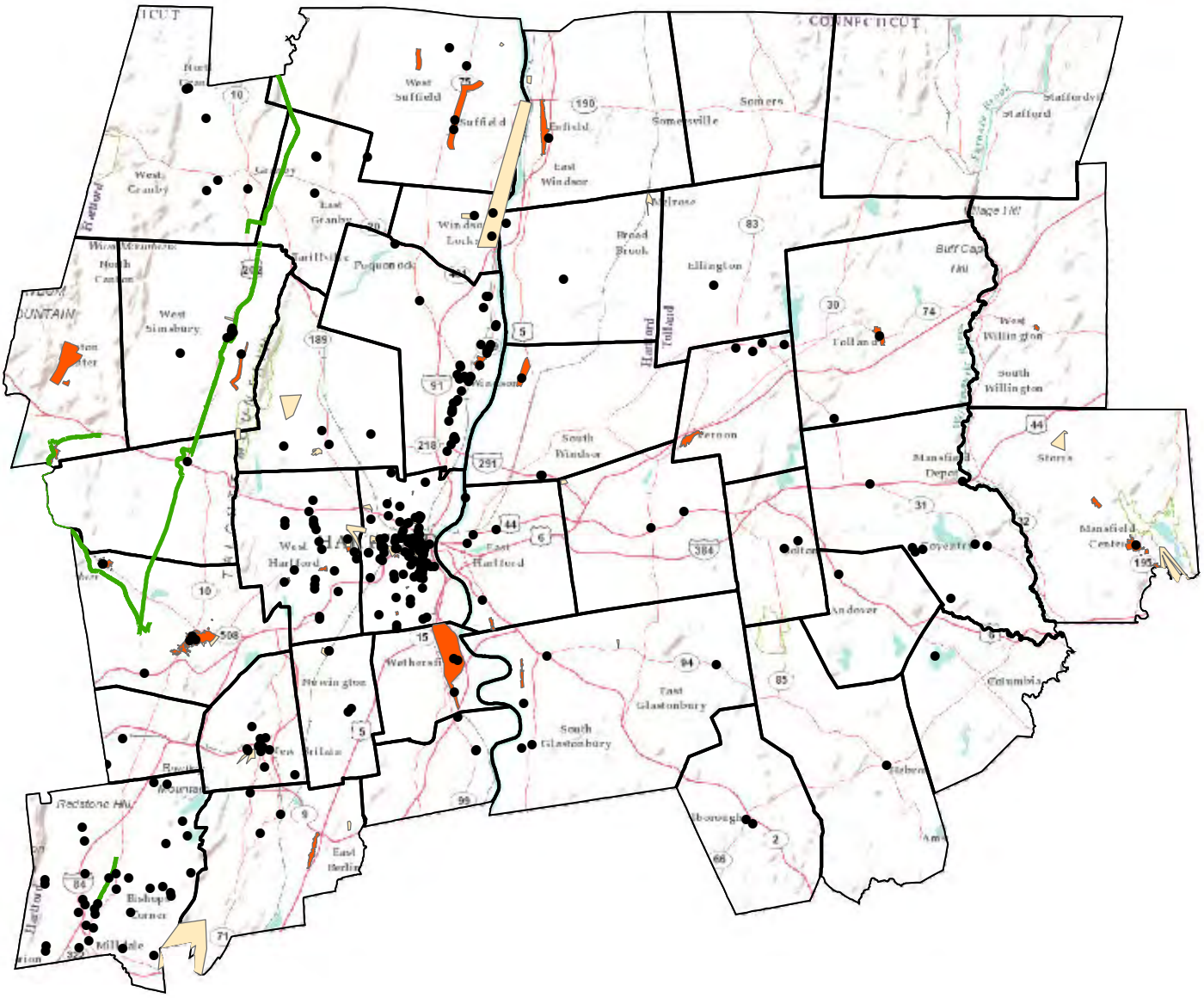


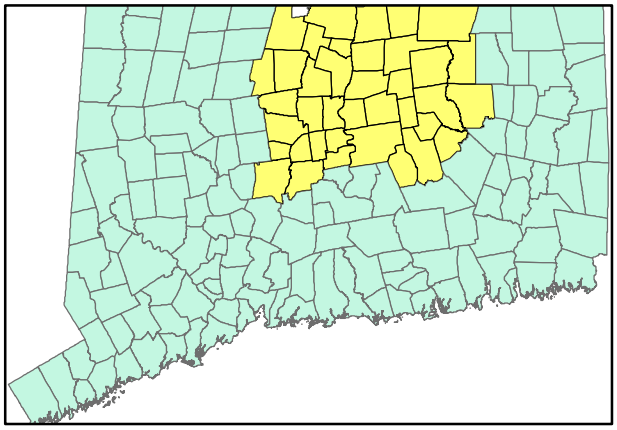


LEGEND

Natural Diversity Database Areas

SOURCE(S): CT DEEP	**Map 4: Locations of Potential Endangered and Threatened Species in the Capitol Region**	**LOCATION:** Capitol Region, CT
N	**Capitol Region Natural Hazards Mitigation Plan Update**	**Map By:** MER **MMI#:** 2020-16 **Original:** 10/11/2017 **Revision:** 10/11/2017 **Scale:** 1 inch = 30,000 feet
MXD: Y:\2020-16\Maps\Map_4_NDDB_.mxd		MILONE & MACBROOM 99 Realty Drive Cheshire, CT 06410 (203) 271-1773 Fax: (203) 272-9733 www.miloneandmacbroom.com





LEGEND

- Cultural Resource Object
- Cultural Resource Areas
- Farmington Canal Trail
- CT Local Historic Districts

SOURCE(S):
National Parks Service-
National Register of Historic Places
CT Office of Policy & Management
CT Dept. of Energy & Environmental Protection

Map 5: National Register of Historic Places Sites and Local Historic Districts in the Capitol Region

LOCATION:
Capitol Region, CT

N

Capitol Region Natural Hazards Mitigation Plan Update

MXD: Y:\2020-16\Maps\Map_5_National_Register_Historic_Places_.mxd

Map By: MER
MMI#: 2020-16
Original: 10/11/2017
Revision: 7/27/2018
Scale: 1 inch = 30,000 feet

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Section II: Hazard Evaluation

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Hazards Impacting the Capitol Region

The Capitol Region is vulnerable to the numerous natural hazards described in this section. While flooding, winter storms, and high wind events are the natural hazards that most frequently occur with enough severity to cause loss of life or property, this plan covers all of the natural hazards that have the potential to cause damage anywhere in the region.

Hazards Considered

The 2014 *Connecticut Natural Hazard Mitigation Plan Update* includes a risk assessment of thunderstorm-related hazards (wind, hail, and lightning); tropical cyclones (hurricanes and tropical storms); tornadoes; winter-related hazards (blizzards, freezing rain, ice storm, nor'easters, sleet, snow, and winter storms); flood-related hazards (riverine, coastal, flash, and shallow flooding); sea level rise; dam failure; wildland fires; drought-related hazards; and earthquakes.

The hazards we evaluated in the Capitol Region are:

- Dam Failure
- Drought
- Earthquake
- Flooding
- Forest and Wildland Fires
- Hurricanes and Tropical Storms
- Tornadoes and High Winds
- Severe Winter Storms

These eight hazards are those which were identified by the ESF5 committee and local planning teams as of most concern for the region and its communities. The only natural hazard that is in the 2014 *Connecticut Natural Hazard Mitigation Plan Update* that is not discussed herein is coastal flooding because the Capitol Region communities are inland communities. Other natural hazards that can impact the region include ice jams, heat waves, and solar flares. While not specifically evaluated in this plan, the impacts of such hazards can be mitigated by some of the measures identified to deal with the eight natural hazards evaluated in this plan update.

Climate Change

Climate change is expected to impact our temperature, precipitation and wind patterns and could cause a change in the frequency or intensity of natural hazards such as floods, droughts, winter storms, and damaging rain storms. Climate change is also projected to result in an acceleration of observed rates of Relative Sea Level Rise (RSLR). The 2014 *Connecticut Natural Hazard Mitigation Plan Update* identifies sea level rise as a natural hazard affecting the state. The state plan evaluated the impact of rises in sea level ranging from 0.5 to 5.0 feet relative to mean sea level. The state analysis determined that a number of state-owned facilities and other critical facilities such as fire stations, EMS and law enforcement structures, and storage tank farms in Fairfield, New Haven, and New London counties could be exposed to the risks associated with sea level rise. The state analysis did not cite any expected impacts on state or other critical facilities in Hartford or Tolland counties, which are the inland counties in which the Capitol Region's communities are located. According to NOAA *Technical Report OAR CPO-1*, the worst-case scenario for sea level rise by 2100 is a global average of 6.6 feet above the 1992 mean sea level. Given the inland location of the Capitol Region,

only those communities located along the Connecticut River may be minimally affected by sea level rise.

Many researchers have shown that average annual precipitation in Connecticut has been increasing by 0.95 inches per decade since the end of the 19th century (Miller et al., 1997; NCDC, 2005). In recent years, much of this increase is attributed to extreme storms. Winter has also produced extreme storms in recent years such as the winter of 2010-2011, which saw upwards of 80 inches of snowfall in parts of Connecticut. The increase in precipitation, along with sea level rise and the potential for increased heavy snowfall during the winter months, must be accounted for in regional planning.

According to the final draft of the Connecticut State Water Plan (2018) climate change analysis, climate models project an increase in temperature for all calendar months. Projected temperature changes appear relatively consistent across calendar months and percentile levels for each of the scenarios. In other words, both summer and winter temperatures are projected to increase by similar amounts, and a similar shift is observed for both extreme cold and extreme hot months. Precipitation projections are more variable although consistently projecting a generally wetter future for all four scenarios. The largest precipitation increases are projected for the wetter months (higher percentiles), including extreme wet months. It follows, then, that the seasonality plots show that winter and spring precipitation changes are projected to be larger than summer and autumn changes. Drier months are generally projected to remain about the same in terms of both frequency and rainfall level. Small decreases in extreme dry month precipitation are projected for the "hot/dry" scenario.

The final *State Water Plan* (2018) notes that there is general consensus in the climate models for a hotter and wetter future. Mean annual temperature changes for the 2080 planning horizon, compared to historical baseline, range from approximately +0.5 ˚C to + 6.5 ˚C. Mean annual precipitation changes range from approximately -5% to +30%, with most of the projections predicting an increase in mean annual precipitation.

Many storm drainage systems and culverts in the CRCOG region were likely designed using rainfall data published in *Technical Paper No. 40* by the U.S. Weather Bureau (now the National Weather Service) (Hershfield, 1961). The rainfall data in this document dates from the years 1938 through 1958. These values are the standard used in the current Connecticut DOT *Drainage Manual* (2000) and have been the engineering standard in Connecticut for many years.

This engineering standard was based on the premise that extreme rainfall series do not change through time, and therefore, historical data reflect current conditions. Recent regional and state-specific analyses have shown that this is not the case: the frequency of 2-inch rainfall events has increased, and storms once considered a 1-percent annual chance event are now likely to occur twice as often. A 2016 paper (Barrett and Salis, 2016) finds that flow rates during peak annual floods, as well as floods with recurrence intervals of 5, 10, and 20 years, have been increasing between 1962 and 2012. Average observed rates are from 0.9 to 1.8 percent per year.

The Northeast Regional Climate Center (NRCC) has partnered with the Natural Resources Conservation Service (NRCS) to provide a consistent, current regional analysis of rainfall extremes (http://precip.eas.cornell.edu/) for engineering design. The availability of updated data has

numerous implications for natural hazard mitigation as it can be used to reevaluate drainage systems, culverts, and bridges.

On November 3, 2015, the Connecticut Department of Transportation (CTDOT) Office of Engineering released a bulletin (number EB-2015-2) directing that updated precipitation frequency estimates from the NOAA Atlas 14 released on September 30, 2015, be used in planning and design. These newest data generally increase the magnitude of smaller storm events but do not increase the larger storm events to the extent of the NRCC data.

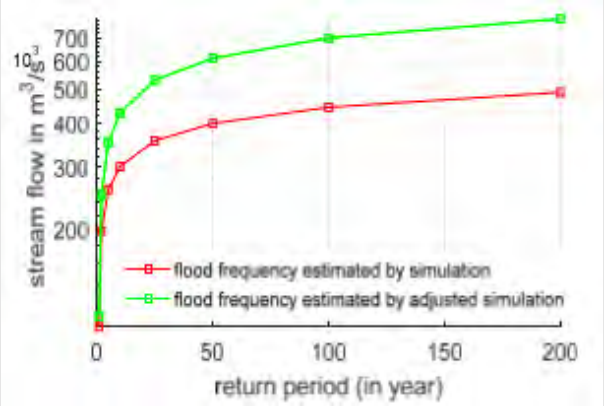
As climate continues to change, Capitol Region communities must consider not just the past and present but also potential future conditions. As the expectation is that the precipitation magnitude associated with smaller, more frequent storms is expected to increase, design standards will likely need to continue to increase to compensate. Furthermore, with the expectation that the precipitation magnitude associated with larger, less frequent storms is also expected to increase, more efficient and effective stormwater management controls will be necessary to mitigate flash and poor drainage flooding. The Town of Willington, in particular, described this as a major concern during the local planning team meetings.

The Connecticut Institute for Resilience and Climate Adaptation (CIRCA) was founded during the review and approval of the prior edition of this plan (2013-2014) and has conducted a number of key studies over the last few years. Beyond addressing phenomena such as sea level rise that predominantly impact coastal areas, CIRCA's efforts encompass climatic changes relevant to inland communities, including changes to precipitation, drought, temperature, and inland flooding. CIRCA also funds climate adaptation planning in Connecticut's inland communities; for example, this Hazard Mitigation Plan Update was funded in part by CIRCA. Some of CIRCA's research relevant to the Capitol Region is highlighted on the stand-alone fact sheets on pages 4, 5, and 6 of this section. These pages are designed to be removed as needed by the Capitol Region's community leaders and used to support initiatives related to climate change.

The City of Hartford is among the leaders in Connecticut for addressing climate change. The city developed a Climate Action Plan that can serve as an example to other communities in the region. An information sheet has been developed as part of this plan update to describe the Hartford Climate Action Plan. Refer to page 7 of this section.

IMPACTS OF CLIMATE CHANGE

INTENSE PRECIPITATION AND RIVERINE FLOODS



Streamflow increases predicted with climate adjusted simulation

The Eagleville Dam located on Eagleville Lake in Coventry & Mansfield

Source: Willimanticriver.org

FOR MORE INFORMATION

Connecticut Institute for Resilience and Climate Adaptation (CIRCA)
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circa@uconn.edu

WHAT IS THE CHALLENGE?

As the climate changes, trends in Connecticut are noticeably shifting toward increased annual temperatures and increased yearly rainfall. Rising air temperatures allow the atmosphere to hold more moisture. With the decrease of the Arctic ice sheet, storms appear to move at a slower rate, allowing for the storm to produce high amounts of rainfall.

Since the late 1960's Connecticut has experienced an increased frequency of greater magnitude rainstorms. These intense storms have increased the average 24 hour 100-year rainfall amounts by 1 to 2 inches in southern New England. Increased rainfall has also lead to an increase in peak flows and riverine flooding throughout Connecticut and New England. These increased streamflows may prove to be a challenge for aging infrastructure, such as culverts and dams.

Under agreement with the Connecticut Institute for Resilience and Climate Adaptation (CIRCA), the University of Connecticut (UConn) has developed a hydrological framework to estimate riverine flood frequency and risks. This framework has also been applied to assess flood-inundation and flood overtopping risks. The modeling demonstrates increased flooding throughout areas of the stream network.

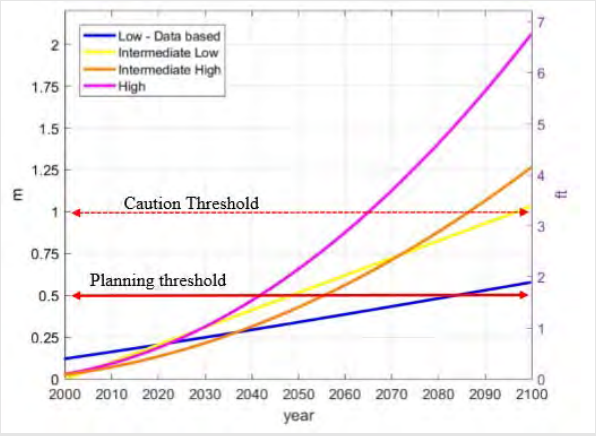
REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

With northern Connecticut already seeing a significant increase in flooding, and climate change continuing to progress, it is likely rain storms of a greater magnitude will continue throughout the Capitol Region.

Climate change projections and riverine flood modeling provide results and information that municipalities can utilize to make informed decisions on flood mitigation. With streams and rivers throughout the region, and over 650 dams, flood mitigation efforts must be implemented to reduce risks.

IMPACTS OF CLIMATE CHANGE

SEA LEVEL RISE AND THE CONNECTICUT RIVER



Connecticut sea level rise projections showing observation and model based predictions, with the planning and caution thresholds.

Flooding on the CT River in Hartford. As sea levels rise flooding upstream may become more frequent

Source: CT.gov/CID

FOR MORE INFORMATION

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WHAT IS THE CHALLENGE?

Global sea level rise (SLR) is occurring at an increasing rate due to the melting of land ice and the expansion of ocean water due to heat absorption associated with climate change. Global sea level represents a global mean; regional variations need to be considered for local planning. Observations and extrapolations show that the sea level in Long Island Sound is rising at a more rapid rate than the global SLR projections.

The Connecticut Institute for Resilience and Climate Adaptation (CIRCA) has conducted regional projections for Connecticut, and has recommended that planning anticipates a 0.5 m (1ft 8 inch) rise in sea level by 2050. There is significant diversion between projections after 2050; for 2050, the difference between the lowest and highest projection is approximately 0.3 m, and for 2100 the difference is almost 1.5 m.

Sea level rise (SLR) impacts both human development and the environment. With rising seas comes increased flooding events along the coast, and along water bodies connected to the coast. This flooding affects homes, business, utilities and infrastructure, and can seriously affect a municipality during a large enough event.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

While the Capitol Region is not coastal, sea level rise will affect the Connecticut River, and potentially populations near the river's floodplain.

Habitats and geography of the river may change as the sea levels rise, which could potentially cause changes upstream in some towns. Also, as tides begin to further inundate the river from the coast, riverine water levels may begin to rise, making flooding worse when it occurs.

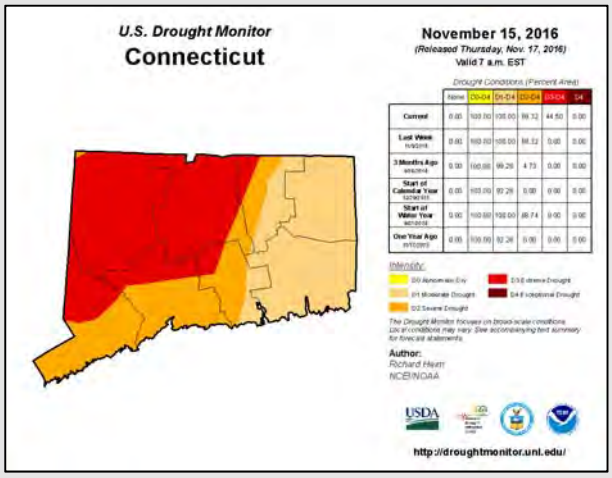
Connecticut's lawmakers have recently adopted Public Act No. 18-82 "An Act Concerning Climate Change Planning and Resiliency." This bill mandates that sea level rise be taken into account when planning, and also requires municipalities to consider sea level rise scenarios when preparing hazard mitigation plans.

IMPACTS OF CLIMATE CHANGE

DROUGHT

Shuttle Meadow Reservoir, New Britain in 2016

Source: Courant.com



The US Drought Monitor

Source: droughtmonitor.unl.edu

FOR MORE INFORMATION

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WHAT IS THE CHALLENGE?

The U.S. Geological Survey states that drought can be defined differently by different people. A farmer may consider a drought the period of time his/her crops go without water, while a water supplier may consider it a period of decreased supply that affects both water quality and quantity. Hydrologists typically consider a drought to be a period of decrease in both precipitation and streamflow.

In recent years Connecticut has experienced shorter but more intense “flash droughts” with some of these short term droughts resulting in record breaking-low stream flows. The drought of 2015-2016 was significant. Within the Salmon River in East Hampton, flows were recorded at levels lower than those observed during the 1960s drought.

Under agreement with the Connecticut Institute for Resilience and Climate Adaptation (CIRCA), the University of Connecticut (UConn) has prepared climate change projections in connection with a drinking water resiliency study. The projections show an increase in temperature that could increase evapotranspiration losses. While the projections also predict an increase in rainfall and storm intensity, this may be coupled with more extreme dry periods between storms, especially during the summer months. Summer droughts are projected to become more frequent. Specifically, the severity of the 1-in-20 year drought rises drastically in these projections.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

While droughts do not pose an immediate threat, a drought can have long term affects on agriculture, the economy, utilities, and the environment.

The Capitol Region is urban and suburban with rural and agricultural areas spread throughout. A drought event could cause impacts across all municipalities and therefore mitigation strategies could be developed that are relevant to the area.

The public water system profile in the Capitol Region is diverse, with water utilities ranging from very small apartment and condominium complexes to the large MDC system. It is important to educate residents on the benefits of ongoing water conservation as well as drought condition conservation. As an active member of the Central Water Utility Coordinating Committee (WUCC), CRCOG can work with municipalities and water utilities that may need communications and coordination assistance during a drought event.

NEW INITIATIVES

CITY OF HARTFORD CLIMATE ACTION PLAN

Plan Cover image: The "My Vision for Hartford" public comment wall during Envisionfest Hartford Image: Hartford Climate Action Plan

Hartford Climate Action Plan

FOR MORE INFORMATION

Shubhada Kambli
Hartford Climate Stewardship Council
c/o Planning & Zoning Commission
250 Constitution Plaza, 4th Floor
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Shubhada.kambli@Hartford.org

WHAT IS IT?

The Climate Action Plan sets forth initiatives to promote environmental stewardship with an emphasis on priority community values to improve public health outcomes, advance the economy, and promote social equity. The goals are focused in six action areas, which evaluate the root causes of climate change and set forth strategies to improve resiliency and respond to challenges. The six action areas are:

- Energy
- Food
- Landscape
- Transportation
- Waste
- Water

The Climate Action Plan strategically targets initiatives intended to achieve multiple wins in education, green jobs, and neighborhood revitalization by anticipating actions that have benefits to the broader community beyond the city limits.

In addition to the goals and strategies, the Plan includes measures that residents and businesses can take to reduce negative impacts of climate change, promote sustainability, and reduce resource consumption. The Plan includes an extensive bibliography of resources for further information and initiatives.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

The Climate Action Plan addresses aspects of climate change that affect all communities, noting that concerns about climate change and the consequences of human activity have far reaching impacts for natural resources that sustain everyone.

The Plan's strategies focus on education and outreach, working collectively to initiate change, and looking at past actions to inform future decisions that influence regulations, policies, and enforcement actions that influence behavioral changes to produce tangible results. **To the extent that these actions reduce losses associated with natural hazards that are exacerbated by climate change, the Climate Action Plan can advance hazard mitigation.**

The goals and policies, while specific to Hartford in some instances, are attributes that are applicable to all communities, households and industries. The Climate Action Plan promotes efforts that can work at state and regional levels where collaboration on initiatives related to transportation, energy, water, and food are critical to reducing costs and environmental degradation of shared resources.

Federal Disaster Declarations

Understanding the natural hazards we are likely to face is crucial for our ability to prepare for and respond to disasters. Researching historic data on major storms and other natural disasters can be helpful in this analysis. Knowing where and when natural disasters have occurred in the past is important to our understanding of our risks. To assess the risks we face from natural disasters, we can evaluate past occurrences of major disasters, looking at the losses to life and property incurred by our communities, state, residents, and businesses. The following pages contain descriptions of major storm events and their impact on the Capitol Region.

Some natural disasters such as stream and river flooding affect specific areas and their damages, although significant, may be localized. Other natural disasters such as hurricanes and blizzards can impact the whole region and beyond. Such widespread natural disasters can overwhelm state and local resources and the Governor may seek assistance from the federal government. Table 6 below lists the federal Emergency ("EM") and Disaster declarations ("DR") for Connecticut since 1954:

Table 6: Connecticut Federally Declared Disasters Since 1954

Disaster Number	Year	Incident Period	Disaster Type	Counties
DR-4385	2018	May 15	Severe Storms, Tornadoes, and Straight-line Winds	Fairfield, New Haven
DR-4213	2015	January 26-29	Severe Winter Storm and Snowstorm	New London, Tolland, Windham
DR-4106 EM-3361	2013	February 8-11	Severe Winter Storm and Snowstorm	All
DR-4087 EM-3353	2012	October 27-November 8	Hurricane	Litchfield, Fairfield, New Haven, Middlesex, New London, Windham, Tolland
DR-4046 EM-3342	2011	October 29-30	Severe Storm	Litchfield, Fairfield, New Haven, Middlesex, Windham, Tolland, Hartford
DR-4023 EM-3331	2011	August 27-September 1	Tropical Storm/ Hurricane	All
DR-1958	2011	January 11-12	Snowstorm	Fairfield, Hartford, Litchfield, New Haven, New London, Tolland
DR-1904	2010	March 12-May 17	Severe Storms and Flooding	Fairfield, Middlesex, New London
DR-1700	2007	April 15-27	Severe Storms and Flooding	Fairfield, Hartford, Litchfield, Middlesex, New London, New Haven, Windham
EM-3266	2006	February 11-12	Snow	Fairfield, Hartford, New Haven, Tolland, Windham
EM-3200	2005	January 22-23	Snow	All
DR-1619	2005	October 14-15	Severe Storms and Flooding	Litchfield, New London, Tolland, Windham
EM-3246	2005	August 29-October 1	Hurricane	All
EM-3192	2003	December 5-7	Snow	Fairfield, Hartford, Litchfield, New Haven, New London, Tolland, Windham

Disaster Number	Year	Incident Period	Disaster Type	Counties
EM-3176	2003	February 17-18	Snow	All
DR-1302	1999	September 16-21	Tropical Storm	Fairfield, Hartford, Litchfield
DR-1092	1996	January 7-13	Blizzard	Not listed
EM-3098	1993	March 13-17	Severe Winds and Blizzard, Snowfall	Not listed
DR-972	1992	December 10-13	Coastal Flooding, Winter Storm	Not listed
DR-916	1991	August 19	Hurricane	Not listed
DR-837	1989	July 10	Severe Storms, Tornadoes	Not listed
DR-747	1985	September 27	Hurricane	Not listed
DR-711	1984	May 27-June 2	Severe Storms, Flooding	Not listed
DR-661	1982	June 4	Severe Storms, Flooding	Not listed
DR-608	1979	October 4	Tornado, Severe Storms	Not listed
EM-3060	1978	February 7	Blizzards and Snowstorms	Not listed
DR-42	1955	August 19	Hurricane, Torrential Rain, Floods	Not listed
DR-25	1954	September 17	Hurricane	Not listed

A federal disaster or emergency declaration for a county opens up the availability of funding reimbursements from the federal government. Such reimbursements may take the form of Public Assistance payments to municipal governments, nonprofit organizations, and state agencies to clean up communities affected by disaster debris and fund the repair, restoration, reconstruction, or replacement of a public facility or infrastructure damaged or destroyed by a disaster. In some cases where private property damage is widespread, FEMA may also offer Individual Assistance payments to individuals and families who have sustained losses due to disasters.

Natural disasters can be costly for local communities. Table 7 outlines the costs incurred by Capitol Region municipalities and other local and private nonprofit agencies in each community from the three federally declared disasters of 2011. The costs incurred due to Storm Alfred in fall 2011 were particularly high due to the enormous amounts of debris generated in the aftermath of that storm.

Table 7: Costs Incurred by Municipalities and Local Agencies Due to Federally Declared Disasters in 2011

2011 Disasters Damage Amounts Eligible for 75% Reimbursement Under FEMA Public Assistance Program				
Applicant: Municipality and Other Agencies (Fire Districts, Schools, Private Nonprofits)	100% of Amount Eligible for 75% Reimbursement			Total Damages Eligible for Public Assistance Due to 2011 Disasters
	DR-1958-CT 2011 Snow	DR-4023-CT Irene August 2011	DR-4046-CT Severe Weather Oct. 2011 (Alfred)	
Town of Andover	$20,262.29	$21,914.70	$12,205.65	$54,382.64
Andover Other	$3,250.81	$15,757.65	$1,827.33	$20,835.79
Andover Total	$23,513.10	$37,672.35	$14,032.98	$75,218.43
Town of Avon	$60,686.78	$148,578.36	$2,388,663.29	$2,597,928.43
Town of Berlin	$62,726.67	$663,099.95	$868,827.16	$1,594,653.77
Berlin Other	$1,932.50			$1932.50
Berlin Total	$64,659.17	$663,099.95	$868.827.16	$1,596,586.27
Town of Bloomfield	$88,130.28	$8,275.76	$2,882,712.48	$2,979,118.52
Bloomfield Other			$26,720.34	$26,720.34
Bloomfield Total	$88,130.28	$8,275.76	$2,909,432.82	$3,005,838.86
Town of Bolton	$27,738.45	$20,197.39	$127,070.54	$175,006.38
Town of Canton	$37,329.72	$33,659.34	$386,482.66	$457,471.72
Canton Other	$3,630.46		$25,154.85	$28,785.31
Canton Total	$40,960.18	$33,659.34	$411,637.51	$486,257.03
Town of Columbia	$28,076.75	$15,833.85	$3,229.68	$47,140.28
Columbia Other		$7,712.33		$7,712.33
Columbia Total	$28,076.75	$23,546.19	$3,229.68	$54,852.61
Town of Coventry	$47,941.56	$92,869.45	$51,294.91	$192,105.92
Coventry Other	$1,600.04			$1,600.04
Coventry Total	$49,541.60	$92,869.45	$51,294.91	$193,705.96
Town of East Granby	$75,416.27	$12,698.57	$555,322.46	$643,437.30
Town of East Hartford	$273,700.15	$226,257.35	$1,812,341.64	$2,312,299.14
East Hartford Other	$7,194.00	$147,730.66	$94,244.91	$249,169.57
East Hartford Total	$280,894.15	$373,988.01	$1,906,586.55	$2,561,468.71
Town of East Windsor	$36,736.12	$118,773.41	$282,704.32	$438,213.85
East Windsor Other	$1,874.34		$8,855.44	$10,729.78
East Windsor Total	$38,610.46	$118,773.41	$291,559.76	$448,943.63
Town of Ellington	$77,625.51	$44,076.23	$620,025.07	$741,726.81
Ellington Other			$16,231.20	$16,231.20
Ellington Total	$77,625.51	$44,076.23	$636,256.27	$757,958.01
Town of Enfield	$99,370.97	$66,936.15	$5,602,310.18	$5,768,617.30
Enfield Other	$19,583.89		$214,754.25	$234,338.14
Enfield Total	$118,954.86	$66,936.15	$5,817,064.43	$6,002,955.44
Town of Farmington	$73,307.82	$144,255.66	$2,371,538.19	$2,589,101.67
Farmington Other	$9,508.58		$58,644.34	$68,152.92
Farmington Total	$82,816.40	$144,255.66	$2,430,182.53	$2,657,254.59
Town of Glastonbury	$151,750.38	$143,264.05	$2,912,150.36	$3,207,164.79
Glastonbury Other	$4,192.05		$61,468.77	$65,660.82
Glastonbury Total	$155,942.43	$143,264.05	$2,973,619.13	$3,272,825.61
Town of Granby	$39,537.37	$84,643.21	$1,925,977.58	$2,050,158.16
City of Hartford	$212,570.62	$176,984.14	$3,895,708.62	$4,285,263.38
Hartford Other	$230,581.69	$261,043.73	$876,819.30	$1,368,444.72
Hartford Total	$443,152.31	$438,027.87	$4,772,527.92	$5,653,708.10

2011 Disasters Damage Amounts Eligible for 75% Reimbursement Under FEMA Public Assistance Program				
Applicant: Municipality and Other Agencies (Fire Districts, Schools, Private Nonprofits)	100% of Amount Eligible for 75% Reimbursement			Total Damages Eligible for Public Assistance Due to 2011 Disasters
	DR-1958-CT 2011 Snow	DR-4023-CT Irene August 2011	DR-4046-CT Severe Weather Oct. 2011 (Alfred)	
Town of Hebron	$47,786.22	$61,537.03	$35,050.27	$144,373.52
Hebron Other	$12,081.81	$6,741.62		$18,823.43
Hebron Total	$59,868.03	$68,278.65	$35,050.27	$163,196.95
Town of Manchester	$195,625.42	$98,051.65	$5,490,873.84	$5,784,550.91
Manchester Other	$16,605.57		$120,205.26	$136,810.83
Manchester Total	$212,230.99	$98,051.65	$5,611,079.10	$5,921,361.74
Town of Mansfield	$41,629.24	$99,983.32	$88,134.61	$229,747.17
Mansfield Other	$301,809.57			$301,809.57
Mansfield Total	$343,438.81	$99,983.32	$88,134.61	$531,556.75
Town of Marlborough	$50,074.99	$31,387.47	$78,128.83	$159,591.29
City of New Britain	$161,207.95	$69,383.89	$715,980.09	$946,571.93
New Britain Other	$173,811.62	$5,730.00	$472,210.92	$651,752.54
New Britain Total	$335,019.56	$75,113.89	$1,188,191.02	$1,598,324.47
Town of Newington	$65,803.73	$140,941.77	$1,975,847.48	$2,182,592.98
Town of Plainville	$61,030.61	$44,741.24	$495,400.17	$601,172.03
Plainville Other	$3,376.06		$3,000.96	$6,377.02
Plainville Total	$64,406.67	$44,741.24	$498,401.14	$607,549.05
Town of Rocky Hill	$113,168.33	$257,069.39	$690,662.55	$1,060,900.27
Town of Simsbury	$75,635.26	$60,224.55	$3,557,624.88	$3,693,484.69
Simsbury Other			$107,978.10	$107,978.10
Simsbury Total	$75,635.26	$60,224.55	$3,665,602.98	$3,801,462.79
Town of Somers	$52,949.48	$35,555.20	$1,218,810.02	$1,307,314.70
Town of South Windsor	$99,058.79	$153,119.56	$6,860,182.25	$7,112,360.60
South Windsor Other			$1,604.08	$1,604.08
South Windsor Total	$99,058.79	$153,119.56	$6,861,786.33	$7,113,964.68
Town of Southington	$115,426.99	$193,928.97	$1,046,690.07	$1,356,046.03
Southington Other	$5,923.38			$5,923.38
Southington Total	$121,350.37	$193,928.97	$1,046,690.07	$1,361,969.41
Town of Stafford	$58,390.40	$24,715.39	$115,652.35	$198,758.14
Stafford Other	$18,923.27	$4,713.82		$23,637.09
Stafford Total	$77,313.67	$29,429.21	$115,652.35	$222,395.23
Town of Suffield	$48,872.01	$26,647.77	$1,411,547.33	$1,487,067.11
Town of Tolland	$93,126.72	$138,848.56	$811,818.36	$1,043,793.64
Tolland Other			$29,789.98	$29,789.98
Tolland Total	$93,126.72	$138,848.56	$841,608.34	$1,073,583.62
Town of Vernon	$106,773.87	$142,079.05	$3,805,918.87	$4,054,771.79
Vernon Other	$5,819.71			$5,819.71
Vernon Total	$112,593.58	$142,079.05	$3,805,918.87	$4,060,591.50
Town of West Hartford	$224,752.76	$111,036.05	$10,423,313.83	$10,759,102.64
West Hartford Other	$11,074.33	$1,630.43	$86,759.95	$99,464.71
West Hartford Total	$235,827.09	$112,666.48	$10,510,073.78	$10,858,567.35
Town of Wethersfield	$114,269.56	$152,522.68	$1,243,730.14	$1,510,522.38
Wethersfield Other	$4,222.19	$2,120.45	$121,939.41	$128,282.05
Wethersfield Total	$118,491.75	$154,643.13	$1,365,669.55	$1,638,804.43
Town of Willington	$29,825.57	$58,457.29	$190,621.35	$278,904.21

2011 Disasters Damage Amounts Eligible for 75% Reimbursement Under FEMA Public Assistance Program				
Applicant: Municipality and Other Agencies (Fire Districts, Schools, Private Nonprofits)	**100% of Amount Eligible for 75% Reimbursement**			**Total Damages Eligible for Public Assistance Due to 2011 Disasters**
	DR-1958-CT 2011 Snow	**DR-4023-CT Irene August 2011**	**DR-4046-CT Severe Weather Oct. 2011 (Alfred)**	
Town of Windsor	$113,320.96	$38,998.75	$1,070,737.94	$1,223,057.65
Windsor Other	$12,961.60		$14,219.63	$27,181.23
Windsor Total	$126,282.56	$38,998.75	$1,084,957.57	$1,250,238.88
Town of Windsor Locks	$58,133.89	$21,047.07	$1,583,630.87	$1,662,811.83

Notes: Amounts shown represent the costs associated with damages incurred by the municipalities and local public and private nonprofit agencies due to the three federally declared disasters of 2011. Up to 75% of these costs are reimbursable under FEMA's Public Assistance Program. **Source:** CT DEMHS, April 2013

A Public Assistance reimbursement database is maintained by FEMA and is available through the FEMA website. The database contains records of damage reimbursements dating back to August 26, 1998, for municipalities, nonprofit organizations, schools, and state agencies. For Connecticut, the vast majority of losses are related to flooding, wind, or winter storm damage. Total damages from the Public Assistance database are summarized for each community in the table below. The total damage column assumes that the federal reimbursement reported by FEMA represented 75% of the actual damages.

Table 8: Public Assistance Reimbursements as of October 10, 2017

Community	Total Damage Reported	Annualized Loss for Flooding	Annualized Loss for Hurricane Wind	Annualized Loss for Winter Storms
Andover	$263,969	$473	$2,678	$10,742
Avon	$3,307,420	$3,018	$7,902	$163,154
Berlin	$2,264,711	$1,425	$34,946	$82,825
Bloomfield	$3,568,666	$6,701	$483	$180,640
Bolton	$445,703	$214	$3,899	$19,345
Canton	$1,115,356	$6,829	$3,703	$48,170
Columbia	$198,427	$42	$1,345	$9,057
Coventry	$805,795	$2,518	$7,251	$32,641
East Granby	$819,287	$1,831	$720	$40,569
East Hartford	$4,009,458	$2,048	$20,889	$188,087
East Windsor	$664,080	$531	$4,656	$29,764
Ellington	$1,382,957	$1,962	$3,709	$67,117
Enfield	$7,730,967	$16,552	$4,849	$385,492
Farmington	$3,876,632	$4,216	$7,680	$192,137
Glastonbury	$4,257,493	$784	$7,620	$215,674
Granby	$2,327,760	$628	$4,481	$117,404
Hartford	$18,345,449	$14,556	$40,714	$910,280
Hebron	$635,486	$74	$6,369	$27,004
Manchester	$7,412,206	$3,927	$5,324	$380,865
Mansfield	$2,442,932	$3,150	$10,511	$114,914
Marlborough	$406,297	$1,844	$1,928	$17,612
New Britain	$3,904,576	$14,406	$4,526	$186,573
Newington	$3,073,963	$627	$7,932	$153,229
Plainville	$1,133,479	$2,180	$2,396	$55,081

Community	Total Damage Reported	Annualized Loss for Flooding	Annualized Loss for Hurricane Wind	Annualized Loss for Winter Storms
Rocky Hill	$1,995,779	$1,373	$21,050	$82,618
Simsbury	$4,452,801	$2,164	$7,149	$225,045
Somers	$1,969,942	$6,978	$4,185	$92,518
South Windsor	$7,946,130	$2,145	$8,118	$407,954
Southington	$2,621,966	$236	$10,347	$127,416
Stafford	$888,756	$11,762	$2,871	$32,144
Suffield	$2,008,476	$678	$1,797	$103,235
Tolland	$3,179,048	$5,629	$20,549	$141,141
Vernon	$5,184,837	$2,403	$11,342	$259,141
West Hartford	$13,044,756	$7,159	$9,763	$669,644
Wethersfield	$2,773,914	$1,967	$11,894	$132,135
Willington	$685,409	$5,849	$6,225	$24,001
Windsor	$1,958,348	$612	$2,120	$100,339
Windsor Locks	$6,280,829	$4,775	$5,890	$319,905
Capitol Region	**$129,384,058**	**$144,265**	**$319,810**	**$6,345,612**

Source: FEMA

The damages above include significant reimbursements to State of Connecticut agencies such as the DOT and the Judicial Branch. State-level reimbursements were allocated into individual communities by estimating the breakdown per county (such as by locating the facilities of the agencies reporting damages) and then distributing the county-wide agency loss based on the ratio of the population of each community to the population of each county.

Annualized loss estimates were also prepared based on the Public Assistance data. The damage for each town due to flooding, wind, and winter storms was summed and divided by the 19 years of available data. The annualized loss for flooding in the region based on this data is $144,265, and the annualized loss due to wind from hurricanes and tropical cyclones is $319,810. The annualized loss due to winter storm damage in the region from these data is much higher at $6,345,612.

Risk Assessment

In assessing our risks from natural hazards, we need to consider what and who will be affected. Identifying where essential community facilities, such as hospitals, police and fire stations, emergency operations centers, and schools, are located and determining if they are likely to be damaged is necessary for our understanding of our risks. Similarly, knowing where other facilities that are important to our communities, as well as where vulnerable populations, are located is important to our ability to protect them from harm. This plan includes maps for each municipality that show the important community facilities, dams, and floodplains.

While knowing where existing vulnerabilities are, it is also important to limit new or increased vulnerabilities. The communities of the Capitol Region have development controls, such as floodplain and inland wetlands regulations and building codes, in place to regulate or restrict the construction of new structures that could increase their level of vulnerability to the natural hazards. Local communities have strictly limited the amount of new development in hazardprone areas and have required any new development to conform to floodplain requirements in accordance with the NFIP and to inland wetlands regulations in accordance with state requirements. Since the adoption of the original 2008 Plan and the 2014 update, most communities have not permitted new structures in the special flood hazard areas. Those that have allowed structures in these areas have required they be built above the base flood elevation and that compensatory storage be provided as needed. Furthermore, many of the local floodplain and wetland permits issued were for projects that improved stormwater drainage and helped mitigate flooding. Details of any local development since 2008 in hazardprone areas are provided for each community in Section IV: Municipal Plans.

Determining our potential losses from disasters is a daunting task. Comprehensive estimates of the losses each community faces from the various natural hazards are generally not available. The costs incurred by local communities as a result of the federal disasters of 2011 shown in Table 7 provide a partial indication of potential losses, but these costs do not cover all the costs associated with natural disasters including those experienced by private businesses and citizens. The equalized net grand list (Table 4) provides an estimate of the market value of all taxable property in each community and can give an

Risk Assessment Terminology

Community assets: The people, structures, facilities, and systems that have value to the community

Extent: The strength or magnitude of the hazard, based on an established scientific scale or measurement system, speed of onset, and duration. Extent defines the characteristics of a hazard regardless of the people and property if affects as opposed to impact (below).

Impact: The consequences or effects of a hazard on the community or its assets

Location: The geographic areas within the planning area that are affected by the hazard

Natural hazard: Source of harm or difficulty created by a meteorological, environmental, or geological event

Probability: The likelihood of the hazard occurring in the future

Risk: The potential for damage, loss, or other impacts created by the interaction of natural hazards with community assets

Risk assessment: Product or process that collects information and assigns values to risks for the purpose of informing priorities, developing or comparing courses of action, and informing decision making

Vulnerability: Characteristics of community assets that make them susceptible to a given hazard

indication of the total value of property exposed to natural disasters of a town-wide or region-wide scope.

Computer modeling is another means of analyzing risks we face from natural disasters. CRCOG used FEMA's HAZUS-MH model to evaluate our risks and estimate the losses we might face to life and property. We used HAZUS-MH to analyze the risks that the region and each municipality might face from flooding, earthquakes, and hurricanes. HAZUS-MH is a software program that can be used throughout the United States and provides standard loss estimations and damage assessments based on historical hazard events, Census data, and other federal and nationally based databases. The HAZUS-MH model uses 2010 Census data and block boundaries as a baseline for analyzing losses. Because of the limitations of the dated Census and inventory data used in the HAZUS-MH analyses, the loss estimates should at best be considered approximate.

Hurricanes and Tropical Storms

Tropical cyclones are a relatively common occurrence in Connecticut and occur every few years producing heavy winds, heavy rainfall, and flooding. Connecticut typically experiences tropical storms as opposed to hurricanes, but strong hurricanes have caused widespread damage to the state, including flooding, and widespread power outages and damages from falling trees and power lines.

Location

All areas of the Capitol Region communities are susceptible to tropical cyclones. Low-lying areas (such as floodplains) can experience additional impacts of tropical cyclones such as flooding.

Extent

A tropical cyclone is defined by the National Weather Service as a "rotating, organized system of clouds and thunderstorms that originates over tropical or subtropical waters and has a closed low-level circulation." A tropical cyclone is further classified as a tropical depression, tropical storm, hurricane, or major hurricane and is most likely to form from June 1 through November 30 each year in the northern Atlantic Ocean.

The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 rating based on a hurricane's sustained wind speed. This scale estimates potential property damage. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Category 1 and 2 storms are still dangerous, however, and require preventative measures.

Saffir-Simpson Hurricane Wind Scale

	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph 64-82 kt 119-153 km/h	**Damaging winds will produce some damage:** Well-constructed framed homes could have damage to roof, shingles, vinyl siding, and gutters. Large branches of trees will snap, and shallow-rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt 154-177 km/h	**Very strong, damaging winds will cause widespread damage:** Well-constructed framed homes could sustain major roof and siding damage. Many shallow-rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111-129 mph 96-112 kt 178-208 km/h	**Dangerous winds will cause extensive damage:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130-156 mph 113-136 kt 209-251 km/h	**Extremely dangerous winds will cause devastating damage:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	157 mph or higher 137 kt or higher 252 km/h or higher	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: National Hurricane Center, NOAA

Previous Occurrences

The Atlantic hurricane season extends from June 1st through November 30th each year. Hurricanes that hit Connecticut normally form in the tropical waters of the Atlantic, Caribbean, or Gulf of Mexico. This is the time period when environmental conditions are most favorable for a tropical cyclone to develop. The greatest risk of a hurricane impacting New England within this 6-month period is from late August to mid October.

Of the 28 disaster declarations in the state since 1954, eight have been for hurricane or tropical-cyclone-related damage. However, as illustrated by Figure 1, many such storms have tracked through the region in the last 70 years. While the Capitol Region is spared the coastal storm surges associated with hurricanes, it is not immune from damaging winds and rain.

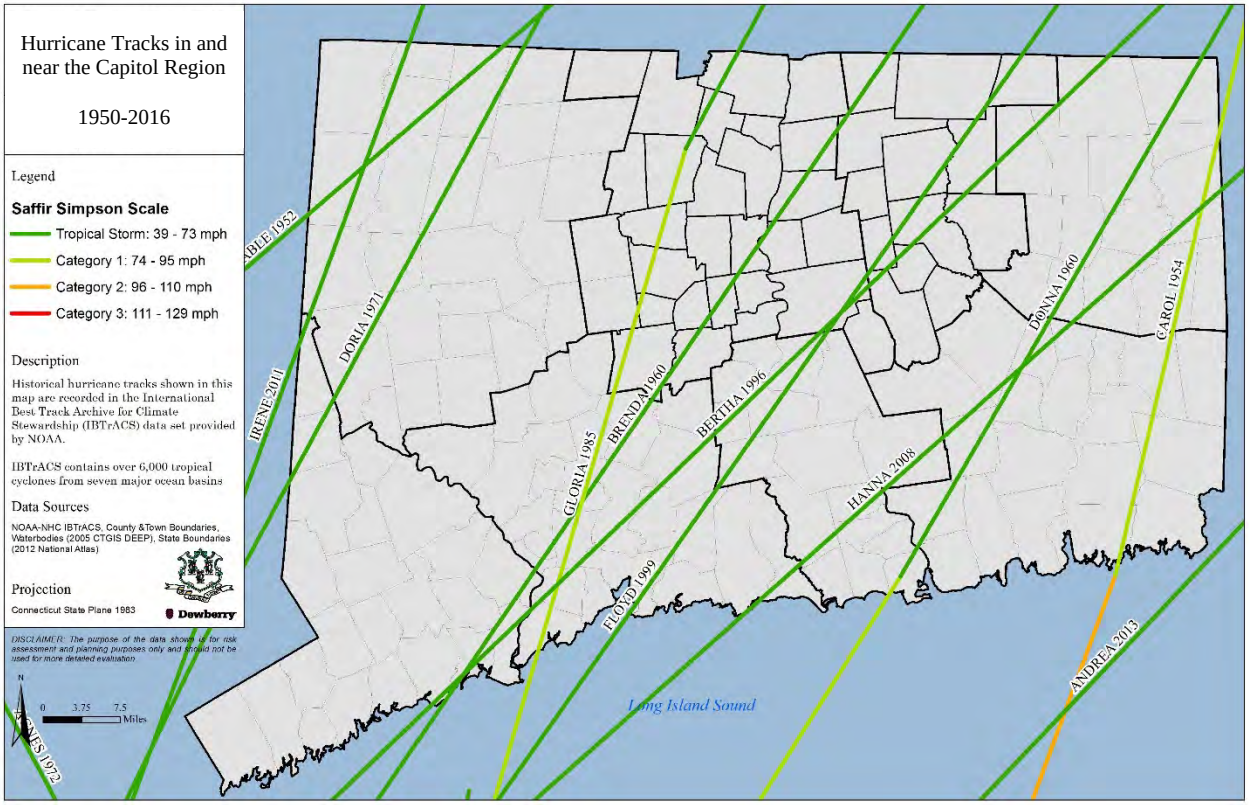


Figure 1: Historic Hurricane and Tropical Storm Tracks across Connecticut (1950-2016)

The wind and rain brought by historic tropical storms and hurricanes caused flooding, property damage, and power outages and left extensive debris and detritus in their wake. Both the 1938 and 1944 hurricanes that hit Connecticut were Category III hurricanes. The 1938 hurricane is still considered the greatest natural disaster to hit the state as it killed 125 people and caused an estimated $53 million (1938 dollars) in damage across the state. Hurricane Carol in 1954 also caused widespread damage across the state. Remnants of two hurricanes (Connie and Diane) struck Connecticut in the same week in August 1955, causing massive flooding and 70 deaths throughout the state. A Category II hurricane, Gloria, made land fall in Connecticut in 1985, downing and damaging several thousand trees and causing widespread power outages but with little rain or flooding. In 1999, Hurricane Floyd, downgraded to a tropical storm prior to making landfall in Connecticut, resulted in presidential disaster declarations for Fairfield, Hartford, and Litchfield Counties. Numerous less intense hurricanes and tropical storms have affected the region and state, some causing significant damage.

More recently, in August 2011, Hurricane Irene, also downgraded to a tropical storm before hitting Connecticut, caused widespread damage to the region and state. Irene was responsible for three deaths associated with flooding and downed wires from falling trees. According to the *Hartford Courant*, insurance companies paid out $235 million on more than 60,000 claims in Connecticut related to damage from Irene. However, this figure does not include hundreds of millions more in uncovered expenses and cleanup costs for Connecticut's largest electric utility at the time (Connecticut Light and Power). At the height of the storm, some 754,000 residents were without power. Capitol Region cities and towns were widely affected by downed trees, flooding, and power

outages as a result of Irene. Many residents and businesses were without power for over a week. According to the Connecticut Division of Emergency Management and Homeland Security, municipalities and other local and private nonprofit agencies incurred expenses of over $3.18 million due to Irene. The municipalities and agencies were eligible for reimbursement of 75% of these costs under FEMA's Public Assistance program.

Flooding in Granby in the Aftermath of Irene

Credit: Ted Glanzer, West Hartford Patch

Downed Wires in Enfield after Hurricane Irene

Credit: Ted Jensen, West Hartford Patch

Hurricane Sandy made landfall on October 29, 2012, causing costly and widespread destruction to coastal communities in Connecticut as well as in numerous other states in the Northeast. Damage due to Sandy was also felt far inland; in Connecticut, all but Hartford County was covered by the Disaster Declaration. In the Capitol Region, communities in Tolland County were designated as eligible for public assistance for funding to repair and rebuild disaster-damaged infrastructure as well as costs for debris removal and emergency protective measures.

Probability of Future Events

Return periods can be a helpful tool to put risk in perspective. Resident and business leaders should ask themselves, "How many times, over the course of a 30-year mortgage will a Category 1 hurricane hit Connecticut?" This exercise may help frame these storms as an eventuality to be prepared for rather than a risk that can be magically avoided.

NOAA has utilized the National Hurricane Center Risk Analysis Program (HURISK) to determine return periods for various hurricane categories at locations throughout the United States. As noted on the NOAA website, hurricane return periods are the frequency at which a certain intensity or category of hurricane can be expected within 75 nautical miles of a given location. For example, a return period of 20 years for a particular category storm means that on average during the previous 100 years a storm of that category passed within 75 nautical miles of that location five times. Thus, it is expected that similar category storms would pass within that radius an additional five times during the next 100 years.

According to NOAA, a Category 1 hurricane can be expected to make landfall in/near Connecticut once every 17 years. A Category 2 hurricane could be expected to make landfall in/near Connecticut once every 39 years, and a Category 3 hurricane has a calculated return period of 68 to

70 years. According to the state's Hazard Mitigation Plan, a moderate Category II hurricane can be expected to hit Connecticut once every 23 to 30 years, and a major Category III or IV hurricane may occur before 2040 based on 20th century trends. Based on this, the occurrence of a major hurricane impacting the state can be expected within the foreseeable future.

The 2014 *Connecticut Natural Hazard Mitigation Plan Update* also notes that some researchers have suggested that the intensity of tropical cyclones has increased over the last 35 years, with some believing that there is a connection between this increase in intensity and climate change. While most climate simulations agree that greenhouse warming enhances the frequency and intensity of tropical storms, models of the climate system are still limited by resolution and computational ability. However, given the past history of major storms and the possibility of increased frequency and intensity of tropical storms due to climate change, it is prudent to expect that there will be hurricanes impacting Connecticut in the near future that may be of greater frequency and intensity than in the past.

Impacts to Community Assets

The state's Hazard Mitigation Plan states that hurricanes pose the most destructive potential of all natural disasters for Connecticut. They occur relatively frequently and cause structural damage, loss of life, felled trees, flooding, power outages, and other damages. However, hurricanes pose a greater risk for coastal Connecticut than the Capitol Region because of storm surges and associated flooding risks.

Factors that influence vulnerability to tropical cyclones in the Capitol Region include building codes currently in place, local zoning and development patterns, and the age and number of structures located in highly vulnerable areas of the communities. In general, as the residents and businesses of Connecticut become more dependent on the internet and mobile communications, the impact of hurricanes on commerce will continue to increase. A major hurricane has the potential of causing complete disruption of power and communications for up to several weeks, rendering electronic devices and those that rely on utility towers and lines inoperative.

Debris such as signs, roofing material, and small items left outside become flying missiles in hurricanes. Extensive damage to trees, towers, aboveground and underground utility lines (from uprooted trees or failed infrastructure), and fallen poles cause considerable disruption for residents. Streets may be flooded or blocked by fallen branches, poles, or trees, preventing egress. Downed power lines from heavy winds can also start fires during hurricanes with limited rainfall. While moving all utilities underground would prevent wind damage to this infrastructure, this activity is generally too cost-prohibitive for communities.

FEMA Team Meeting in Hartford in Response to Hurricane Irene, 2011, Credit: FEMA

Population

Based on the population and housing growth analysis for the Capitol Region, the population of the region is estimated to increase 3% over the next 5 years. All areas of growth and development increase the region's vulnerability to natural hazards such as hurricanes although new development is expected to mitigate potential damage by meeting the standards of the most recent building code.

Loss Estimates from HAZUS-MH

Using FEMA's HAZUS-MH software, CRCOG analyzed the 1% annual chance (i.e., 100-year) hurricane scenario to estimate the potential loss to property and life for the region as a whole. The HAZUS-MH hurricane model primarily considers wind damage for inland areas such as the Capitol Region that are not subject to storm surges. The software assesses physical damage and the associated economic losses. Economic losses associated with the loss of electricity are not considered except as a factor in determining the number of households displaced and/or likely to use public shelters.

According to the 1% annual chance event scenario, the Capitol Region could suffer a total economic loss of about $511.7 million. Of this amount, approximately $381.8 million would be related to building losses, approximately $107.9 million would be related to content losses, and $21.9 million would be related to business disruption costs. The greatest total losses would be expected in Hartford and Manchester. Table 9 below displays the economic losses estimated by HAZUS-MH for each municipality in the region.

Table 9: HAZUS-MH Loss Estimates for a 1% Annual Chance Hurricane and Annualized Loss Estimates by Municipality ($1,000s)

Municipality	Building Loss	Content Loss	Business Disruption Loss	Total Economic Losses	Annualized Loss
Andover	$1,426	$84	$84	$1,594	$223
Avon	$3,353	$1,633	$25	$5,011	$1,135
Berlin	$4,411	$1,121	$40	$5,573	$1,245
Bloomfield	$6,792	$2,368	$164	$9,325	$1,284
Bolton	$2,140	$138	$144	$2,422	$337
Canton	$837	$278	$6	$1,120	$645
Columbia	$2,545	$151	$157	$2,853	$372
Coventry	$5,230	$380	$321	$5,931	$843
East Granby	$1,840	$927	$17	$2,784	$323
East Hartford	$22,261	$5,147	$1,803	$29,211	$3,213
East Windsor	$7,026	$2,524	$425	$9,975	$700
Ellington	$7,850	$577	$547	$8,974	$1,057
Enfield	$23,029	$6,911	$1,309	$31,249	$2,799
Farmington	$4,432	$1,896	$48	$6,375	$1,589
Glastonbury	$19,135	$3,907	$998	$24,039	$2,158
Granby	$1,723	$559	$3	$2,285	$707
Hartford	$42,160	$5,258	$4,569	$51,987	$7,822
Hebron	$5,961	$2,269	$245	$8,476	$656
Manchester	$36,813	$10,147	$2,552	$49,511	$3,651
Mansfield	$11,397	$3,970	$581	$15,949	$1,799
Marlborough	$2,843	$194	$172	$3,210	$401
New Britain	$11,794	$1,648	$878	$14,320	$4,589
Newington	$10,353	$4,143	$272	$14,767	$1,916
Plainville	$2,553	$850	$18	$3,421	$1,111
Rocky Hill	$8,281	$1,084	$456	$9,821	$1,236
Simsbury	$5,888	$3,363	$17	$9,268	$1,474
Somers	$5,556	$1,718	$195	$7,469	$776
South Windsor	$16,066	$5,279	$662	$22,008	$1,612
Southington	$5,629	$1,558	$21	$7,207	$2,700
Stafford	$6,890	$3,381	$280	$10,551	$819
Suffield	$6,631	$1,965	$286	$8,882	$986
Tolland	$11,377	$6,133	$407	$17,917	$1,020
Vernon	$19,381	$4,699	$1,469	$25,549	$1,977
West Hartford	$22,515	$8,594	$1,072	$32,181	$3,966
Wethersfield	$12,153	$4,349	$572	$17,075	$1,672
Willington	$3,700	$1,769	$173	$5,643	$409
Windsor	$14,661	$5,860	$541	$21,062	$1,821
Windsor Locks	$5,173	$1,100	$383	$6,656	$783
TOTAL	**$381,807**	**$107,932**	**$21,911**	**$511,650**	**$61,827**

While the region could experience severe and widespread losses from rare, strong hurricanes, this hazard poses moderate risk for the Capitol Region given that coastal Connecticut bears the initial brunt of such storms.

Other Loss Estimates

FEMA Public Assistance reimbursement data was used to estimate annualized losses due to hurricane and tropical cyclone wind damage in each community. Based on the 19 years of Public Assistance data available, the annualized loss estimate for the Capitol Region is $319,810. Annualized losses for each community based on this data are presented in each municipal annex. As this data is only limited to the last 19 years and does not take into account the damaging hurricanes of the last century, an alternate method of estimating annualized loss was used for this plan.

Additional estimates of community impacts have been determined based on data presented in the 2014 *Connecticut Natural Hazard Mitigation Plan Update*. The percentage of the population of each Capitol Region community as compared to the population of its county was used to adjust the hurricane wind losses estimated by HAZUS-MH for a full spectrum of probabilistic events (10-year to 1,000-year) as reported in Table 2-21 of the 2014 *Connecticut Natural Hazard Mitigation Plan Update*. The annualized loss estimate for hurricane wind damage in each Capitol Region community is presented in the table above and in each municipal annex.

Floods

Flooding is the most common natural disaster encountered in the Capitol Region. Triggered by a variety of events, flooding can occur as a result of other natural hazards such as heavy precipitation, hurricanes, winter storms, snowmelt, ice jams, or dam failures. The Capitol Region's numerous rivers and streams, as well as its urbanized areas, make floods and flash floods a regular risk. Historical development patterns encouraged dense construction of town centers near water bodies; consequently, many areas with chronic flooding problems are in population centers. Individuals and local governments face significant economic loss, risks to public safety, and degraded waterways from flooding.

Location

According to FEMA, most municipalities in the United States have at least one clearly recognizable area at risk of flooding around a river, stream, or large body of water. Many communities also have localized flooding areas outside the Special Flood Hazard Area (SFHA). These floods tend to be shallower and chronically reoccur in the same area due to a combination of factors. Such factors can include ponding, poor drainage, inadequate storm sewers, clogged culverts or catch basins, sheet flow, obstructed drainageways, sewer backup, or overbank flooding from minor streams.

Extent

According to FEMA, there are several different types of inland flooding:

- **Riverine Flooding**: Also known as overbank flooding, it occurs when channels receive more rain or snowmelt from their watershed than normal, or the channel becomes blocked by an ice jam or debris. Excess water spills out of the channel and into the channel's floodplain area.

- **Flash Flooding**: A rapid rise of water along a water channel or low-lying urban area, usually a result of an unusually large amount of rain and/or high velocity of water flow (particularly in hilly areas) within a very short period of time. Flash floods can occur with limited warning.

- **Shallow Flooding**: Occurs in flat areas where a lack of a water channel results in water being unable to drain away easily. The three types of shallow flooding include:

- **Sheet Flow**: Water spreads over a large area at uniform depth.
- **Ponding**: Runoff collects in depressions with no drainage ability.
- **Urban Flooding**: Occurs when man-made drainage systems are overloaded by a larger amount of water than the system was designed to accommodate.

Floodplains are lands along watercourses that are subject to periodic flooding; **floodways** are those areas within the floodplains that convey the majority of flood discharge. Floodways are subject to water being conveyed at relatively high velocity and force. The **floodway fringe** contains those areas of the 1% annual chance floodplain that are outside the floodway and are subject to inundation but do not convey the floodwaters at a high velocity.

In order to provide a national standard without regional discrimination, the 1% annual chance flood has been adopted by FEMA as the base flood for purposes of floodplain management and to determine the need for insurance. The floods are often described in terms of the annual percentage chance of occurrence. Floodplains have been delineated by FEMA to reflect 1% and 0.2% annual flood events previously known as 100-year and 500-year floods, respectively. The area that has a 1% annual chance to flood each year is delineated as a Special Flood Hazard Area (SFHA) for the purposes of the National Flood Insurance Program (NFIP). The 0.2% annual chance floodplain indicates areas of moderate flood hazard.

However, because the 1% floodplain (or any percent floodplain) reflects the percentage chance that area will be inundated in any given year, it is possible to observe a 1% flood more than once every 100 years. For example, FEMA notes that a structure located within a 1% annual chance flood zone has a 26% change of suffering flood damage during the term of a 30-year mortgage. Furthermore, the 1% floodplain is based on empirical evidence. If more or less floods of a certain magnitude are observed, FEMA may restudy the floodplains and update corresponding insurance maps. This means that there can be a lag between the official risk and the empirical risk. A table of the two terms, x% annual chance flood and their corresponding y-year floods, is found in Table 10.

Table 10: Current and Antiquated Terms for Various Intensities of Flooding

Previous Terminology	Current Annual Percent Chance Terminology
2-Year	50%
10-Year	10%
25-Year	4%
50-Year	2%
100-Year	1%
500-Year	0.20%

SFHAs in the Capitol Region communities are delineated on a Flood Insurance Rate Map (FIRM) delineated as part of a Flood Insurance Study (FIS). Major watercourses in the Capitol Region communities typically have SFHAs mapped as Zone AE while smaller tributary streams are mapped as Zone A. Other small streams have shading as Zone X, and other classifications are also possible. Table 11 presents the various flood hazard zones mapped on FIRM panels in the Capitol Region.

Table 11: FIRM Zone Descriptions in the Capitol Region

Zone	Description
A	An area with a 1% chance of flooding in any given year for which no base flood elevations (BFEs) have been determined
AE	An area with a 1% chance of flooding in any given year for which base flood elevations have been determined. This area may include a mapped floodway.
X (Levee)	An area where the flood risk has been reduced below the 1% annual chance by a levee
X (Shaded)	An area with a 0.2% chance of flooding in any given year for which no base flood elevations have been determined
X (Unshaded)	An area that is determined to be outside of the 1% and 0.2% annual chance floodplains

Source: FEMA

During large storms, the recurrence interval level of a flood discharge on a tributary tends to be greater than the recurrence interval level of the flood discharge on the main channel downstream. In other words, a 1% annual chance flood event on a tributary may only contribute to a 2% annual chance flood event downstream. This is due to the distribution of rainfall throughout large watersheds during storms and the greater hydraulic capacity of the downstream channel to convey floodwaters. Dams and other flood control structures can also reduce the magnitude of peak flood flows if pre-storm storage is available. Similarly, the recurrence interval level of a precipitation event also generally differs from the recurrence interval level of the associated flood. Flood events can also be mitigated or exacerbated by in-channel and soil conditions such as low or high flows, the presence of frozen ground, or a deep or shallow water table as can be seen in the following historic record.

Previous Occurrences

Historically, the region has seen a great deal of flooding. According to the FEMA FIS for Hartford County, major floods have occurred in 1927, 1936, 1938, 1949, 1955, and 1960. Historic floods of the 1930s and 1950s resulted in widespread damage in Connecticut.

The greatest flood of record on the Connecticut River occurred in March 1936 with a discharge of 290,000 cubic feet per second (cfs) in Hartford. According to accounts from the National Atmospheric and Oceanic Administration (NOAA), the combination of several heavy rain events and melting snow resulted in major flooding throughout New England. New flow records were established on the Connecticut River in Hartford and other locations upstream such as on the Hockanum River in East Hartford. Flooding was again widespread in New England following the hurricane of 1938.

The flood of 1955 was one of the worst in Connecticut's history. It resulted from heavy rains caused by back-to-back hurricanes in August. According to NOAA, Hurricane Connie produced 4 to 6 inches of rainfall over southern New England on August 11 and 12, saturating the ground and raising river and reservoir levels to above-normal levels. Then Hurricane Diane came a week later and "dealt a massive punch" to New England. Rainfall totals from Diane ranged up to nearly 20 inches over a 2-day period. The headwaters of the Farmington River in Connecticut recorded 18 inches in a 24-hour period. These were record accumulations. Damage was widespread throughout Connecticut - for example, Salmon Brook in East Granby experienced a 500-year flood, and the Willimantic River in Mansfield experienced a 200-year flood according to the Town of Mansfield FIS. Table 12 below summarizes the damages experienced in the Capitol Region communities.

Table 12: Damage Estimates to Capitol Region Municipalities from the August 19, 1955, Flood

Capitol Region Municipality	Public Facilities	Residential	Industrial	Business	Private Schools, Churches, & Institutions	Total
Avon	$18,184	$100,000		$16,500		$134,684
Bloomfield	$17,500	$17,500	$22,500	$66,250	$1,600	$125,350
Canton	$80,000	$215,000	$1,000,000	$219,275		$1,514,275
Coventry	$104,000	$5,000	$15,000			$124,000
East Granby	$47,000	$480,000				$527,000
East Hartford	$35,000					$35,000
East Windsor	$20,000	$35,000	$6,500	$41,000		$102,500
Ellington	$35,000					$35,000
Enfield	$55,000					$55,000
Farmington	$200,000	$1,800,000	$1,700,000	$500,000		$4,200,000
Glastonbury	$8,000	$10,000	$58,300	$14,550		$90,850
Granby	$455,000	$15,110	$14,000			$484,110
Hartford	$25,000	$1,500,000	$1,800,000	$270,000	$100,000	$3,695,000
Manchester	$12,095					$12,095
Mansfield	$78,500					$78,500
New Britain	$266,275					$266,275
Plainville	$25,000					$25,000
Rocky Hill		$2,000				$2,000
Simsbury	$57,350	$350,000				$407,350
Somers	$175,000					$175,000
South Windsor	$5,000	$50,000				$55,000
Stafford	$190,000	$150,000	$500,000	$250,000		$1,090,000
Suffield	$75,000	$50,000				$125,000
Tolland	$11,000					$11,000
West Hartford	$62,065	$255,000		$545,000		$862,065
Wethersfield	$2,500	$75,000	$10,000			$87,500
Willington	$17,000					$17,000
Windsor	$78,500	$50,000	$100,000	$11,500		$240,000
Windsor Locks	$10,000					$10,000
Capitol Region	$2,164,969	$5,159,610	$5,226,300	$1,934,075	$101,600	$14,586,554

Source:
Report of the Connecticut Flood Recovery Committee to Governor Abraham Ribicoff, November 3, 1955
http://cslib.cdmhost.com/digital/collection/p128501coll2/id/188260/rec/1

Heavy rainfall in June 1982 also resulted in record floods on the Farmington River and many smaller streams through the central part of the state. For example, the June 1982 flood is the most severe flood on record for the Quinnipiac River in Southington, with the 1938 and 1982 floods having recurrence intervals of 100 years and 350 years, respectively.

According to NOAA, "One of the ironies of this event was that one of the facilities that was impacted was the Northeast River Forecast Center. The NERFC offices, which at that time were located in Bloomfield CT, were flooded for a day. Staff had to move to other locations including one home in order to complete their forecast responsibilities. The floods caused the loss of at least eleven lives.

In addition damage estimates of approximately 230 million dollars were incurred. Thousands of homes suffered varying degrees of damage. One significant development from the aftermath of this flooding was the development of a statewide flood warning system (the now-defunct Automated Flood Warning System) under the management of the Connecticut Department of Environmental Protection. While this will not prevent flooding to occur in the future, it may help provide advance warning and prevent the loss of lives and property."

October 2005 Flooding of Capitol Region Rivers and Streams

River/Stream	Flooding Severity	Recurrence Interval
Broad Brook	Major	> 100-year
Connecticut River	Minor	2-Year
Hockanum River	Moderate	25-Year
Stony Brook	Moderate	40-Year

The severe flooding of October 2005 demonstrated once again the region's vulnerability to this hazard. Two heavy rainfalls during the week of October 7-15, 2005, caused major flooding in several small rivers in Hartford and Tolland Counties and moderate flooding elsewhere. Several dams were breached, and roads and bridges washed out. The storms flooded many basements, and some towns conducted evacuations because of severe urban flooding. Interstate 91 developed a sinkhole in Windsor. Enfield was particularly hard hit. The storms produced sufficient damage to provoke a federally declared major disaster in certain counties, including Tolland County ($1.16 million) and eventually Hartford County ($2.52 million).

Route 191, East Windsor

From http://ct.water.usgs.gov/DATA/floodindex.html

Municipality	Rainfall for Week of Oct. 7-15, 2005
Enfield	15.90"
Farmington	11.61"
Glastonbury	13.27"
Hartford	10.51"
South Windsor	15.90"
Wethersfield	13.22"
Windsor Locks	13.12"

The National Centers for Environmental Information (NCEI) Storm Events Database lists a number of other flooding events in the Capitol Region over the past 2 decades including the following:

July 8, 1995: Thunderstorms produced very heavy rainfall. One road was reported to be impassable between Ellington and Stafford Springs, and overflow and street flooding was reported on secondary roads off Route 84.

January 24, 1996: Strong south winds with gusts to 40 to 60 mph and isolated gusts to hurricane force preceded a sharp cold front. Peak wind gusts to 58 mph were recorded at both Bradley International Airport in Windsor Locks and at Glastonbury. There were scattered reports of wind damage including downed trees, downed tree limbs, and scattered power outages. Part of a roof of a Hartford apartment building was damaged, displacing about 15 people. Power outages affected up to 41,000 electric customers statewide. The high winds also brought a strong January thaw with temperatures rising into the 50s. This combined with rain and melting snow caused some street flooding. Flash flooding occurred in West Hartford and Hartford where homes flooded and roads washed out along the upper portion of

the South Branch of the Park River and also along the North Branch of the Park River in the parking lots at the University of Hartford and Hartford Community College.

April 16, 1996: Two to 3 inches of rain fell on April 16 in northern Connecticut, with totals of 3 to 5 inches in the south portion of Hartford and Tolland Counties. All of the rain fell in about a 12-hour period. The ground had remained saturated from heavy snowmelt during the previous week and this combined with the heavy rain to produce urban flooding, flooding of small streams, and finally minor to moderate flooding of the major rivers resulting in the most significant main-stem river flooding along the Connecticut River in 9 years. A flash flood occurred in Berlin where boats were needed to rescue people stuck in two cars on Route 71. Moderate flooding was reported along the Quinnipiac River in Southington. In general, during this event, low-lying riverfront land and some roads were flooded, but no significant damage was reported.

July 13, 1996: Tropical Storm Bertha brought heavy rainfall totals of 3 to 5.5 inches as the center of the storm passed over the southeast part of Connecticut, moving northeast. The maximum rainfall reported was 5.5 inches at Vernon. Urban street flooding occurred throughout the area, and minor river flooding occurred along the North Branch of the Park River in Hartford.

December 2, 1996: Heavy rainfall amounts of 2 to 3 inches on the first and second of the month, combined with some snowmelt in the Connecticut River Basin, produced runoff that resulted in minor flooding of several small streams and flooding along the Connecticut River below Thompsonville.

August 29, 1997: A cold front moving very slowly across Connecticut caused an area of showers and thunderstorms that produced intense rainfall amounts of 3 to 6 inches in 1 to 3 hours across parts of Hartford County. A flash flood occurred in Manchester where Bigelow Brook rose at least 6 feet out of its banks, flooding roads and basements. Sixteen homes received extensive water damage. A majority of these had basement flooding. Three homes had total basement failure or collapse. One home was severely damaged. Many residents had to be evacuated to local shelters. Electric power was disrupted for 1,200 customers. A local shopping area also was flooded. An estimated 6 to 12 automobiles received extensive water damage when water rose to at least as high as the windows. Property damage was likely a half million dollars. Maximum rainfall totals reached 5 to 6 inches in the area of the flash flood, and there was extensive urban street flooding in addition to the flash flood. The cloudburst was really confined to Manchester. Only one town away in Vernon, there was heavy rain, but no flooding was reported.

March 9, 1998: A powerful storm system moving slowly northeast from the Ohio Valley to the eastern Great Lakes brought strong winds and heavy rainfall to Connecticut, which resulted in urban street flooding, basement flooding, small stream flooding, and main-stem river flooding. At times, the rainfall was torrential, especially in thunderstorms during the evening hours.

June 30, 1998: An area of heavy showers and thunderstorms associated with a slow-moving warm front brought 2 to 4 inches of rainfall to Hartford County, resulting in urban street, basement, small stream, and river flooding. In West Hartford, the Trout Brook went over its banks flooding nearby areas. Urban street flooding was reported with water 4 feet deep on Pen Drive and 1 foot deep in some other areas.

September 16, 1999: Tropical Storm Floyd brought torrential rainfall and strong winds to northern Connecticut as it tracked up the Connecticut River valley into central Massachusetts. Although many areas received torrential rainfall, with totals between 4 and 8 inches, the heaviest rain fell in western Hartford County where as much as 10.80 inches was reported in Bristol. The rainfall produced widespread flooding of low-lying areas, especially in Hartford County. Surprisingly, no flood damage was reported, even in those areas where the smaller rivers rose rapidly. Strong winds were also felt in northern

Connecticut as Floyd passed. There were scattered reports of small trees or branches downed, which did not cause significant damage.

June 2, 2000: Severe thunderstorms moved across northern Connecticut in advance of a strong cold front. The storms moved through late in the afternoon and early evening. In Hartford County, a spotter in Granby reported nickel- to quarter-size hail and observed a funnel cloud near State Route 20. The hail accumulated 2 inches deep. In Ellington, in Tolland County, thunderstorm winds downed two large trees, and torrential rainfall caused flash flooding of a small stream in the vicinity of Pinney Road.

March 22-30, 2001: The combination of melting snow and heavy rain caused flooding along the Quinnipiac River in Southington. The river crested at 4.6 feet. Several roads near the river were closed by floodwaters, but no damage was reported. River levels remained above normal for nearly a week when a storm system brought 2 to 3 additional inches of rainfall. The river crested at 4.4 feet during the latter event, and no damage was reported.

May 28, 2003: A slow-moving severe thunderstorm produced penny-size hail in Enfield and Manchester. The storm then dumped 3 to 4 inches of rain in Bloomfield, West Hartford, and Hartford in less than one hour. This resulted in flash flooding on Beaman Brook in Bloomfield and significant urban flooding in West Hartford and Hartford. Dozens of cars were submerged in floodwaters, and several people needed to be rescued. The north end of West Hartford along Trout Brook Drive was hardest hit along with the neighborhood surrounding Bloomfield High School. There were no injuries reported. Lightning from the storm struck several houses in West Hartford causing minor damage. Power was briefly knocked out in West Hartford and Windsor, cutting off service to thousands of customers.

September 28, 2003: Significant urban flooding affected central Hartford County after nearly 4 inches of rain fell in a few hours. Several cars were stranded in Berlin, and Willow Brook rose out of its banks in New Britain flooding a nearby park. This event included flash flooding in Berlin that caused $25,000 worth of property damage.

July 15, 2005: Slow-moving, nearly stationary, thunderstorms produced heavy downpours that lead to flash flooding and road closures in Hartford County. No direct injuries resulted from these storms.

July 27, 2005: A hot and humid air mass combined with an approaching cold front sparked strong to severe thunderstorms. These thunderstorms produced severe winds, damaging lightning, and flash flooding across north central and northeast Connecticut, especially Hartford County. The severe winds brought trees, utility poles, and power lines down. In Hebron, approximately 40 trees were knocked down as these storms pushed through the area. Lightning and flash flooding were also produced from these storms. In Hartford, lightning destroyed a wooden shed. In East Hartford, flash flooding left cars stranded on a road. No direct injuries resulted from these storms, however.

April 16, 2007: An unusually strong and slow-moving coastal storm for mid April tracked to western Long Island Sound on April 16 before weakening slowly and drifting offshore. This storm brought strong winds and widespread river and stream flooding to northern Connecticut. Northeast winds gusted as high as 55 mph in the higher elevations of Tolland and Windham Counties. Rainfall totals of 3 to 5 inches, combined with wet antecedent conditions, resulted in widespread river and stream flooding as well as significant flooding of urban areas. Minor to moderate flooding occurred on the Farmington and Connecticut Rivers. The Connecticut River at Thompsonville crested at 7 feet at 3:00 p.m. on the 17 (flood stage is 5 feet), and at Hartford, it crested at 23.4 feet at 12:15 pm on the 18 (flood stage is 16 feet). On the Farmington River, a crest of 16.6 feet was recorded at Simsbury at 9:15 a.m. on the 17 (flood stage is 12 feet) while at Tarriffville the river crested at 9.9 feet at 4:30 p.m. on the 17 (flood stage is 9 feet). The Hockanum River in Manchester came out of its banks and threatened nearby homes. Several roads were flooded in Granby.

September 28, 2008: Tropical Storm and then Hurricane Kyle moved east of Massachusetts on its trek toward Maine and Nova Scotia. The effects of Kyle were minimal on southern New England with heavy rainfall and high surf the only concerns. Kyle, combined with a separate coastal storm that moved through southern New England the day before, produced anywhere from 2 to 7 inches of rain. This resulted in significant flooding across two counties in southeastern Massachusetts and flash flooding in Hartford County, Connecticut. Heavy rainfall behind Tropical Storm Kyle resulted in flash flooding across Hartford. On Elliot Street and on Flatbush Avenue, a total of six cars were stuck in floodwaters. Numerous basements were flooded on both Maple and Wethersfield Avenues and on Parkview Drive.

July 21, 2010: Severe thunderstorms produced 12 to 18 inches of water over Corbin Avenue in New Britain.

March 7, 2011: Heavy rains with amounts ranging 2 to 5 inches across coastal and interior New England, coupled with melting snows, resulted in flooding of tributaries and major rivers, inundating local neighborhoods and roadways. Several rivers and small streams in Hartford County flooded including the Farmington River at Tarriffville, Unionville, and Simsbury; the Hockanum River at East Hartford; and the Connecticut River at Hartford. In addition, basements were flooded in Avon, Windsor, and Windsor Locks. Bloomfield Avenue was closed near the Bloomfield/Windsor line because a nearby pond overflowed its banks. Several intersections were flooded, including the intersection of Old Farms and Tillotson Roads in Avon and the intersection of Wolcott and Wescott Roads in Simsbury. In Ellington, Route 140 was closed near its intersection with Route 30 because of flooding. Portions of Freshwater Boulevard in Enfield were flooded. In Somers, portions of Durkee, Four Bridges, and King Roads adjacent to the Scantic River flooded.

September 8, 2011: A slow-moving cold front moved across southern New England and stalled just south of the area. This front was instrumental in bringing tropical moisture from the remnants of Tropical Storm Lee into New England, resulting in several periods of showers and steady rainfall. Rainfall totals throughout the area over the 4 days totaled anywhere from 2 to 8 inches, with most areas receiving 4 to 6 inches. This resulted in flooding both on the rivers and small streams and in urban areas. The bulk of the flooding in urban areas occurred on September 8 as a band of very heavy rain moved through, dumping up to 2 inches of rain in an hour to hour and a half in some locations. Numerous roads were closed throughout Bloomfield because of water 1 to 2 feet deep over the roads. In addition, a 10-foot section of Bloomfield Avenue was washed out near the intersection of Bloomfield Avenue and Route 218. Dozens of cars in Parking Lot E of the University of Hartford were floating after the north branch of the Park River overflowed its banks into the parking lot. University officials said it was only the second time in the past 15 years that flooding had been this bad. In addition, several main-stem rivers experienced flooding, including the Farmington River at Simsbury and Unionville and the Connecticut River at Thompsonville and Hartford. No damage associated with this flooding was reported.

June 22, 2012: Severe storms occurred throughout southern New England, resulting in damaging winds, large hail, and some flash flooding. Collins and Gardner Streets in Hartford were flooded and impassable. Several streets were flooded in Manchester. Peldon Street in East Hartford was closed due to flooding.

July 28, 2012: Several areas of low pressure along a stationary front stalled across southern New England, producing very heavy rain showers and a few thunderstorms. Many locations received up to 2 to 3 inches in less than an hour. This resulted in flash flooding, particularly in more urban areas. Flooding was reported in New Britain on Farmington Avenue near Barube Street. Several cars were stuck in floodwaters or stalled. West Main Street between Norton Road and Corbin Avenue was flooded with 4 to 8 inches of water. In addition, Route 190 and Stafford Road in Stafford were flooded with 2 feet of water, and cars were stuck in the floodwaters. In Stafford Springs, the parking lot in front of the Stafford Springs Savings Bank was flooded with 1 foot of water.

August 5, 2012: Rainfall from showers and thunderstorms resulted in minor street flooding in New Britain at the intersections of Corbin Avenue and Osgood Avenue and at the intersection of Berube Street and Farmington Avenue.

August 10, 2012: Very heavy rain showers and thunderstorms developed, many with high winds. Route 190 in Stafford Springs was closed due to flooding.

September 18, 2012: A line of thunderstorms produced rainfall resulting in flooding at the intersection of Clinton Street and Albany Avenue in New Britain as well as at the intersection of Lincoln Street and West Main Street.

July 10, 2013: A warm front lifted northward through southern New England, igniting showers and thunderstorms and a tornado across much of the area. The main threat with many of these storms was flash flooding. Three feet of water flooded Love Lane in Hartford, and a car was stuck in floodwaters on Lyme and Palm Streets. $3,000 in damage was reported.

August 9, 2013: Widespread rain, along with thunderstorms, occurred across southern New England. The high moisture content of the atmosphere resulted in torrential downpours across much of the region, which led to flash flooding in some areas. Route 10 and Route 189 in Granby were flooded, with cars stuck on both roads. In Windsor Locks, the Farmington River overflowed its banks near the junction of Interstate 91 and Route 159. $30,000 in damage was reported.

September 2, 2013: Showers and thunderstorms produced heavy rain that caused flooding 4 to 8 inches deep on several streets in New Britain. A car was stuck in floodwaters on Golden Hill Street. $5,000 in damage was reported.

May 31, 2015: Showers and thunderstorms produced flooding and pockets of flash flooding. Route 189 in Granby was blocked by floodwaters that were not draining. The Lower Lane area of Berlin also experienced localized flooding.

July 30, 2015: A cold front produced showers and thunderstorms across much of southern New England. Heavy rain came with some of these storms, resulting in some minor street flooding such as on Trout Brook Drive in West Hartford.

August 25, 2015: Thunderstorms occurred across much of western Massachusetts and northern Connecticut. A few of these storms produced damaging winds. Floydville Road was flooded between Routes 202 and 189 in Granby and East Granby.

August 11, 2016: A few afternoon showers and thunderstorms developed across northern Connecticut. Several of these storms produced wind damage, flooding, and numerous lightning strikes. Route 83 (Main Street) in Manchester was flooded with 8 inches of water between Henry and Woodland Streets. In Glastonbury, minor street flooding occurred on Route 17, and at the nearby intersection of Hubbard and Willieb Streets, manhole covers popped off due to flooding.

June 30, 2017: Showers and thunderstorms were generated over western Connecticut. In West Hartford, the junction of North Main Street and Albany Avenue had flooding to a depth of 2.5 feet.

August 2, 2017: Some showers and storms produced heavy downpours and strong wind gusts. Heavy downpours in Manchester brought street flooding to the east side. Pearl Street and Birch Street were under 1 to 2 feet of water, making them impassable. $10,000 in damage was reported.

The storms listed in the NCEI database present notable storm events tied to flooding, but unlisted storms also have a significant impact on the region. For example, in 1992 New Britain, experienced extensive flooding from a rainstorm that, according to a report by Maguire Group, exceeded a 100-year storm. The flooding that resulted from this unlisted storm inundated local playing fields and caused $654,000 worth of damage to bridges, culverts, and roads.

Probability of Future Events

There is not a "flood season" per se in Connecticut; however, waterways are normally higher during spring and are thus especially vulnerable to flooding from intense precipitation. According to the state's Hazard Mitigation Plan, major flooding of small rivers and loss of life can be expected every 5 to 10 years throughout the state. Major flooding of larger rivers, such as the Connecticut and Farmington, with loss of life and structural damage can be expected once every 30 years. While inundation-related flood loss is a significant component of flood disasters, fluvial (river-related) erosion is another significant source of damage.

The Connecticut Department of Transportation (DOT) maintains indexes linking return periods with expected precipitation amounts. A chart including events by expected return period, the expected volume of precipitation recorded in 1 day for each hypothetical event, the observed number of events that have crossed the volume threshold, and the observed probability for the return of any such event in any given year is given in Table 13. This table highlights the uncertainty of the predictions. According to the official numbers, 2% annual chance rainfall events have occurred five times in the last roughly 50 years. This implies that there is actually a 10% annual observed chance of an event of this magnitude within the region; this is five times more likely than expected probability.

Table 13: CTDOT Observed Rainfall vs. Expected Flood Probability

Return Period	Expected Probability	Expected Rainfall/Day (inches)	Observed Occurrences	Observed Probability
100-Year	1%	7.00	4	8.2%
50-Year	2%	6.35	5	10.2%
25-Year	4%	5.75	8	16.4%
10-Year	10%	4.95	10	20.5%
5-Year	20%	4.20	17	34.8%
2-Year	50%	3.25	41	84.0%

Several recent studies have shown that the amount of rainfall being experienced in Connecticut is increasing over time. Although annual precipitation in Connecticut is approximately 47 inches per year, the average annual precipitation has been increasing by 0.30 inches per decade since the end of the 19th century according to the NOAA National Centers for Environmental Information (NCEI). Figure 2 demonstrates this information graphically.

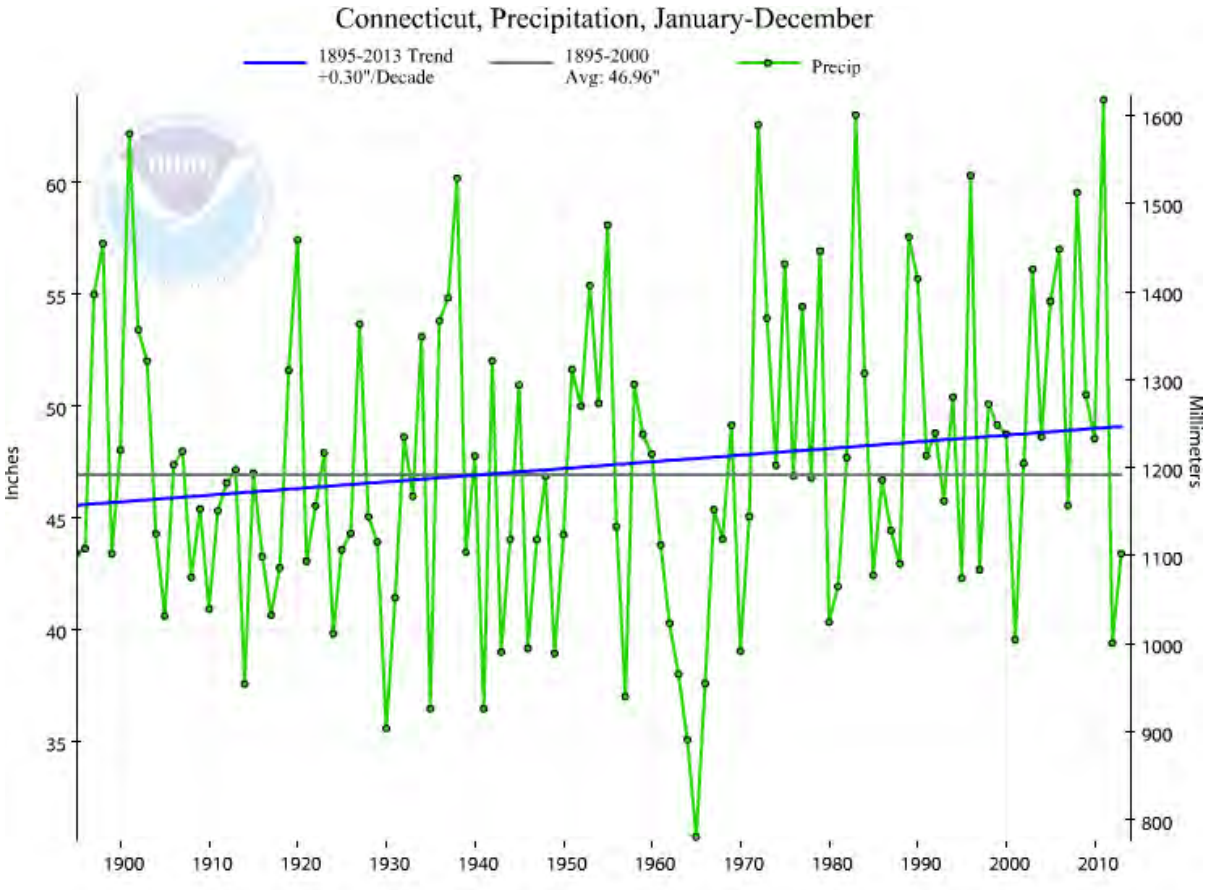


Figure 2: Precipitation Trends in Connecticut, 1895-2013

Like many areas in the United States, the Capitol Region experienced a population boom following World War II. This population increase led to concurrent increases in impervious surfaces and the amount of drainage infrastructure. Many post-war storm drainage systems and culverts were likely designed using rainfall data published in *Technical Paper No. 40* by the U.S. Weather Bureau (now the National Weather Service) (Hershfield, 1961). The rainfall data in this document dates from the years 1938 through 1958. These figures are the standard used in the current Connecticut DOT *Drainage Manual* (2000) and were the engineering standard in Connecticut for many years. This engineering standard was based on the now disproven premise that extreme rainfall series in Connecticut do not change through time, and therefore, the older analyses reflect current conditions.

The Northeast Regional Climate Center (NRCC) has partnered with the Natural Resources Conservation Service (NRCS) to provide a consistent, current regional analysis of rainfall extremes for engineering design (http://precip.eas.cornell.edu/). The increase in precipitation over time is reflected in the changing rainfall magnitudes published by the NRCC. As shown in Table 14, the 24-hour storm has increased in magnitude since the initial figures were published by the National Weather Service in 1961, with the greatest increase occurring in the more extreme events. Note that the 2004 USGS rainfall recurrence intervals were based on rainfall data processed by NRCC through 2003 as post-processed by USGS.

On November 3, 2015, the Connecticut Department of Transportation (CT DOT) Office of Engineering put out a bulletin (number EB-2015-2) directing that updated precipitation frequency estimates from the NOAA Atlas 14 released on September 30, 2015, be used in planning and design. Twenty-four-hour rainfall amounts for Hartford are presented in Table 14.

Table 14: Increase in Rainfall Recurrence Intervals for 24-Hour Storm

Rainfall Data Source	Total Rainfall (Inches) by Storm Recurrence Interval					
	2-Year (50% Annual Chance)	10-Year (10% Annual Chance)	25-Year (4% Annual Chance)	50-Year (2% Annual Chance)	100-Year (1% Annual Chance)	500-Year (0.2% Annual Chance)
TP-40 (1961)	3.2	4.7	5.5	6.2	6.9	8.9
USGS *StreamStats (2004)*	3.2	4.5	5.5	6.4	7.5	N/A
NRCC (2008)	3.21	4.75	5.95	7.05	8.36	12.43
NOAA Atlas 14 (2015)	2.47	4.91	6.05	6.93	7.81	11.1

The National Climate Assessment estimates 5% to 20% more precipitation will occur during winter and spring months for the northeast by the turn of the next century. The assessment also predicts an increase in severe weather events for the region, which may increase the chance of experiencing floods. Additional intense precipitation, combined with an increase in impervious surfaces and thus increase in surface runoff, suggests that the potential for flooding will likely increase in the future. Municipalities can improve their resiliency to flooding by considering the impacts of locally observed severe weather and by exceeding, where necessary, federal, state, and local requirements to meet local needs.

> The continued increase in precipitation only heightens the need for hazard mitigation planning as the occurrence of floods may change in accordance with the greater precipitation.

Impacts to Community Assets

Flooding presents several safety hazards to people and property and can cause extensive damage and potential injury or loss of life. Floodwaters cause massive damage to the lower levels of buildings, destroying business records, furniture, and other sentimental papers and artifacts. In addition, floodwaters can prevent emergency and commercial egress by blocking streets, deteriorating municipal drainage systems, and diverting municipal staff and resources.

Furthermore, damp conditions trigger the growth of mold and mildew in flooded buildings, contributing to allergies, asthma, and respiratory infections. Snakes and rodents are forced out of their natural habitat and into closer contact with people, and ponded water following a flood presents a breeding ground for mosquitoes. Gasoline, pesticides, poorly treated sewage, and other aqueous pollutants can be carried into areas and buildings by floodwaters and soak into soil, building components, and furniture.

As recorded in the above descriptions of past flooding events, the potential impacts go beyond lost or damaged property and include reducing access to transportation and limiting the movement of economic goods and services. All communities in the Capitol Region are impacted by floods on a regular basis. The Connecticut, Farmington, Quinnipiac, and Willimantic Rivers flow through the

region among numerous other smaller streams and rivers, and each has floodplains at risk of flooding. Impacts from flooding vary according to the severity of each flood event but can range from minor damage of personal property to dam failure, septic and sewer system failure, and even the destruction of homes and businesses and loss of lives.

Other means can also provide insights into the risks our communities face from flooding. Analysis of the types of land uses within FEMA designated 1% annual chance flood zones gives some indication of the type of damage that flooding can cause in the region. Figure 3 and Table 15 reveal percentages of general land uses, based on municipal zoning districts, in the 1% annual chance flood zone in each municipality. Generally, about half of the region's land in flood zones is zoned residential while over a quarter is zoned resource, recreation, public use, or other uses such as agricultural. Residential areas in flood zones are of particular concern for risk from this hazard.

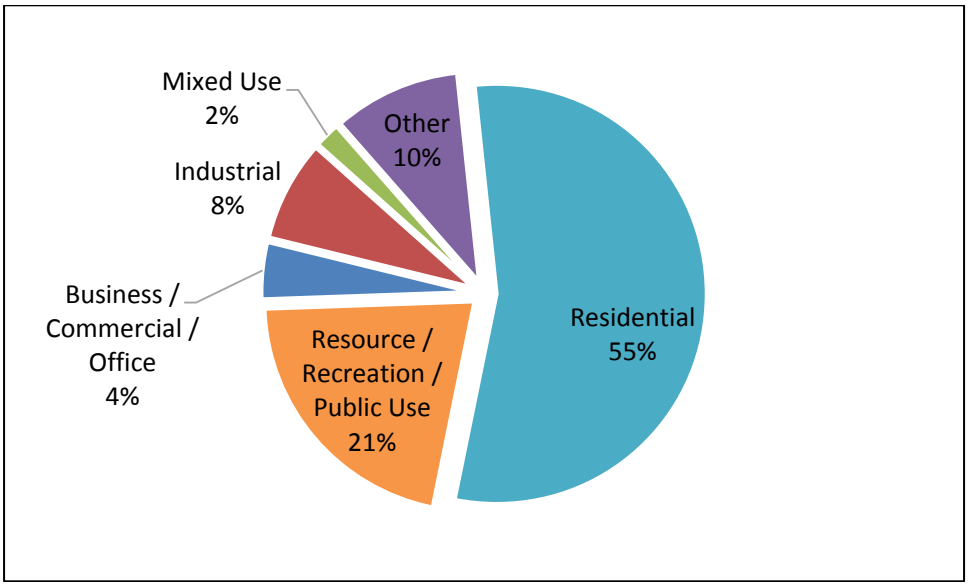


Figure 3. Capitol Region Zoning in FEMA Flood Zones

Table 15: Percentage of Land Uses (by Zoning District Categories) in FEMA Flood Zones

Municipality and Municipal Statistics		Zoning Category	Total Acres in 1% Floodplain	Percent of Floodplain Land by Zoning Category
ANDOVER				
Town Total Acres	**10,057**	Business/Commercial/Office	35	4.70%
Total Acres in 100-Year Floodplain	**750**	Industrial	116	15.40%
% Town in Floodplain	**7.50%**	Residential	166	22.10%
		Resource/Recreation/Public Use	287	38.20%
		Water	148	19.70%

Municipality and Municipal Statistics		Zoning Category	Total Acres in 1% Floodplain	Percent of Floodplain Land by Zoning Category
AVON				
Town Total Acres	**14,989**	Business/Commercial/Office	39	2.20%
Total Acres in 100-Year Floodplain	**1,779**	Industrial	56	3.20%
% Town in Floodplain	**11.90%**	Residential	602	33.90%
		Resource/Recreation/Public Use	1,081	60.80%
BERLIN				
Town Total Acres	**17,359**	Business/Commercial/Office	129	7.30%
Total Acres in 100-Year Floodplain	**1,774**	Industrial	565	31.80%
% Town in Floodplain	**10.20%**	Mixed Use	266	15.00%
		Residential	814	45.90%
BLOOMFIELD				
Town Total Acres	**16,872**	Business/Commercial/Office	15	0.90%
Total Acres in 100-Year Floodplain	**1,748**	Industrial	145	8.30%
% Town in Floodplain	**10.40%**	Mixed Use	140	8.00%
		Residential	1,447	82.80%
BOLTON				
Town Total Acres	**9,433**	Business/Commercial/Office	12	2.70%
Total Acres in 100-Year Floodplain	**433**	Industrial	11	2.40%
% Town in Floodplain	**4.60%**	Residential	411	94.90%
CANTON				
Town Total Acres	**16,018**	Business/Commercial/Office	30	3.90%
Total Acres in 100-Year Floodplain	**770**	Industrial	81	10.50%
% Town in Floodplain	**4.80%**	Residential	659	85.60%
COLUMBIA				
Town Total Acres	**1,3565**	Business/Commercial/Office	447	61.60%
Total Acres in 100-Year Floodplain	**726**	Industrial	28	3.90%
% Town in Floodplain	**5.40%**	Mixed Use	73	10.10%
		Residential	175	24.10%
		Resources/Recreation/Public Use	3	0.40%
COVENTRY				
Town Total Acres	**23,400**	Business/Commercial/Office	43	3.10%
Total Acres in 100-Year Floodplain	**1,370**	Industrial	42	3.10%
% Town in Floodplain	**5.90%**	Mixed Use	25	1.80%
		Residential	847	61.80%
		Resources/Recreation/Public Use	53	3.90%
		Other	360	26.30%

Municipality and Municipal Statistics		Zoning Category	Total Acres in 1% Floodplain	Percent of Floodplain Land by Zoning Category
EAST GRANBY				
Town Total Acres	**11,217**	Business/Commercial/Office	88	8.80%
Total Acres in 100-Year Floodplain	**994**	Industrial	19	1.90%
% Town in Floodplain	**8.90%**	Mixed Use	13	1.40%
		Residential	216	21.70%
		Resource/Recreation/Public Use	658	66.20%
EAST HARTFORD				
Town Total Acres	**12,040**	Business/Commercial/Office	529	22.40%
Total Acres in 100-Year Floodplain	**2,362**	Industrial	83	3.50%
% Town in Floodplain	**19.60%**	Mixed Use	113	4.80%
		Residential	1,638	69.30%
EAST WINDSOR				
Town Total Acres	**17,108**	Business/Commercial/Office	37	2.30%
Total Acres in 100-Year Floodplain	**1,575**	Industrial	182	11.60%
% Town in Floodplain	**9.20%**	Mixed Use	20	1.30%
		Residential	1,336	84.80%
ELLINGTON				
Town Total Acres	**22,140**	Business/Commercial/Office	66	4.30%
Total Acres in 100-Year Floodplain	**1,532**	Industrial	168	11.00%
% Town in Floodplain	**6.90%**	Residential	890	58.10%
		Resource/Recreation/Public Use	87	5.70%
		Water	321	20.90%
ENFIELD				
Town Total Acres	**21,890**	Business/Commercial/Office	154	7.20%
Total Acres in 100-Year Floodplain	**2,158**	Industrial	185	8.60%
% Town in Floodplain	**9.90%**	Mixed Use	6	0.30%
		Residential	1,257	58.30%
		ROW	37	1.70%
		Water	518	24.00%
FARMINGTON				
Town Total Acres	**18,384**	Business/Commercial/Office	99	3.10%
Total Acres in 100-Year Floodplain	**3,146**	Industrial	228	7.30%
% Town in Floodplain	**17.10%**	Mixed Use	9	0.30%
		Residential	839	26.70%
		Resource/Recreation/Public Use	1,971	62.60%

Municipality and Municipal Statistics		Zoning Category	Total Acres in 1% Floodplain	Percent of Floodplain Land by Zoning Category
GLASTONBURY				
Town Total Acres	**33,413**	Business/Commercial/Office	14	0.40%
Total Acres in 100-Year Floodplain	**3,327**	Industrial	10	0.30%
% Town in Floodplain	**10.00%**	Mixed Use	28	0.90%
		Residential	159	4.80%
		Resource/Recreation/Public Use	3,056	91.90%
		ROW	60	1.80%
GRANBY				
Town Total Acres	**26,301**	Business/Commercial/Office	11	1.00%
Total Acres in 100-Year Floodplain	**1,147**	Industrial	57	5.00%
% Town in Floodplain	**4.40%**	Mixed Use	178	15.50%
		Residential	882	76.90%
		ROW	19	1.60%
HARTFORD				
Town Total Acres	**11,553**	Business/Commercial/Office	14	2.20%
Total Acres in 100-Year Floodplain	**661**	Industrial	81	12.30%
% Town in Floodplain	**5.70%**	Mixed Use	15	2.30%
		Residential	209	31.70%
		Resource/Recreation/Public Use	341	51.70%
HEBRON				
Town Total Acres	**23,938**	Industrial	38	2.40%
Total Acres in 100-Year Floodplain	**1,607**	Mixed Use	3	0.20%
% Town in Floodplain	**6.70%**	Residential	1,565	97.40%
MANCHESTER				
Town Total Acres	**17,704**	Business/Commercial/Office	49	5.90%
Total Acres in 100-Year Floodplain	**823**	Industrial	167	20.30%
% Town in Floodplain	**4.60%**	Mixed Use	4	0.50%
		Residential	552	67.10%
		ROW	51	6.20%
MANSFIELD				
Town Total Acres	**28,182**	Business/Commercial/Office	70	2.60%
Total Acres in 100-Year Floodplain	**2,740**	Industrial	2	0.10%
% Town in Floodplain	**9.70%**	Mixed Use	11	0.40%
		Residential	690	25.20%
		Resources/Recreation/Public Use	2	0.10%
		Other	1,966	71.80%

Municipality and Municipal Statistics		Zoning Category	Total Acres in 1% Floodplain	Percent of Floodplain Land by Zoning Category
MARLBOROUGH				
Town Total Acres	**15,032**	Business/Commercial/Office	21	2.00%
Total Acres in 100-Year Floodplain	**1,045**	Industrial	30	2.90%
% Town in Floodplain	**7.00%**	Residential	748	71.60%
		Resource/Recreation/Public Use	246	23.50%
NEW BRITAIN				
Town Total Acres	**7,028**	Business/Commercial/Office	82	41.20%
Total Acres in 100-Year Floodplain	**199**	Industrial	2	1.00%
% Town in Floodplain	**2.80%**	Mixed Use	15	7.50%
		Residential	72	36.20%
		Resources/Recreation/Public Use	28	14.10%
		Other	0.07	0.04%
NEWINGTON				
Town Total Acres	**8,394**	Business/Commercial/Office	27	5.00%
Total Acres in 100-Year Floodplain	**534**	Industrial	262	49.10%
% Town in Floodplain	**6.40%**	Residential	222	41.70%
		ROW	23	4.20%
PLAINVILLE				
Town Total Acres	**6,360**	Business/Commercial/Office	22	2.90%
Total Acres in 100-Year Floodplain	**739**	Industrial	187	25.30%
% Town in Floodplain	**11.60%**	Residential	110	14.90%
		Other	421	56.90%
ROCKY HILL				
Town Total Acres	**8,904**	Business / Commercial / Office	10	0.65%
Total Acres in 100-Year Floodplain	**1,531**	Industrial	98	6.40%
% Town in Floodplain	**17.19%**	Mixed Use	10	0.65%
		Residential	143	9.34%
		Agricultural	1,035	67.60%
		Water	235	15.35%
SIMSBURY				
Town Total Acres	**21,970**	Business/Commercial/Office	17	0.60%
Total Acres in 100-Year Floodplain	**3,093**	Industrial	409	13.20%
% Town in Floodplain	**14.10%**	Mixed Use	11	0.30%
		Residential	2,656	85.90%
SOMERS				
Town Total Acres	**18,318**	Business/Commercial/Office	3	0.20%
Total Acres in 100-Year Floodplain	**2,109**	Industrial	51	2.40%
% Town in Floodplain	**11.50%**	Residential	2,055	97.50%

Municipality and Municipal Statistics		Zoning Category	Total Acres in 1% Floodplain	Percent of Floodplain Land by Zoning Category
SOUTH WINDSOR				
Town Total Acres	**18,368**	Business/Commercial/Office	37	1.10%
Total Acres in 100-Year Floodplain	**3,386**	Industrial	121	3.60%
% Town in Floodplain	**18.40%**	Mixed Use	24	0.70%
		Residential	3,172	93.70%
		ROW	32	0.90%
SOUTHINGTON				
Town Total Acres	**23,240**	Business/Commercial/Office	135	10.90%
Total Acres in 100-Year Floodplain	**1,235**	Industrial	248	20.10%
% Town in Floodplain	**5.30%**	Residential	851	68.90%
		Mixed Use	0.07	0.500%
STAFFORD				
Town Total Acres	**37,568**	Business/Commercial/Office	111	4.20%
Total Acres in 100-Year Floodplain	**2,620**	Industrial	178	6.80%
% Town in Floodplain	**7.00%**	Other	11	0.40%
		Residential	1,198	45.70%
		Resource/Recreation/Public Use	659	25.10%
		ROW	94	3.60%
		Water	370	14.10%
SUFFIELD				
Town Total Acres	**27,540**	Business/Commercial/Office	9	0.50%
Total Acres in 100-Year Floodplain	**1,834**	Industrial	328	17.90%
% Town in Floodplain	**6.70%**	Mixed Use	16	0.90%
		Residential	1,330	72.50%
		Resource/Recreation/Public Use	152	8.30%
TOLLAND				
Town Total Acres	**25,740**	Business/Commercial/Office	2	0.10%
Total Acres in 100-Year Floodplain	**1,076**	Industrial	36	3.30%
% Town in Floodplain	**4.20%**	Residential	1,038	96.50%
VERNON				
Town Total Acres	**11,601**	Business/Commercial/Office	82	10.80%
Total Acres in 100-Year Floodplain	**753**	Industrial	25	3.30%
% Town in Floodplain	**6.50%**	Mixed Use	73	9.60%
		Residential	537	71.30%
		Resource/Recreation/Public Use	37	4.90%

Municipality and Municipal Statistics		Zoning Category	Total Acres in 1% Floodplain	Percent of Floodplain Land by Zoning Category
WEST HARTFORD				
Town Total Acres	**14,336**	Business/Commercial/Office	15	1.50%
Total Acres in 100-Year Floodplain	**975**	Industrial	29	3.00%
% Town in Floodplain	**6.80%**	Residential	931	95.50%
		Resource/Recreation/Public Use	LT 1	0.00%
WETHERSFIELD				
Town Total Acres	**8,430**	Business/Commercial/Office	57	2.30%
Total Acres in 100-Year Floodplain	**2,529**	Mixed Use	76	3.00%
% Town in Floodplain	**30.00%**	Residential	552	21.80%
		Resource/Recreation/Public Use	1,844	72.90%
WILLINGTON				
Town Total Acres	**21,593**	Business / Commercial / Office	11.5	1.85%
Total Acres in 100-Year Floodplain	**621**	Industrial	0.25	0.04%
% Town in Floodplain	**2.88%**	Residential	577	92.91%
WINDSOR				
Town Total Acres	**19,868**	Business/Commercial/Office	27	1.10%
Total Acres in 100-Year Floodplain	**2,500**	Industrial	115	4.60%
% Town in Floodplain	**12.60%**	Mixed Use	14	0.60%
		Residential	389	15.60%
		Resource/Recreation/Public Use	1,954	78.20%
WINDSOR LOCKS				
Town Total Acres	**5,977**	Business/Commercial/Office	2	1.20%
Total Acres in 100-Year Floodplain	**157**	Industrial	133	84.90%
% Town in Floodplain	**2.60%**	Residential	22	13.90%
CAPITOL REGION				
Region Total Acres	**665,830**	Business / Commercial / Office	2,552	4.50%
Total Acres in 100-Year Floodplain	**56,827**	Industrial	4,516	7.90%
% Region in Floodplain	**8.5%**	Mixed Use	1,143	2.00%
		Other	5,701	4.90%
		Residential	31,957	55.60%
		Resource/Recreation/Public Use	12,373	22.20%

How to explain the 1% annual chance of flooding (100-year event)

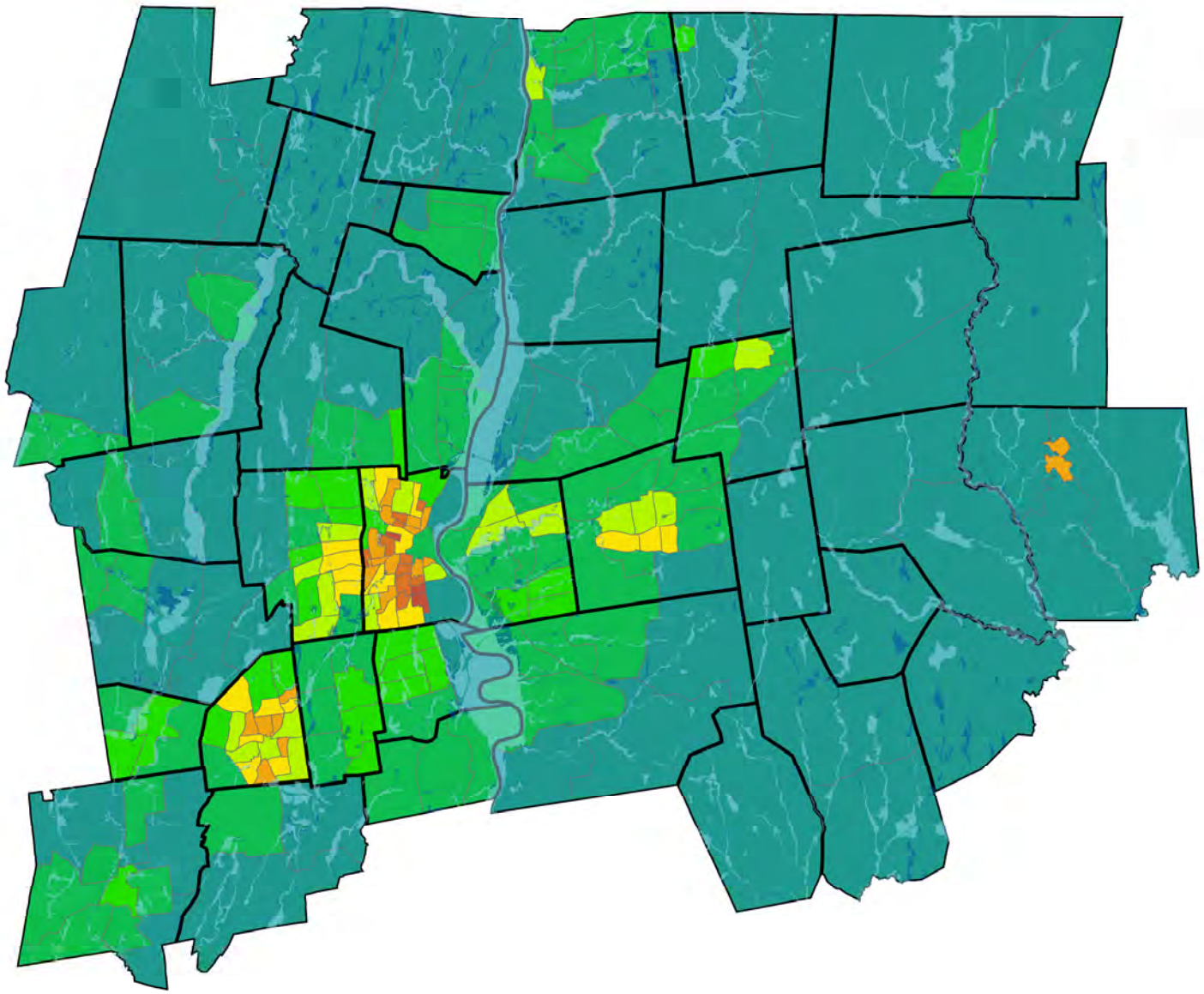
The 1% annual chance exceedance flood sometimes referred to as the 100-year flood, or base flood, has a 1% chance of occurring in any given year. It is not a safety standard, and it has been set as the level that flood insurance is not required if the 1% annual chance flood can be excluded from the floodplain. Although a 1% annual chance flood sounds remote, keep in mind that over the life of an average 30-year mortgage a home located within the 1% flood zone (A or V zone) has a 26% chance of being inundated by the size flood. This same home has less than a 1% chance of fire damage during the same period. What is more significant is the house in a 10-year flood area is almost certain to see a 10-year flood (96% chance) in the same 30-year mortgage cycle. In many areas, the difference in flood heights between a 10% and a 1% event is less than 1 foot.

Flood Frequency Chart

Flood frequency (years)	Chance of flooding in any given year	Percent chance of flooding during 30-year mortgage
10	10 out of 100 (10%)	96%
50	2 out of 100 (2%)	46%
100	1 out of 100 (1%)	26%
500	0.2 out of 100 (0.2%)	6%

Source: U.S. Army Corps of Engineers, Flood Risk Management Program, http://www.nfrmp.us/faqtypical.cfm#question5

The maps and data on the following pages show FEMA flood zones and flood insurance claims and the repetitive flood loss claims community. These illustrate the Capitol Region's potential for losses due to flooding. A review of flood insurance loss claims and repetitive flood loss claims from the past three decades indicates that flooding is a significant risk to the region not only because of its frequency but also because of its damage potential.



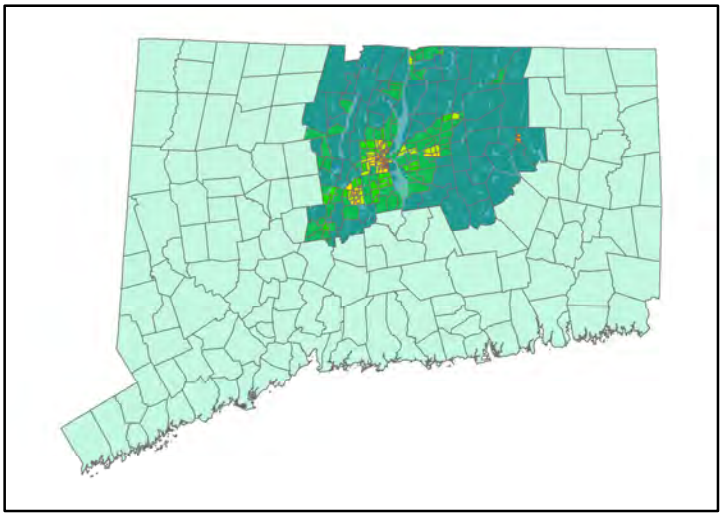
LEGEND

Population Density

- Greater than 20,000
- 15,000 to 20,000
- 9,000 to 15,000
- 6,000 to 9,000
- 4,000 to 6,000
- 2,500 to 4,000
- 1,000 to 2,500
- Less than 1,000

FEMA Flood Zone

- 100 Year Flood Zone
- 500 Year Flood Zone



SOURCE(S):
US Census

Map 6: Population Density and Flood Zones

LOCATION:
Capitol Region, CT

N

Capitol Region Natural Hazards Mitigation Plan Update

MXD: Y:\2020-16\Maps\Map_6_Pop_Density_Dams_Flood_zones_.mxd

Map By: MER
MMI#: 2020-16
Original: 10/11/2017
Revision: 7/25/2018
Scale: 1 inch = 30,000 feet

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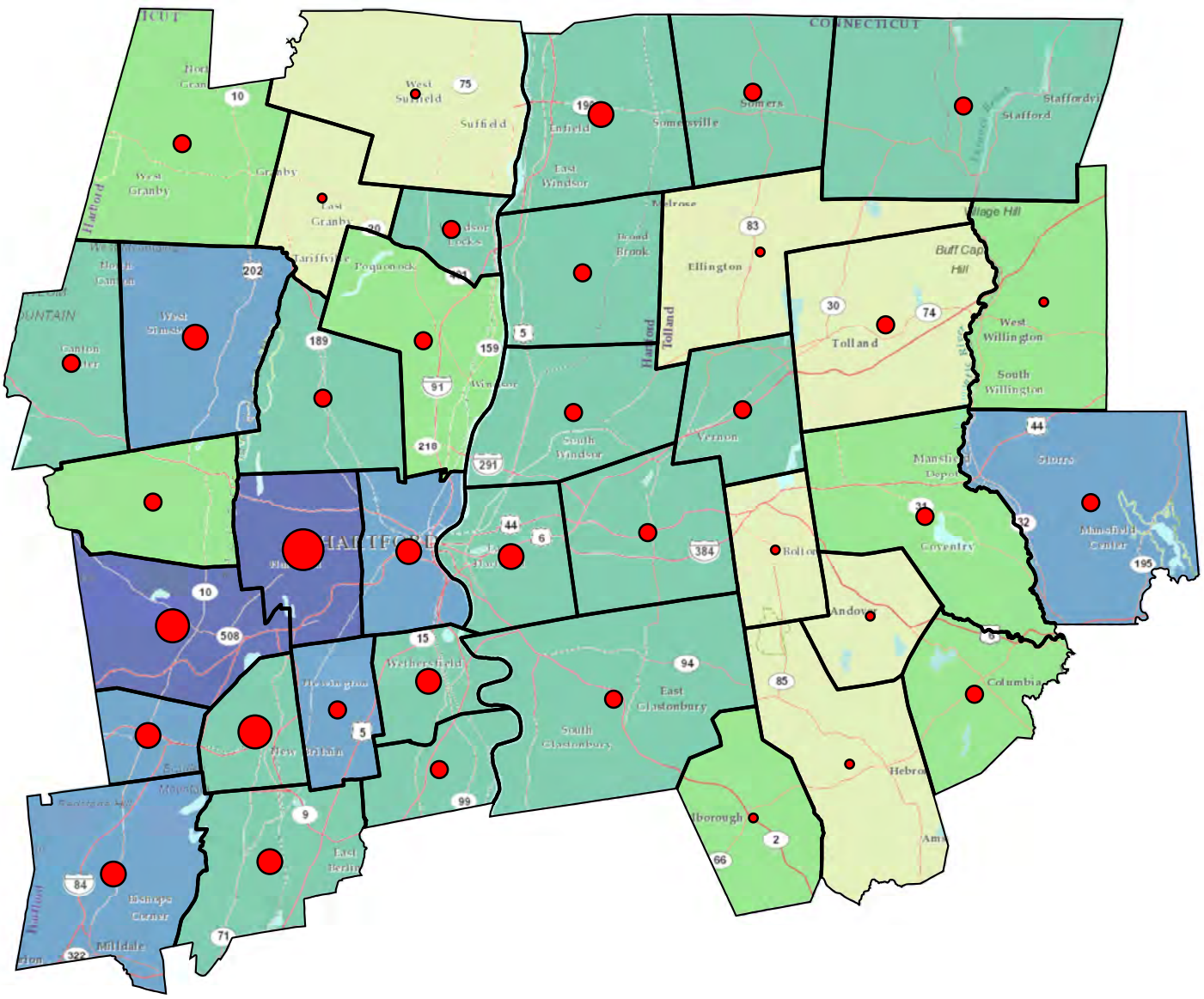
Repetitive Loss Properties

Flood damage is predictable in its location. As seen in Table 16 and Map 7 below, properties in Farmington and West Hartford have experienced substantial losses due to floods. Plainville, Southington, Mansfield, Hartford, Simsbury, East Hartford, and New Britain have also experienced large numbers of losses.

Table 16: National Flood Insurance Program Loss Statistics as of August 31, 2017

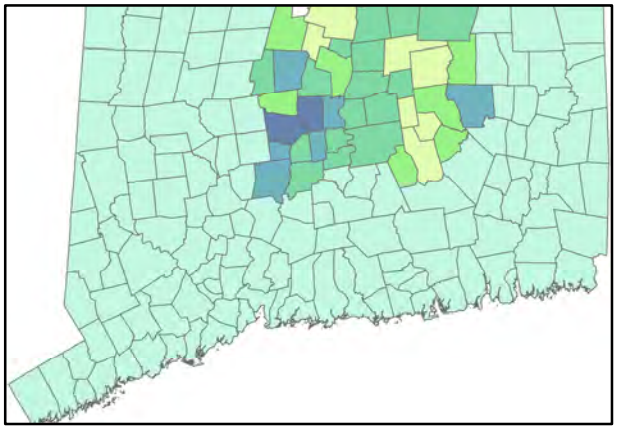
Community	Total Losses	Total Payments
Andover	4	$4,980.94
Avon	16	$50,059.02
Berlin	61	$365,993.40
Bloomfield	41	$333,146.02
Bolton	2	$3,989.54
Canton	25	$122,853.58
Columbia	10	$29,450.02
Coventry	13	$56,411.87
East Granby	3	$2,317.60
East Hartford	99	$470,667.20
East Windsor	23	$281,501.59
Ellington	4	$8,954.08
Enfield	57	$301,225.35
Farmington	125	$1,335,197.52
Glastonbury	47	$161,876.64
Granby	17	$98,904.16
Hartford	52	$656,508.93
Hebron	3	$5,043.26
Manchester	27	$118,081.78
Mansfield	38	$678,775.37
Marlborough	8	$46,647.64
New Britain	103	$424,247.91
Newington	45	$664,970.85
Plainville	81	$991,750.95
Rocky Hill	11	$111,493.43
Simsbury	100	$532,669.79
Somers	10	$243,412.27
South Windsor	20	$151,997.33
Southington	86	$770,413.60
Stafford	32	$403,411.37
Suffield	5	$5,733.52
Tolland	10	$9,289.54
Vernon	28	$149,474.90
West Hartford	322	$1,182,878.93
Wethersfield	69	$350,144.32
Willington	4	$11,233.89
Windsor	26	$90,399.44
Windsor Locks	12	$174,036.37
Capitol Region	**1,635**	**$11,400,143.92**

Source: FEMA



LEGEND

Total Payments	Total Claims
Less than $10,000	Under 10
$10,000 to $100,000	11 - 50
$100,000 to $500,000	51 - 100
$500,000 to $1,000,000	101 - 250
Over $1,000,000	Over 250



SOURCE(S):
FEMA

Map 7: Total Flood Insurance Claims in the Capitol Region by Town Through July 31, 2017

LOCATION:
Capitol Region, CT

N

Capitol Region Natural Hazards Mitigation Plan Update

MXD: Y:\2020-16\Maps\Map_7_Claims_and_Losses.mxd

Map By: MER
MMI#: 2020-16
Original: 10/11/2017
Revision: 7/19/2018
Scale: 1 inch = 30,000 feet

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Many towns in the region have one or more specific properties that are damaged by flooding on a regular basis. These properties are defined by the National Flood Insurance Program (NFIP) as repetitive flood loss properties or severe repetitive flood loss properties (SRLP). A Repetitive Loss Property (RLP) is any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling 10-year period since 1978. At least two of the claims must be more than 10 days apart but within 10 years of each other.

The table below shows the Capitol Region communities that have experienced repetitive losses as of October 2017. The Capitol Region has 144 RLPs region-wide and one SRLP in Simsbury. Properties in Wethersfield, West Hartford, Southington, Simsbury, New Britain, and Mansfield have experienced high repetitive loss payments. Most of these properties are residential. No insured properties in Andover, Bolton, Coventry, East Granby, East Windsor, Ellington, Glastonbury, Hebron, Somers, Stafford, Suffield, Tolland, or Willington have experienced repetitive loss claims as of October 2017.

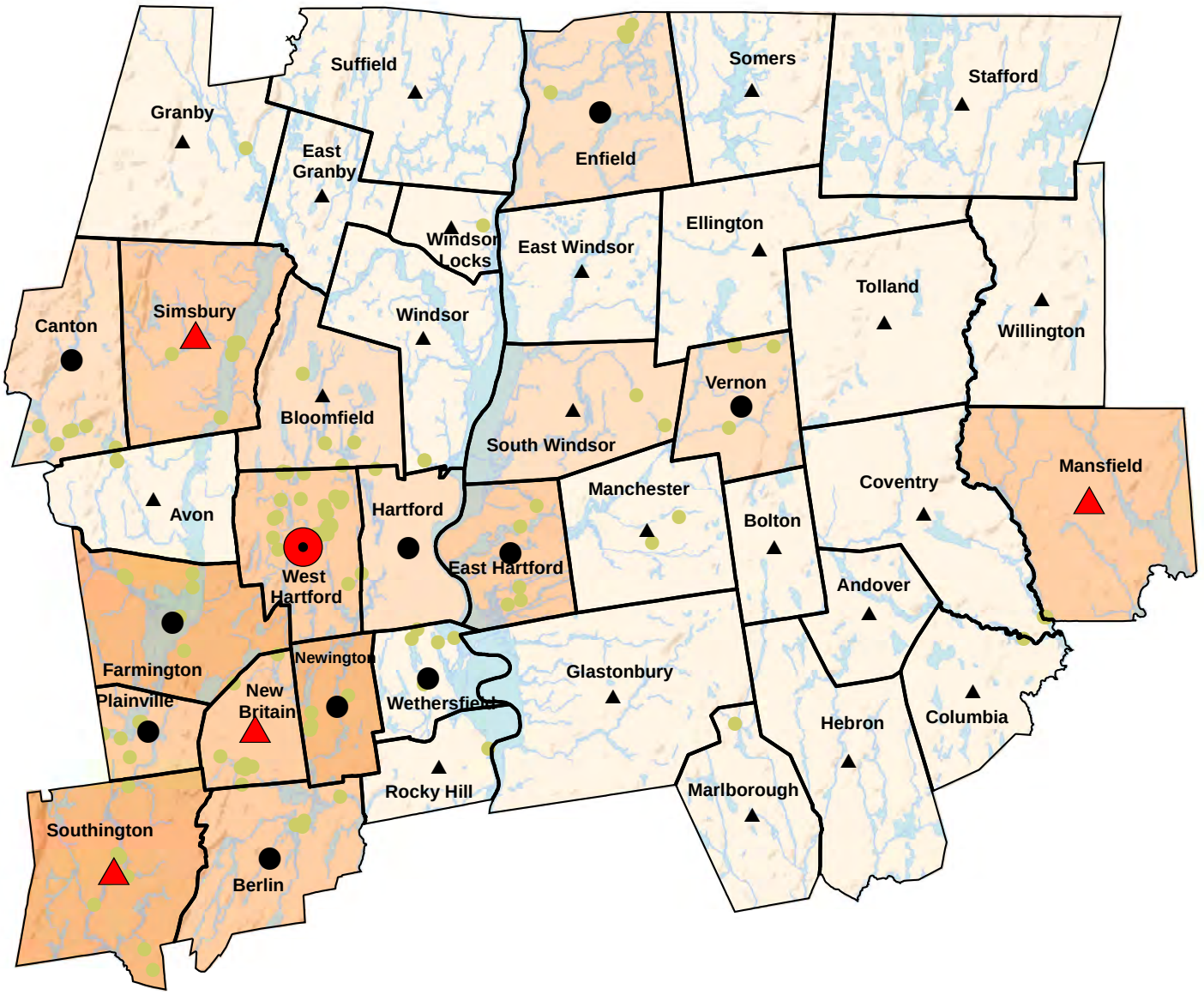
Table 17: National Flood Insurance Program Repetitive Loss Claims 1982-2017

Municipality	Building Payments	Contents Payments	Total Payments	Average Payments	Losses (#)	Properties (#)	Type of Property
Avon	$41,717.80	$3,479.24	$45,197.04	$18,879.27	7	3	3-R
Berlin	$157,809.72	$93,730.35	$251,540.07	$74,948.84	19	6	3-R, 3-N
Bloomfield	$70,009.50	$716.00	$70,725.50	$23,575.17	9	3	3-R
Canton	$74,665.89	$21,436.90	$96,102.79	$37,551.79	18	7	6-R, 1-N
Columbia	$0.00	$8,425.54	$8,425.54	$4,212.77	2	1	0-R, 1-N
East Hartford	$210,352.42	$18,227.91	$228,580.33	$83,716.53	17	6	4-R, 2-N
Enfield	$138,408.65	$30,731.06	$169,139.71	$60,960.28	15	6	6-R
Farmington	$729,652.46	$83,712.20	$813,364.66	$121,062.31	20	6	5-R, 1-N
Granby	$14,146.60	$8,898.02	$23,044.62	$5,761.16	4	1	0-R, 1-N
Hartford	$37,726.31	$80,029.08	$117,755.39	$30,295.89	11	3	2-R, 1-N
Manchester	$16,543.90	$26,660.04	$43,203.94	$21,601.97	4	2	1-R, 1-N
Mansfield	$383,652.37	$108,433.62	$492,085.99	$55,835.40	29	4	4-R
Marlborough	$6,386.46	$14.20	$6,400.66	$3,200.33	2	1	1-R
New Britain	$251,543.19	$12,796.68	$264,339.87	$117,133.19	35	14	13-R, 1-N
Newington	$135,900.45	$507,654.38	$643,554.83	$226,941.07	17	5	2-R, 3-N
Plainville	$290,963.41	$28,111.82	$319,075.23	$113,507.33	23	7	6-R, 1-N
Rocky Hill	$33,183.05	$10,244.16	$43,427.21	$14,475.74	3	1	1-R
Simsbury	$326,410.85	$62,787.63	$389,198.48	$94,267.75	46	11	11-R
South Windsor	$53,208.65	$29,046.50	$82,255.15	$16,183.71	8	2	1-R, 1-N
Southington	$213,996.26	$327,029.65	$541,025.91	$176,881.24	30	10	8-R, 2-N
Vernon	$41,230.09	$51,502.19	$92,732.28	$30,978.38	11	4	2-R, 2-N
West Hartford	$507,949.52	$169,734.75	$677,684.27	$220,281.56	89	33	33-R
Wethersfield	$34,737.36	$1,794.00	$36,531.36	$17,305.15	11	5	5-R
Windsor	$26,579.85	$5,058.57	$31,638.42	$15,819.22	4	2	2-R
Windsor Locks	$11,877.85	$0.00	$11,877.85	$5,938.93	2	1	1-R

*R = Residential, N = Nonresidential, i.e., Commercial

Source: CT DEEP October 2017

Note: The above data represent a non-validated sample; several errors are apparent in the list (for example, one property appears twice). Refer to the sheet ***Regional Challenges – Repetitive Loss Properties*** for more information.



LEGEND

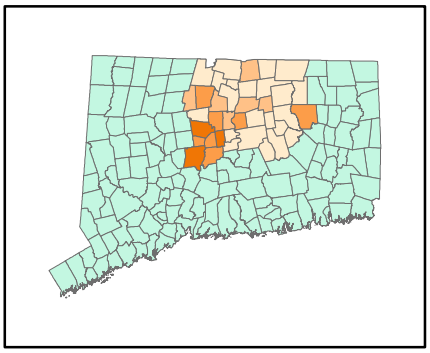
Value of Loss Claims

- Under $50,000
- $50,000- $200,000
- $200,000- $500,000
- Over $500,000

Number of Claims

- Under 10
- 10-25
- 25-50
- Over 50

- Repetitive Loss Locations
- FEMA Flood Zones



SOUTCE(S):
FEMA
CT DEEP

Map 8: Repetitive Flood Insurance Claims in the Capitol Region
June 1982- June 2017

LOCATION:
Capitol Region, CT

N

Capitol Region Natural Hazards Mitigation Plan Update

MXD: Y:\2020-16\Maps\Map_8_Repetitive_Loss_Claims.mxd

Map By: MER
MMI#: 2020-16
Original: 10/11/2017
Revision: 7/19/2018
Scale: 1 inch = 30,000 feet

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Loss Estimates from HAZUS-MH

To help assess the risks we face from major flooding, CRCOG used FEMA's HAZUS-MH loss estimation program to model the effects of flooding primarily at the local level. The HAZUS-MH model has three levels of analysis depending upon the data used for the analyses. CRCOG performed Level 1 analyses, which primarily rely on default data provided with the software. At this level, loss estimates are approximate, and the analysis does not include damage/loss due to ground failure or erosion (riverine only), damage/loss due to earthquake driven flooding, or damage/loss due to dam failure. Level 2 **a**nalysis improves Level 1 results and requires more extensive inventory data and effort than the Level 1 analysis. For example, knowledgeable users of hydrology and hydraulics models are required to define flood elevations. Level 3 analyses require extensive efforts in developing information on the flood hazards and the measures of exposure. This type of analysis incorporates results from engineering and economic studies carried out using methods and software not included within the software. At this level, one or more technical experts would be required to acquire data, perform detailed analyses, assess damage/loss, and assist in gathering extensive inventory data. It is anticipated that at this level there would need to be extensive participation by local utilities and owners of special facilities. A multiyear effort would likely be required to complete a Level 3 analysis. Level 2 and 3 Analyses are beyond the scope of this planning process.

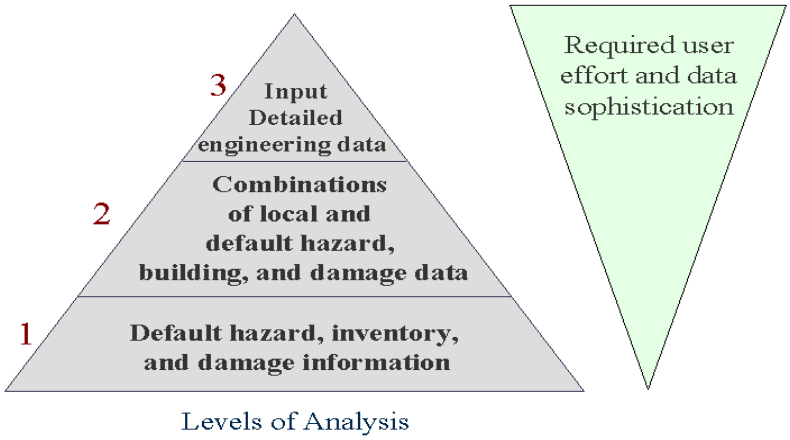


Figure 4: HAZUS-MH Levels of Analysis and User Sophistication

Source: *HAZUS-MH MR4 User Manual*, FEMA

HAZUS-MH was used to estimate losses due to a 1% annual chance (i.e., 100-year) flood in the Capitol Region using an Interpolated Riverine and Coastal Analysis. The flood hazard modeling included the following input datasets:

- **National Elevation Dataset (NED) 1-Arc Second Digital Elevation Models** – NED 1 arc second DEMs are roughly equivalent to 30-meter grid cells. Therefore, the input ground data utilized for this effort has utilized a dataset that is typical of a HAZUS-MH Level 1 modeling effort.

- **Flood Insurance Rate Maps (FIRM)** – Flood modeling included consultation of the currently effective Flood Insurance Study (FIS) published by FEMA for the region.

Additional details about the datasets used in this analysis, including the specific Flood Insurance Studies, can be found in Appendix C.

Table 18 below shows the damages each town in the region might face from a flood with a 1% probability of occurring in any given year (i.e., the 100-year flood). As can be seen, losses could be particularly high for the East Hartford and Vernon communities. In all, the Capitol Region could experience losses of over $1.6 billion from such a major flooding event. Summaries of the 1% annual chance flood risk assessments are provided in the municipal sections of this Plan.

Table 18: Estimated Losses to Capitol Region Communities Due to a 1% Annual Chance Flood Event

Municipality	Building and Contents Losses	Business Disruption	Total Loss
Andover	$7,776,000.00	$97,000.00	$7,873,000.00
Avon	$69,093,000.00	$762,000.00	$69,855,000.00
Berlin	$62,387,000.00	$2,415,000.00	$64,802,000.00
Bloomfield	$51,253,000.00	$558,000.00	$51,811,000.00
Bolton	$1,193,000.00	$0.00	$1,193,000.00
Canton	$33,031,000.00	$1,075,000.00	$34,106,000.00
Columbia	$21,553,000.00	$1,725,000.00	$23,278,000.00
Coventry	$20,009,000.00	$197,000.00	$20,206,000.00
East Granby	$7,721,000.00	$161,000.00	$7,882,000.00
East Hartford	$140,198,000.00	$1,663,000.00	$141,861,000.00
East Windsor	$35,541,000.00	$455,000.00	$35,996,000.00
Ellington	$14,223,000.00	$410,000.00	$14,633,000.00
Enfield	$55,286,000.00	$1,714,000.00	$57,001,000.00
Farmington	$76,878,000.00	$1,782,000.00	$78,659,000.00
Glastonbury	$93,154,000.00	$1,212,000.00	$94,366,000.00
Granby	$11,598,000.00	$72,000.00	$11,670,000.00
Hartford	$60,196,000.00	$771,000.00	$60,966,000.00
Hebron	$3,701,000.00	$8,000.00	$3,709,000.00
Manchester	$31,690,000.00	$1,267,000.00	$32,957,000.00
Mansfield	$29,616,000.00	$488,000.00	$30,104,000.00
Marlborough	$9,453,000.00	$85,000.00	$9,538,000.00
New Britain	$32,477,000.00	$875,000.00	$33,351,000.00
Newington	$42,678,000.00	$920,000.00	$43,598,000.00
Plainville	$42,882,000.00	$1,600,000.00	$44,482,000.00
Rocky Hill	$8,894,000.00	$175,000.00	$9,069,000.00
Simsbury	$47,630,000.00	$440,000.00	$48,070,000.00
Somers	$7,581,000.00	$138,000.00	$7,719,000.00
South Windsor	$66,068,000.00	$1,055,000.00	$67,123,000.00
Southington	$62,353,000.00	$1,788,000.00	$64,141,000.00

Municipality	Building and Contents Losses	Business Disruption	Total Loss
Stafford	$55,610,000.00	$2,039,000.00	$57,649,000.00
Suffield	$10,639,000.00	$44,000.00	$10,683,000.00
Tolland	$8,930,000.00	$209,000.00	$9,139,000.00
Vernon	$113,110,000.00	$5,685,000.00	$118,795,000.00
West Hartford	$85,339,000.00	$2,786,000.00	$88,125,000.00
Wethersfield	$92,162,000.00	$1,146,000.00	$93,308,000.00
Willington	$3,948,000.00	$23,000.00	$3,971,000.00
Windsor	$88,807,000.00	$998,000.00	$89,805,000.00
Windsor Locks	$8,261,000.00	$455,000.00	$8,716,000.00
Total	**$1,612,919,000.00**	**$37,293,000.00**	**$1,650,210,000.00**

Other Loss Estimates

Based on the public assistance reimbursements in Table 8, the Capitol Region has incurred losses of at least $2,741,041 since 1998 (19 years) for impacts due to flooding. Based on the information for the NFIP in Table 16, a total of $11,400,144 has been paid out to NFIP-insured properties since 1979 (38 years). The annualized loss due to flooding in the Capitol Region based on this information is $444,269. Annualized losses for each community based on this data are presented below and in each municipal annex.

Table 19: Annualized Loss Estimates due to Flooding

Town	Loss Estimate	Town	Loss Estimate	Town	Loss Estimate
Andover	$604	Farmington	$39,353	Somers	$13,384
Avon	$4,336	Glastonbury	$5,044	South Windsor	$6,145
Berlin	$11,056	Granby	$3,231	Southington	$20,510
Bloomfield	$15,468	Hartford	$31,832	Stafford	$22,378
Bolton	$319	Hebron	$207	Suffield	$829
Canton	$10,062	Manchester	$7,035	Tolland	$5,873
Columbia	$817	Mansfield	$21,012	Vernon	$6,336
Coventry	$4,003	Marlborough	$3,072	West Hartford	$38,288
East Granby	$1,892	New Britain	$25,570	Wethersfield	$11,181
East Hartford	$14,434	Newington	$18,126	Willington	$6,145
East Windsor	$7,939	Plainville	$28,279	Windsor	$2,991
Ellington	$2,197	Rocky Hill	$4,308	Windsor Locks	$9,355
Enfield	$24,479	Simsbury	$16,181		

Dam Failure

Dams provide vital benefits to our region such as water supply, power generation, flood control, and recreation, but in the event of failure, they can pose a threat to lives and property. Dam failure can happen for a number of reasons including as a result of natural disasters such as structural failure due to earthquakes or overtopping due to heavy precipitation. Failure due to material fatigue is also possible, but regular maintenance and dam inspections can detect leaks and other signs of material fatigue before the problem escalates.

Location

Dam failure can only occur at and along the watercourses and low-lying areas downstream of dams. Although the effects of dam failure can impact any of the Capitol Region communities, the actual level of impact can differ based on the number and hazard classification of the dams within and upstream of the community. In the case of a lower hazard dam, the effect of the failure would likely be constrained within the 1% annual chance floodplain or the 0.2% annual chance floodplain. The failure of a higher hazard dam could produce effects far greater than the 0.2% annual chance flood and could also cause a chain reaction where downstream dams also overtop and fail.

The location of dams and mapped floodplains in the Capitol Region are presented on Map 9.

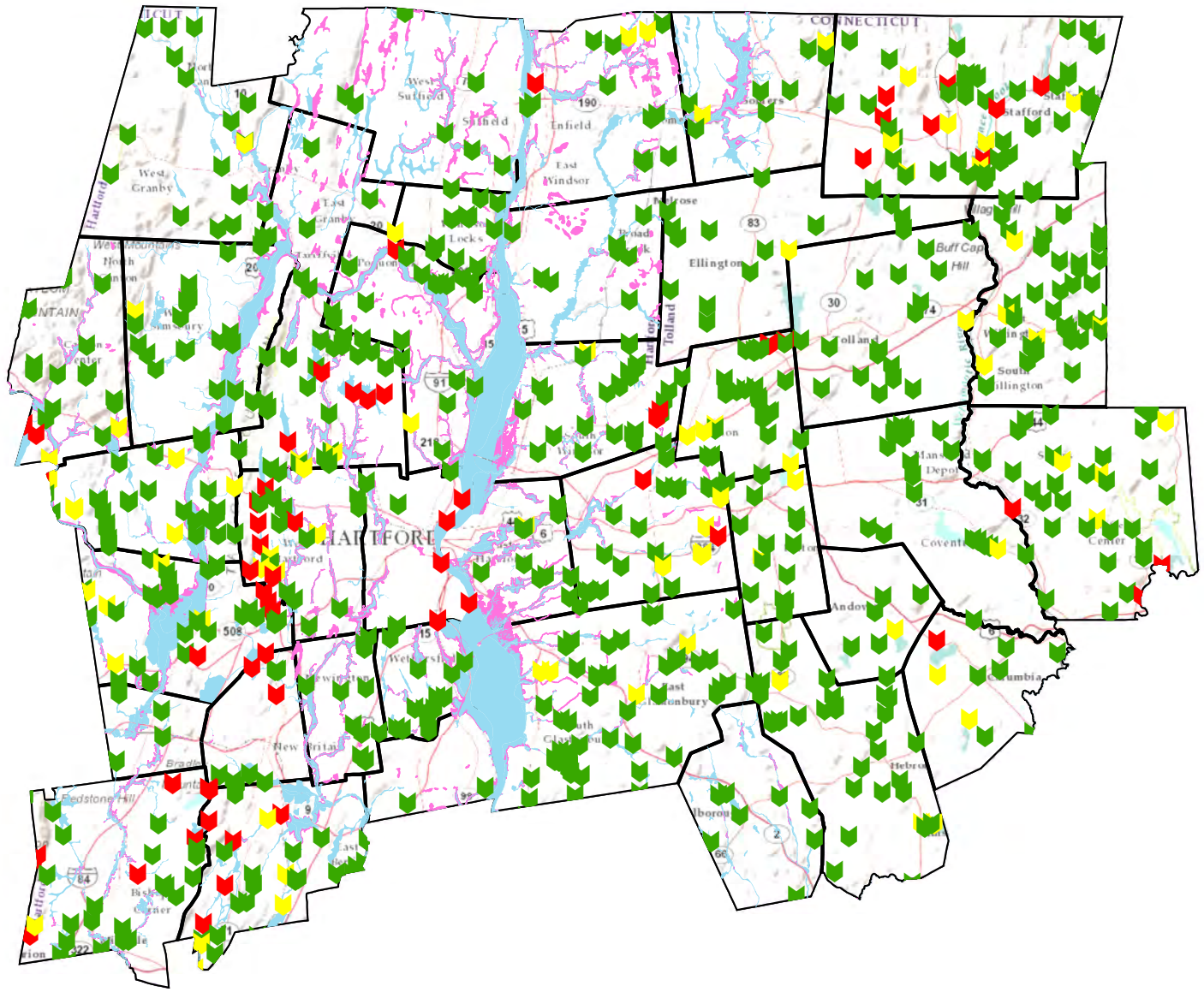
Extent

Dams in Connecticut are regulated by the Department of Energy & Environmental Protection (DEEP). Dams are rated by their hazard potential as outlined in the table below. According to DEEP's *Guidelines for Inspection and Maintenance of Dams*, owners of Class B and C dams are required to prepare and implement an emergency operations plan (EOP), which would include an identification of the area inundated by a dam failure, establishment of a procedure for monitoring the dam during heavy rainfall and runoff, and formalizing a warning system to alert local emergency management officials. The hazard classifications are described in Table 20.

Table 20: Dam Hazard Categories

Hazard Classification	Hazard Potential
Class C:	**High** hazard potential dam which, if it were to fail, would result in the probable loss of life; major damage to habitable structures, residences, hospitals, convalescent homes, schools, etc.; damage to main highways; or great economic loss
Class B:	**Significant** hazard potential dam which, if it were to fail, would result in possible loss of life; minor damage to habitable structures, residences, hospitals, convalescent homes, schools, etc.; damage to or interruption of the use or service of utilities; damage to primary roadways and railroads; or significant economic loss
Class BB:	**Moderate** hazard potential dam which, if it were to fail, would result in damage to normally unoccupied storage structures, damage to low-volume roadways, or moderate economic loss
Class A:	**Low** hazard potential dam which, if it were to fail, would result in damage to agricultural land, damage to unimproved roadways, or minimal economic loss
Class AA:	**Negligible** hazard potential dam which, if it were to fail, would result in no measurable damage to roadways, land and structures, and negligible economic loss

Source: *Guidelines for Inspection and Maintenance of Dams,* Connecticut Department of Environmental Protection, September 2001, available for download at http://www.ct.gov/deep/cwp/view.asp?a=2720&q=325634&deepNav_GID=1654



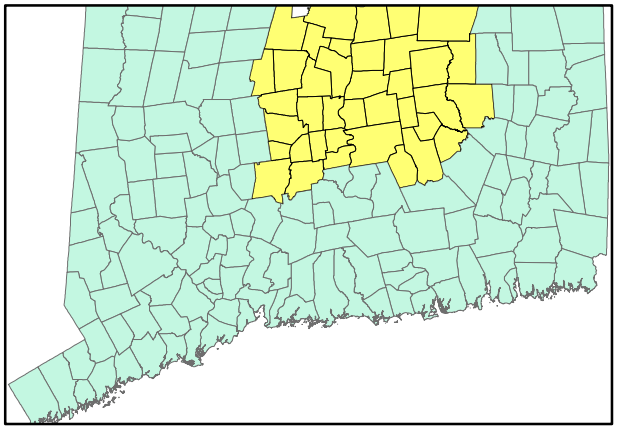
LEGEND

Dam Hazard Class

- BB, A, AA, OR Unclassified
- Class B- Signifigant Hazard
- Class C- High Hazard

FEMA Flood Hazard Area

- 1% Annual Chance Flood Hazard
- 0.2 % Annual Chance Flood Hazard



SOURCE(S):
CT DEEP

Map 9: Flood Zones and Dams

LOCATION:
Capitol Region, CT

N

Capitol Region Natural Hazards Mitigation Plan Update

MXD: Y:\2020-16\Maps\Map_9_Flood_Zones_and_Dams.mxd

Map By: MER
MMI#: 2020-16
Original: 10/11/2017
Revision: 10/12/2017
Scale: 1 inch = 30,000 feet

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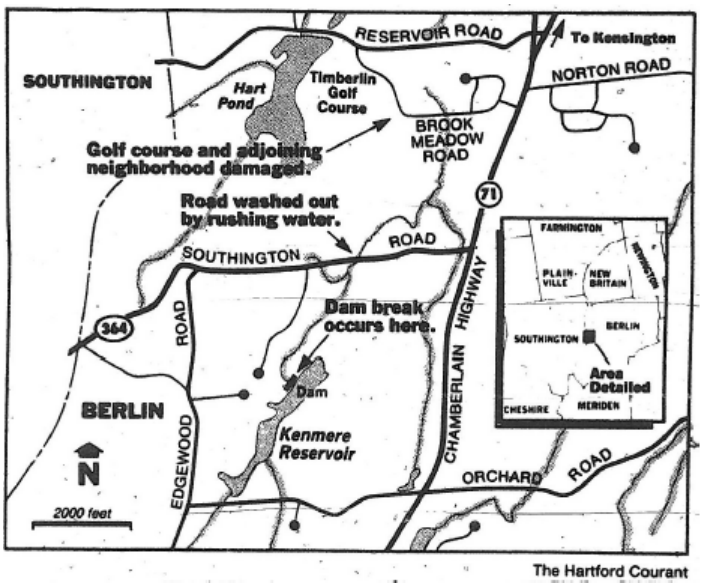
Previous Occurrences

There have been a few dam failures in the Capitol Region in recorded history:

- March 31, 1987: The Kenmere Reservoir Dam (Class C dam) in Berlin collapsed on March 31, 1987, during a reconstruction effort. According to the *Hartford Courant* (see inset below), torrential rains overwhelmed the dam and sent roughly 80 million gallons of water into surrounding Berlin where it destroyed a bridge, inundated homes and businesses, and did extensive damage to a municipal golf course. No serious injuries resulted from the dam failure, and the property damage incurred was estimated to be approximately $187,000 (1987 dollars).



Other major dam failures in Connecticut have occurred in 1938 and 1955 due to hurricanes, 1961 (Crystal Lake Dam in Middletown), 1963 (Spaulding Pond Dam in Norwich), and June 5-6, 1982 (Bushy Hill Pond Dam in Deep River). The October 7-15, 2005, heavy rainfall caused 10 complete or partial dam failures in Hartford and Tolland Counties and damage to another 30 dams across the state, demonstrating the region's vulnerability to localized storm impacts on dams. Several low and moderate hazard potential dams suffered some impact from localized major flooding. The table below shows a list of dams that were breached or damaged in October 2005; six of these occurred within the Capitol Region.

Table 21: Dams Impacted by October 2005 Flooding

Number	Name	Location	Class	Damage Type	Ownership
-----	Somerville Pond Dam	Somers	--	Partial Breach	DEEP
4701	Windsorville Dam	East Windsor	BB	Minor Damage	Private
10503	Mile Creek Dam	Old Lyme	B	Full Breach	Private
-----	Staffordville Reservoir #3	Union	--	Partial Breach	CT Water Co.
8003	Hanover Pond Dam	Meriden	C	Partial Breach	City of Meriden
-----	ABB Pond Dam	Bloomfield	--	Minor Damage	Private
4905	Springborn Dam	Enfield	BB	Minor Damage	DEEP
13904	Cains Pond Dam	Suffield	A	Full Breach	Private
13906	Schwartz Pond Dam	Suffield	BB	Partial Breach	Private
14519	Sessions Meadow Dam	Union	BB	Minor Damage	DEEP

Probability

Dam failures are most likely triggered by the occurrence of another natural disaster or hazard and are not likely to occur when regular maintenance and inspections are performed. Therefore, dam failures are less likely to occur than the natural disasters that may trigger them. For example, a 1% annual chance flood will not always cause a dam failure.

Impacts to Community Assets

Not all dams pose a serious threat; the vast majority of dams in the state impound water bodies that, either because of their size or location, would not cause major destruction in the event of a dam failure. DEEP's list of dams currently has 83% of all dams in the state classified as AA, A, or BB (dam classification can change as a result of downstream development) such that only a small percentage are classified as significant or high hazard dams. All dams are subject to inspection by DEEP although DEEP has recently shifted the onus of regular dam inspections to dam owners. High hazard and significant hazard dams are required to have Emergency Action Plans prepared to guide response personnel in the case a failure is imminent; these plans also identify downstream areas at risk in case of a failure.

According to the DEEP, there are hundreds of dams in the Capitol Region. The majority of these are either Class A (low hazard) or Class AA (negligible hazard); failure of a Class A dam would lead to minimal economic loss and may cause damage to agricultural land or unpaved roadways while failure of a Class AA dam would cause negligible loss or damage. Dams of concern for hazard mitigation are those in Classes BB, B, and C. In the Capitol Region, 61 dams are Class C, or high hazard (see Table 22 below). Failure of a Class C dam would result in probable loss of life, major damage to habitable structures, damage to major highways, and great economic loss. There are 53 Class B, or significant hazard, dams in the region. Failure in these dams would result in similar but less severe damage. Finally, there are 146 Class BB, or moderate hazard, dams in the region. Failure of one of these dams would result in damage to normally unoccupied structures or local roadways or would cause moderate economic loss; no loss of life would be expected.

Following is a list of the high hazard potential dams located within the Capitol Region; these dams pose the primary risks to the region. The CT DEEP, Metropolitan District Commission (MDC), or municipalities own the majority of these dams, which serve for recreation, flood control, or water supply. Significant and moderate hazard (Classes B and BB) dams are listed on the CT DEEP website at https://www.ct.gov/deep/dams. A list of low and negligible hazard dams is not maintained by the state.

Table 22: Capitol Region High Hazard Dams (Class C)

CT Dam#	Dam Name	Town	Downstream Watercourse	Hazard Class	Owner
701	LOWER HART PONDS DAM	BERLIN		C	CITY OF NEW BRITAIN WATER DEPARTMENT
702	HALLMERE RESERVOIR DAM	BERLIN		C	CITY OF MERIDEN WATER DIVISION
703	KENSINGTON DAM (MARJORIE MOORE, RAILROAD POND)	BERLIN		C	TOWN OF BERLIN

CT Dam#	Dam Name	Town	Downstream Watercourse	Hazard Class	Owner
704	KENMERE RESERVOIR DAM	BERLIN		C	CITY OF MERIDEN WATER DIVISION
709	UPPER HART POND DAM	BERLIN		C	CITY OF NEW BRITAIN WATER DEPARTMENT
722	WASEL RESERVOIR DAM	BERLIN		C	CITY OF NEW BRITAIN WATER DEPARTMENT
1101	BLOOMFIELD FLOOD CONTROL SITE #3 (TUNXIS SITE #3)	BLOOMFIELD	WASH BROOK	C	CT DEEP
1103	WINTONBURY FLOOD CONTROL SITE #1	BLOOMFIELD	BEAMANS BROOK	C	CT DEEP
1104	COLD SPRING FLOOD CONTROL SITE #9	BLOOMFIELD	TUMBLE BROOK	C	CT DEEP
1105	BLUE HILLS FLOOD CONTROL SITE #2	BLOOMFIELD	BEAMANS BROOK TRIB.	C	CT DEEP
1138	BLUE HILLS FLOOD CONTROL SITE #2	BLOOMFIELD	BEAMANS BROOK TRIB.	C	CT DEEP
2320	NEPAUG EAST DIKE	CANTON		C	METROPOLITAN DISTRICT COMMISSION
4902	FRESHWATER POND	ENFIELD	FRESHWATER BROOK	C	TOWN OF ENFIELD
5201	BATTERSON PARK POND DAMS	FARMINGTON	BASS AND CADWELL BROOKS	C	CITY OF HARTFORD
5202	FARMINGTON RESERVOIR	FARMINGTON	PEQUABUCK RIVER TRIB.	C	TOWN OF FARMINGTON
5211	SOUTH FLOOD CONTROL DAM	FARMINGTON	UNNAMED	C	CT DEEP
5401	WILLIAMS POND DAM	GLASTONBURY		C	SOAP FACTORY CONDO. ASSOC.
6405	SOUTH MEADOWS PUMP POND LEVEE	HARTFORD		C	CITY OF HARTFORD-PUBLIC WORKS
6407	HARTFORD LEVEE	HARTFORD	CONNECTICUT RIVER	C	CITY OF HARTFORD-PUBLIC WORKS
6408	NORTH MEADOW LEVEE	HARTFORD	CONNECTICUT RIVER	C	CITY OF HARTFORD-PUBLIC WORKS
6409	SOUTH MEADOW LEVEE	HARTFORD	CONNECTICUT RIVER	C	CITY OF HARTFORD-PUBLIC WORKS
6410	FOLLY BROOK LEVEE	HARTFORD	CONNECTICUT RIVER	C	CITY OF HARTFORD-PUBLIC WORKS
6412	NORTH MEADOWS PUMPING POND - LEVEE	HARTFORD		C	CITY OF HARTFORD-PUBLIC WORKS
7703	HOWARD RESERVOIR DAM	MANCHESTER	PORTER BROOK	C	MANCHESTER, WATER & SEWER DEPT.
7706	UNION POND DAM	MANCHESTER	HOCKANUM RIVER	C	TOWN OF MANCHESTER
7803	WILLIMANTIC RESERVOIR DAM	MANSFIELD	NATCHAUG RIVER	C	WINDHAM WATER WORKS
7804	EAGLEVILLE DAM	MANSFIELD	WILLIMANTIC RIVER	C	CT DEEP
7829	MANSFIELD HOLLOW LAKE DAM	MANSFIELD	NATCHAUG RIVER	C	UNITED STATES ARMY CORPS OF ENGINEERS
8901	SHUTTLE MEADOW RESERVOIR DAM	NEW BRITAIN		C	CITY OF NEW BRITAIN WATER DEPARTMENT
8910	BATTERSON PARK POND DIKE	NEW BRITAIN		C	CITY OF HARTFORD PUBLIC WORKS

CT Dam#	Dam Name	Town	Downstream Watercourse	Hazard Class	Owner
13101	PLAINVILLE RESERVOIR DAM	SOUTHINGTON		C	TOWN OF SOUTHINGTON WATER DEPARTMENT
13105	SOUTHINGTON RESERVOIR #3 DAM	SOUTHINGTON		C	TOWN OF SOUTHINGTON WATER DEPARTMENT
13122	SPRING LAKE DAM	SOUTHINGTON		C	SPRING LAKE CONDOMINIUMS BUILDERS
13123	WASEL RESERVOIR DIKE	SOUTHINGTON		C	CITY OF NEW BRITAIN WATER DEPARTMENT
13129	NEW BRITAIN RESERVOIR DIKE (WOLCOTT RESERVOIR)	SOUTHINGTON		C	CITY OF NEW BRITAIN WATER DEPARTMENT
13228	AVERY FLOOD CONTROL SITE #1 DAM	SOUTH WINDSOR		C	CT DEEP
13229	AVERY FLOOD CONTROL SITE #2 DAM	SOUTH WINDSOR	AVERY BROOK	C	CT DEEP
13401	WHITNEY FLOOD CONTROL SITE #1	STAFFORD	PATTEN BROOK	C	CT DEEP
13402	ELLIS FLOOD CONTROL SITE #2	STAFFORD	ELLIS BROOK	C	CT DEEP
13403	POMEROY FLOOD CONTROL SITE #3	STAFFORD	MCINTYRES BROOK	C	CT DEEP
13405	ELLITHORPE FLOOD CONTROL SITE #5	STAFFORD	MIDDLE RIVER	C	CT DEEP
13406	SHENIPSIT FLOOD CONTROL SITE #6	STAFFORD	EDSONBROOK TRIB.	C	CT DEEP
13408	STAFFORDVILLE RESERVOIR DAM	STAFFORD	FURNACE BROOK	C	TOWN OF STAFFORD
13410	WARREN POND DAM	STAFFORD	FURNACE BROOK	C	AMERICAN WOOLEN CO., INC.
13411	RIVERSIDE POND	STAFFORD	FURNACE BROOK	C	TTM PRINTED CIRCUIT GROUP, INC.
14601	HOCKANUM RESERVOIR	VERNON	HOCKANUM RIVER	C	FROMSON, H. A.
14602	SHENIPSIT LAKE	VERNON	HOCKANUM RIVER	C	CONNECTICUT WATER COMPANY
14606	PAPER MILL POND	VERNON	HOCKANUM RIVER	C	TOWN OF VERNON
15507	HARTFORD RESERVOIR #1	WEST HARTFORD	UNNAMED	C	METROPOLITAN DISTRICT COMMISSION
15508	HARTFORD RESERVOIR #2	WEST HARTFORD	UNNAMED	C	METROPOLITAN DISTRICT COMMISSION
15509	HARTFORD RESERVOIR #3	WEST HARTFORD	UNNAMED	C	METROPOLITAN DISTRICT COMMISSION
15511	HARTFORD RESERVOIR #6	WEST HARTFORD	UMBLE BROOK	C	METROPOLITAN DISTRICT COMMISSION
15512	BURNT HILL FLOOD CONTROL DAM	WEST HARTFORD	TROUT BROOK	C	CT DEEP
15513	TALCOTT FLOOD CONTROL DAM #1	WEST HARTFORD	UNNAMED	C	CT DEEP
15514	BUGBEE FLOOD CONTROL DAM	WEST HARTFORD	TROUT BROOK TRIB.	C	CT DEEP
15523	TALCOTT FLOOD CONTROL DAM #2	WEST HARTFORD	TROUT BROOK TRIB.	C	CT DEEP

CT Dam#	Dam Name	Town	Downstream Watercourse	Hazard Class	Owner
15529	SOUTH FLOOD CONTROL DIKE	WEST HARTFORD		C	CT DEEP
15536	NEW PARK AVENUE FLOOD PREV. LEVEE	WEST HARTFORD		C	TOWN OF WEST HARTFORD
15538	HARTFORD RESERVOIR #6 SOUTH DAM & DIKE	WEST HARTFORD		C	METROPOLITAN DISTRICT COMMISSION
15539	HARTFORD RESERVOIR #3 DIKE	WEST HARTFORD		C	METROPOLITAN DISTRICT COMMISSION
16401	RAINBOW RESERVOIR	WINDSOR	FARMINGTON RIVER	C	THE FARMINGTON RIVER POWER CO.

Source: CT DEEP Dam Safety Section, January 2016

According to the 2014 Connecticut Natural Hazard Mitigation Plan Update:

> "The most critical and hazardous dams are required to meet a spillway design standard much higher than passing the runoff from a 100-year rainfall event. Although not all of the dams under DEEP jurisdiction have been shown to be able to withstand the 100-year rainfall event, most of the dams meet this standard due to original design requirements or recent spillway upgrades. For the most part if smaller rainfall events, (e.g. 10-year and 25-year events) occur more frequently there will be little impact on the ability of Connecticut dams to operate safely."

Once a dam collapses, the damage it does is largely dependent upon the sorts of land uses surrounding it. While the Kenmere Dam inflicted damage primarily upon a golf course, other dams in the region (notably the Shuttle Meadow Reservoir Dam, which overlooks densely developed New Britain) could do far more damage in a collapse. Not only can buildings downstream be inundated by resulting flooding, they can be damaged by the violent torrent of water as well, which impacts like a battering ram. Utility connections can be severed, in turn causing fires and power outages; people can be injured or even killed by rushing waters and the debris carried therein. Refer to the "Impacts to Community Assets" section for flooding for more information.

Due to the relatively minimal historical record of dam failure events in the CRCOG region with recorded damages, annualized loss estimates were compiled for each town using information from Table 2-54 of the 2014 Connecticut Natural Hazard Mitigation Plan Update. This information was supplemented with data from the National Performance of Dams Program database, Connecticut DEP (now DEEP) post-storm damage reports from 1982, and information from the former CCRPA region hazard mitigation plan regarding the Kenmere Reservoir dam failure in Berlin in 1987. The period of record for these loss estimates is 136 years (1877 through 2013). Based on these data, the annualized loss for Hartford County is $1,599, and the annualized loss for Tolland County is $9,385.

The ratio of each town's population to the county population was utilized to attribute a portion of the county-wide annualized loss to each town (Table 23). Note that this method does not take into account site-specific details or particular dam failure damages that may have directly affected a particular community in the historic record. For example, the Connecticut DEP estimated the damage to the Columbia Lake Dam in Columbia from the June 1982 flood to be $20,000. Therefore, these annualized loss estimates should be used with caution and as a minimum loss estimate. Nevertheless, these figures provide useful planning numbers when considering the overall

vulnerability of the Capitol Region to dam failure, suggesting that the annualized risk is relatively minimal for most communities.

Table 23: Annualized Loss Estimates due to Dam Failure

Town	Loss Estimate	Town	Loss Estimate	Town	Loss Estimate
Andover	$203	Farmington	$45	Somers	$703
Avon	$32	Glastonbury	$62	South Windsor	$46
Berlin	$36	Granby	$20	Southington	$77
Bloomfield	$37	Hartford	$223	Stafford	$743
Bolton	$306	Hebron	$595	Suffield	$28
Canton	$18	Manchester	$104	Tolland	$925
Columbia	$337	Mansfield	$1,631	Vernon	$1,793
Coventry	$764	Marlborough	$11	West Hartford	$113
East Granby	$9	New Britain	$131	Wethersfield	$48
East Hartford	$92	Newington	$55	Willington	$371
East Windsor	$20	Plainville	$32	Windsor	$52
Ellington	$959	Rocky Hill	$35	Windsor Locks	$22
Enfield	$80	Simsbury	$42		

The 2014 *Connecticut Natural Hazard Mitigation Plan Update* estimates there are nearly 12,000 people in Hartford County (1.3% of the population) and 4,150 people in Tolland County (2.7% of the population) within the mapped dam inundation areas of high and significant hazard dams. The Capitol Region includes most, although not all, municipalities in Hartford and Tolland Counties. Thus, the regional population exposed to this risk is likely less than 2 percent.

Severe Winter Storms

Winter storms, consisting of snow, ice, wind, and other cold-weather precipitation, are a regular occurrence in Connecticut. Temperatures during the winter months typically drop below freezing at night and occasionally fall below zero degrees Fahrenheit. Some winter storms are mild and of little consequence. However, others, including blizzards, ice storms, and nor'easters, cause large-scale and regular disruptions by restricting transportation, causing the loss of electricity, and through direct physical damages due to wind, snow, sleet, ice, and bitter cold.

Location

All areas of the Capitol Region communities are susceptible to winter storms. Some areas, particularly those at higher elevations, experience more frequent winter storms than those at lower elevations. In addition, low-lying areas (such as floodplains) can experience additional impacts of winter storms such as flooding.

Extent

According to NOAA, there are several types of winter storms and associated precipitation conditions.

- **Blizzards** include winter storm conditions of sustained winds or frequent gusts of 35 mph or greater that cause major blowing and drifting of snow, reducing visibility to less than one-

quarter mile for 3 or more hours. Extremely cold temperatures and/or wind chills are often associated with dangerous blizzard conditions.

- **Freezing Rain** consists of rain that freezes on objects, such as trees, cars, or roads, and forms a coating or glaze of ice. Temperatures in the mid to upper atmosphere are warm enough for rain to form, but surface temperatures are below the freezing point, causing the rain to freeze on impact.

- **Ice Storms** are forecast when freezing rain is expected to create ice buildups of one-quarter inch or more that can cause severe damage.

- **Nor'easters** are the classic winter storm in New England caused by a warm, moist, low pressure system moving up from the south colliding with a cold, dry, high-pressure system moving down from the north. The nor'easter derives its name from the northeast winds typically accompanying such storms, and such storms tend to produce a large amount of rain or snow. They usually occur between November 1 and April 1 of any given year, with such storms occurring outside of this period typically bringing rain instead of snow.

- **Sleet** occurs when raindrops freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects. It can accumulate like snow and cause a hazard to motorists.

- **Snow** is frozen precipitation composed of ice particles that forms in cold clouds by the direct transfer of water vapor to ice.

- **Winter Storms** are defined as heavy snow events that have a snow accumulation of more than 6 inches in 12 hours or more than 12 inches in a 24-hour period.

Until recently, the Northeast Snowfall Impact Scale (NESIS) was used by NOAA to characterize and rank high-impact northeast snowstorms. This ranking system has evolved into the currently used Regional Snowfall Index (RSI). The RSI ranks snowstorms that impact the eastern two thirds of the United States, placing them in one of five categories: Extreme, Crippling, Major, Significant, and Notable. The RSI is based on the spatial extent of the storm, the amount of snowfall, and the juxtaposition of these elements with population based on the 2000 census. RSI differs from NESIS in that it uses more refined geographic areas to define the population impact, resulting in a more region-specific analysis of a storm's impact. The use of population in evaluating impacts provides a measure of societal impact from the event. The table below presents the RSI categories, their corresponding RSI values, and a descriptive adjective.

Table 24: Regional Snowfall Index (RSI) Categories

Category	RSI Value	Event Description
1	1 to 3	Notable
2	3 to 6	Significant
3	6 to 10	Major
4	10 to 18	Crippling
5	18+	Extreme

Source: NOAA

RSI values are calculated within a Geographic Information System (GIS). The aerial distribution of snowfall and population information are combined in an equation that calculates the RSI score, which varies from around one for smaller storms to over 18 for extreme storms. The raw score is then converted into one of the five RSI categories. The largest RSI values result from storms producing heavy snowfall over large areas that include major metropolitan centers. Approximately 210 of the most notable historic winter storms to impact the Northeast have been analyzed and categorized by RSI through March 2018.

Previous Occurrences

The Capitol Region receives an average annual snowfall of about 40 inches per year although snowfall amounts vary widely from year to year and can vary dramatically across the region in any given storm. Severe winter storms can result in damage to buildings and infrastructure, loss of life, and disruptions to regional transportation and communication systems.

Approximately half of the federal disaster declarations for Connecticut since 1954 have followed major winter or snowstorms. Federal assistance is frequently used to offset the snow/ice removal costs the state and municipalities incur. For example, a federal emergency was declared for the February 11-12, 2006, snowstorm in several counties in Connecticut (including Hartford and Tolland) to help share the costs of snow removal. FEMA obligated over $74 million in Public Assistance funds to Connecticut to reimburse state agencies, local governments, and nonprofit organizations for costs associated with the January 11-12, 2011, snowstorm and Storm Alfred in October (see Table 7). The frequency, intensity, and timing of winter storms dramatically impacts snow removal budgets. Storm Alfred was particularly costly for municipalities because of the heavy debris loads resulting from the high number of fully leafed trees downed in this storm. Municipalities also incur higher labor costs for snow removal on weekends and holidays.

Notable winter storms such as the blizzards of 1888, 1978, and 2013 delivered nearly an entire season's worth of snow in single events to the region. The blizzard of 1888, called the Great White Hurricane, occurred on March 11 through 14. This blizzard produced over 50 inches of snow in some parts of the state and caused over 400 deaths along the East Coast. The blizzard of 1978, which occurred on February 6, paralyzed the state for 3 days and resulted in four Connecticut deaths. The blizzard caused widespread damage throughout New England, resulting in 99 deaths and $520 million in damages. This storm is rated 4th overall in the RSI as an "Extreme" storm. Ice storm Felix which occurred on December 18, 1973, was Connecticut's most severe ice storm and resulted in two deaths and widespread power outages.

Other notable winter storms in Connecticut include nor'easters in 1979, 1983, 1988, 1992, 1996, 2003, October 2011's Storm Alfred, and most recently, the February blizzard of 2013. Following are descriptions of some of the winter storms that have hit the region in the last 15 years and their impacts from the National Weather Service's Storm Events Database (unless otherwise noted). As is evident from these descriptions, individual winter storm events need not be unusually intense to cause damages and even loss of life.

March 13-14, 1993: A massive, powerful storm dubbed the "Storm of the Century" caused "whiteout" blizzard conditions stretching from Jacksonville, Florida, into eastern Canada and affected 26 states, producing 24 inches of snow in Hartford and up to 21 inches of snow in New Haven County. A total of 40,000 power outages and $550,000 in property damage was reported throughout Connecticut, and the state received a federal emergency declaration. The storm had an RSI rating of "Extreme" and is the 2nd highest ranking storm recorded by RSI.

January 7, 1996: This storm was one of the most significant winter storms to hit southern New England in the past 20 years and was named the "Blizzard of '96" from the middle Atlantic states to southern New England. However, by National Weather Service definition, Winter Storm Ginger did not bring actual blizzard conditions to the state. Snowfall across the north and northeast portions of the state ranged from 15 to 23 inches. In Hartford County, Bradley International Airport recorded 18.2 inches. New Britain had 18 inches, and Wethersfield had 15.3 inches. In Tolland County, 22.5 inches were recorded in Mansfield. This storm disrupted transportation systems and closed schools and businesses. A barn roof collapsed in Simsbury within a week or so following this very heavy snowfall. The storm had an RSI rating of "Extreme" and is the 3rd highest ranking storm recorded by RSI.

March 2, 1996: A total of 6 to 7 inches of snow fell across the northern part of the state. There were 391 skidding accidents reported to the state police. Three people were killed and dozens injured on the icy roadways. A number of state highways were closed for a time due to the numerous accidents and very slippery conditions, including Route 30 in Tolland and Route 195 in Mansfield.

December 6, 1996: An intensifying storm system moving eastward from the southeast tip of Long Island caused heavy, wet snow across northern Connecticut. The greatest totals were reported from the higher elevations. Several thousand electric customers lost power, including a total of 1,700 in Avon. In Simsbury, a town-owned tobacco barn collapsed under the weight of the snow. The barn was in rough shape to start with, but the collapse amounted to approximately $37,000 according to the Simsbury Assessors' Office. Road conditions became very poor as the snow continued to fall throughout the day.

December 7, 1996: This storm brought heavy, wet snow and resulted in widespread power outages. There had been another heavy, wet snow event the day before, too. A total of 225,000 electric customers lost power statewide, including 100,000 in central Connecticut and 95,000 in the eastern part of the state. Power remained out for several days despite the efforts of dozens of electric company repair crews, many from out of state. Many roads remained unplowed until the utility companies could clear away fallen wires. A firefighter died instantly while on duty in Somers when he came in contact with a 23,000-volt power line that had been knocked down by the heavy snow. Route 44 was closed for 15 hours due to a fallen power line. Up to 22 shelters were opened across the region, and many residents left their unheated and darkened homes. Many vehicles and homes were damaged by falling tree limbs, and damage was estimated in the millions of dollars.

January 24, 1997: Light freezing rain created very treacherous driving conditions and caused numerous skidding accidents, including many multiple-car accidents. State police at the Tolland barracks reported 60 to 80 accidents, mostly minor, late Friday night, January 24. Several bridges had to be closed in the Hartford area when more than a dozen cars collided. Several other highways also were closed in northern Connecticut due to icing conditions. A spotter in Windsor reported 1/4" to 1/3" of ice on trees during the early morning hours on January 25.

December 20, 1999: Light freezing rain fell in the deeper valleys of northern Connecticut as rain fell into a shallow layer of below-freezing air at the surface. The resultant light coating of ice formed "black ice" on many roadways, which caused many accidents. It was estimated that there were nearly 100 accidents, mostly fender benders, throughout Hartford, Tolland, and Windham Counties as a result of the slick driving conditions.

November 26, 2000: Low pressure moving north up the mid Atlantic coast brought a period of light freezing rain to much of northern Connecticut. Ice accretion was under one quarter inch, but the freezing rain left black ice on roads, causing dozens of accidents at the end of the Thanksgiving weekend, usually a busy travel day. Temperatures warmed into the 40s by late morning, ending the danger of icing.

February 5, 2001: A major winter storm brought heavy snow and strong winds to northern Connecticut. The highest snowfall totals, between 12 and 24 inches, were reported in Hartford County. Totals of 12 to 18 inches were widely observed in Tolland and Windham Counties. Several minor accidents were attributed to the storm, and traffic in greater Hartford was brought to a standstill during the height of the storm. Several thousand electric customers were left without power.

November 16, 2002: A major ice storm caused significant damage in north central Connecticut. There were numerous reports of downed trees, limbs, and power lines as a result of one-half to three-quarters of an inch of icing. An estimated 100,000 customers in Hartford and Tolland Counties were left without power because of the storm. Damage was especially severe in western Hartford County where entire communities such as Hartland, Granby, Simsbury, and Canton were left without power for as much as 5 days. Sections of Canton were completely isolated due to downed trees and wires according to local police. The damage from the ice storm was compounded by high winds 1 day later. Gusts as high as 50 mph hampered the cleanup effort and downed more trees and branches that were weighted down by ice. Total damage from the storm in Hartford County was estimated at 2 million dollars. The damage was less severe in neighboring Tolland County, but there were still many reports of downed trees, limbs, and wires county wide. Total damage was estimated at half a million dollars.

February 17, 2003: A heavy snowstorm caused near-blizzard conditions and produced 24 inches of snow in areas of the state. The storm had an RSI rating of "Crippling" and is the 8th ranked winter storm by RSI. Connecticut received a federal emergency declaration.

January 8, 2005: Low pressure quickly strengthened as it passed south of New England and brought a mix of snow, sleet, and freezing rain to much of interior southern New England. North central Connecticut was especially hard hit by freezing rain where as much as one half inch of glaze brought down trees, tree limbs, and power lines. There was no estimate of how many customers lost power, but dozens of accidents were reported as a result of icy roads.

March 8, 2005: Low pressure strengthened rapidly off the Delaware coast and tracked southeast of New England, bringing heavy snow and high winds to parts of northern Connecticut. Several highways, including Interstate 84, were described by state police as "barely passable" during the height of the storm. In Hartford, downtown streets were jammed with cars as many businesses and state offices closed early. Commuting times were doubled or tripled in many locations.

February 11, 2006: The "Blizzard of 2006" was a nor'easter that began on the evening of February 11, 2006. It dumped heavy snow across the northeast United States from Virginia to Maine through the early evening of February 12 and ended in Canada on February 13. Hartford received a total of 21.9 inches of snow — the second largest snowfall since 1906 — and West Hartford received 27 inches of snow. Despite the large amounts of snow, there were only isolated individual power outages. Bradley International Airport was closed for several hours. While Connecticut was one of the hardest hit areas, the state was well prepared for the storm and managed to avoid major problems. At the storm's onset, Governor M. Jodi Rell ordered all tractor-trailer trucks off the state's highways to facilitate the efforts of highway crews with snow removal. Connecticut mobilized 2,500 state-owned and privately contracted snowplows to keep state highways open during the storm. The state's 169 cities and towns employed hundreds of additional plows to keep local roads passable.

December 2, 2007: A strong low-pressure system moved across southern New England producing wintry precipitation across much of northern Connecticut. Ice accretion downed tree limbs and wires, causing power outages across much of Hartford County.

Winter 2010/2011: Significant snowfalls from December 2010 through February 2011 with only brief thaws in between allowed snow to pile up across southern New England, resulting in numerous roof collapses, towns seeking permission to dump excess snow in area rivers and bays, and numerous disruptions to transportation. The first major snowstorm occurred December 26 and 27, 2010, with several other snowfalls following in January. On January 11 and 12, 2011, a developing nor'easter and coastal storm dumped up to 2.5 of snow across Connecticut in a 24-hour period. Twenty-two and a half inches fell at Bradley International Airport, setting a 1-day snowfall record for that location. This was the second major storm of an above-average winter of snowfall. Then on January 26, 2011, a strong low-pressure system moved up the coast and southeast of Nantucket producing up to a foot and a half of snow across Connecticut. Six to 17 inches of snow fell across Hartford County, and 13 to 19 inches fell across Tolland County. Another major storm hit February 1 and 2. Because there was no appreciable melting between storms, roof collapses continued, including 75 structures in Hartford County. Federal assistance was sought by Governor Malloy for costs associated with the January 12 winter storm and its cleanup. It was granted by President Obama for Hartford and Tolland Counties. According to the Connecticut Division of Emergency Management and Homeland Security, municipalities and other local and private nonprofit agencies incurred expenses of over $3.15 million due to the heavy snowfalls associated with the federally declared disaster. The municipalities and agencies are eligible for reimbursement of 75% of these costs under FEMA's Public Assistance program. Snow for the winter season totaled 86.4 inches.

Hebron Building Collapse due to Heavy Snow Loads, February 2, 2011
Credit: John Sholtis, WTNH.com

Storm Alfred, October 29, 2011: A rare and historic October nor'easter brought very heavy snow to portions of southern New England on Saturday October 29. Low pressure tracked northeast from the North Carolina coast Saturday morning, rapidly strengthening as it passed well south of Nantucket Saturday evening. As the storm intensified, colder air from aloft was drawn into New England resulting in heavy snow in the interior. The precipitation started as mainly snow early Saturday afternoon across the interior of southern New England although a brief period of rain at the onset was common across the lower elevations. The snow tapered off just after midnight Saturday night in western New England with

the last of the precipitation exiting eastern New England Sunday morning. The accumulation of the heavy wet snow on trees and power lines resulted in widespread tree damage and power outages across many communities in central and western Massachusetts, southern New Hampshire, and northeastern Connecticut. Six to 17 inches of snow fell across Hartford County, and 6 to 10 inches of snow fell across Tolland County. Heavy, wet snow fell on foliated trees, breaking branches and downing trees and wires, resulting in widespread power outages that lasted for up to 11 days. This resulted in school closures, and numerous towns cancelled or rescheduled Halloween and trick-or-treating activities. At the peak, 830,000 customers in Connecticut were without power. Over 250 trees and 106 utility poles were downed in Somers. In addition, eight transformers were destroyed and 24 were damaged in Tolland County. A motorist died in a traffic accident in Hebron that was blamed on the road conditions and weather. The Glastonbury Pheasant Farm lost more than 4,000 birds. Throughout Connecticut, 164 AT&T cell phone towers were damaged, resulting in degraded cell phone service until towers could be repaired and power restored. Air travel in and around the Hartford area was disrupted when numerous flights were diverted to Bradley International Airport from the New York City metro area and then power outages affected the airport. Several airplanes were not able to allow their passengers to disembark for 7 hours or more. The Enfield DMV roof was compromised by the heavy snow and was shut down. Both Avon and South Windsor estimated 100,000 cubic yards of debris from fallen trees and power lines. According to the Connecticut Division of Emergency Management and Homeland Security, municipalities and other local and private nonprofit agencies incurred expenses of over $68 million due to Alfred. Most of this expense was due to cleanup efforts associated with the enormous amount of debris generated by the storm. The municipalities and agencies are eligible for reimbursement of 75% of these costs under FEMA's Public Assistance program.

Snow Covered Trees and Streets, Glastonbury, October 30, 2011, CRCOG

October 2011 Storm Cleanup in Windsor, FEMA

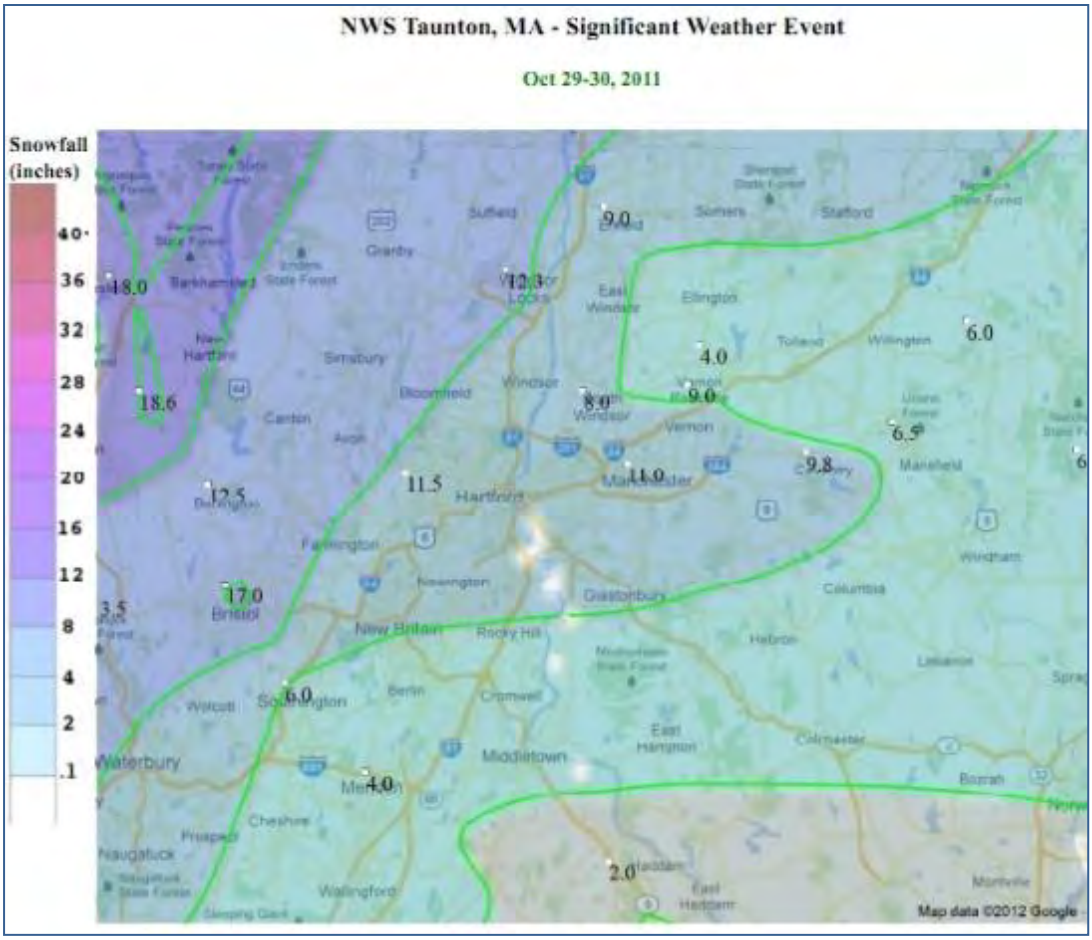


Figure 5: October 2011 Snowfall Totals Across Central Connecticut
Source: National Weather Service

Manchester Shelter, October 31, 2011, Credit: CTNow

Blizzard of 2013: A massive nor'easter hit the Northeast February 8 and 9 bringing record amounts of snow to Connecticut and other areas in New England. According to NOAA's National Climatic Data Center (http://www.ncdc.noaa.gov/news/evaluating-february-2013-blizzard-regional-snowfall-index), over 49,000 people across a 192-square-mile area (including much of Connecticut) saw 30 inches or more of snow as a result of this storm. According to meteorologist Geoff Fox, the National Weather Service reported snow totals in Hartford County that ranged from 20 inches in East Hartford and Enfield to 33.5 inches in Glastonbury and snow totals in Tolland County that ranged from 25 inches in Vernon to 32.5 inches in Coventry (http://www.geofffox.com/MT/archives/2013/02/09/2013-blizzard-snow-totals-for-connecticut.php). At times, snow fell at a rate of 6 inches per hour. The governor closed limited-access highways on February 8 and all roads on February 9. Cleanup took days and required cities and the State to bring in additional crews and equipment. According to the *Hartford Courant*, the Connecticut DOT brought in 150 additional payloaders to handle the massive accumulations of snow on the roads. The blizzard was also responsible for several deaths in Connecticut including two in Manchester (http://articles.courant.com/2013-02-12/news/hc-weather-snow-connecticut-0208-20130205_1_clear-snow-dannel-p-malloy-asylum-avenue). The Connecticut Department of Agriculture reported that more than 300 agricultural structures partially or completely collapsed (Connecticut Weekly Agricultural Report, February 27, 2013; http://www.ct.gov/doag/cwp/view.asp?a=3243&q=400466).

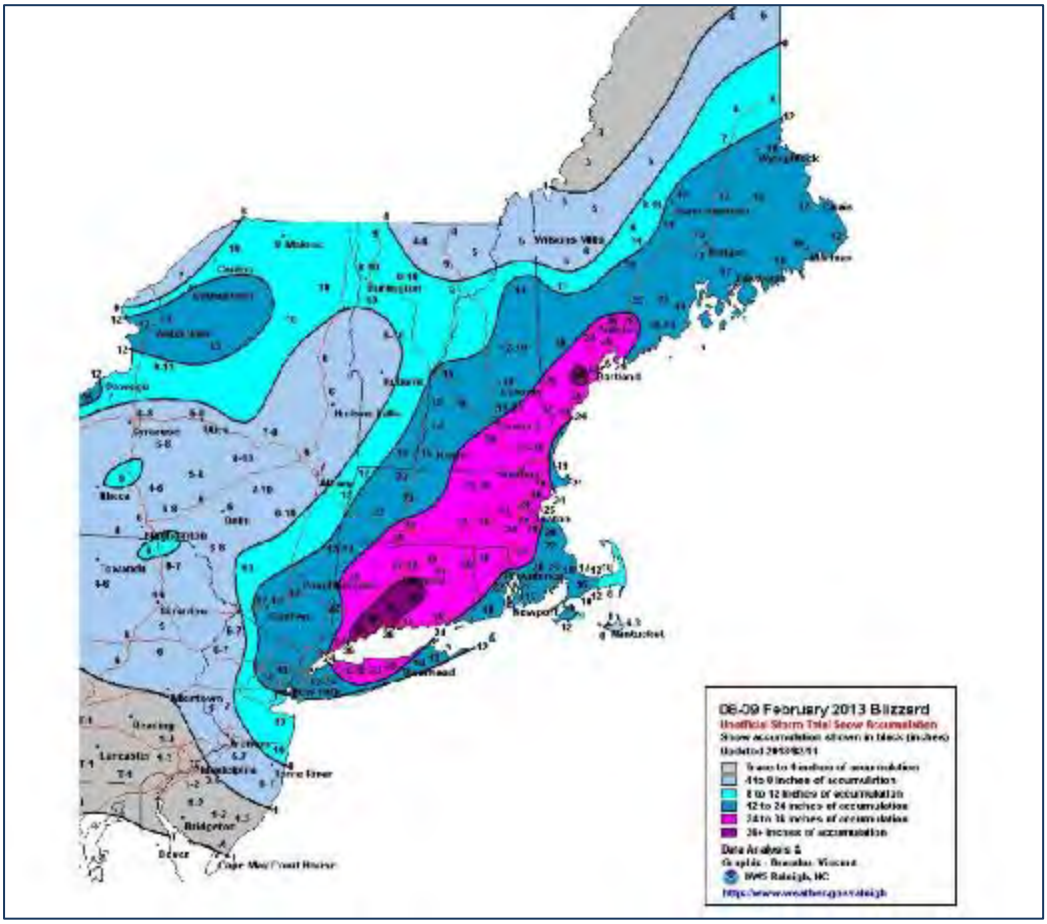


Figure 6: Blizzard of 2013 Snowfall Totals

Source: National Oceanic and Atmospheric Administration, National Weather Service, Raleigh, North Carolina, taken from http://en.wikipedia.org/wiki/February_2013_nor%27easter

Probability of Future Events

Winter storms of varying levels of severity are fairly common in the region. Data from weather stations in the Capitol Region reveals that in an average year there are more than 80 days when it snows 0.1 inches or more. Most of those days are during December through February. During this same time period, there are more than 30 days where snow totals at least 1 inch, and about 3 days on average have a snowfall total of 10 inches or higher. These data demonstrate that the Capitol Region communities should expect several heavy snows per year and, therefore, should be adequately prepared for these storms.

Impacts to Community Assets

Impacts from severe winter weather can become dangerous and a threat to people and property. Most winter weather events occur between December and March although in 2011 Connecticut experienced a significant October snowstorm that left much of the state without power for a week. According to NOAA, winter storms were responsible for the death of 25 people per year from 2004 to 2013. Most deaths from winter storms are indirectly related to the storm such as from traffic accidents on icy roads and hypothermia from prolonged exposure to cold. Damage to trees and tree limbs and the resultant downing of utility cables is a common effect of these types of events. Secondary effects include loss of power and heat and flooding as a result of snowmelt.

While the probability of a winter storm occurring is roughly the same in all parts of the region, the risk of damage will vary depending on infrastructure and population density. There is a high probability for traffic accidents and traffic jams during heavy snow and light icing events. Roads may become impassable, inhibiting the ability of emergency equipment to reach trouble spots and the accessibility of medical and shelter facilities. To a large extent, the areas with the greatest risk of experiencing damage due to winter storms are those with the greatest amount of development and the most extensive networks of roads (which increases the burden of snow removal). Conversely, the travelers who must go through less-developed areas face a potentially greater risk due to the lower density of roads, which provides fewer alternate routes as well as potentially relatively steep topography.

After a storm, snow piled on the sides of roadways can inhibit sight lines and reflect a blinding amount of sunlight. When coupled with slippery road conditions, poor sight lines and heavy glare create dangerous driving conditions. Stranded motorists, especially senior and/or handicapped citizens, are at particularly high risk of injury or death from exposure during a blizzard.

According to the 2014 *Connecticut Natural Hazard Mitigation Plan Update*, recent climate change studies predict a shorter winter season for Connecticut (by as much as 2 weeks) and less snow-covered days with a decreased overall snowpack. These models also predict that fewer, more intense precipitation events will occur with more precipitation falling as rain rather than snow. This trend suggests that future snowfalls will consist of heavier (denser) snow, and the potential for ice storms will increase. Such changes will have a large impact on how the state and its communities manage future winter storms and will affect the impact such storms have on the residents, roads, and utilities in the state.

Areas with greater levels of development are also at greater risk of business disruptions, loss of life, and damage to structure. Hartford and New Britain have the greatest level of development (with the exception of a few parks, the entire area of each city is developed) and the greatest potential

risk. For example, with more roofs comes more potential for roof collapse. There are also simply more sidewalks to clear, more homes to heat, and more people to protect.

While picturesque, snow and ice can create impassable roads, interrupt utility service, knock down trees and power lines, and isolate people in their homes or workplaces, sometimes without electricity or heat. Melting snow and ice can also cause flooding as can winter rainstorms that hit when the ground is already frozen. The following discussions examine the economic impact of snowstorms on the region.

Municipal Budgets

Snow and ice removal has a tremendous impact on municipal budgets. The impact varies by community; some communities use their own staff to clear roads, which may represent savings but also be inefficient. Other towns hire contractors to remove 100% of the snow and ice. The remainder of towns use a combination of municipal staff and contractors. Regardless of staffing, every community is faced with spending between $100,000 and $1 million per year on snow and ice management. In recent years, towns have budgeted and spent widely varying amounts on their snow removal budgets depending on severity. The winter of 2013-14 saw the state and many towns exceeding their budgets and running out of salt, sand, and other resources before the winter ended.

The size, scope, and timing of a particular storm can drastically affect a community's annual expenditures. Blizzards in 1888 and 1978 each delivered nearly a season's worth of snow in a single event. Nor'easters in 1979, 1983, 1988, 1992, 1996, 2003, 2005, 2007, 2011, 2013, and 2014 dropped masses of snow, causing deadly car crashes and widespread blackouts. Even storms that are not unusual can cause damage and loss of life.

Roof Collapse

Heavy snow and ice accumulation bring with it the threat of roof collapse and catastrophic damage to the building's occupants. As seen in the table below, snow alone can put a large burden on roofs; however, when coupled with rain and sleet, this load per square foot increases.

Table 25: The Burden of Snow on a Roof

Type	Equivalent to 1 inch of water	Load per Square Foot	Maximum
Fresh Snow	10-12 inches	5 lbs.	4 ft.
Packed Snow	3-5 inches	5 lbs.	2 ft.

Source: Insurance Institute for Business & Home Safety

Two feet of old snow and 2 feet of new snow could weigh as much as 60 pounds per square foot of roof space, which is beyond the typical snow load capacity of most roofs. One inch of ice is equivalent to 1 foot of fresh snow. A house should be able to support 20 to 25 pounds of snow per square foot (Insurance Institute for Business & Home Safety; https://disastersafety.org/).

The winter of 2011 saw many buildings condemned by snow accumulation, collapsing their roofs. In Southington, several businesses experienced roof collapse including the Home Depot and Country Dog Training. Yarde Metals also had to be evacuated after the roof was damaged.

Road Closures

Like many other types of disasters, winter weather and heavy snowfall can cause localized and widespread road closures. Closures can result from a variety of causes such as poor driving conditions, heavy snow, and drifts as well detritus like fallen trees and power lines. When a blizzard struck on February 8, 2013, Governor Malloy called for a traffic ban on all vehicles for the following day except for those emergency response and recovery vehicles with the capacity to maneuver in heavy snow. Events with large impacts on transit also have major economic impacts such as preventing employees from reaching work and halting or delaying shipments and deliveries.

Burst Pipes

Cold and winter weather not only wreaks havoc outside a building but inside as well. Frozen pipes can cause severe damage. A complete ice blockage in a pipe causes freezing and expansion which in turn causes water pressure to increase to the faucet. The increase in water pressure leads to pipe failure. In 2013, frozen and broken water pipes ranked second to hurricanes in terms of both the number of homes damaged and the total amount of damages claimed in the U.S. (Insurance Information Network of California, 2014). While there are few records of burst pipes in the region, in Farmington at the UConn Health Center, a frozen sprinkler pipe burst. This caused extensive damage with water leaking into the main floor, the ground floor and a storage room, and some labor and delivery rooms as well as the newborn nursery (Lank, 2014).

Power Outages

Heavy snow and ice can cause tree limbs to fall, bringing power lines down with them. Winter weather frequently causes significant power outages throughout the state, especially in more rural areas. Urban areas where a greater percentage of power lines are underground are impacted to a lesser degree. Not only are power outages an inconvenience, but they can cause damage to property, disrupt business, and threaten lives if heating systems or medical devices and equipment are impacted.

The snowstorm of October 2011 was particularly impactful. During that storm, more than 80% of the region was without power during peak outages, and outages often lasted for 5 days or more. The figure below has a summary of the number of customers who were without power. In each of the town sections, more detail is provided about how many days customers in those towns were without power (if the local planning teams were able to provide this information).

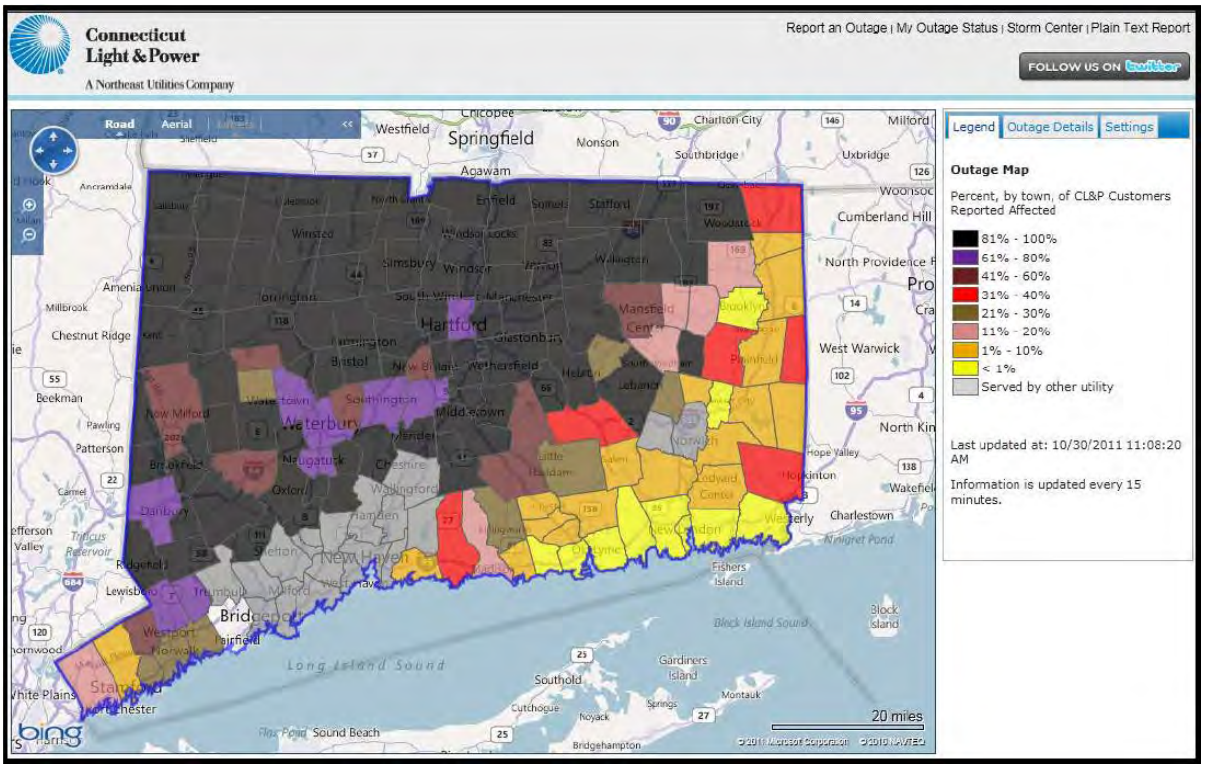


Figure 7: Outage Map from October 2011 Winter Storm Alfred
Source: CT DEMHS

Other Loss Estimates

Based on the public assistance reimbursements in Table 8, the Capitol Region has incurred losses of approximately $120,566,622 since 1998 (19 years) from impacts due to winter storms. Based on this information, the annualized loss due to winter storms in the Capitol Region is $6,345,612. Annualized losses for each community are presented below. These annualized loss estimates should be used with caution and as a minimum loss estimate. Nevertheless, these figures provide useful planning numbers when considering the overall vulnerability of the Capitol Region to winter storms.

Table 26: Annualized Loss Estimates due to Winter Storms Based on Public Assistance Reimbursements

Town	Loss Estimate	Town	Loss Estimate	Town	Loss Estimate
Andover	$10,742	Farmington	$192,137	Somers	$92,518
Avon	$163,154	Glastonbury	$215,674	South Windsor	$407,954
Berlin	$82,825	Granby	$117,404	Southington	$127,416
Bloomfield	$180,640	Hartford	$910,280	Stafford	$32,144
Bolton	$19,345	Hebron	$27,004	Suffield	$103,235
Canton	$48,170	Manchester	$380,865	Tolland	$141,141
Columbia	$9,057	Mansfield	$114,914	Vernon	$259,141
Coventry	$32,641	Marlborough	$17,612	West Hartford	$669,644
East Granby	$40,569	New Britain	$186,573	Wethersfield	$132,135
East Hartford	$188,087	Newington	$153,229	Willington	$24,001
East Windsor	$29,764	Plainville	$55,081	Windsor	$100,339
Ellington	$67,117	Rocky Hill	$82,618	Windsor Locks	$319,905
Enfield	$385,492	Simsbury	$225,045		

Annualized loss estimates were also prepared based on the county-wide damages presented in the 2014 Connecticut Natural Hazard Mitigation Plan Update. Based on the data provided in Table 2-35 of the state plan, the annualized loss for Hartford County is $952,764, and the annualized loss for Tolland County is $532,131. The ratio of each town's population to the county population was utilized to attribute a portion of the county-wide annualized loss to each town (Table 27). In general, the annualized loss estimates prepared by this method were lower than those developed through the Public Assistance reimbursements (the total annualized loss for the region was estimated to be $1.4 million). Note that this method does not take into account site-specific details or particular winter storm damages that may have directly affected a particular community in the historic record. The estimates developed using the Public Assistance information were used for this plan as they represent a greater level of potential damages.

Table 27: Annualized Loss Estimates due to Winter Storms based on the State Hazard Mitigation Plan

Town	Loss Estimate	Town	Loss Estimate	Town	Loss Estimate
Andover	$11,511	Farmington	$27,005	Somers	$39,883
Avon	$19,287	Glastonbury	$36,689	South Windsor	$27,398
Berlin	$21,171	Granby	$12,023	Southington	$45,899
Bloomfield	$21,832	Hartford	$132,975	Stafford	$42,123
Bolton	$17,355	Hebron	$33,756	Suffield	$16,769
Canton	$10,968	Manchester	$62,068	Tolland	$52,457
Columbia	$19,115	Mansfield	$92,503	Vernon	$101,689
Coventry	$43,336	Marlborough	$6,825	West Hartford	$67,426
East Granby	$5,486	New Britain	$78,017	Wethersfield	$28,420
East Hartford	$54,620	Newington	$32,570	Willington	$21,053
East Windsor	$11,896	Plainville	$18,880	Windsor	$30,953
Ellington	$54,373	Rocky Hill	$21,004	Windsor Locks	$13,319
Enfield	$47,588	Simsbury	$25,056		

Tornadoes

Tornadoes are a relatively infrequent occurrence in Connecticut but can be very destructive when they occur. While small tornadoes in outlying areas cause little to no damage, larger tornadoes in populated sections of Connecticut have historically caused significant damage, injury, and death through the destruction of trees, buildings, vehicles, and power lines.

Location

All areas of the Capitol Region communities are susceptible to tornadoes. The likelihood of damage, injury, and death increases dramatically when a tornado occurs in a populated area. Tornadoes typically cause damage in a straight line although "skipping" tornadoes are also possible where a tornado can pass over portions of its route without causing damage.

Extent

A tornado is a violent, destructive whirling wind storm accompanied by a funnel-shape cloud that progresses in a narrow path over the land.

The strength of tornadoes is measured based on the Enhanced Fujita scale (EF) released by NOAA in 2007. The EF scale updated the original Fujita (F) scale developed in 1971. The EF scale uses 3-second gusts estimated at the point of damage based on a judgement of eight levels of damage to 28 specific indicators. The table on the next page links EF classifications to estimated 3-second wind gusts.

Previous Occurrences

Connecticut averages approximately three tornadoes every 2 years; however, as of October 2018, eight tornadoes have hit the state, including four that occurred during a single storm on May 16. Although these were not located in the Capitol Region, they were a reminder of the very severe impacts that can occur from these powerful storms. Hartford and Litchfield Counties are at the highest risk for tornadoes within the state based on historical patterns and locations of their occurrence. Between 1950 and 2003, Hartford County experienced 14 tornadoes, and Tolland County experienced 10. These tornadoes occurred between April and October. Between 2006 and 2018, Connecticut experienced 27 tornadoes. Three of these were in Hartford County, and three were in Tolland County.

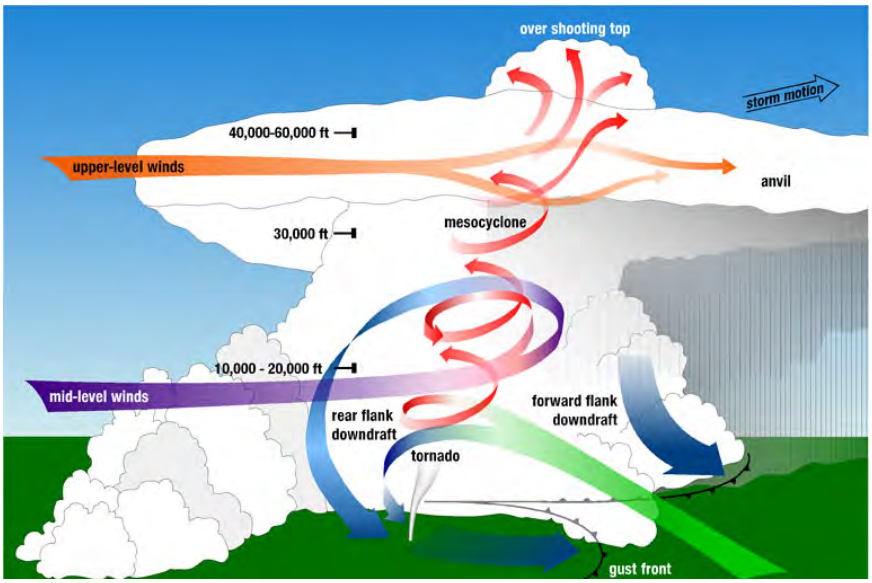


Figure 8: Anatomy of a Tornado

(Image from NOAA National Severe Storms Laboratory)

Table 28: Enhanced F-Scale for Tornado Damage

FUJITA SCALE			DERIVED EF SCALE		OPERATIONAL EF SCALE	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

IMPORTANT NOTE ABOUT ENHANCED F-SCALE WINDS: *The Enhanced F-scale still is a set of wind estimates (not measurements) based on damage judgments.* **Source:** http://www.spc.noaa.gov/efscale/ef-scale.html

An extensively researched list of tornado activity in Connecticut is available on Wikipedia. Milone & MacBroom, Inc. routinely compares this list to NOAA reports and has found that the list remains reliable and surprisingly current with frequent updates. This list extends back to 1648 although it is noted that the historical data prior to 1950 is incomplete due to lack of official records and gaps in populated areas. Tornadoes that have impacted the Capitol Region communities are noted below:

June 14, 1648: A "great tempest" downed trees somewhere in present-day Hartford County.

1728 or 1729: A possible tornado passed through New Britain and/or Wethersfield.

August 17, 1784: Two tornadoes struck central-western Connecticut. The second tornado injured one person while moving down a hillside west of Southington.

August 15, 1787: The "Four-State Tornado Swarm" affected most of New England. The first of four tornadoes to impact Connecticut on this day touched down near New Britain and tracked into Wethersfield where it did most of its damage, killing a mother and her two children and injuring 10 others. What may have been another tornado caused additional damage as far east as Coventry. Another tornado struck East Windsor, damaging several homes and barns.

June 30, 1808: One or more tornadoes moved from Windsor to Coventry, killing one person.

July 22, 1808: Trees and buildings were damaged by a tornado that moved from East Windsor to North Bolton.

July 16, 1810: A tornado produced damage in or around Somers.

August 9, 1851: A "tornado" (possibly a squall line) affected New Hartford, Suffield, and Windsor.

August 17, 1872: What may have been a small tornado hit Windsor Locks.

August 18, 1877: "Something like a tornado," described as a "whirling mass of black clouds" cut across Hartford, tearing down trees and branches.

May 29, 1880: A tornado touched down in Suffield, moving northeast and crossing the Connecticut River. It destroyed 25 buildings in Thompsonville and Enfield.

August 25, 1885: A tornado passed through the towns of Bloomfield and Windsor, crossing the Connecticut River before dissipating. Nearly the entire tobacco crop in the area was destroyed at a loss in the millions of dollars. Another tornado may have struck East Hartford a few weeks earlier.

September 12, 1886: A tornado touched down outside of Ellington, Connecticut, destroying barns and downing trees before lifting near Burnside (East Hartford), Connecticut.

June 12, 1918: A small tornado (possibly a microburst) caused $50,000 in damage to roofs and windows in New Britain.

From A History of Connecticut's Deadliest Tornadoes (Robert Hubbard, 2015)

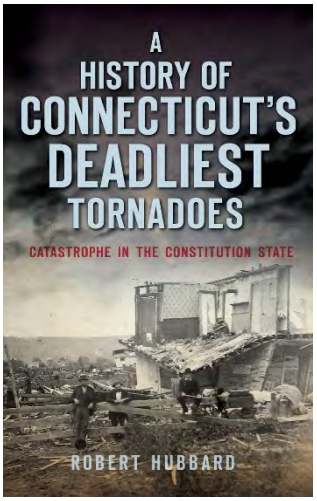
Wethersfield Tornado of 1787

- Path was New Britain to Newington to Wethersfield to Glastonbury to Bolton to Coventry
- It was only the second time that a tornado in Connecticut caused fatalities and the first time in the area that is now the Capitol Region
- It was the state's deadliest tornado until the Wallingford tornado of 1878

Windsor/Windsor Locks Tornado of 1979

- Path was Windsor to Windsor Locks to Suffield
- ¼ to 1 mile wide
- Three fatalities
- At the time, it was the 6th most costly tornado in U.S. history
- Remains one of the three most deadly tornadoes in Connecticut

July 13, 1922: A weak tornado tracked across Hartford, downing tree branches and utility poles.



September 24, 1942: A tornado touched down in Plainville, destroying a church. The tornado passed into Bristol, destroying a garage on its 3-mile path.

August 20, 1951: An F2 tornado briefly touched down in Willington.

August 21, 1951: A long-tracked F2 tornado touched down in New Milford and tracked 40 miles to eastern Hartford County. Nine people were injured by this tornado.

May 10, 1954: An F3 tornado (some sources say F2) hit Windsorville (East Windsor) at 9:30 a.m., destroying a house and some sheds, injuring two, and causing $30,000 in damage. Additionally, an F2 tornado touched down in northwestern Hartford County that afternoon.

October 24, 1955: An F1 tornado touched down in central Hartford County.

August 8, 1956: An F0 tornado briefly touched down in East Glastonbury.

June 19, 1957: An F1 tornado touched down in central Glastonbury.

September 7, 1958: An F2 tornado injured two in Willington.

May 30, 1959: An F1 tornado briefly touched down in Bloomfield, damaging a few greenhouses.

April 26, 1961: An F1 tornado briefly touched down in western Tolland County.

May 24, 1962: An F3 tornado killed one person, injured 50 more, and razed 200 buildings and damaged 600 more, causing $4 million in damage along its 11-mile path from Middlebury to Southington.

August 19, 1965: An F2 tornado tracked 6 miles (10 km) through northern Tolland County.

August 17, 1968: An F1 tornado touched down in southern Tolland County.

October 3, 1970: An F1 tornado injured one in northern Hartford County.

June 28, 1973: An F1 tornado injured one person in western Hartford County.

August 31, 1973: An F2 tornado briefly touched down in central Hartford County.

September 6, 1973: An F2 torndo touched down in eastern Hartford County, damaging houses in Manchester, Vernon, and Talcottville (Vernon).

September 18, 1973: Three tornadoes briefly touched down, an F1 in Greenwich, an F2 in southwestern Hartford County, and another F1 in southern Tolland County.

Tornado Damaged Aircraft from New England Air Museum, 10/4/1979
Credit: John Long, *Hartford Courant*
http://www.courant.com/business/connecticut-insurance/hrt-hc-aircraft-devasted20120104123803,0,2414026.photo

October 3, 1979: The Windsor Locks, Connecticut, tornado, an extremely destructive F4 tornado and one of the worst in Connecticut history, killed three and injured 500 in northern Hartford County. The tornado, with winds in excess of 200 mph, struck without warning, tearing an 11-mile path from Windsor to Suffield. The tornado destroyed more than a dozen airplanes at Bradley International Airport and narrowly missed a Boeing 727 that was attempting to land. The tornado killed 3 people, injured 500, and caused an estimated $250 million in damage, mostly in Windsor Locks and Suffield. About 100 homes were completely leveled.

July 5, 1984: An F2 tornado tracked from Bristol to Farmington, injuring one person and causing $500,000 in damage to homes and vehicles.

August 4, 1992: An F0 tornado struck central Hartford County.

June 29, 1994: A strong microburst accompanied by an F0 tornado struck Avon. Many trees were downed, but there was very little property damage.

August 16, 2000: An F1 tornado touched down in Ellington. It tossed several large trailers through the air and damaged a cow barn.

May 28, 2007: An EF0 land spout damaged the roof of a barn in Somers on an otherwise calm day.

June 26, 2009: An EF1 tornado hit the town of Wethersfield. There was widespread damage across town, especially near the area of Wolcott Hill. Many downed trees caused damages, most notably in Old Wethersfield where a tree split a house in two and destroyed a front porch. Damage was estimated at around $2.4 million, but no injuries were reported.

Wethersfield House torn in two by tree toppled during tornado of June 26, 2009
Credit: Wethersfield Historical Society **http://www.wethhist.org**

July 1, 2013: A series of three tornadoes touch down across the state; one in Fairfield County and two in Hartford County (an EF0 in Enfield and an EF1). The majority of impact was limited to downed trees although the EF1 tornado that tracked from Windsor Locks to East Windsor caused notable structural damage near East Windsor. This EF1 tornado, with an estimated maximum wind speed of 86 mph and a width of 200 yards, hit between 1:30 p.m. and 1:35 p.m. Various news outlets reported that the tornado traveled through tobacco fields, flattening the crops and tearing netting off the crops and sending it onto trees, roofs, and I-91. The tornado also knocked down a sports center bubble dome. Young campers at the center sought shelter in an adjacent building before the tornado struck. There were no injuries reported. Minutes later, the EF0 tornado, with a maximum wind speed of 65 mph, hit Enfield, knocking down trees and fencing. Over $5 million in damage was reported.

During this same storm, three tornadoes touched down in Hampden County, Massachusetts, just north of the Connecticut state line. The strongest, an EF3 tornado, resulted in four deaths, 200 injuries, and $227,600,000 in property damage. This tornado first touched down in Westfield and continued on a 39-mile path through West Springfield, Springfield, Wilbraham, Monson, Brimfield, and Sturbridge.

The July 1, 2013 Tornado Credit: http://wjar.images.worldnow.com/images/22735124_BG1.jpg

Sports Dome Damage from July 1, 2013 Tornado in East Windsor
Credit: John Woike, *Hartford Courant*. http://articles.courant.com/2013-07-01/news/hc- tornado- warning-0702-20130701_1_windsor-locks-tornado-rips-ef1

July 10, 2013: An EF1 tornado touched down in Andover and caused tree damage along an 11.2-mile-long (18.0 km) intermittent path in Tolland County through Coventry and Mansfield. The tornado traveled for over 30 minutes, had maximum wind speeds of 90 mph, and was up to 100 yards wide. The same storm system caused a microburst that hit Tolland, toppling numerous large trees.

July 27, 2014: An EF0 tornado occurred in Wolcott, causing minor damage around the high school (note, this was not within the Capitol Region).

August 10, 2016: An EF0 tornado hit North Haven, causing minor damage in the Montowese area (note, this was not within the Capitol Region).

May 15, 2018: Four tornadoes, three EF1 and one unrated, struck Litchfield and New Haven Counties. The first touched down in Winsted, damaging houses and trees. The second was observed over the Barkhamsted Reservoir and therefore caused no damage (for this reason, it was not able to be rated on the EF scale). The third struck Southbury and Oxford, damaging the roof of a school. The fourth passed through Beacon Falls, Bethany, and northern Hamden near Sleeping Giant State Park. A barn was destroyed in Bethany. Many roads were blocked by downed trees, and several individuals were trapped in their cars. This storm also produced straight-line winds (note, this was not within the Capitol Region).

Storm approaching Sleeping Giant State Park
Credit: Hailey Wilson. https://www.nbcconnecticut.com/weather/stories/May-15-2018---Southbury-to-Hamden-Tornado-483123751.html

July 17, 2018: An EF-0 tornado briefly touched down west of Ashford Lake in Ashford, with peak winds of 80 to 85 mph, causing minor damage (note, this was not within the Capitol Region).

August 4, 2018: An EF-0 tornado with winds of approximately 80 mph touched down in Woodstock, causing minor property damage and moderate tree damage (note, this was not within the Capitol Region).

October 2, 2018: An EF-0 tornado touched down in Mansfield center, with winds of 70 mph. The tornado was almost 100 feet wide and traveled for nearly a half mile. Minor damage was caused to roofs and buildings, and debris was lifted into the air.

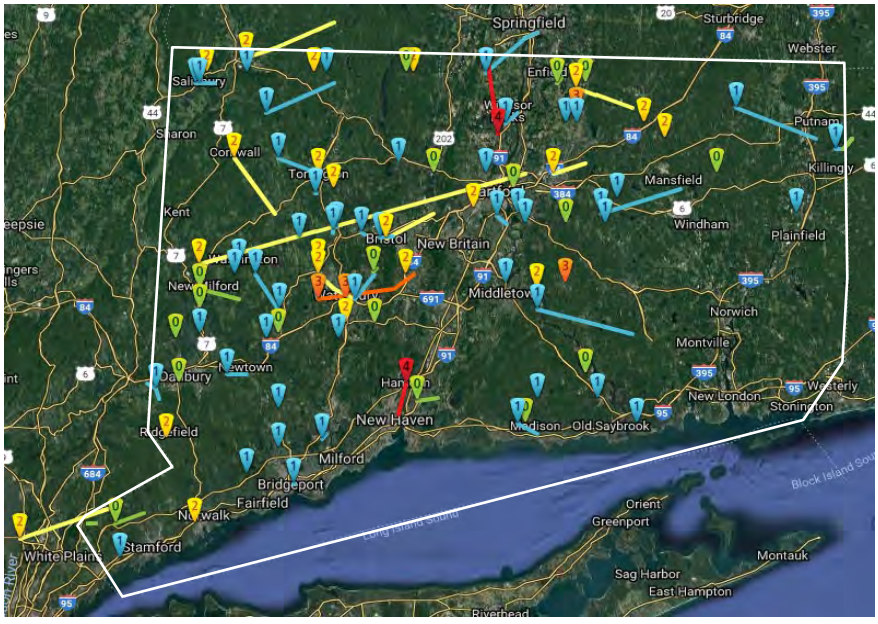


Figure 9: 1950 to 2016 Tornado Tracks across Connecticut
Approximate spot locations and tracks of all 97 tornadoes that affected Connecticut between July 1950 and August 2016, shown with Fujita scale rankings
Source: TornadoHistoryProject.com

Table 29 displays a list of the tornadoes that occurred in Hartford and Tolland Counties from 1950 to 2018. The majority of tornadoes that touch down in the Capitol Region are of a lesser intensity; however, the 1979 Windsor Locks tornado illustrates that the region is vulnerable to tornadoes as strong as those that occur in the Midwest.

Table 29: Tornadoes in Hartford and Tolland Counties 1950-2018

Location of Touchdown / Date	Time	# Dead	# Injured	F Scale
Hartford County				
August 21, 1951	1715	0	9	F2
May 10, 1954	1255	0	0	F2
October 24, 1955	1735	0	0	F1
June 19, 1957	1500	0	0	F1
May 30, 1959	1530	0	0	F1
May 24, 1962	1700	0	5	F3
October 3, 1970	1700	0	1	F1
June 28, 1973	1345	0	1	F1
August 31, 1973	1730	0	0	F2
September 6, 1973	1000	0	0	F2
October 3, 1979	1400	3	500	F4
July 5, 1984	1657	0	0	F2
August 4, 1992	1505	0	0	F0
June 29, 1994	1416	0	0	F0
June 26, 2009	1450	0	0	EF1
July 1, 2013	1328	0	0	EF1
July 1, 2013	1400	0	0	EF0
Tolland County				
August 20, 1951	1630	0	0	F2
May 10, 1954	930	0	2	F3
August 8, 1956	1630	0	0	F0
September 7, 1958	1610	0	2	F2
April 26, 1961	1115	0	0	F1
August 19, 1965	1705	0	0	F2
August 17, 1968	1800	0	0	F1
September 18, 1973	1208	0	0	F1
August 16, 2000	1135	0	0	F1
May 28, 2007	1100	0	0	EF0
July 10, 2013	1720	0	0	EF1
October 2, 2018	1600	0	0	EF0

Sources: The Tornado Project, www.tornadoproject.com
"List of Connecticut Tornadoes," https://en.wikipedia.org/wiki/List_of_Connecticut_tornadoes

Probability

According to the 2014 *Connecticut Natural Hazard Mitigation Plan Update*, "The pattern of occurrence and potential locations for tornadoes to occur in Connecticut is expected to remain relatively unchanged in the 21st Century. Based on NOAA's historical data, the northwest area of the state, namely Litchfield and Hartford Counties, have the highest historical incidences of tornadoes and therefore may be considered to have a higher risk for the occurrence of future tornadoes." Based on the data presented in Table 2-30 of the state plan for Hartford and Tolland Counties, the Capitol Region could experience approximately 0.23 tornado events per year, or roughly one tornado every 4 years. NOAA states that climate change has the potential to increase the frequency and intensity of tornadoes, so it is possible that the pattern of occurrence in Connecticut could change in the future.

Impacts to Community Assets

While Connecticut clearly faces some risk from tornadoes, the nature of the storms makes them unpredictable. Tornadoes can strike with very little warning; cause significant to catastrophic damage to homes, vehicles, and businesses; and result in significant injury and death. All towns in the region share equal vulnerability to these events (although Hartford County towns are likely to be at higher risk due to a slightly increased frequency of occurrence), and although property destruction may be unavoidable, loss of life can be minimized through efficient, coordinated response. The more populated areas in the Capitol Region are more likely to experience damage and casualties than the less densely populated communities.

Although impacts to Connecticut and the Capitol Region from tornadoes are infrequent, tornadoes that have struck the area have had devastating impacts. According to the NCEI Database, three people have died as a result of tornadoes since 1951 in Hartford County, and 520 people have been injured in both Hartford and Tolland Counties. The total property damage from the events since 1951 has cost both counties approximately $829 million.

Annualized loss estimates were prepared based on the county-wide damages presented in the 2014 *Connecticut Natural Hazard Mitigation Plan Update*. Based on the data provided in Table 2-30 of that document, the annualized loss for Hartford County is $13,116,854, and the annualized loss for Tolland County is $44,371. The ratio of each town's population to the county population was utilized to attribute a portion of the county-wide annualized loss to each town (Table 30). Note that this method does not take into account site-specific details or particular tornado damages that may have directly affected a particular community in the historic record. Therefore, these annualized loss estimates should be used with caution and as a minimum loss estimate. Nevertheless, these figures provide useful planning numbers when considering the overall vulnerability of the Capitol Region to tornadoes.

Table 30: Annualized Loss Estimates due to Tornadoes

Town	Loss Estimate	Town	Loss Estimate	Town	Loss Estimate
Andover	$960	Farmington	$371,785	Somers	$3,326
Avon	$265,531	Glastonbury	$505,108	South Windsor	$377,199
Berlin	$291,471	Granby	$165,528	Southington	$631,903
Bloomfield	$300,568	Hartford	$1,830,682	Stafford	$3,512
Bolton	$1,447	Hebron	$2,815	Suffield	$230,862

Town	Loss Estimate	Town	Loss Estimate	Town	Loss Estimate
Canton	$151,003	Manchester	$854,504	Tolland	$4,374
Columbia	$1,594	Mansfield	$7,713	Vernon	$8,479
Coventry	$3,614	Marlborough	$93,959	West Hartford	$928,260
East Granby	$75,531	New Britain	$1,074,069	Wethersfield	$391,269
East Hartford	$751,962	Newington	$448,402	Willington	$1,755
East Windsor	$163,767	Plainville	$259,927	Windsor	$426,130
Ellington	$4,534	Rocky Hill	$289,168	Windsor Locks	$183,369
Enfield	$655,158	Simsbury	$344,950		

Thunderstorms

Thunderstorms are a common occurrence in Connecticut and occur on approximately 20 to 30 days each year. While many thunderstorms produce relatively little damage, stronger "supercell" thunderstorms can produce heavy winds, hail, significant damaging lightning strikes, and even tornadoes. Such storms have historically caused significant damage, injury, and even death through the destruction of trees; damage to buildings, vehicles, and power lines; and direct lightning strikes.

Location

All areas of the Capitol Region communities are susceptible to thunderstorms. The likelihood of damage, injury, and death increases dramatically when a supercell thunderstorm occurs in a populated area. While the heavy winds and tornadoes (see previous section) associated with strong thunderstorms are more likely to cause measurable damage near populated areas, hail can cause damage to crops in rural areas as well as damaging vehicles and buildings in populated areas, and lightning can cause injuries or fires in any area.

Extent

The strength of thunderstorms is typically measured in terms of its effects, namely the speed of the wind, the presence of significant lightning, and the size of hail. In general, thunderstorm winds are less than tropical cyclone speeds, but strong winds associated with downbursts can be extremely hazardous and reach speeds up to 168 mph (as described in the previous section).

Lightning

Lightning is a discharge of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. According to NOAA, the creation of lightning during a storm is a complicated process that is not fully understood. In the initial stages of development, air acts as an insulator between the positive and negative charges. However, when the potential between the positive and negative charges becomes too great, a discharge of electricity (lightning) occurs.

Image courtesy of NOAA

In-cloud lightning occurs between the positive charges near the top of the cloud and the negative charges near the bottom. Cloud-to-cloud lightning occurs between the positive charges near the top of the cloud and the negative charges near the

bottom of a second cloud. Cloud-to-ground lightning is the most dangerous. In summertime, most cloud-to-ground lightning occurs between the negative charges near the bottom of the cloud and positive charges on the ground.

Downbursts

A downburst is a severe localized wind blasting down from a thunderstorm. They are more common than tornadoes in Connecticut. Depending on the size and location of downburst events, the destruction to property may be significant.

Downburst activity is, on occasion, mistaken for tornado activity. Both storms have very damaging winds (downburst wind speeds can exceed 165 mph) and are very loud. These "straight line" winds are distinguishable from tornadic activity by the pattern of destruction and debris such that the best way to determine the damage source is to fly over the area.

Downbursts fall into two categories:

Microbursts affect an area less than 2.5 miles in diameter, last 5 to 15 minutes, and can cause damaging winds up to 168 mph.

Macrobursts affect an area at least 2.5 miles in diameter, last 5 to 30 minutes, and can cause damaging winds up to 134 mph.

Hail

Hailstones are chunks of ice that grow as updrafts in thunderstorms keep them in the atmosphere. Most hailstones are smaller in diameter than a dime, but stones weighing more than 1.5 pounds have been recorded. NOAA has estimates of the velocity of falling hail ranging from 9 meters per second (m/s) (20 mph) for a 1-centimeter (cm)-diameter hailstone to 48 m/s (107 mph) for an 8 cm, 0.7 kilogram stone.

Previous Occurrences

Previous occurrences of thunderstorm damage since 1993 are reported in the NCEI Storm Events database for the Capitol Region communities. Highlights of this damage are presented below:

August 28, 1993: Thunderstorm winds knocked out power to 44,000 customers in Connecticut. Large limbs were downed in Southington.

April 4, 1995: Thunderstorm winds with wind gusts of 40 to 60 mph, with some gusts exceeding 70 mph, caused damage in Connecticut. Trees and power lines were reported blown down in Plymouth, and considerable wind damage was reported in Southington. Up to 87,000 customers lost power.

May 29, 1995: Severe thunderstorms produced large hail and gusty winds. 0.88-inch diameter hail was reported in Southington.

July 11, 1995: 1.00-inch-diameter hail was reported in New Britain and Burlington.

July 3, 1996: The remnants of an F1 tornado that moved through Waterbury produced thunderstorm wind gusts and pea-size hail in Southington. Trees and power lines were blown down.

May 6, 1997: Dime-size hail (0.75-inch) was reported in New Britain.

July 23, 1998: A severe thunderstorm produced nickel-size hail. Lightning struck a chimney in New Britain, starting a fire.

July 24, 1999: Severe thunderstorms produced damaging winds and large hail, with 1.50-inch-diameter hail reported in New Britain.

May 18, 2000: A severe thunderstorm downed large tree limbs in Southington.

June 20, 2001: Lightning struck a house in Berlin, setting the roof on fire. No injuries were reported.

August 13, 2003: A severe thunderstorm downed power lines and caused minor flooding. Plainville was hardest hit with nearly 3,600 customers left without power. $25,000 in property damage was reported.

May 23, 2004: Severe thunderstorms produced ping-pong-ball-size (1.50-inch) hail in Plainville and Bristol.

August 21, 2004: Severe thunderstorms downed large branches in Southington.

May 27, 2005: Severe thunderstorms brought down power lines in Southington, igniting several house fires. Damage was estimated at $50,000.

July 11, 2006: Severe thunderstorms produced penny-size (0.75-inch) hail in Berlin.

October 29, 2006: A storm with peak gusts of 49 mph brought down trees and power lines in West Hartford, Andover, Ellington, and Tolland.

June 5, 2007: A thunderstorm dropped hail varying in size from pennies to golf balls (1.75-inch) in Southington. A few cars sustained damage from some of the larger hailstones.

July 15, 2007: Thunderstorm winds knocked down trees and wires on Camp Street in Plainville.

March 8, 2008: Trees and wires were downed in Glastonbury, closing a portion of Route 17. In South Windsor, a light pole was downed on Garnett Lane, and large tree limbs were downed on Avery Street,

June 8, 2008: Thunderstorm winds were reported in Southington that knocked down large branches and power lines. Two homes were struck by lightning. $10,000 in damages were reported.

June 26, 2009: Severe thunderstorms produced hail 0.88 inches in diameter in New Britain, with trees knocked down near a golf course. 0.75-inch-diameter hail was reported in Southington. The storms caused $1.8 million in property damage across Connecticut.

May 26, 2010: 1.00-inch-diameter hail was reported in Berlin and Terryville. Thunderstorm winds downed trees and limbs on Brooklawn Street and Pierremount Avenue in New Britain, causing $10,000 in property damage.

July 21, 2010: Severe thunderstorms produced an intermittent F1 tornado in northwestern Connecticut. One-inch hail was reported in New Britain and Berlin. Numerous trees were downed in Plainville and Southington by straight-line winds. In Southington, tree damage occurred on West Queen Street and Dunham Road as well as a tree downed onto a car on Oakland Drive. A tree on Stanley Street in New Britain was downed as well as large branches on Kenyon Circle. Total damage in the region was estimated at $108,000.

February 19, 2011: Multiple trees were downed across Hartford County, including one that was downed onto a garage on Halwood Drive in Granby, another on a garage in East Hartford, and two on April Drive and Indian Hill Road in Glastonbury.

June 22, 2012: A cold front moved through a hot and humid southern New England, producing showers and thunderstorms. Many of these storms became severe, resulting in damaging winds, large hail, and some flash flooding. Trees on Perkins Street in Manchester were downed by thunderstorm winds, causing $5,000 is damage, and 0.75-inch-diameter hail was observed. A tree and wires were downed by thunderstorm winds on Crystal Lake Road and Old Post Road in Tolland, causing $10,000 in damage. Also in Tolland, trees and wires on Route 30, Doyle Road, and Robin Circle were downed by thunderstorm winds, causing another $30,000 in damage, and 0.88- to 1.0-inch-diameter hail was observed. 0.75-inch-diameter hail was observed in Vernon, and 0.88-inch-diameter hail was observed in Mansfield. A tree on Bridge Street in Ellington was downed onto wires by thunderstorm winds; $10,000 in damages were reported. Several trees in Hartford were downed by thunderstorm winds; $15,000 in damages were reported.

July 2, 2012: Scattered showers and thunderstorms occurred throughout southern New England. Two trees in Hebron were struck by lightning, one falling on a house and ripping out some of the power lines. The lightning travelled through the house, likely through the plumbing, sending a jolt through an occupant's arm as he was brushing his teeth, holding his hand in the running water. The man was injured. $10,000 in property damage occurred.

July 18, 2012: Several trees and branches were downed by thunderstorm winds in Berlin, including one on New Britain Road. Part of a screen was blown off a screen door. Pea- to nickel-size hail fell in New Britain, and hail 1.0 inch in diameter was measured in Tolland. Lightning struck at the intersection of the two main runways at Bradley International Airport, damaging the runway surface. The runways were closed for about an hour while debris was cleared and the runway was patched. $11,000 in property damage was reported.

August 12, 2012: According to the *Hartford Courant*, a microburst resulted from a violent storm that formed on a warm front to the south and moved into central Connecticut. Winds up to 100 mph hit an area of Glastonbury one-half mile wide and 2.5 miles long, bringing down trees and damaging property. Based on the damage, the National Weather Service determined the microburst had wind speeds of 85 to 100 mph in the Butler Drive and Needletree Lane area and 75 to 90 mph around Homestead Drive and Paddok Street. Outside of those areas, the storm brought wind speeds ranging from 55 to 80 mph. The National Weather Service explained that for the area it affected the microburst was as powerful as a category 2 hurricane, which is characterized by wind speeds of 96 to 100 mph. While Glastonbury appeared to be the hardest hit, other parts of the state saw flash flooding and wind-related damage. Downed trees and wires were reported in Coventry, Enfield, Hebron, Manchester, Mansfield, South Windsor, Tolland, and Vernon. About 17,000 homes and businesses powered by Connecticut Light & Power were without electricity as a result of the storm. $65,000 in property damage was reported.

June 17, 2013: A cold front pushed through southern New England, resulting in showers and thunderstorms. Some of the storms became severe, producing damaging winds. A large tree in Manchester was uprooted and downed by thunderstorm winds, causing $5,000 in damage. A utility pole in South Windsor was downed by thunderstorm winds, causing $10,000 in damage. Trees and wires along Route 6 in Bolton were downed by thunderstorm winds, causing $10,000 in damage.

July 10, 2013: A severe thunderstorm downed several trees and large branches on Mountain Spring Road in Tolland. All of the downed trees were blown down in the same direction, indicating straight-line winds. $25,000 in damages occurred.

July 3, 2014: Thunderstorm winds downed trees and wires in Southington. In New Britain, a wind gust reached 63 mph. $12,000 in property damage was reported. Trees and wires were downed on Merrow Road in Tolland, causing $10,000 in damages.

July 27, 2014: Showers, thunderstorms, and severe thunderstorms occurred over New York and New England. Lightning struck a house on Prospect Street in Thompsonville, setting it on fire, causing $50,000 in damage. A tree was downed onto a car on Shaker Road in Enfield by thunderstorm winds, causing $5,000 in damage. Trees and wires on North Maple Street in Enfield were downed by thunderstorm winds, causing $10,000 in damage, and 1.0-inch-diameter hail was reported. Trees and wires on George Wood Road in Somers were downed by thunderstorm winds, and $10,000 in damage occurred. A tree was downed onto wires on Jobs Hill Road in Ellington, causing $5,000 in damage, and 0.88-inch-diameter hail was reported. 0.75-inch-diameter hail was reported in Vernon. A microburst occurred in Tolland with winds 80 to 90 mph, downing numerous trees and wires on Interstate 195; Goose Lane; and Cedar Mill, Reed, and Mile Hill Roads, with $50,000 in damages occurring. A tree was downed onto wires on Route 320 near the Willington/Mansfield line, causing $5,000 in damages. Trees and wires on Jonathan Lane in Mansfield were downed by thunderstorm winds, causing $10,000 in damages. Trees and wires on Westwood Road and Codfish Falls Road in Storrs were downed by thunderstorm winds, causing $10,000 in damages.

October 8, 2014: Thunderstorm winds downed trees and wires on Liberty Street in Southington. $10,000 in property damage was reported.

June 23, 2015: Showers and thunderstorms occurred across southern New England. Many of these thunderstorms became severe, producing strong to damaging winds. Trees, utility poles, and wires were downed at the intersection of Russell Road and Route 10, causing $40,000 in damage. Trees and wires were downed on Chestnut Hill Road, Maston Hill Road, and Clark Hill Road, causing $15,000 in damage.

February 25, 2016: Severe thunderstorm winds and high winds occurred across Connecticut. Wind gusts up to 68 mph were recorded at Hartford-Brainard Airport. Several tree limbs in New Britain were downed by severe thunderstorm winds, causing $2,000 in damages. Trees and wires were downed throughout South Windsor, with several roads closed due to this damage including Ellington Road between Pierce Road and Deming Street and Niederwerfer Road at the East Windsor town line, and $30,000 in damages occurred. Multiple large branches, small trees, and wires were downed in the eastern part of Enfield, and $5,000 in damages occurred. Power lines on Newbury Street and a large limb and wires on Grandview Terrace in Hartford were downed by severe thunderstorm winds, and $5,000 in damages occurred. Trees and wires on Hubbard Road in Hartford were also downed, causing another $10,000 in damages. A tree and wires on Forest Valley Road in Hebron were downed by severe thunderstorm winds, causing $5,000 in damages. Trees and wires were downed by severe thunderstorm winds in Tolland, causing $10,000 in damages. Power lines on Anthony Road between Virginia Lane and Rhodes Road in Tolland were downed by thunderstorm winds, causing $5,000 in damages. Wires at the intersection of Stone House Road and Old Eagleville Road in Coventry were downed, and $5,000 in damages occurred. An amateur radio operator recorded a wind gust of 75 mph on their home weather station in Glastonbury. A tree and wires on Grist Mill Road at Route 83 in Glastonbury were downed, causing $5,000 in damages. A tree and wires were downed in Andover, causing $5,000 in damages. Trees and wires in East Windsor were downed, causing $10,000 in damages. Trees and wires in Stafford were downed, causing $10,000 in damages.

May 15, 2018: According to the *Hartford Courant*, two lines of severe thunderstorms produced damaging tornadoes, high winds, and hail in Connecticut. At least two people were killed, and many more were injured due to falling trees. Nearly 122,000 people lost power throughout Connecticut, and 17 state roads were closed. Although damage was greatest in western Connecticut, damage extended across Hartford and Tolland Counties into Windham County. Baseball-size hail was reported in some parts of

northern Connecticut. According to WFSB Channel 3, barns were reported collapsed on South Street in Coventry, and an oak tree crashed through the roof of a home.

Probability

According to NOAA's National Weather Service, there is an average of 100,000 thunderstorms per year in the United States. An average of 33 people per year died from lightning strikes in the United States from 2004 to 2013. Most lightning deaths and injuries occur outdoors, with 45% of lightning casualties occurring in open fields and ballparks, 23% under trees, and 14% involving water activities.

Thunderstorms typically occur on 18 to 35 days each year in Connecticut. According to the NCEI, there have been a total of 24 days with a reported lightning strike in Harford and Tolland Counties since 1996. Only 18 lightning-related fatalities occurred in Connecticut between 1959 and 2015, and only two have occurred since 2008. On June 8, 2008, lightning struck a pavilion at Hammonasset Beach in Madison, injuring four and killing one. On May 8, 2010, lightning struck three men fishing on a jetty at Seaside Park in Bridgeport, killing one and injuring two.

NOAA reports that there are 10 downburst reports for every tornado report in the United States. This implies that there are approximately 10,000 downbursts reported in the United States each year and further implies that downbursts occur in approximately 10% of all thunderstorms in the United States annually. This figure suggests that downbursts are a relatively uncommon yet persistent hazard.

According to NOAA's National Weather Service, hail caused two deaths and an average of 27 injuries per year in the United States from 2004 to 2013. Hailstorms typically occur in at least one part of Connecticut each year during a severe thunderstorm. According to the NCEI, there has been a total of 96 days with a hail event in Hartford and Litchfield Counties since 1956.

Impacts to Community Assets

All areas of the Capitol Region communities are susceptible to thunderstorms. Fortunately, in Connecticut, injury and death due to thunderstorm winds is relatively uncommon. Although thunderstorm damage is expected each year, the majority of events do not cause measureable damage. Most thunderstorm damage is associated with downbursts, which typically have a greater effect on elevated areas such as hilltops, ridges, and "wind corridors" within communities. Areas with more trees in close proximity to power lines and structures are more vulnerable to the effects of thunderstorm damage than more urban areas.

While crops are the major victims of hail, larger hail is also a hazard to people, vehicles, and property. Lightning strikes are relatively infrequent in Connecticut but can cause permanent damage or death to a person along with starting fires. Lightning can also occur on any day even if a thunderstorm is not occurring. In general, the economic impact of thunderstorms is much lower than that of tropical cyclones but still significant because the damage is expected to occur each year.

Estimates of community impacts have been determined based on data presented in the 2014 *Connecticut Natural Hazard Mitigation Plan Update*. The percentage of the population of each Capitol Region community as compared to the population of the county was used to adjust the

thunderstorm losses reported to the NCEI for each county as presented in Table 2-19 of the 2014 state plan. The annualized loss estimate for thunderstorm damage in each Capitol Region community is presented in the table below. Overall, the annualized losses are relatively modest in the region.

Table 31: Annualized Loss Estimates due to Thunderstorms

Town	Loss Estimate	Town	Loss Estimate	Town	Loss Estimate
Andover	$1,202	Farmington	$3,365	Somers	$4,166
Avon	$2,404	Glastonbury	$4,572	South Windsor	$3,414
Berlin	$2,638	Granby	$1,498	Southington	$5,720
Bloomfield	$2,721	Hartford	$16,572	Stafford	$4,400
Bolton	$1,813	Hebron	$3,526	Suffield	$2,090
Canton	$1,367	Manchester	$7,735	Tolland	$5,479
Columbia	$1,997	Mansfield	$9,662	Vernon	$10,621
Coventry	$4,526	Marlborough	$851	West Hartford	$8,403
East Granby	$684	New Britain	$9,723	Wethersfield	$3,542
East Hartford	$6,807	Newington	$4,059	Willington	$2,199
East Windsor	$1,482	Plainville	$2,353	Windsor	$3,857
Ellington	$5,679	Rocky Hill	$2,618	Windsor Locks	$1,660
Enfield	$5,931	Simsbury	$3,123		

Earthquakes

Although damaging earthquakes are rare in Connecticut, low-magnitude earthquakes occur regularly in the state. In addition, very strong, damaging earthquakes have occurred in Connecticut, and the state can also feel the effects of earthquakes that occur several hundred miles away.

Location

All areas of the Capitol Region communities are susceptible to earthquakes although the likelihood of an earthquake occurring directly below the region is relatively small. In general, the Capitol Region communities are likely to be part of a larger regional area affected by an earthquake as opposed to being individually affected.

Extent

An earthquake is a sudden rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. Earthquakes can cause buildings and bridges to collapse; disrupt gas, electric, and telephone lines; and often cause landslides, flash floods, fires, avalanches, and tsunamis. Earthquakes can occur at any time without warning.

The underground point of origin of an earthquake is called its focus; the point on the surface directly above the focus is the epicenter. Earthquakes are described based on their magnitude and intensity.

Magnitude is an estimate of the relative size or strength of an earthquake and is related to the amount of seismic energy released at the hypocenter of the earthquake. It is based on the amplitude of earthquake waves recorded on instruments that have a common calibration. The

magnitude of an earthquake is thus represented by a single instrumentally determined value recorded by a seismograph, which records the varying amplitude of ground oscillations.

The Richter scale was developed in 1935 and was used exclusively until the 1970s. It set the magnitude of an earthquake based on the logarithm of the amplitude of recorded waves. Being logarithmic, each whole number increase in magnitude represents a tenfold increase in measured strength. Earthquakes with a magnitude of about 2.0 or less are usually called "microearthquakes" and are generally only recorded locally. Earthquakes with magnitudes of 4.5 or greater are strong enough to be recorded by seismographs all over the world.

As more seismograph stations were installed around the world following the 1930s, it became apparent that the method developed by Richter was valid only for certain frequency and distance ranges, particularly in the southwestern United States. New magnitude scales that are an extension of Richter's original idea were developed for other areas[2]. In particular, the Moment magnitude scale (Mw) was developed in the 1970s to replace the Richter scale and has been in official use by the USGS since 2002.

According to USGS[3], these multiple methods are used to estimate the magnitude of an earthquake because no single method is capable of accurately estimating the size of all earthquakes. Some magnitude types are calculated to provide a consistent comparison to past earthquakes, and these scales are calibrated to the original Richter scale. However, differences in magnitude of up to 0.5 can be calculated for the same earthquake through different techniques. In general, Moment magnitude provides an estimate of earthquake size that is valid over the complete range of magnitudes and so is commonly used today.

Although Moment magnitude is the most common measure of earthquake size for medium and larger earthquakes, the USGS does not calculate Mw for earthquakes with a magnitude of less than 3.5. Localized Richter scales or other scales are used to calculate magnitudes for smaller earthquakes. This is often the case in Connecticut.

Regionally, the Weston Observatory utilizes two scales to track the magnitude of earthquakes. These include the Nuttli magnitude (Mn) for North America east of the Rocky Mountains and is more appropriate for the relatively harder continental crust in Connecticut compared to California. Weston Observatory also utilizes the Coda Duration magnitude (Mc), which is based on the duration of shaking at a particular station. The advantages of the Coda Duration magnitude is that this method can quickly estimate the magnitude before the exact location of the earthquake is known.

Earthquakes in Connecticut are intraplate or intratectonic as opposed to occurring at fault lines. In these types of earthquakes, soil composition determines the magnitude of the impact. Soft soils and filled wetlands conduct energy better than bedrock. A magnitude 5.1 earthquake near Plattsburgh, New York, in April 2002 was felt in Hartford and lower-lying areas in western Connecticut because of ground-motion amplification resulting from the soft soils located in these areas. Many of the

[2] https://www.usgs.gov/faqs/moment-magnitude-richter-scale-what-are-different-magnitude-scales-and-why-are-there-so-many?qt-news_science_products=0#qt-news_science_products
[3] https://www.usgs.gov/faqs/why-do-usgs-earthquake-magnitudes-differ-those-published-other-agencies?qt-news_science_products=0#qt-news_science_products

strongest earthquakes felt in Connecticut had epicenters in upstate New York, New Hampshire, and Massachusetts.

The effect of an earthquake on the earth's surface is called the intensity. The Modified Mercalli Intensity Scale consists of a series of key responses such as people awakening, movement of furniture, damage to chimneys, and total destruction. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It is an arbitrary ranking based on observed effects. A comparison of Richter magnitude to typical Modified Mercalli intensity is presented in Table 32 while a description of each intensity level is presented as Table 33.

Table 32: Comparison of Earthquake Magnitude and Intensity

Moment Magnitude	Typical Maximum Modified Mercalli Intensity
1.0 to 3.0	I
3.0 to 3.9	II to III
4.0 to 4.9	IV to V
5.0 to 5.9	VI to VII
6.0 to 6.9	VII to IX
7.0 and above	VIII or higher

Source: USGS

Table 33: Modified Mercalli Intensity

Modified Mercalli Intensity	Description
I	Not felt except by a very few under especially favorable conditions
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes and windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.

Modified Mercalli Intensity	Description
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry), structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown in the air.

Source: USGS[4]

Magnitude 3.0 to 3.9 earthquakes are often felt by people up to a hundred miles away from the epicenter but rarely cause damage. Magnitude 4.0 to 4.9 earthquakes cause shaking of objects indoors but generally cause none to slight damage. Magnitude 5.0 to 5.9 earthquakes can cause moderate to major damage to poorly constructed buildings but none to slight damage to other buildings.

Previous Occurrences

Connecticut has a moderate risk of earthquakes based on the frequency of their occurrence, not the intensity of individual earthquakes. Between 1568 and 1989, the state had 137 recorded earthquakes. According to records kept by Weston Observatory, between 1837 and 2018, 17 earthquakes were recorded in the Capitol Region. These were mainly centered in Hartford or east of the Connecticut River, except for one in the Kensington section of Berlin in 2017. Of those where the magnitude was known, all were under magnitude 4.0. Additional instances of seismic activity occurring in and around the region are noted below based on information in USGS documents and from the Weston Observatory, the 2014 *Connecticut Natural Hazard Mitigation Plan Update*, other municipal hazard mitigation plans, and newspaper articles. Figure 10 depicts the locations of historical earthquakes across the New England region.

February 5, 1663: A devastating earthquake near Three Rivers, Quebec, on February 5, 1663, caused moderate damage in parts of Connecticut.

November 1727 and November 1755: Strong earthquakes in Massachusetts were felt strongly in Connecticut.

May 16, 1791: The strongest earthquake in Connecticut history occurred in East Haddam in 1791 and is recorded with intensity VII. According to USGS, the earthquake, which was felt in Boston and New York City, caused stone walls and chimney tops to fall and latched doors to open. Weston Observatory estimates that this quake had a 4.4 magnitude.

August 1840: A moderate tremor with its epicenter 10 to 20 miles north of New Haven shook Hartford buildings but caused little damage. This quake is estimated as having a 3.8 magnitude.

October 1845: An intensity V earthquake occurred in Bridgeport and approximated at 4.3 on the Richter scale.

July 28, 1875: An early morning tremor caused intensity V damage throughout Connecticut and Massachusetts.

[4] https://earthquake.usgs.gov/learn/topics/mag_vs_int.php

November 1935: The Timiskarning, Ontario earthquake caused minor damage as far south as Cornwall, Connecticut. This earthquake affected 1 million square miles of Canada and the United States.

September 1944: An earthquake near Massena, New York, produced mild effects in Hartford, Marion (Southington), and New Haven, Connecticut.

June 23, 2010: A magnitude 5.0 earthquake struck at the Ontario-Quebec border region of Canada. This earthquake did not cause damage in Connecticut but was felt by residents in Hartford and New Haven Counties.

August 21, 2011: A magnitude 5.8 earthquake struck 38 miles from Richmond, Virginia. The quake was felt from Georgia to Maine and reportedly as far west as Chicago. Many residents of Connecticut experienced the swaying and shaking of buildings and furniture during the earthquake. According to Cornell University, the quake was the largest event to occur in the east-central United States since instrumental recordings have been available to seismologists.

October 16, 2012: A magnitude 4.6 earthquake that struck near Portland, Maine, was felt in Connecticut, including the Capitol Region. However, no damage was reported.

January 8-12, 2015: A series of quakes hit Plainfield, Connecticut. These events registered magnitudes of 2.0, 0.4, and 3.1. Residents in the Moosup section of Plainfield reported minor damage such as the tipping of shelves and fallen light fixtures.

December 17, 2017: A small event struck near Kensington in Berlin, Connecticut, registering Mn 1.0 and Mc 1.6.

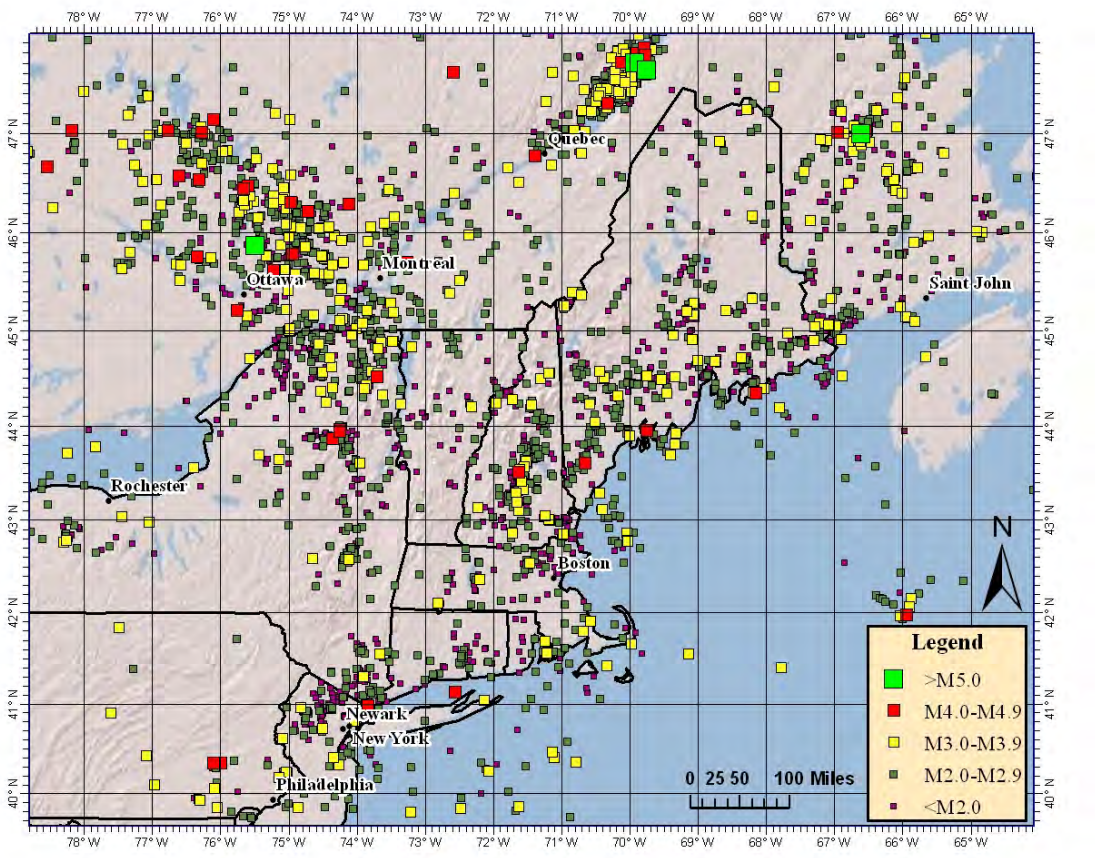


Figure 10: Earthquakes in New England, January 1975 – October 2013

This map, produced by Boston College's Weston Observatory, shows the epicenter of every earthquake detected in New England between 1975 and 2013.

Source: Weston Observatory, https://www.bc.edu/bc-web/schools/mcas/sites/weston-observatory.html

Connecticut: Earthquake History

According to the USGS, the lack of historical and instrumental reports of strong earthquakes in Connecticut suggests that the state is a region of very minor seismic activity, even when compared to other states in the Northeast region. Connecticut has, however, a history of earthquakes. The cause of earth noises or "rumblings" in the area near Moodus, a few miles north of East Haddam, have been a matter of scientific speculation for years. Native Indians called East Haddam *Morehemoodus*, or place of noises, and the town name "Moodus" is derived from the Indian word.

The most severe earthquake in Connecticut's history occurred at East Haddam on May 16, 1791. Describing that earthquake, an observer said, "It began at 8 o'clock p.m., with two very heavy shocks in quick succession. The first was the most powerful; the earth appeared to undergo very violent convulsions. The stone walls were thrown down, chimneys were untopped, doors which were latched were thrown open, and a fissure in the ground of several rods in extent was afterwards discovered. Thirty lighter ones followed in a short time and upwards of one hundred were counted in the course of the night."

Historical records show the next moderate tremor occurred at Hartford in April 1837. "It jarred loose articles, set lamps swinging, and rang bells. Alarmed residents rushed from their homes into the streets." In August 1840, an earthquake of similar intensity centered apparently 10 to 20 miles north of New Haven shook Hartford strongly and was felt at many points in Connecticut. No damage resulted however. At Chester, not far from East Haddam, observers compared the tremor "to the rumble of thunder."

The strongest tremor since that in 1791 hit near Hartford on November 14, 1925, at about 8:00 a.m. Plaster was knocked from walls, and many residents were frightened. At Windham, dishes were shaken from shelves, and at East Haddam, the familiar "Moodus" rumblings were noted. More recently, in March 1953, Stamford sustained a minor tremor that alarmed many. "Radiators beat a weird tattoo against the floor of the police station," notes one report. Houses were jarred, and earth noises were heard. The tremor caused no damage. An intensity V earthquake in southern Connecticut occurred on November 3, 1968, at about 3:30 in the morning. Plaster cracked at Madison, furniture shifter at Chester, and small items fell and broke. Loud earth noises accompanied the tremor. The Moodus noises were noted once again at East Haddam.

A few damaging shocks centered in neighboring states and several Canadian tremors have been felt in Connecticut over the past 300 years. A devastating earthquake near Tros-Rivieres (Three Rivers), Quebec, on February 5, 1663, caused moderate effects in some areas of Connecticut. Massachusetts quakes in November 1727 and November 1755 were felt strongly by some in Connecticut. Both resulted in collapsed walls, toppled chimneys, and other damage common to most strong earthquakes at their epicenters.

The Timiskaming, Ontario, earthquake in November 1935 was quite noticeable in Connecticut and other New England states. Several cracked windowpanes were noted at Cornwall, Connecticut. Because of the sparse population, damage at the epicenter of this tremor was insignificant. However, an indication of its severity was the large felt area – one million square miles of Canada and the United States. An earthquake near Massena, New York, in September 1944 was also felt over a wide region. Mild effects were noticed by residents of Hartford, Marion, New Haven, and Meriden, Connecticut. At its epicenter, the shock destroyed nearly all chimneys, crippled several buildings, and caused $2 million property damage in that region.

Source: Abridged from Earthquake Information Bulletin, January - February 1971. Taken from USGS

Probability

According to the 2014 *Connecticut Natural Hazard Mitigation Plan Update*, Connecticut experiences less than one earthquake event per year and "may be categorized as having a low or moderate risk for an earthquake greater than or equal to 3.5 occurring in the future and a moderate risk of an earthquake less than 3.0 occurring in the future." When earthquakes are reported in Connecticut, they have most frequently occurred in the southern and eastern parts of the state.

According to the USGS, Connecticut is in an area of moderate to low risk for earthquakes. Central Connecticut has a 2% chance of seeing an earthquake with peak ground acceleration exceeding 8% to 10% of gravity in 50 years (corresponding to a return period for an earthquake of this intensity of over 2,000 years, Figure 11). An earthquake in exceedance of 10% of gravity is generally considered one that would damage older dwellings and those not resistant to earthquakes.

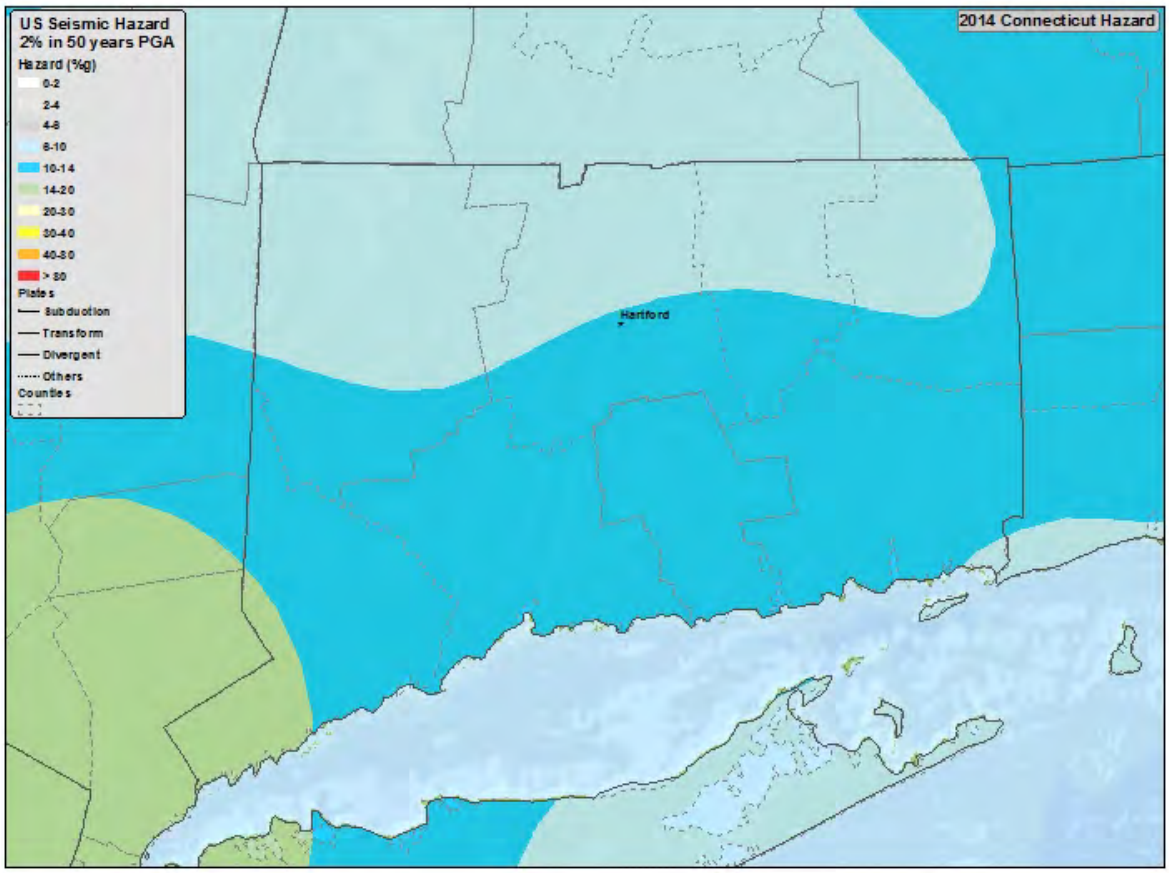


Figure 11: Earthquake Hazard Map for Connecticut

This map shows the peak ground acceleration (a measure of earthquake intensity) that has a 2% chance of occurring over the course of a 50-year period in Connecticut. Note that the southern half of the Capitol Region has a slightly higher exposure to earthquake hazards than the northern half. Overall risk is low.

Source: USGS, https://earthquake.usgs.gov/earthquakes/byregion/connecticut-haz.php

Impacts to Community Assets

Unlike seismic activity in California, earthquakes in Connecticut are not associated with specific known faults. Instead, earthquakes with epicenters in Connecticut are referred to as intraplate activity. Bedrock in Connecticut and New England in general is highly capable of transmitting seismic energy; thus, the area impacted by an earthquake in Connecticut can be four to 40 times greater than that of California. For example, the relatively strong earthquake that occurred in Virginia in 2011 was felt in Connecticut because the energy was transmitted over a great distance through hard bedrock. In addition, population density is up to 3.5 times greater in Connecticut than in California, potentially putting a greater number of people at risk.

Areas of artificial fill, finer textured soils, and steep slopes are particularly at risk of earthquakes, especially when saturated with water, due to liquefaction and landslides.

Surficial earth materials behave differently in response to seismic activity. Unconsolidated materials such as sand and artificial fill can amplify the shaking associated with an earthquake. In addition, artificial fill material has the potential for liquefaction. Liquefaction is a phenomenon in which the strength and stiffness of a soil are reduced by earthquake shaking or other rapid loading. It occurs in soils at or near saturation and especially in finer textured soils as well as artificial fill. When liquefaction occurs, the ability of soil to support building foundations and bridges is reduced. Increased shaking and liquefaction can cause greater damage to buildings and structures and a greater loss of life.

Areas of steep slopes can collapse during an earthquake, creating landslides. Seismic activity can also break utility lines such as water mains, electric and telephone lines, and stormwater management systems. Damage to utility lines can lead to fires, especially in electric and gas mains. Dam failure can also pose a significant threat to developed areas during an earthquake.

The built environment in Connecticut includes old nonreinforced masonry that is not seismically designed. Connecticut incorporated building codes for seismic activity into the state building code in 1992. There were no requirements prior to that. So, while the risk for a very damaging earthquake is relatively low in the region, some structures may be impacted by less intense earthquakes depending on the soil and integrity of the structure. Those who live or work in nonreinforced masonry buildings, especially those built on filled land or unstable soils, are at the highest risk for injury due to the occurrence of an earthquake.

According to the 2014 *Connecticut Natural Hazard Mitigation Plan*, Hartford and Tolland Counties are considered to have a low earthquake hazard ranking. Of the towns in the region, Hartford and New Britain would have the highest risk from earthquakes simply because their buildings and infrastructure are tightly packed, and many structures may have been erected before seismic impacts were incorporated into the state building code in 1992. However, due to a variety of factors, including distance from fault lines, building types, and settlement patterns, risk to the region in general from earthquake damage is quite small.

Loss Estimates from HAZUS-MH

The 2014 *Connecticut Natural Hazard Mitigation Plan Update* simulated four "maximum plausible" earthquake scenarios (three historical, one potential) within HAZUS-MH to generate the potential

earthquake risk to the state of Connecticut. The same four scenarios were simulated within HAZUS-MH to generate potential damages in the Capitol Region from those events using the default year 2010, building inventories and census data. The four events are as follows:

- Magnitude 5.7, epicenter in Portland, based on historic event
- Magnitude 5.7, epicenter in Haddam, based on historic event
- Magnitude 6.4, epicenter in East Haddam, based on historic event
- Magnitude 5.7, epicenter in Stamford, magnitude based on USGS probability mapping

Copies of these HAZUS-MH Earthquake Event Reports are included in Appendix C. Results are included in the individual community annexes. It should be noted that the 2018 update to the Connecticut Natural Hazard Mitigation Plan (anticipated adoption in 2019) repeated the same four scenarios, and many local Hazard Mitigation Plans in Connecticut have moved toward the same approach.

These simulations highlight the significance of the location of the epicenter to the damages that could be expected. A moderately strong earthquake centered near a more populated, built-up area would be expected to result in considerably more damage than one located in a more remote area.

In addition to the four scenarios included in the 2014 *Connecticut Natural Hazard Mitigation Plan Update,* HAZUS-MH was used to simulate a probabilistic earthquake for the Capitol Region. These results are likewise included in the individual community annexes.

Based on our history and geology, the Capitol Region's overall risk of damaging earthquakes is low. The damages we are likely to face here from earthquakes are much lower than in other parts of the nation and world. Annualized losses help express this low-risk profile. In order to estimate annualized loss due to earthquakes for the Capitol Region, CRCOG used probabilistic curves developed by the USGS for the National Earthquakes Hazards Reduction Program to run a probabilistic earthquake scenario. Based on the results of this analysis, the annualized loss due to earthquake damage is estimated at $3.1 million. The magnitude of this figure stems from the fact that the Capitol Region has a large building inventory that could be damaged in a severe earthquake.

Table 34: HAZUS-MH Probabilistic Annualized Loss Estimates due to Earthquakes

Town	Loss Estimate	Town	Loss Estimate	Town	Loss Estimate
Andover	$7,886	Farmington	$105,864	Somers	$23,947
Avon	$72,140	Glastonbury	$149,513	South Windsor	$127,885
Berlin	$76,322	Granby	$23,104	Southington	$86,576
Bloomfield	$79,129	Hartford	$477,547	Stafford	$30,084
Bolton	$13,170	Hebron	$22,373	Suffield	$36,593
Canton	$27,971	Manchester	$186,330	Tolland	$34,417
Columbia	$14,010	Mansfield	$79,399	Vernon	$81,543
Coventry	$25,283	Marlborough	$17,160	West Hartford	$221,366
East Granby	$17,850	New Britain	$195,635	Wethersfield	$75,002
East Hartford	$149,650	Newington	$109,535	Willington	$12,463
East Windsor	$36,503	Plainville	$62,897	Windsor	$95,119
Ellington	$34,226	Rocky Hill	$76,143	Windsor Locks	$43,015
Enfield	$120,650	Simsbury	$67,629	**Total Region**	**$3,115,929**

Drought

Although Connecticut has a relatively even distribution of precipitation throughout the year, droughts periodically occur. Lack of precipitation in combination with the typical summer temperatures in the high 80s and low 90s can quickly dry out the soil and streams, leading to drought conditions.

Location

All areas of the Capitol Region communities are susceptible to drought although the likelihood of crop damage and economic loss is generally greater in rural communities. More developed communities are also susceptible to drought, particularly when the drought impacts the availability of water supply. In general, the Capitol Region communities are likely to be part of a larger regional area affected by drought as opposed to being individually affected.

Extent

There are three types of droughts that are a concern in Connecticut: meteorological, hydrological, and agricultural droughts. Both types of droughts can and often do occur simultaneously.

- **Meteorological Droughts** are periods of time where precipitation is lower than "normal" for a time period that is longer than "normal." Because it is defined according to typical conditions, it is region specific. In the New England region, both hydrological droughts and agricultural droughts are directly tied to meteorological droughts.

- **Hydrological Droughts** are characterized by low streamflow, groundwater, and reservoir levels resulting from a lack of precipitation over the course of months. When the presence of rainfall becomes scarce, streams, rivers, and groundwater can suffer, and water utilities can be forced to set restrictions on usage. It can take months to recover from such droughts. Land use also influences the severity and timing of droughts. Areas with vast impervious surface coverage inhibit groundwater recharge and can therefore hasten the onset of a hydrological drought or increase its intensity. Wildfires can also be more prevalent during such droughts.

- **Agricultural Droughts** occur during the growing season due to a lack of adequate precipitation and soil moisture to sustain crops. It is determined when the hydration needs of crops are not being sustained by the soil. The region can recover from an agricultural drought more quickly than from a hydrological drought; however, an agricultural drought can result in significant economic losses for the agricultural community.

The Palmer Drought Severity Index was devised in 1965. It uses temperature and precipitation data to calculate water supply and demand, incorporates soil moisture, and is considered most effective for determining the severity of drought on unirrigated cropland. It primarily reflects long-term drought and has been used extensively to initiate drought relief. The index ranges from -4.0 (or less) to +4.0 (or more), with an index of 0.0 representing normal conditions. Indexes from -2.0 to -.9 indicate moderate drought, indexes from -3.0 to -3.9 represent severe drought, and indexes of -4.0 or less indicate extreme drought. Positive indices represent increasing moisture in the soil.

Previous Occurrences

According to the Connecticut Drought Preparedness and Response Plan, droughts have occurred periodically in the state. Serious hydrological droughts were recorded from June 1929 through July 1932. The 1957 drought was both hydrological and agricultural, with the largest impact being on crops. The most recent droughts occurred in 1964-1968, 1981, 1987, 2002, 2005, 2007-2008, 2012, and 2015-2016.

During the 2002 drought, several water utilities imposed mandatory water conservation and restriction measures on their customers while most other companies imposed voluntary restrictions. Such restrictions can impact businesses as well as residences. The state responded to the 2002 drought by developing a drought management plan, which established monitoring and assessment protocols. (See the Drought Matrix below.) During the height of this drought, some municipalities conducted public outreach and education regarding water conservation.

A meteorological drought was most recently declared for Hartford, Tolland, and Windham Counties from April 12 through April 24, 2012, due to precipitation levels that were approximately half of normal levels. According to the NOAA Storm Events Database, rivers and streams were most affected as most ran at record low levels during the spring runoff season. The state did not issue a drought declaration; however, as reservoirs were at normal levels thanks largely to above-normal precipitation falling between August 2011 and November 2011. The main impact of this meteorological drought was periods of very high fire danger. In addition, small pond levels were reduced. While soil moisture was well below normal, this drought occurred prior to the beginning of the growing season. Thus, no agricultural impacts were realized.

The 2016 drought was one of the most severe for Connecticut in recent memory, with precipitation in Windsor Locks measured at nearly 13 inches below normal for the year. Numerous water utilities imposed mandatory water use restrictions on their customers, and several areas reported private wells running dry. The state has responded to this most recent drought by reevaluating the 2003 drought plan.

Probability

The 2014 *Connecticut Natural Hazard Mitigation Plan Update* indicates that Connecticut has a medium-high probability of future drought events. In the Northeast, short seasonal droughts lasting

1 to 3 months usually occur every 2 or 3 years. Longer droughts, with durations exceeding 3 months, are less frequent and occur every 20 to 30 years.

The future frequency of droughts in the region may depend upon the changes in climate and resource use. As the state's plan notes, predicting the future occurrences of drought within any given time period is difficult. As pointed out in the state plan, climate change acts, which amplify natural hazards and extreme weather events, have become more frequent over the past half century. Climate change can bring more intense heat waves, which may result in more droughts. Drought remains a potential natural hazard for the Capitol Region. Also, as the state's plan notes, because human actions can increase the risk of water shortages without any change in meteorological conditions, efforts to conserve water and reduce runoff can protect our water resources even in nondrought periods.

Impacts to Community Assets

Droughts periodically occur in Connecticut and can have serious consequences. While a drought does not pose immediate threats to life and property, it can have severe economic, environmental, and social consequences. A lack of precipitation can affect not only agricultural production but also tourism, water utilities, residential wells, businesses, and more. Droughts may also lead to losses or destruction of fish and wildlife habitat, loss of wetlands, and lower water levels in reservoirs, lakes, and ponds. The reduction in water levels can also cause private wells to go dry or pumps to fail and can cause dry hydrants to be unusable for fire protection purposes.

In addition, droughts can increase the severity of flooding as land that has been dry for extended periods of time does not allow water to infiltrate as quickly, which may lead to flash flooding. Droughts also exacerbate the possibility of wildfires due to the very dry conditions. See the following pages for a checklist of potential consequences from the National Drought Mitigation Center.

According to the American Planning Association, since 1980, drought has been the fourth most common type of disaster in the United States but is the second most costly overall and per incident. Much of the United States was in the midst of a severe and persistent drought in 2012. This drought affected almost 40% of the country's agricultural land and nearly a third of all farms. Although the eastern seaboard did not experience severe drought conditions in 2012, the impacts are likely to be felt nationwide. One consequence of the 2012 drought was an increase in the cost of food; 2013 prices were expected to rise by 2% to 4.5% for a variety of food products.

Based on information reported to the NCEI, drought has not caused any damages in Hartford and Tolland Counties. However, this may simply be because drought is a persistent hazard when it occurs, and losses occur gradually over time. The Capitol Region communities believe that the annualized loss due to drought is minimal and is therefore estimated as $0 for each community in this plan. More information is presented in the individual annex for each community.

Figure 12: Connecticut Drought Matrix

					Palmer Drought Index		
	Precipitation	**Groundwater**	**Streamflow**	**Reservoirs**	**Severity**	**Crop Moisture**	**Fire Danger**
ADVISORY	2 months (cumulative) below %65 of normal	3 consecutive months below normal *	2 out of 3 months below normal *	Average levels less than 80% of normal	-2.0 to -2.99	-1.0 to -1.99 abnormally dry,	Moderate
WATCH	3 months cumulative below 65% of normal	4 consecutive months below normal *	4 out of 5 months below normal *	Average levels less than 70% of normal	-3.0 to -3.99	-2.0 to -2.99 excessively dry	High
WARNING	More than 4months cumulative below 65% of normal,	4 consecutive months below normal *	6 out of 7 months below normal *	Average levels less than 60% of normal.	-4 or less	-3 or less	Very High
EMERGENCY	More than 6 months cumulative below 65% of normal	8 consecutive months below normal *	7 months below normal *	Average levels less than 50% of normal or less than 50 days of supply	-4 or less	-3 or less severely dry	Extreme

* Normal levels for groundwater and streamflow are defined as the 25th percentile of the period of record.

Source: State of Connecticut Interagency Drought Work Group, www.ct.gov/waterstatus/cwp/view.asp?a=3238&q=397062

Checklist of Potential Drought Impacts

Economic:

Costs and losses to agricultural and livestock producers—

- Annual and perennial crop losses
- Damage to crop quality
- Income loss for farmers due to reduced crop yields
- Reduced productivity of cropland (wind erosion, long-term loss of organic matter, etc.)
- Insect infestation
- Plant disease
- Wildlife damage to crops
- Increased irrigation costs
- Cost of new or supplemental water resource development (wells, dams, pipelines)
- Reduced milk production
- Forced reduction of foundation stock
- High cost/unavailability of water and/or feed for livestock
- Increased feed transportation costs
- High livestock mortality rates
- Disruption of reproduction cycles (delayed breeding, more miscarriages)
- Decreased stock weights

Loss from timber production—

- Wildland fires
- Tree disease
- Insect infestation
- Impaired productivity of forest land
- Direct loss of trees, especially young ones

Loss from fishery production—

- Damage to fish habitat
- Loss of fish and other aquatic organisms due to decreased flows

General economic effects—

- Decreased land prices
- Loss to industries directly dependent on agricultural production
- Unemployment from drought-related declines in production
- Strain on financial institutions (foreclosures, more credit risk, capital shortfalls)
- Revenue losses to federal, state, and local governments (from reduced tax base)
- Reduction of economic development
- Fewer agricultural producers (due to bankruptcies, new occupations)
- Rural population loss

Loss to recreation and tourism industry—

- Loss to manufacturers and sellers of recreational equipment
- Losses related to curtailed activities: hunting and fishing, bird watching, boating, etc.

Energy-related effects—

- Increased energy demand and reduced supply because of drought-related power curtailments
- Costs to energy industry and consumers associated with substituting more expensive fuels (oil) for hydroelectric power

Water suppliers—

- Revenue shortfalls and/or windfall profits
- Cost of water transport or transfer
- Cost of new or supplemental water resource development

Transportation industry—

- Loss from impaired navigability of streams, rivers, and canals

Decline in food production/disrupted food supply—

- Increase in food prices
- Increased importation of food (higher costs)

Checklist of Potential Drought Impacts

Environmental:

Damage to animal species—

- Reduction and degradation of fish and wildlife habitat
- Lack of feed and drinking water
- Greater mortality due to increased contact with agricultural producers as animals seek food from farms and producers are less tolerant of the intrusion
- Disease
- Increased vulnerability to predation (from species concentrated near water)
- Migration and concentration (loss of wildlife in some areas and too many wildlife in other areas)
- Increased stress to endangered species
- Loss of biodiversity

Hydrological effects—

- Lower water levels in reservoirs, lakes, and ponds
- Reduced flow from springs
- Reduced streamflow
- Loss of wetlands
- Estuarine impacts (e.g., changes in salinity levels)
- Increased groundwater depletion, land subsidence, reduced recharge
- Water quality effects (salt concentration, increased water temperature, pH, dissolved oxygen, turbidity)

Damage to plant communities—

- Loss of biodiversity
- Loss of trees from urban landscapes, shelterbelts, wooded conservation areas
- Increased number and severity of fires
- Wind and water erosion of soils, reduced soil quality
- Air quality effects (e.g., dust, pollutants)
- Visual and landscape quality (e.g., dust, vegetative cover, etc.)

Social:

Health—

- Mental and physical stress (e.g., anxiety, depression, loss of security, domestic violence)
- Health-related low-flow problems (e.g., cross-connection contamination, diminished sewage flows, increased pollutant concentrations, reduced firefighting capability, etc.)
- Reductions in nutrition (e.g., high-cost food limitations, stress-related dietary deficiencies)
- Loss of human life (e.g., from heat stress, suicides)
- Public safety from forest and wildland fires
- Increased respiratory ailments
- Increased disease caused by wildlife concentrations

Increased conflicts—

- Water user conflicts
- Political conflicts
- Management conflicts
- Other social conflicts (e.g., scientific, media based)

Reduced quality of life, changes in lifestyle—

- Population migrations (rural to urban areas, migrants into the United States)
- Loss of aesthetic values
- Disruption of cultural belief systems (e.g., religious and scientific views of natural hazards)
- Reevaluation of social values (e.g., priorities, needs, rights)
- Public dissatisfaction with government drought response
- Perceptions of inequity in relief, possibly related to socioeconomic status, ethnicity, age, gender, seniority
- Loss of cultural sites
- Increased data/information needs, coordination of dissemination activities
- Recognition of institutional restraints on water use

Source: National Drought Mitigation Center, University of Nebraska-Lincoln, http://drought.unl.edu/Home.aspx

Forest and Wildland Fires

Wildfires are a relatively common occurrence in Connecticut but are typically small and cause little to no damage to populated areas. Structural fires in higher-density areas of the region are not considered herein.

Location

Wildfires typically occur in undeveloped rural or forested areas although smaller fires can also occur along highway medians. Wildfire damage is typically greatest at the wildland interface where low-density suburban/rural developed areas border undeveloped wooded and shrubby areas. Wildfires are of particular concern for areas with limited firefighting access such as outlying areas without public water service and large contiguous forest parcels with limited access. All Capitol Region communities are susceptible to lightning. Unlike the other hazards described in this Plan, the likelihood of damage due to wildfires in Connecticut typically decreases with increasing population density, meaning that less developed communities such as Willington have a greater risk than heavily developed communities such as New Britain.

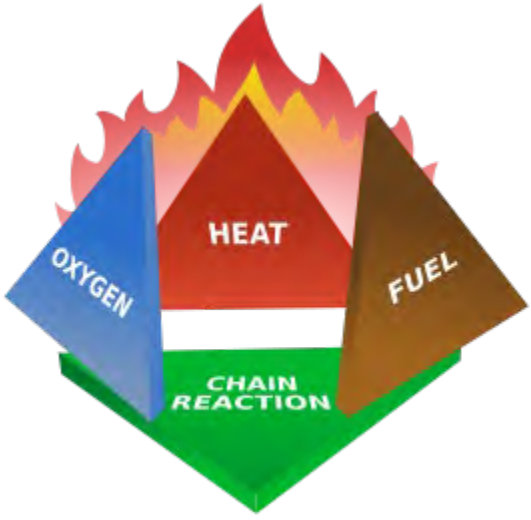
Areas of wildfire risk in the Capitol Region are depicted in Map 10.

Extent

Wildfires are any nonstructure fire, other than a prescribed burn, that occurs in undeveloped areas. They are considered to be highly destructive, uncontrollable fires. Although the term brings to mind images of tall trees engulfed in flames, wildfires can occur as brush and shrub fires, especially under dry conditions. Wildfires are also known as "wildland fires."

According to the National Fire Protection Agency, several elements (known as the fire tetrahedron) must be present in order to have any type of fire:

- **Fuel**: Without fuel, a fire will stop. Fuel can be removed naturally (when the fire has consumed all burnable fuel) or manually by mechanically or chemically removing fuel from the fire. In structure fires, removal of fuel is not typically a viable method of fire suppression. Fuel separation is important in wildfire suppression and is the basis for controlling prescribed burns and suppressing other wildfires. The type of fuel present in an area can help determine overall susceptibility to wildfires. According to the Forest Encyclopedia Network, four types of fuel are present in wildfires:



The Fire Tetrahedron
Image Provided Wikimedia Commons

- Ground Fuels: organic soils, forest floor duff, stumps, dead roots, buried fuels
- Surface Fuels: the litter layer, downed woody materials, dead and live plants to 2 meters tall
- Ladder Fuels: vine and draped foliage fuels
- Canopy Fuels: tree crowns

- **Heat**: Without sufficient heat, a fire cannot begin or continue. Heat can be removed through the application of a substance, such as water, powder, or certain gases, that reduces the amount of heat available to the fire. Scraping embers from a burning structure also removes the heat source.

- **Oxygen**: Without oxygen, a fire cannot begin or continue. In most wildland fires, this is commonly the most abundant element of the fire triangle and is therefore not a major factor in suppressing wildfires.

- **Uninhibited Chain Reaction**: The chain reaction is the feedback of heat to the fuel to produce the gaseous fuel used in the flame. In other words, the chain reaction provides the sustained heat necessary to maintain the fire. Fire suppression techniques, such as dry chemical extinguishers, break up the uninhibited chain reaction of combustion to stop a fire.

The Connecticut Department of Energy & Environmental Protection Division of Forestry issues forest fire danger ratings. The ratings are low, moderate, high, very high, and extreme. These are based on an index of how quickly a fire is likely to spread and measures of drought. In addition, the National Weather Service issues "Red Flag" warnings. A Red Flag warning means that if a fire occurs, firefighters can expect it to behave erratically due to weather conditions.

Previous Occurrences

According to the Connecticut DEEP Forestry Division, much of Connecticut was deforested by settlers and turned into farmland during the colonial period. A variety of factors in the 19th century caused the decline of farming in the state, and forests reclaimed abandoned farm fields. In the early 20th century, deforestation again occurred in Connecticut, this time for raw materials needed to ship goods throughout the world. Following this deforestation, shipping industries in Connecticut began to look to other states for raw materials, and the deciduous forests of today began to grow in the state.

During the early 20th century, wildfires regularly burned throughout Connecticut. Many of these fires began accidentally by sparks from railroads and industry while others were deliberately set to clear underbrush in the forest and provide pasture for livestock. A total of 15,000 to 100,000 acres of land was burned annually during this period. This destruction of resources led to the creation of the position of the State Forest Fire Warden and led to a variety of improved coordination measures described in Section III.

In the last 20 years, a handful of notable fires have occurred in the Capitol Region. Statewide droughts in 1999 and 1995 resulted in fires in the region and in other locations in the state. Several fires from the Capitol Region were reported on in the *Hartford Courant*:

May 1995: A forest fire burned nearly 40 acres on a ridge near the Sweetheart Lake area of Tolland. Officials believed the fire was started accidentally. Unusually dry conditions contributed to the fire's spread. Approximately 50 firefighters from seven departments laid nearly 2,000 feet of hose to contain the fire at its perimeter.

September 1995: During a drought, a blaze started in Southington that burned over 25 acres of land for 3 days before being contained. No homes or businesses were affected.

April 1999: A brush fire in the Talcotville section of Vernon burned about 40 acres. Eight fire departments battled the blaze, hauling water in tanker trucks. The fire came within 100 feet of houses in a nearby neighborhood.

August 1999: A forest fire burned over 18 acres of woodland along the Berlin/Meriden border for 7 days before being extinguished. The Berlin Fire Chief suspected that the blaze originated from a campfire. No homes or businesses were affected. This was just one fire in what is considered the worst wildfire year in Connecticut, where over 1,733 acres burned in 345 separate wildfires, or an average of 5 acres per fire.

April 2005: A fire burned about 8 acres near the Farmington River in Avon. About 30 firefighters from five departments put the fire out. The DEP (predecessor of DEEP) Division of Forestry reported a "high" forest fire danger level for that day.

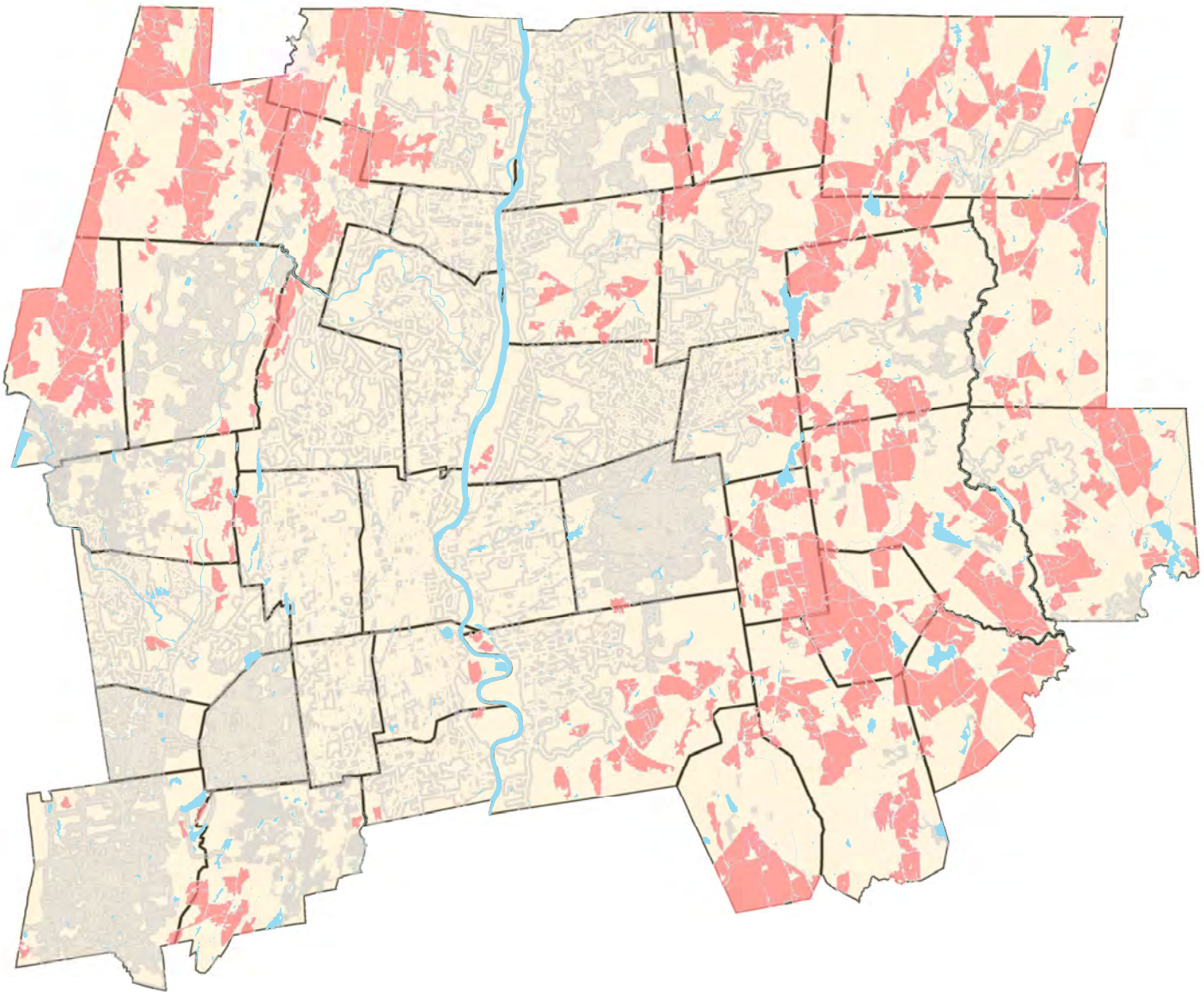
Throughout Connecticut, 1999 was a particularly busy fire year because of drought conditions. The state's 2014 *Natural Hazard Mitigation Plan Update* notes that the worst year for wildland fires in the past decade was 2012 when 577 separate fire events occurred throughout the state. The 2016 drought also exacerbated wildland fires, with over 900 acres burned in the state (Table 35 below).

Probability

Nationwide, humans have caused approximately 90% of all wildfires in the last decade. Accidental and negligent acts include unattended campfires, sparks, burning debris, children playing with matches, and irresponsibly discarded cigarettes. The remaining 10% of fires are caused primarily by lightning.

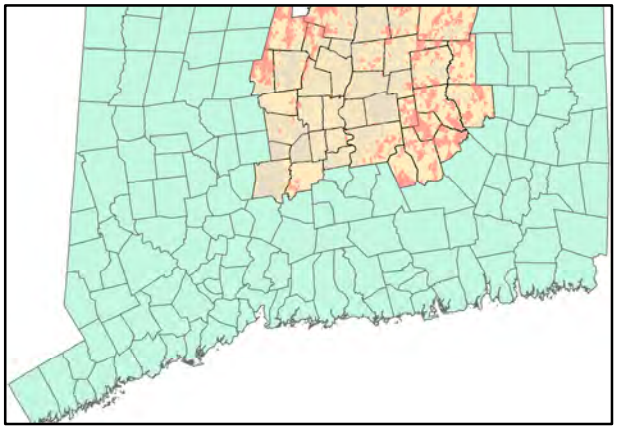
There are three fire seasons in Connecticut. The spring season runs from mid-March to mid-May. Prior to leaf-out, fuels such as grasses, dead leaves, branches, and twigs on the forest floor are heated and dried out by the sun. These fuels cause spring fires that tend to spread quickly although they tend to cause little long-term damage to the forest. The summer fire season lasts from mid-May through September and is largely dependent on precipitation, or lack thereof. Summer fires tend to spread less quickly than spring fires because they burn deeper into the ground. However, the burning of organic material in the soil makes summer fires more difficult to suppress. Summer fires are the most destructive to vegetation. Consequently, erosion usually follows summer forest fires. The fall fire season runs from October through the first snowfall. Fall fires can spread rapidly because of drying leaves that have fallen.

Fire risk in the region is believed to be roughly the same as in the rest of the state. According to the USDA *Forest Service Annual Wildfire Summary Report* for 1994 through 2003, an average of 600 acres per year in Connecticut was burned by wildfires. The National Interagency Fire Center (NIFC) reports that a total of 4,935 acres of land burned in Connecticut from 2002 through 2017 due to 2,879 nonprescribed wildfires, an average of 1.7 acres per fire and 308 acres per year (Table 35).



LEGEND

- High Wildfire Risk Area
- Low Wildfire Risk Area
- Rivers & Lakes
- PWS Distribution Systems



SOURCE(S):
Connecticut DEEP

Map 10: Wildfire Risk Areas

LOCATION:
Capitol Region, CT

N

Capitol Region Natural Hazards Mitigation Plan Update

MXD: Y:\2020-16\Maps\Map_10_Wildire_Risk_Areas.mxd

Map By: VLB
MMI#: 2020-16
Original: 7/25/2018
Revision: 7/26/2018
Scale: 1 inch = 30,000 feet

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Table 35: Wildland Fire Statistics for Connecticut

Year	Number of Wildland Fires	Acres Burned	Number of Prescribed Burns	Acres Burned	Total Acres Burned
2017	97	243	3	31	274
2016	268	778	3	152	930
2015	76	159	4	25	184
2014	28	69	4	34	103
2013	76	238	4	37	275
2012	180	417	4	42	459
2011	196	244	7	42	286
2010	93	262	6	52	314
2009	264	246	6	76	322
2008	330	893	6	68	961
2007	361	288	7	60	348
2006	322	419	6	56	475
2005	316	263	10	130	393
2004	74	94	12	185	279
2003	97	138	8	96	234
2002	101	184	13	106	290
Total	**2,879**	**4,935**	**103**	**1,192**	**6,127**

Source: National Interagency Fire Center

The Connecticut DEEP Forestry Division estimates the average acreage burned per year statewide to be much higher (1,300 acres per year) in the 2014 *Connecticut Natural Hazard Mitigation Plan Update*. In general, the wildland fires in Connecticut are small and detected quickly, with most of the largest wildfires being contained to less than 10 acres in size. While the overall incidence of forest fires is relatively low (an average of 180 fires per year from 2002 to 2017, or slightly more than one fire per Connecticut municipality per year), wildfires are a hazard communities must be prepared for each year.

Based on the historic record, the average wildfire in Connecticut in a very dry year (1999) burned an average of 5 acres per fire while the average acres burned per fire has been 1.7 acres per year since 2002. These averages are also reasonable for the Capitol Region communities although it is expected that larger wildfires could occur, particularly in relatively undeveloped areas such as parts of Berlin, Southington, Vernon, and Willington.

Impacts to Community Assets

The Connecticut DEEP also states that the primary cause of wildland fires in seven of the eight counties is undetermined, with the secondary cause being arson or debris burning. Forest fires can cause not only long-term damage to vegetation and ecosystems but also damage to developments, especially as residential development has increased in woodland areas.

Estimates of annualized loss have been determined based on data presented in the 2014 *Connecticut Natural Hazard Mitigation Plan Update*. The inverse of the population density of each town as compared to the population density of the county was used to adjust the wildfire statistics for average fire size and the number of annual events (Table 2-61 of the state plan). An estimated average cost of $2,000 per event was used to determine costs based on previous estimates developed during the former WinCOG region hazard mitigation plan update. This method generally allows for larger wildfire losses to be estimated for the communities with a lower population density as these communities are known to generally be more prone to wildfires in Connecticut. Overall, the annualized losses for the Capitol Region due to wildfire are relatively modest.

Table 36: Annualized Loss Estimates due to Wildfire

Town	Loss Estimate	Town	Loss Estimate	Town	Loss Estimate
Andover	$2,027	Farmington	$5,208	Somers	$3,723
Avon	$4,303	Glastonbury	$9,530	South Windsor	$5,216
Berlin	$4,892	Granby	$7,561	Southington	$6,675
Bloomfield	$4,849	Hartford	$3,230	Stafford	$7,616
Bolton	$1,891	Hebron	$4,847	Suffield	$7,855
Canton	$4,571	Manchester	$5,093	Tolland	$5,200
Columbia	$2,886	Mansfield	$5,852	Vernon	$2,323
Coventry	$4,930	Marlborough	$4,340	West Hartford	$4,059
East Granby	$3,264	New Britain	$2,489	Wethersfield	$2,288
East Hartford	$3,346	Newington	$2,442	Willington	$4,368
East Windsor	$4,879	Plainville	$1,805	Windsor	$5,483
Ellington	$4,469	Rocky Hill	$2,500	Windsor Locks	$1,677
Enfield	$6,184	Simsbury	$6,305		

Hazards Summary

The outline below summarizes the risks faced throughout the Capitol Region to the natural hazards evaluated in this plan update. The frequencies, potential impacts, vulnerable locations, and likely economic losses of each natural hazard are presented. Following this outline is Table 37, which summarizes the vulnerabilities and key issues concerning these natural hazards each of the 38 communities of the Capitol Region face. Table 37 summarizes the concerns local officials identified during the plan update process relating to the impacts natural hazards have on the critical facilities, vulnerable locations and populations, and cultural assets of their communities.

Dam Failure

Frequency:	The likelihood of dam failure is greatest in conjunction with floods, hurricanes, and earthquakes. A dam failure has not occurred in the Capitol Region since the prior plan was approved in 2014.
Potential Impacts:	Bodily harm and loss of life and property. A water shortage may occur if a dam failure impacts an active reservoir.
Vulnerable Locations:	Stream reaches below dams
Economic Loss:	Repair and replacement costs, business disruption, debris removal and cleanup costs

Drought

Frequency:	A drought occurs about once every 7 years (a 14% annual-chance of occurrence), although flashy droughts may become more common due to climate change. The drought of 2015-2016 occurred in the Capitol Region since the prior plan was approved in 2014.
Potential Impacts:	Water shortages, environmental and human health issues, and increased risk of wildfires, especially in low-density, forested areas
Vulnerable Locations:	Entire region
Economic Loss:	Agricultural and water-dependent businesses may incur losses.

Earthquake

Frequency:	A magnitude four or higher earthquake is likely to occur approximately once every 25 years, or a 4% chance of occurrence in any given year. A very low-magnitude earthquake occurred in the Capitol Region since the prior plan was approved in 2014.
Potential Impacts:	Minimal property and content damage
Vulnerable Locations:	Entire region
Economic Loss:	Repair and replacement costs

Floods

Frequency:	Major flooding of small rivers and loss of life can be expected every 5 to 10 years throughout the state. Major flooding of larger rivers, such as the Connecticut and Farmington, with loss of life and structural damage can be expected once every 30 years. Only small localized floods have occurred in the Capitol Region since the prior plan was approved in 2014.
Potential Impacts:	Breached dams, street closures, power outages, utility damage, property and content damage, basement flooding, bodily harm, and death
Vulnerable Locations:	Floodprone and poorly drained areas
Economic Loss:	Repair and replacement costs, business disruption, debris removal, and cleanup costs

Forest and Wildland Fires

Frequency:	Very low likelihood of damaging wildfires. Small wildfires occur frequently. Only small wildfires have occurred in the Capitol Region since the prior plan was approved in 2014.
Potential Impacts:	Property and content damage, bodily harm, and death
Vulnerable Locations:	At the woodland/suburban interface
Economic Loss:	Repair and replacement costs, business disruption, debris removal, and cleanup costs

Hurricanes and Tropical Storms

Frequency:	A moderate category II hurricane can be expected to hit the state once every 10 years. A major category III or IV hurricane may hit before 2040 based on 20th century trends. Hurricanes are often downgraded to Tropical Storm status by the time they reach inland Connecticut. A tropical storms or hurricane has not passed through the Capitol Region since the prior plan was approved in 2014.
Potential Impacts:	Street closures, power outages, tree damage, utilities damage, property and content damage, bodily harm, and death
Vulnerable Locations:	Entire region but especially floodprone and poorly drained areas
Economic Loss:	Repair and replacement costs, business disruption, debris removal, and cleanup costs

Tornadoes

Frequency:	An average of three tornadoes every 2 years occur in the state. Only one tornado has occurred in the Capitol Region since the prior plan was approved in 2014 although several others occurred in close proximity to the region as recently as October 2018.
Potential Impacts:	Bodily harm and death, tree damage, utilities damage, and property and content damage
Vulnerable Locations:	Entire region although Hartford County is at highest risk
Economic Loss:	Repair and replacement costs, business disruption, debris removal, and cleanup costs

Thunderstorms

Frequency:	Occur on 18 to 35 days each year in the state, but only 1.1 damaging lightning strikes are reported each year in Hartford and Tolland Counties. Many have occurred in the Capitol Region since the prior plan was approved in 2014.
Potential Impacts:	Bodily harm and death, tree damage, utilities damage, crop damage, and property and content damage
Vulnerable Locations:	Entire region
Economic Loss:	Repair and replacement costs, business disruption, debris removal, and cleanup costs

Severe Winter Storms

Frequency:	A severe winter storm (blizzard, nor'easter, ice storm) is likely to occur once every 5 years, or 20% chance of occurrence in any given year. Several winter storms have occurred in the Capitol Region since the prior plan was approved in 2014, with only one classified as severe.
Potential Impacts:	Street closures, power outages, schools closures, utility damage, property and content damage, car accidents, tree damage, bodily harm, and death
Vulnerable Locations:	Entire region
Economic Loss:	Repair and replacement costs, business disruption, debris removal, and cleanup costs

Table 37: Summary of Local Vulnerabilities to Natural Hazards and Key Issues

Summary of Local Vulnerabilities to Natural Hazards									
Key:	**CF = Critical Facility Impact**		**VP = Vulnerable Population Impact**		**TW = Town-wide Impact**				
	SA = Specific Area Affected		**CA = Cultural Assets Affected**		**OC = Other Concerns**				
Note: This table summarizes the key issues local officials identified as concerns for their communities relating to natural hazards based on past occurrences of hazard events and the probability of impacts resulting from future events. Problem statements and additional details related to the concerns, risks, and vulnerabilities of individual communities' structures, systems, populations, and other community assets can be found in their respective Challenges description in Section IV: Municipal Plans.									
TOWN	**DAM FAILURE**	**DROUGHT**	**EARTH-QUAKE**	**FLOOD**	**WILDLAND & FOREST FIRES**	**HURRICANES & TROPICAL STORMS**	**TORNADOES & HIGH WINDS**	**WINTER STORMS**	**OTHER CONCERNS/ COMMENTS/ISSUES**
Andover				VP, SA, OC	SA		SA	TW	Debris accumulation and bank erosion are problems
Avon	SA			CF, VP, SA	SA	TW		TW	Floods and storms can impact transportation and access
Berlin	SA			SA, OC	SA	OC	OC	TW, OC	Isolation due to flooding and winter storms
Bloomfield	SA			SA, VP, CA	SA	VP, OC	OC	OC	Debris management, transportation and access, limited tree budget
Bolton				SA	SA	OC		OC	Power outages a major concern; require generators for grinder pumps
Canton	SA			VP, SA, CF	SA	TW, SA		TW, SA, VP	North Canton – access and fire; many dams in Farmington upstream
Columbia	SA	SA, OC		SA	SA	TW, OC	TW, OC	TW, OC	Power outage and road blockages from storms. Droughts deplete firefighting water.
Coventry	SA			SA, OC	TW	TW	TW	TW	Three scour bridges may be undermined by soil erosion.
East Granby				SA	SA	OC		OC	Snow loads on flat roofs; areas with overhead wires; scouring of Floydville bridge

Summary of Local Vulnerabilities to Natural Hazards									
Key:	**CF = Critical Facility Impact**	**VP = Vulnerable Population Impact**	**TW = Town-wide Impact**						
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East Hartford				SA, VP, CF, OC				VP, SA	Levee system upkeep; undersized drainage systems
East Windsor	SA			CF, VP, SA		TW, OC			Hazardous materials; shelter capacity; flooding at Blue Ditch, Melrose Bridge
Ellington					SA	CF, CA, OC		TW, SA, OC	Transportation and access issues to Crystal Lake area; most town facilities are located in close proximity to each other.
Enfield				SA		CF, TW, VP		CF, TW	Flooding impacts on key routes
Farmington	SA			SA, CF		TW, OC		TW, OC	Transportation and access issues, EOC at risk of flooding
Glastonbury	SA	SA		SA, CF, CA		TW, OC		TW, OC	Backup power for town center
Granby		TW, VP, CF		SA	SA	OC		SA, OC	Transportation and access, water wells (higher elevations)
Hartford				SA, CF	SA	VP		OC, CF	MDC Clean Water Project; snow storage; snow loads on roofs

Summary of Local Vulnerabilities to Natural Hazards

Key: **CF = Critical Facility Impact** **VP = Vulnerable Population Impact** **TW = Town-wide Impact**
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Note: This table summarizes the key issues local officials identified as concerns for their communities relating to natural hazards based on past occurrences of hazard events and the probability of impacts resulting from future events. Problem statements and additional details related to the concerns, risks, and vulnerabilities of individual communities' structures, systems, populations, and other community assets can be found in their respective Challenges description in Section IV: Municipal Plans.

TOWN	DAM FAILURE	DROUGHT	EARTH-QUAKE	FLOOD	WILDLAND & FOREST FIRES	HURRICANES & TROPICAL STORMS	TORNADOES & HIGH WINDS	WINTER STORMS	OTHER CONCERNS/ COMMENTS/ISSUES
Hebron		CF, SA		CF	SA	CF, SA		CF, OC	Power outages impact wells, grinder pumps and schools, town hall; debris and snow storage
Manchester	CF			CF, SA	SA	OC	OC	OC	Damage to power grid from falling branches is a problem.
Mansfield	SA	OC		SA, OC	SA		TW	TW	Invasive species exacerbate treefall; isolation a concern during flooding; six scour bridges; drought impacts firefighting water
Marlborough		TW		SA	SA	VP, TW		VP, TW	Power outages impact wells and critical facilities
New Britain	SA			SA, OC	SA	TW	SA	TW	Undersized and outdated drainage infrastructure easily overwhelmed
Newington	SA			SA, OC	SA	CF, VP, TW			Two low pressure areas in water system. Flooding in Amtrak rail area.
Plainville	SA			SA, CF, OC	SA	TW	TW	TW	Concern that major flood could wash out essential bridge
Rocky Hill				SA, CF		TW		TW, VP, OC	Coordination with state for snow removal; power loss at town facilities

Summary of Local Vulnerabilities to Natural Hazards									
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Simsbury		TW		SA, CF, VP	SA	VP		VP	Transportation and access; power outages; flooding of electric utilities
Somers				SA, OC		CF, OC		CF, OC	Power outages/sheltering capacities; river flow restriction from old mill
South Windsor	SA	TW	CF	SA, VP, CA		VP, TW, CF	TW	VP, TW, CF	Power and communications outages, debris management
Southington	SA			TW, SA	SA	TW		TW, OC	Some areas are prone to drifting snow.
Stafford	SA			SA, CF, CA	SA	VP			Dam failure a major concern; downed trees hampering wildfire fighting
Suffield	SA			SA	SA	VP, CA, OC	OC	OC	Street flooding: drainage and access; snow loads on roofs; road blockage
Tolland				SA, VP	SA	VP, OC		TW, OC	Street flooding; stormwater utility maintenance; Del-Aire Campground; extreme snow and temperature
Vernon	SA			SA	SA	TW, CF		TW	Flooding; no public water at Bolton Lake

Summary of Local Vulnerabilities to Natural Hazards									
Key:	**CF = Critical Facility Impact**	**VP = Vulnerable Population Impact**	**TW = Town-wide Impact**						
	SA = Specific Area Affected	**CA = Cultural Assets Affected**	**OC = Other Concerns**						
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TOWN	**DAM FAILURE**	**DROUGHT**	**EARTH-QUAKE**	**FLOOD**	**WILDLAND & FOREST FIRES**	**HURRICANES & TROPICAL STORMS**	**TORNADOES & HIGH WINDS**	**WINTER STORMS**	**OTHER CONCERNS/ COMMENTS/ISSUES**
West Hartford	SA, CF	TW, CA	TW	SA, VP, CF		TW, VP	TW	TW	Erosion and sedimentation concern; droughts a concern in recent years
Wethersfield	SA		CF, VP	SA, CF, CA	SA	CF, VP, TW	TW, CF	TW, CF, OC	PW facility in floodplain; ice storms a concern
Willington	SA			SA, OC	TW				Two scour bridges may be undermined by erosion. Disruption of traffic on Routes 44 and 74 a major concern.
Windsor	SA	SA	TW, CF	SA, VP, CF, CA	SA	TW, CF, VP	TW	TW, CF, VP	Transportation and access
Windsor Locks				SA, CF, VP, OC	SA	VP, TW	TW	TW	Isolation; access to WWTP; flooding of HazMAT areas

Section III: Mitigation Strategies

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COUNCIL OF GOVERNMENTS

Natural Hazard Mitigation in the Capitol Region

In most cases, a severe natural hazard will affect several municipalities at once although significant variations with highly localized damage can occur. In addition to the inevitable regional effect of natural hazards, CRCOG staff recognized common existing strategies, concerns, and mitigation needs in the course of working with individual member municipalities on this plan. Therefore, this section reviews existing mitigation strategies common to most if not all municipalities and the region and discusses the challenges that are common throughout the region. Because of the regional nature of natural hazards and common concerns, some mitigation activities are better addressed at the regional level; however, the means to carry out certain activities may not be available to regional agencies but are available to municipalities.

This section discusses the capabilities and effectiveness of the existing authorities, policies, programs, and resources available to accomplish hazard mitigation. This section also examines the municipal and regional strategies proposed and evaluates the costs and benefits associated with the myriad actions considered. This section also establishes our regional goals and objectives for addressing natural hazards and sets out the mitigation strategies and actions that may best be undertaken on a regional level. Finally, summaries and analyses of the mitigation activities and projects proposed by the municipalities are presented.

Our Capabilities for Implementing Mitigation Actions

The Capitol Region Council of Governments (CRCOG) is the largest of Connecticut's regional planning organizations. CRCOG was established in 1968 under the Connecticut General Statutes as a voluntary association of municipal governments serving the City of Hartford and 28 surrounding suburban and rural communities. The Town of Stafford joined CRCOG in September 2010, bringing the total membership to 30 municipalities. Under the reorganization of the state's councils of governments in 2015, eight additional municipalities joined CRCOG.

The Capitol Region Council of Governments is governed by a Policy Board comprised of the mayors, first selectmen, and town council chairs of its 38 member municipalities. Our members have collaborated on a wide range of projects to benefit our towns individually and the region as a whole. CRCOG serves the Capitol Region and its member municipalities by:

- Helping members improve governmental efficiency and save tax dollars through shared services and other direct service initiatives
- Promoting efficient transportation systems, responsible land use and preservation of land and natural resources, and effective economic development
- Strengthening the Capitol City of Hartford as the core of a strong region and as our economic, social, and cultural center
- Strengthening our regional community by helping coordinate regional agencies and programs;
- Advocating for the region and its towns with the state and federal governments
- Assisting local governments and citizens in articulating, advocating, and implementing the vision, needs, and values of their regional community

- To accomplish this work, CRCOG relies primarily on grants and member dues. CRCOG is not permitted to borrow money or issue debt in any form. As a regional planning organization, CRCOG does not have the ability to enact regulations, levy taxes, or undertake construction projects.

Each of CRCOG's member municipalities has a broad scope of government authorities and powers including the ability to tax; establish laws, ordinances, and regulations; exercise eminent domain; provide police protection; and establish, construct, and maintain public facilities including roads, sewers, drainage, and utilities. Municipal powers are outlined in the Connecticut General Statutes Sec. 7-148 (https://www.cga.ct.gov/2015/pub/chap_098.htm#sec_7-148). The table below outlines the governing structures of CRCOG's 38 municipal members.

Table 38: Capitol Region Member Communities' Municipal Governmental Structures

Municipality	Legislative Body	Chief Executive Officer
Andover	Board of Selectmen	1st Selectman
Avon	Town Council	Town Manager
Berlin	Town Council	Town Manager
Bloomfield	Town Council	Town Manager
Bolton	Board of Selectmen	1st Selectman
Canton	Board of Selectmen	1st Selectman
Columbia	Board of Selectmen	1st Selectman
Coventry	Board of Selectmen	Town Manager
East Granby	Board of Selectmen	1st Selectman
East Hartford	Town Council	Mayor
East Windsor	Board of Selectmen	1st Selectman
Ellington	Board of Selectmen	1st Selectman
Enfield	Town Council	Town Manager
Farmington	Town Council	Town Manager
Glastonbury	Town Council	Town Manager
Granby	Board of Selectmen	1st Selectman
Hartford	City Council	Mayor
Hebron	Board of Selectmen	Chairman
Manchester	Board of Directors	General Manager
Mansfield	Town Council	Town Manager
Marlborough	Board of Selectmen	1st Selectman
New Britain	City Council	Mayor
Newington	Town Council	Mayor
Plainville	Town Council	Town Manager
Rocky Hill	Town Council	Town Manager
Simsbury	Board of Selectmen	1st Selectman
Somers	Board of Selectmen	1st Selectman
South Windsor	Town Council	Town Manager
Southington	Town Council	Town Manager

Municipality	Legislative Body	Chief Executive Officer
Stafford	Board of Selectmen	1st Selectman
Suffield	Board of Selectmen	1st Selectman
Tolland	Town Council	Town Manager
Vernon	Town Council	Mayor
West Hartford	Town Council	Town Manager
Wethersfield	Town Council	Town Manager
Willington	Board of Selectmen	1st Selectman
Windsor	Board of Selectmen	1st Selectman
Windsor Locks	Town Council	Town Manager

Existing Capabilities and Strategies

Regional Cooperation and Services

The 38 municipalities participating in this planning process are members of the Capitol Region Council of Governments, a regional agency in which member communities have collaborated for over 30 years on a range of projects to benefit the municipalities individually and the region as a whole. This institutional experience and capacity allows CRCOG to provide services that can advance hazard mitigation throughout the region such as service sharing, cooperative purchasing, and bidding services; public safety planning, training, and collaboration; data analysis and sharing; transportation studies and planning and traffic incident management; and land use and natural resources conservation planning. Through these services, CRCOG helps member municipalities save tax dollars, coordinate efforts, and enhance operating efficiencies.

Regional Emergency Support Plan (RESP)

The purpose of the Regional Emergency Support Plan (RESP) is to provide a framework for the 42 DEMHS Region 3 communities and agencies to collaborate in planning, communication, information sharing, and coordination activities before, during, or after a regional emergency. The goal of this effort is to enhance the ability of each municipality to meet their emergency management objectives, which can be described as the following:

- Maximize the preservation of life and property.
- Correct or alleviate, as expeditiously as possible, serious disaster or emergency-related conditions that present continued threats to the health or welfare of the residents of Region 3.
- Facilitate a return to normalcy by all practical means.

Emergency Alerting and Notification Systems

All of the CRCOG communities currently have a reverse notification system. This may be part of or an addition to the CT Alert Emergency Alerting and Notification System offered by the State of Connecticut. This emergency notification system, which relies on GIS technologies, will allow communities in the region to alert residents to impending natural hazards thereby reducing risks to life and property. According to the CTALERT.gov website, all Capitol Region municipalities currently subscribe to the CTAlert system. All citizens in Connecticut, however, can register with CTAlert to receive emergency notifications that are sent statewide.

National Flood Program, FEMA Flood Maps, and Floodplain Regulations

The 38 Capitol Region municipalities have participated in FEMA's National Flood Insurance Program (NFIP) for at least 30 years, and all are in good standing in the program. It is the intention of all municipalities in the region to continue participation in the NFIP, including continued compliance and enforcement on the local level of all NFIP requirements. See Table 39 for the latest information on current flood insurance rate maps.

All 38 municipalities have adopted floodplain management regulations that have helped to prevent increased flood risks from new developments. Most municipalities in the region incorporate floodplain regulations in their zoning regulations; others provide separate ordinances for floodplain regulation. Connecticut DEEP periodically reviews these municipal regulations for conformance to the latest Flood Insurance Studies, FEMA flood maps, and model flood hazard regulations. The 2018 Connecticut State Building Code, adopted October 1, 2018, includes model floodplain regulation language (Appendix D). Chapter 124, Section 8-2 l of the Connecticut General Statutes governs the municipal regulation of development within floodplains as defined by the National Flood Insurance Program.

Table 39: Community Participation in National Flood Program

Community ID	Municipality	County	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date
090161#	ANDOVER	TOLLAND	04/18/75	02/03/82	02/03/82
090021#	AVON	HARTFORD	01/23/74	05/16/77	09/16/11
090022#	BERLIN	HARTFORD	08/16/74	07/16/80	09/26/08
090122#	BLOOMFIELD	HARTFORD	02/01/74	08/15/77	09/16/11
090109#	BOLTON	TOLLAND	06/07/74	06/01/81	06/01/81
090135#	CANTON	HARTFORD	08/02/74	08/01/79	09/16/11
090160#	COLUMBIA	TOLLAND	11/08/74	09/16/82	09/16/82
090110#	COVENTRY	TOLLAND	06/09/74	06/04/80	06/11/82
090025#	EAST GRANBY	HARTFORD	05/31/74	01/06/82	09/16/11
090026#	EAST HARTFORD	HARTFORD	12/28/73	12/18/79	09/16/11
090027#	EAST WINDSOR	HARTFORD	11/16/73	04/03/78	09/16/11
090158#	ELLINGTON	TOLLAND	11/01/74	03/15/82	02/05/97
090028#	ENFIELD	HARTFORD	04/05/74	03/28/80	09/16/11
090029#	FARMINGTON	HARTFORD	06/28/74	08/15/77	09/16/11
090125#	GRANBY	HARTFORD	07/19/74	02/15/80	09/16/11
090124#	GLASTONBURY	HARTFORD	04/20/73	06/15/78	09/16/11
095080#	HARTFORD	HARTFORD	07/01/70	07/01/74	09/16/11
090162#	HEBRON	TOLLAND	11/29/74	10/15/81	03/18/91
090031#	MANCHESTER	HARTFORD	05/24/74	08/16/82	09/16/11
090128#	MANSFIELD	TOLLAND	01/09/74	01/02/81	01/02/81
090148#	MARLBOROUGH	HARTFORD	07/19/74	05/17/82	09/16/11
090032C	NEW BRITAIN	HARTFORD	05/24/74	07/16/81	05/16/17
090033#	NEWINGTON	HARTFORD	07/26/74	10/16/79	09/16/11
090034C	PLAINVILLE	HARTFORD	05/31/74	11/19/80	05/16/17
090142#	ROCKY HILL	HARTFORD	06/07/74	08/01/80	09/16/11

Community ID	Municipality	County	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date
090035#	SIMSBURY	HARTFORD	08/02/74	05/16/77	09/16/11
090112#	SOMERS	TOLLAND	08/02/74	02/17/82	08/16/06
090036#	SOUTH WINDSOR	HARTFORD	08/16/74	05/01/80	09/16/11
090037C	SOUTHINGTON	HARTFORD	05/10/74	07/16/81	05/16/17
090152#	STAFFORD	TOLLAND	08/09/74	06/01/82	06/01/82
090038#	SUFFIELD	HARTFORD	08/02/74	08/15/79	09/16/11
090171#	TOLLAND	TOLLAND	01/31/75	04/01/82	04/01/82
090131#	VERNON	TOLLAND	01/04/74	12/04/79	08/09/99
095082#	WEST HARTFORD	HARTFORD	NA	07/01/74	09/16/11
090040#	WETHERSFIELD	HARTFORD	05/11/73	05/02/77	09/16/11
090159#	WILLINGTON	TOLLAND	12/20/74	06/15/82	06/15/82
090042#	WINDSOR LOCKS	HARTFORD	06/28/74	01/03/79	09/16/11
090041#	WINDSOR	HARTFORD	10/05/73	09/29/78	09/16/11

Source: FEMA National Flood Insurance Program Community Status Book, 4/3/2018

The National Flood Insurance Program offers an additional voluntary program, the Community Rating System (CRS), which provides discounts on flood insurance premiums to property owners. The CRS recognizes a community's efforts that go beyond the minimum standards for floodplain management by reducing flood insurance premiums from 5% to 45%, depending on the number and type of activities undertaken in the community. These activities may include issuing elevation certificates for new construction in floodplains, outreach to property owners, maintaining flood and property data digitally, stormwater management regulations, open space preservation, and a host of other activities, many of which may be currently undertaken in a community. In the Capitol Region, only West Hartford currently participates in the CRS.

Table 40: Participating CRS Communities in CRCOG

Community #	Community	Current Class	Discount for SFHA	Discount for Non-SFHA	Status
95082	Town of West Hartford	8	10%	5%	C

A number of other municipalities have, however, identified participation in the CRS as a mitigation action they will consider in this plan update. In the 2008 Plan, several communities identified investigating participation in the CRS program but were unable to advance this effort significantly. The limited progress made was generally due to constraints on the municipalities' ability to commit personnel to fully explore the program and its impact on and relevance to the community. Eight communities (Granby, Hartford, Simsbury, Somers, South Windsor, Vernon, Wethersfield, and Windsor) expressed an interest in undertaking this activity in the 2014-2019 planning period. For the 2019-2024 planning period, only Granby, Simsbury, South Windsor, Vernon, Wethersfield, and Windsor have expressed an interest.

CRCOG hopes that assisting these communities and others by passing on notices of FEMA-sponsored training opportunities and arranging for local workshops, as was done in September 2016, will give added impetus to these efforts.

Table 41: Municipal Floodplain Regulations

Municipality	Regulation/Ordinance	Reference
Andover	Zoning Regulations	Section 10
Avon	Zoning Regulations	Section III G
Berlin	Code of Ordinances	August 23, 2008
Bloomfield	Zoning Regulations	Article 5.1
Bolton	Zoning Regulations	Section 3.A.18
Canton	Zoning Regulations	Article V, Section 53
Columbia	Zoning Regulations	Section 53
Coventry	Zoning Regulations	Section 5.06
East Granby	Zoning Regulations	Section III E
East Hartford	Zoning Regulations	Article VI, Section 601
East Windsor	Zoning Regulations	Chapter VIII, Section 810
Ellington	Zoning Regulations	Article 5
Enfield	Zoning Regulations	Article VIII, Section 8.50
Farmington	Zoning Regulations	Article II, Sections 15, 16, 17
Glastonbury	Zoning Regulations	Section 4.11
Granby	Zoning Regulations	Section 8.18
Hartford	Zoning Regulations	Article III, Division 21 FP
Hebron	Zoning Regulations	Section 8.10
Manchester	Zoning Regulations	Article II Section 19
Mansfield	Zoning Regulations	Article 10, Section E
Marlborough	Code of Ordinances	Ordinance J. Flood Plain Management
New Britain	Code of Ordinances	Chapter 9
Newington	Zoning Regulations	Section 6.3
Plainville	Zoning Regulations Code of Ordinances	Section 3.01, Pages II-68-1 to 22
Rocky Hill	Zoning Regulations Town Code	Section 5.2, Chapter 141
Simsbury	Zoning Regulations	Article 7, Section M
Somers	Zoning Regulations	Article XV, Section 214.84
South Windsor	Zoning Regulations	Article 5, Section 5.2
Southington	Zoning Regulations	Section 06
Stafford	Zoning Regulations	Section 5.20
Suffield	Zoning Regulations	Section 5. K.
Tolland	Zoning Regulations	Article XII, Section 12
Vernon	Zoning Regulations	Section 5
West Hartford	Code of Ordinances	Chapter 177 – Zoning, Section 177-8
Wethersfield	Zoning Regulations	Article IV, Section 4.2
Willington	Zoning Regulations	Section 4.17
Windsor	Code of Ordinances	Chapter 3, Article III
Windsor Locks	Zoning Regulations	Section 223

Options for Mitigating Flood Losses

Floods are inevitable, but there are many different approaches that can help reduce flood losses. One common approach in the past has been to intensively manage river channels by armoring and dredging and through the construction of berms, levees, and floodwalls. In addition to being very costly, these traditional engineering solutions often fail, leading to even more extensive and costly flood damages. This approach has been shown to be unsustainable and has led to the situation we are in today, trapped in an escalating cycle of increasing flood damages and costly repairs. In addition, this engineering approach has negative impacts on the ecological health of river systems and the wildlife they support.

In recent decades, more environmentally friendly river restoration techniques (including "natural channel design") have gained popularity. While these techniques still try to control riverine processes, they attempt to employ a more natural channel configuration. These restoration techniques can be an effective tool for mitigating fluvial erosion hazards by slowing bank erosion or limiting lateral channel migration. The high cost of designing and installing restoration projects limits the usefulness of restoration as a general approach to flood hazard mitigation. In addition, restoration projects are prone to failure, either during high flow events or because the design may not have been compatible with river processes.

Another approach to mitigate flood losses is to remove or relocate existing structures that are threatened by flood hazards. Removal of structures from hazardous areas can be an effective approach when it is feasible. While removal or relocation is effective, it is generally far too costly to be applied at a broad scale. In addition, many large structures, particularly transportation infrastructure or public facilities, are rarely feasible to remove or relocate. Retrofitting, another engineering approach (which includes elevating and floodproofing), is appropriate for mitigating inundation hazards but is ineffective in addressing fluvial erosion hazards.

In sum, river management alternatives include stabilization practices, retrofit or removal of existing structures, active restoration, and avoidance. **The most cost-effective way to mitigate flood hazards is *avoidance*: limiting human investments in river corridors.** In addition to preventing future flood losses to structures built in hazardous areas, this approach limits constraints on a river, allowing them over time to achieve a more stable, equilibrium condition.

Source: Municipal Guide to Fluvial Erosion Hazard Mitigation, River Management Program Vermont Agency of Natural Resources

Stormwater and Erosion Control

By statute (Section 22a-325 – 22a-329 of the CGS), all municipalities in Connecticut are required to adopt regulations pertaining to soil erosion and sediment control, and all applications for proposed development that will disturb more than a half-acre must include a soil erosion and sediment control plan. The DEEP has guidelines that serve as the technical standard for compliance with the statute. The *Connecticut Stormwater Quality Manual* provides guidance on site planning, source control, and stormwater practices, including the design, construction, and maintenance of stormwater systems, to protect the quality of Connecticut waters. The practices detailed in the manual aim to reduce the volume of urban runoff and pollutant discharges, recharge groundwater, and control peak flows. These types of stormwater best practices not only protect water quality but also minimize flooding risks. The *Connecticut Guidelines for Erosion and Sedimentation Control* also detail specific measures that can reduce the damages and pollution associated with erosion and sedimentation while simultaneously reducing flooding risks.

In 2012, the state DEEP updated the manual and guidelines to incorporate appendices on Low Impact Development (LID). LID manages stormwater by designing with nature in mind. LID techniques seek to retain stormwater close to where it falls thus keeping runoff out of pipes that drain to waterways. CRCOG encourages its member municipalities to adopt and enforce regulations that would require new development to implement these types of best practices in as far as is possible.

LID and the use of green infrastructure are often considered first by the urban and suburban communities of a region. The City of Hartford has advanced the use of green infrastructure and modified its Zoning Regulations to reduce areas of impervious surfaces. LID is also useful for rural communities. With funding from CIRCA, the Northwest Hills Council of Governments conducted a study of how LID can be used for advancing resilience in rural communities and commissioned the development of a LID design manual. The information sheets following this page describe these two efforts.

Open Space Acquisition

The permanent preservation of undeveloped land can help support natural hazard mitigation efforts by preventing development in areas prone to natural hazards such as floodplains and wildland/urban interfaces. The State of Connecticut has established a goal of preserving 21 percent (or 673,210 acres) of the state's land area for open space for public recreation and natural resource conservation and preservation by 2023. According to the Connecticut Council on Environmental Quality (CEQ), to date, the state has preserved 259,022 acres throughout Connecticut as state land. In addition, a review by the CEQ in 2015 of published landholdings of land trusts showed nearly 60,000 acres held in fee and close to 30,000 in easements. According to the 2014-2024 Capitol Region Plan of Conservation and Development, of the Capitol Region's 66,830 total acres, approximately 18.8% (98,695.5 acres) is open space, and 1.5% (7,789.8 acres) is preserved farmland.

NEW INITIATIVES

Hartford Green Infrastructure and Zoning Regulations

Courtesy of City of Hartford Office of Sustainability

Courtesy of City of Hartford Office of Sustainability

FOR MORE INFORMATION

City of Hartford
Planning & Zoning
250 Constitution Plaza, 4th Floor
Hartford, CT 06103
860-757-9077

WHAT IS IT?

In 2016, the Hartford Planning and Zoning Commission, in consultation with the City's Office of Sustainability, adopted new zoning regulations that incorporate green infrastructure (GI) practices into new developments affecting more than 5,000 square feet of land. The goal is to promote environmental sustainability in new development, including reducing threats to water quality from stormwater runoff.

The regulation changes are to manage the impact of events of 1-inch of precipitation without discharging stormwater runoff into the public drainage systems. The purpose is to address the capture and treatment of stormwater runoff by reducing impervious surfaces and add green spaces that have additional benefits such as cooling and cleaning the air and beautifying streets and neighborhoods.

In addition to the new zoning regulations, the City implemented several prototype projects to demonstrate the benefits, including construction of a green roof at the Connecticut Science Center, a bioswale at UConn Law campus, a new rain garden at Keney Park, and construction of permeable pavement at the State Capitol building.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Green infrastructure (GI), sometimes used synonymously with "low impact development" (LID), is an important tool in addressing climate change. Consider the following:

- Reducing stormwater runoff reduces billions of gallons of sewage-stormwater mixing into local waters from sewer overflows
- GI reduces heat-island effects through reduction of heat emission from pavements, which can cool temperatures by 20-45 degrees
- GI captures pollutants such as particulate matter and contaminants in wastewater, providing improved water quality and significant public health benefits for communities.

The new zoning regulations promote GI and LID by creating "development-free" buffers near waterways, advancing GI to limit impervious coverage, and requiring management of a 1-inch storm either on-site or at an off-site location that diverts stormwater from any public drainage system. The regulations also include specific innovations such as the removal of minimum parking area requirements, which may lead to smaller paved areas.

NEW INITIATIVES

LOW IMPACT DEVELOPMENT FOR RURAL RESILIENCY

Images: nrcs.usda.gov

WHAT IS IT?

Low-impact development (LID) prioritizes minimally invasive design, construction, and site operation techniques to reduce stormwater runoff quantity, undesirable water quality, and the corresponding negative impacts to receiving waters. Strategies such as reducing impervious services, installing infiltration systems, and zone-specific standards are used to address environmental impacts that come from typical development approaches such as extensive parking areas, box-building construction, and rapid stormwater removal from a site. LID helps to increase local resilience to climate change by mitigating the impacts of drought, protecting drinking water reserves, reducing flooding, and reducing stress on infrastructure.

A joint initiative between Northwest Hills Council of Governments, Northwest CT Conservation District, and CIRCA resulted in development of a municipal-scale manual for a sustainable approach to protect water sources and historic development patterns in rural communities. The manual presents techniques designed to help properly capture, infiltrate, and manage stormwater, which in turn recharges groundwater, reduces erosion, and protects sensitive habitats. The manual provides a framework to improve water quality through engineering specifications, enforcement tools and development standards to reduce erosion and impacts from pollution on aquatic and natural environments.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

LID can increase the resilience to the impacts of climate change on the natural, built, and human environments. The installation of LID infrastructure increases small and rural community resiliency in many ways, including:

- protecting drinking water supplies, streams, rivers and other water resources throughout the watershed
- protecting natural vegetation, hydrology and other resources on development sites
- reducing damage to local roads, bridges, the built environment, as well as to agricultural resources and human environments.

The development of a LID Manual focuses on strategies achievable by municipalities with maximum effect, which offers significant returns on investments by producing a product easily transferrable to many towns in the rural parts of the Capitol Region. **Municipalities in the Capitol Region can benefit from mitigation actions related to increasing resiliency through LID.**

FOR MORE INFORMATION

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The statute governing open space preservation, CGS Section 23-8, divides responsibility for meeting this goal between the state (10% or 320,576 acres) and municipalities, nonprofit land conservation organizations, and water utilities (11% or 352,634 acres). The state provides financial assistance to municipalities, conservation organizations, and water utilities to help them acquire land under a competitive grant program. Funding through the DEEP Open Space and Watershed Land Acquisition Grant Program is usually available every 2 years. According to the Connecticut Council on Environmental Quality (CEQ) *2017 Annual Report*, in 2017, State grants helped municipalities and land trusts acquire 895 acres while in 2016 the number was 2,200 acres. In 2018, in the Capitol Region, municipalities or organizations in Ellington, Hebron, Mansfield, and Windsor were awarded a total of $1,431,000 for the acquisition of a total of 291 acres of land[5]. In 2012, municipalities or organizations in Bloomfield, Canton, Bolton, Enfield, Hebron, Manchester, Simsbury, Somers, Tolland, and Vernon were awarded funds for land acquisition. CRCOG assists municipalities and land trusts in their efforts to secure grants by writing letters of support on their behalf to the DEEP. The state grant program requires a local match be provided. Some municipalities have passed bond referenda, and some local trusts have established fund-raising programs to provide local resources for open space acquisition. At times these resources are used to provide the local match for the state grant; at other times they are used to acquire lands without state assistance.

Open space acquisition can be an effective means of preventing development in vulnerable areas; however, the CEQ *2017 Annual Report* states that Connecticut is not on track for meeting its open space preservation goal. While the report notes that probably thousands of acres are preserved by municipalities and land trusts in some years, there is no means to accurately track these acquisitions. To remedy the lack of an accurate inventory of open space, PA No. 12-52, An Act Concerning the State's Open Space Plan, was passed in 2012, which should eventually lead to an accurate inventory of preserved lands.

Conservation easements can also be granted to land trusts and municipalities for the purpose of preserving and preventing development on environmentally sensitive lands. Municipalities often acquire conservation easements through the land development approval process. Conservation easements constitute a legally binding agreement that limits certain types of uses or prevents development on land that remains privately held.

Regulation of Wetlands and Watercourses

Activities in wetlands areas and watercourses are regulated under Chapter 440 (Sec. 22a-28 – Sec. 22a-45d) of the Connecticut General Statutes. Under this statute, each municipality is required to establish an inland wetlands agency, identify boundaries of inland wetlands and watercourse areas, promulgate regulations to protect the inland wetlands and watercourses within its boundaries, and require that no regulated activities shall be conducted without a permit. All municipalities in the region have established inland wetlands agencies (refer to Table 42 below) and have enacted inland wetlands and watercourses regulations. According to the CEQ, between 60 and 90 acres of inland wetlands were altered statewide by development from 2004 until 2011 when the rate spiked to more than 200 acres. (Detailed data are not available to the public or CEQ; CEQ has not updated this data since 2011.) Also according to CEQ, municipal agencies, which issue 95 percent of all inland wetlands permits, have become more

[5] https://portal.ct.gov/Office-of-the-Governor/Press-Room/Press-Releases/2018/02-2018/Gov-Malloy-Announces-Open-Space-Grants-That-Will-Preserve-Nearly-2005-Acres-of-Land

conserving of wetlands in recent years. CEQ attributes this increased protectiveness to the completion of wetlands training programs by municipal agency members and staff.

Plans of Conservation and Development

Regional planning agencies and municipalities are required by state law (Chapter 127, Section 8-35a and Chapter 126, Sec. 8-23, respectively) to update plans of conservation and development every 10 years. These plans outline the policies and goals for physical and economic development of the region or municipality. Table 42 lists the status of each plan of conservation and development for the 38 municipalities in the Capitol Region along with the responsible agencies for enacting zoning regulations and inland wetlands protection.

Table 42: Municipal Land Use Agencies and Plans

Municipality	Current Plan of Conservation & Development	Agency Responsible for Enacting Zoning Regulations	Designated Inland Wetlands Agency
Andover	5/16/2016	Planning & Zoning Commission	Inland Wetlands Commission
Avon	11/15/2016	Planning & Zoning Commission	Inland Wetlands Commission
Berlin	9/1/2013	Planning & Zoning Commission	Inland Wetlands and Watercourses Commission
Bloomfield	8/15/2012	Plan & Zoning Commission	Inland Wetlands and Watercourses Commission
Bolton	10/1/2015	Planning & Zoning Commission	Inland Wetlands Commission
Canton	5/19/2014	Zoning Commission	Inland Wetlands and Watercourses Commission
Columbia	6/27/2016	Planning & Zoning Commission	Inland Wetlands and Watercourses Commission
Coventry	5/1/2010	Planning & Zoning Commission	Inland Wetlands Agency
East Granby	12/13/2016	Planning & Zoning Commission	Conservation Commission
East Hartford	6/25/2014	Planning & Zoning Commission	Inland Wetlands/Environment Commission
East Windsor	10/25/2016	Planning & Zoning Commission	Inland Wetlands Watercourse Agency
Ellington	9/22/2014	Planning & Zoning Commission	Inland Wetlands Agency
Enfield	4/7/2011	Planning & Zoning Commission	Inland Wetlands and Watercourses Agency
Farmington	11/15/2017	Planning & Zoning Commission	Inland Wetland Commission
Glastonbury	Draft October 2018	Town Council	Conservation Commission/Inland Wetlands and Watercourses Agency
Granby	9/27/2016	Planning & Zoning Commission	Inland Wetlands and Watercourses Commission
Hartford	6/3/2010	Planning & Zoning Commission	Planning & Zoning Commission
Hebron	6/10/2014	Planning & Zoning Commission	Conservation Commission/ Inland Wetland Agency

Municipality	Current Plan of Conservation & Development	Agency Responsible for Enacting Zoning Regulations	Designated Inland Wetlands Agency
Manchester	12/17/2012	Planning & Zoning Commission	Planning & Zoning Commission/Inland Wetlands Commission
Mansfield	9/8/2015	Planning & Zoning Commission	Inland Wetlands Agency
Marlborough	11/24/2009	Zoning Commission	Conservation Commission
New Britain	12/6/2010	Common Council	Conservation Commission
Newington	6/9/2010	Planning & Zoning Commission	Conservation Commission/ Inland Wetlands Commission
Plainville	1/1/2009	Planning & Zoning Commission	Inland Wetlands and Watercourses Commission
Rocky Hill	6/8/2015	Planning & Zoning Commission	Open Space & Conservation Commission
Simsbury	9/26/2017	Zoning Commission	Conservation Commission/ Inland Wetlands Agency
Somers	6/11/2015	Zoning Commission	Conservation Commission
South Windsor	6/23/2013	Planning & Zoning Commission	Inland Wetlands Agency/Conservation Commission
Southington	5/17/2016	Planning & Zoning Commission	Inland Wetlands and Watercourses Agency
Stafford	10/9/2012	Planning & Zoning Commission	Inland Wetlands Commission
Suffield	9/20/2010	Zoning & Planning Commission	Conservation Commission
Tolland	7/1/2011	Planning & Zoning Commission	Inland Wetlands & Watercourses Commission
Vernon	11/17/2011	Planning & Zoning Commission	Inland Wetlands Commission
West Hartford	12/1/2008	Town Plan & Zoning Commission	Town Plan & Zoning Commission
Wethersfield	5/7/2013	Planning & Zoning Commission	Inland Wetlands and Watercourses Commission
Willington	2/5/2008	Planning & Zoning Commission	Inland Wetlands and Watercourses Commission
Windsor	9/29/2015	Town Planning & Zoning Commission	Inland Wetlands and Watercourses Commission
Windsor Locks	9/12/2016	Planning & Zoning Commission	Inland Wetlands and Watercourses Commission

Communities are required to incorporate elements of hazard mitigation into their comprehensive plans, and most in Connecticut have complied over several cycles of hazard mitigation planning. Table 43 describes if – and how – the Capitol Region communities have incorporated hazard mitigation into their plans of conservation and development. Most have emphasized flood risk in some way, and many have directly referenced the hazard mitigation plan that was effective at the time of the POCD development.

Table 43: Incorporation of Hazard Mitigation Into Plans of Conservation and Development

Municipality	Current POCD	Is hazard mitigation incorporated?	Incorporation by reference (the POCD recognizes the NHMP as a municipal plan)	Incorporation by element or chapter (a chapter of the POCD addresses natural hazards and disaster response)	Incorporation by goal or action (the POCD includes natural hazards and disaster response as goals or actions)
Andover	5/16/2016	Yes - minor	No	No	Yes - flood control at one property
Avon	11/15/2016	Yes	No	Yes - flood	No
Berlin	9/1/2013	Yes	Yes	Yes	Yes
Bloomfield	8/15/2012	Yes	No	No	Yes - flood
Bolton	10/1/2015	Yes	Yes	Yes	Yes
Canton	5/19/2014	Yes	No	Yes - flood	No
Columbia	6/27/2016	Yes	Yes	Yes - flood	Yes
Coventry	5/1/2010	No	No	No	No
East Granby	12/13/2016	Yes	No	Yes - flood	No
East Hartford	6/25/2014	Yes	Yes	Yes - flood	Yes - flood
East Windsor	10/25/2016	Yes	No	No	Yes
Ellington	9/22/2014	Yes, minor	No	No	Yes - flood
Enfield	4/7/2011	Yes, minor	No	Yes - flood	No
Farmington	11/15/2017	Yes	No	Yes - flood, drought	No
Glastonbury	9/18/2007	Yes	No	Yes - flood, erosion	No
Granby	9/27/2016	Yes	Yes	Yes - flood	Yes - climate change, flood
Hartford	6/3/2010	Yes	No	Yes	No
Hebron	6/10/2014	Yes	Yes	No	No
Manchester	12/17/2012	Yes	No	Yes	No
Mansfield	9/8/2015	Yes	Yes	Yes	Yes
Marlborough	11/24/2009	Yes	No	No	Yes - flood, fire, erosion
New Britain	12/6/2010	Yes	No	No	Yes - flood
Newington	6/9/2010	Yes	No	No	Yes - flood
Plainville	1/1/2009	Yes	No	No	Yes - flood
Rocky Hill	6/8/2015	Yes	No	No	Yes - flood
Simsbury	9/26/2017	Yes	Yes	No	Yes
Somers	6/11/2015	Yes	Yes	No	Yes
South Windsor	6/23/2013	Yes	Yes	Yes	Yes
Southington	5/17/2016	Yes	No	No	Yes - flood
Stafford	10/9/2012	Yes	No	No	Yes - dams and flood control

Municipality	Current POCD	Is hazard mitigation incorporated?	Incorporation by reference (the POCD recognizes the NHMP as a municipal plan)	Incorporation by element or chapter (a chapter of the POCD addresses natural hazards and disaster response)	Incorporation by goal or action (the POCD includes natural hazards and disaster response as goals or actions)
Suffield	9/20/2010	Yes, minor	No	No	Yes - flood
Tolland	7/1/2011	Yes	No	No	Yes - flood, drought
Vernon	11/17/2011	Yes, minor	No	Yes - flood	Yes - flood
West Hartford	12/1/2008	Yes, minor	No	Yes - flood	Yes - flood control
Wethersfield	5/7/2013	Yes, minor	No	No	Yes
Willington	2/5/2008	Yes	Yes	No	Yes
Windsor	9/29/2015	Yes	No	No	Yes
Windsor Locks	9/12/2016	Yes - minor	No	No	Yes - flood

State Building Code

Connecticut municipalities employ the State Building Code, which is periodically amended. The Code incorporates the standards in high-wind design and seismic activity appropriate for the state. Local building officials are bound by the state code. Through local implementation of the State Building Code, Capitol Region municipalities help reduce the risks associated with natural hazards in new developments.

The State Building Inspector, State Fire Marshal, and the Codes and Standards Committee have adopted the 2018 State Building and Fire Safety Codes, effective October 1, 2018. These codes are based on the 2015 editions of the International Code Council (ICC) and National Fire Protection Association (NFPA) documents. Technical review of these codes was conducted by the committee's Codes Amendment Subcommittee (CAS) along with DAS staff. This review began January 2017 and was completed with the Codes and Standards Committee's approval for CAS to move both codes to the legislative approval process at its November 8, 2017, meeting. The new codes are as follows:

- 2015 International Building Code
- 2015 International Existing Building Code
- 2015 International Energy Conservation Code
- 2015 International Mechanical Code
- 2015 International Plumbing Code
- 2015 International Residential Code
- 2015 International Fire Code
- 2015 NFPA 101 Life Safety Code
- 2017 NFPA 70 National Electrical Code
- 2009 ANSI A117.1 Accessible and Usable Buildings and Facilities

The new code is significant relative to flood mitigation. It requires 1 foot of freeboard in all A, AE, and VE zones (VE zones have a risk of significant wave action and tend to be found along coastlines; there

are no VE zones in the Capitol Region); coastal A zones (A or AE zones occurring in coastal areas; there are no coastal A zones in the Capitol Region) are regulated like VE zones in certain cases; flood openings are required in breakaway walls; and essentially facilities must be elevated 2 feet above the BFE or to the 0.2% annual chance flood elevation. The 2018 State Building Code includes model municipal floodplain ordinances (included with this Plan Update as Appendix D).

Connecticut State Historic Preservation Office (SHPO)

Recognizing that historic and cultural resources are increasingly at risk to natural hazards and climate change, SHPO embarked on a resiliency planning study for historic and cultural resources beginning in 2016. Working with the state's Councils of Government and municipalities throughout the planning process, numerous examples were identified where historic and cultural resources were specifically at risk now, could be at risk in the future, and could help generate consensus for resiliency actions. Historic resources are difficult to floodproof, elevate, or relocate without potential loss of their historicity. Therefore, a thorough understanding of the site-specific options for each set of historic resources is necessary prior to disasters that could damage these resources in order to avoid damage during recovery.

The five coastal COGs in Connecticut hosted historic resources resiliency planning meetings in June 2016. During winter 2016-2017, individual meetings were held with the shoreline communities. Reports were issued to these communities in late 2017 based on the COG meetings and the local meetings. These reports outline eight strategies that can be employed to make historic and cultural resources more resilient. They are:

- Strategy: Identify Historic Resources
- Strategy: Revisit Historic District Zoning Regulations
- Strategy: Strengthen Recovery Planning
- Strategy: Incorporate Historic Preservation into Planning Documents
- Strategy: Revisit Floodplain Regulations and Ordinances
- Strategy: Coordinate Regionally and with the State
- Strategy: Structural Adaptation Measures
- Strategy: Educate

A best practices guide for planning techniques to make historic resources more resilient was distributed in 2018. This guide can be used by all jurisdictions in Connecticut, including those in the Capitol Region, when undertaking development of hazard mitigation plans. Resiliency concepts were added to the update of the *State Historic Preservation Plan* in 2017-2018, with the goal of helping all of the state's communities making historic resources more resilient.

Connecticut Institute for Resilience and Climate Adaptation (CIRCA)

CIRCA is a multidisciplinary center of excellence that brings together experts in the natural sciences, engineering, economics, political science, finance, and law to provide practical solutions to problems arising as a result of a changing climate. The institute helps coastal and inland floodplain communities in Connecticut and throughout the Northeast better adapt to changes in climate and also make their human-built infrastructure more resilient while protecting valuable ecosystems and the services they offer to human society. Initiatives focus on living shorelines, critical infrastructure, inland flooding, coastal flooding, sea level rise, and policy and planning.

CIRCA runs a research program as well as an external grants program for Connecticut municipalities and partners in resilience. To date, CIRCA has awarded 18 projects through its Municipal Resilience Grants Program to 14 municipalities and the state's regional planning organizations, councils of governments. An additional nine grants were awarded to municipalities, nonprofits, academic researchers, a land trust, and a conservation district to assist them with meeting the match requirement for federal or foundation grants programs. The CIRCA research program has received funding from CT DEEP, CT DOT, the Connecticut Department of Housing, and NOAA. Research projects cover sea level rise and storm flooding statistics, green infrastructure and living shorelines evaluation, economic modeling, and policy analysis and planning.

Through its first 3 years as an institute, CIRCA projects and products provided significant support to municipalities and the state for resilience planning. In October 2017, CIRCA released localized sea level rise scenarios for the state and recommended that Connecticut plan for the upper end of the likely range of 20 inches/50 centimeters of sea level rise by 2050.

Dam Safety

The Connecticut DEEP Dam Safety Program has jurisdiction over all nonfederally owned or licensed dams in the state that would by failing or otherwise endanger life or property. The program staff maintain an inventory for nearly 4,800 dams in Connecticut. Smaller dams determined to be of Negligible Hazard and other small dams of undetermined hazard classification, while inventoried, are not presently being closely monitored. CT DEEP does not monitor or have jurisdiction over dams that are federally owned including U.S. Army Corps of Engineers (USACE) flood control dams and hydropower dams licensed by the Federal Energy Regulatory Commission (FERC). As of March 2018, the CT DEEP dam inventory includes:

- 281 total and 258 DEEP jurisdictional High Hazard (Class C) dams
- 275 total and 262 DEEP jurisdictional Significant Hazard (Class B) dams
- 722 total and 714 DEEP jurisdictional Moderate Hazard (Class BB) dams
- Approximately 1,900 Low Hazard (Class A) dams

The Dam Safety Program's ultimate responsibility is to ensure all jurisdictional dams in the state are being operated and maintained in a safe condition. The owners of high and significant hazard dams are required by statute to regularly inspect, maintain, and repair their dams and have current Emergency Action Plans (EAPs) ready for implementation should hazardous conditions arise. The program's major responsibilities include:

- *Inspections*. The responsibility to undertake regulatory inspections was transferred from the state DEEP to dam owners through legislation in 2013. Program staff still perform inspections of all types, but all regulatory inspections are required to be performed by engineers hired by the dam owner. In rare cases, DEEP has the authority to perform these inspections and charge the property owner. Regulatory Inspections must meet the requirements of Section 22a-409 of the regulation.
- *Emergency Action Plans (EAP) for B and C dams*. Program staff review all EAPs for conformance with Section 22a-411a of the regulation. Staff attend EAP tabletops and drills. The owners of the larger flood control levees in the state, which are DEEP jurisdictional and have more recently been accredited by FEMA and certified by the USACE, are not presently being required to submit an EAP pursuant to 22a-411a of the regulations as an appropriate guideline for writing an EAP for these levee structures does not exist at this time. The need to have updated EAPs for this small subset of

dams was put on hold until guidelines could be written and because the existing levee operations plans written by the USACE are the presiding documents for these structures.

  - A total of 245 Class C High hazard dams are expected to have DEEP-reviewed EAPs that conform to Section 22a-411a of the regulation. As of March 2018, about 173 dam owners have EAPs that have been updated and are in various stages of review and approval. EAPs for another 37 dams are being prepared, and another 35 dam owners recently were sent notices of violation for failing to submit an updated EAP.
  - A total of 259 Class B Significant hazard dams are expected to have DEEP-reviewed EAPs that conform to Section 22a-411 of the regulation. As of March 2018, about 94 dam owners have EAPs that have been updated and are in various stages of review and approval. EAP's for another 30 dams are being prepared, and another 135 dam owners recently were sent notices of noncompliance for failing to submit an updated EAP.

- *Permitting*. Program staff attend preapplication technical meetings, review general and individual permit applications, issue permits and approvals, and follow up on repair projects.
- *Enforcement*. When a dam is found to be in need of repairs and the dam owner is not responsive, program staff initiate enforcement as needed. Informal enforcement such as Notices of Violation or Non-Compliance and formal enforcement such as unilateral and consent orders are available to ensure that critical issues such as regulatory inspections requirements, EAP preparation requirements, and critical needed repairs are undertaken by the dam owners.
- *Technical Support*. Program staff provide technical support to the staff of the DEEP state-owned dams program and other state agencies. There are over 250 DEEP-owned dams and approximately 50 additional dams owned by other state agencies or institutions. Program staff also respond to calls and emails and FOIA requests submitted to the program from dam owners, consultants, elected officials, other state officials, and the general public.
- *Inventory*. Program staff maintain an inventory of dams in Connecticut in a database that is regularly updated with dam owner information, inspection report data, EAPs and status, dam physical size and shape data, and communications data. Program staff also maintain an electronic document archive of *Word* and PDF documents and an email archive for each dam along with the original paper files.
- *GIS Data.* Program staff maintain a GIS data layer that has an old dam failure inundation shapefile, which was obtained by digitizing the dam failure inundations maps prepared for the 1980-1982 era Phase I and II dam inspection reports. While outdated, they remain a useful resource in a flood event.
- *Critical Facilities*. DEEP state-owned dams program staff maintain Critical Facilities mapping.
- *DamWatch*. The DEEP subscribes to the U.S. Engineering DamWatch program for DEEP-owned dams. DamWatch is an online real-time Nexrad radar precipitation-based monitoring application for dams. All 250 DEEP-owned dams are monitored by DamWatch. DamWatch will notify DEEP staff whenever a preset precipitation threshold has been surpassed within the drainage area to one of the monitored dams. The notice allows staff to know as early as possible when precipitation intensity and duration may create flood conditions at a monitored dam.

Levees

There are levees in the city of Hartford and the town of East Hartford that provide invaluable flood protection for the residents and businesses of those municipalities. In East Hartford, a nearly 4-mile-long levee runs along the east side of the Connecticut River and north of the Hockanum River, keeping floodwaters from over 728 acres of land generally west of Main Street. In Hartford, a 7.27-mile-long

levee runs along the west side of the Connecticut River, providing coverage for over 2,176 acres of land. Also in Hartford, a .14-mile-long levee runs along the Park River, providing flood coverage for over 200 acres on the west side of the city (see the map below). These levees were constructed by the USACE and are overseen by the USACE Levee Safety Program, but the municipalities are responsible for operations and maintenance. The levee systems are periodically inspected.

In 2014, a USACE evaluation determined that the East Hartford levee is likely to withstand water to the top of the levee without breaching; a breach could result in flood depths over 24 feet and damages over $360 million. There are some uncertainties with how the system will perform during a flood event due to significant sections of the toe drain system that are in poor condition and the fact that there has not been a flood event that has loaded the system more than 75% of its capacity. An inspection of the East Hartford levee in 2015 found the state of the system to be minimally acceptable.

A USACE evaluation in 2013 determined that the Hartford levee is likely to withstand water to the top of the levee without breaching, but breach is possible; a breach could result in flood depths of over 31 feet and damages over $840 million. There are some uncertainties with how the system will perform during a flood event due to significant concerns with the uncertainty of the materials used to construct the embankments, the conditions of the toe drains and penetrations through the levees, and the possibility of floodwall failure due to sections of tilting and rotation. The system has withstood flood events multiple times, including one that reached 75% of the levee's capacity. Inspections of the Hartford levee in 2013, 2014, and 2015 found the state of the system to be unacceptable.

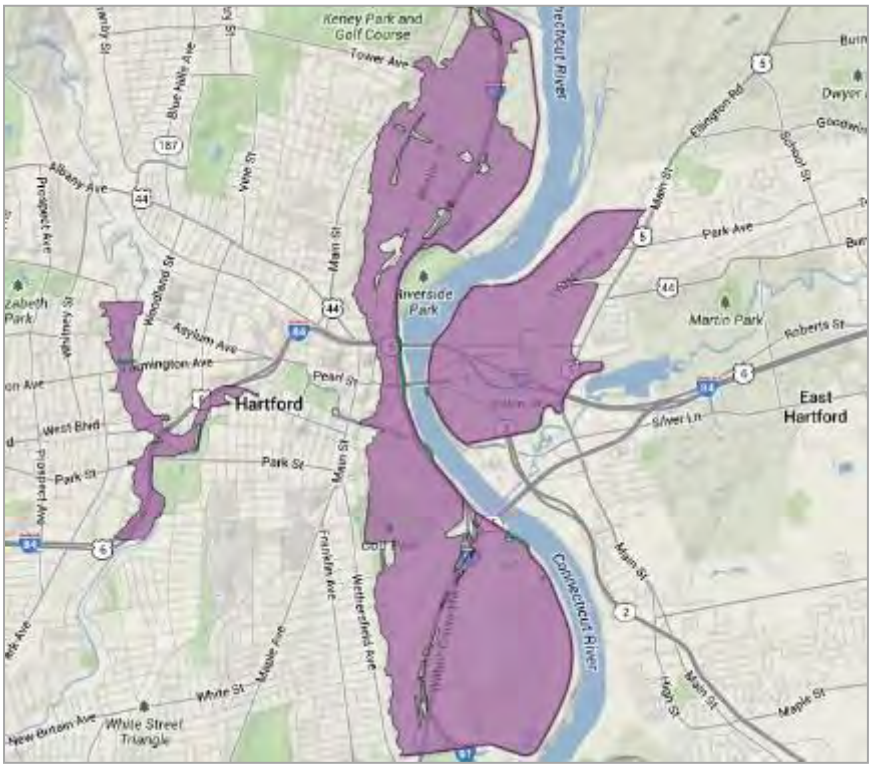


Figure 13: Leveed Areas in East Hartford and Hartford

Source: USACE National Levee Database, https://levees.sec.usace.army.mil/#/

USDA Assistance

Several towns within the region have used the technical and financial assistance of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) to minimize damages from natural disasters. The Emergency Watershed Program provides financial and technical assistance to the state and towns to address dangerous problems that result from natural hazards. The Watershed Protection and Flood Prevention program provides technical assistance in designing and planning for structural measures to reduce flooding damage. The CT DEEP then assists in the actual installation of planned measures.

Forest Fire Aid

There are procedures in place for requesting assistance or other resources to aid in responding to all hazards including forest and wildland fires. In the State of Connecticut, the first responding authority would be the local jurisdiction. If there is a need for additional aid or resources beyond the local capabilities, the Intrastate Mutual Aid Compact (CGS Sec. 28-22a) outlines the process for requesting assistance. If regional resources are depleted, CT DEEP's Division of Forestry may be requested to assist local fire departments in suppressing wildland fires. The Forestry Division maintains an active forest fire prevention program and a specially trained force of firefighting personnel to combat fires that ravage an average of 1,300 acres of forestland per year. During the spring fire season and at other times of high or above fire danger, the division broadcasts daily predictions of fire danger and issues advisories to state park staff, municipalities, fire departments, and the media. The division also has crews ready to assist the U.S. Forest Service in controlling large fires across the nation.

Summary of Effectiveness of Existing Strategies, Authorities, Policies, Programs, and Resources

The communities of the Capitol Region have a variety of tools and resources to draw upon to prepare for and mitigate the impacts of natural hazards. Connecticut municipalities are enabled with a broad scope of government authorities and powers including the ability to tax; establish laws, ordinances, and regulations; exercise eminent domain; provide police protection; and establish, construct, and maintain public facilities and infrastructure. The municipalities have established commissions and boards to undertake their planning, zoning, inland wetlands, development, and conservation responsibilities. These commissions and boards are supported by professional staff and/or consultants. Local communities also have either full-time or volunteer fire departments. Police services are provided by a local department in most communities; however, in smaller communities, a resident state trooper may provide police services. Most municipalities also have public works or highway departments and building inspection departments.

Several mitigation successes are evident in the Capitol Region. A series of mitigation success story fact sheets follow this page, highlighting mitigation successes in the six categories of property protection, prevention, natural resources restoration, structural projects, emergency services, and public education.

MITIGATION SUCCESS STORY

PROPERTY ACQUISITIONS: PEQUABUCK RIVER

Plainville Citizen

View of vacant parcel,; photo by MMI, 2018

WHAT IS IT?

When repeatedly experiencing and recovering from flood events, along with the ever-rising cost of flood insurance, becomes too much of a hassle, homeowners may decide that it's time to relocate.

The town of Plainville has worked with over 20 residents living along the Pequabuck River to purchase their properties. Many of these properties were within the 1% annual-chance floodplain and had been hit by recent storms, including Hurricane Irene in 2011. By acquiring the properties, the town relieved the owners of a financial burden, and enabled them to move to a less hazard-prone area.

Following the acquisitions, Plainville has converted the areas to open space. These areas are now a valuable aesthetic and recreational asset for the town, with the added benefits of improving wildlife habitat and creating areas where floodwaters can safely accumulate, decreasing flood risks elsewhere.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

If a property owner does decide it's time to move, their town and state, as well as the federal government, may be able to help. Some local communities may have their own property acquisition programs, and grants are available for application through the federal government. Property owners unable to sell their property on the market may be eligible for a property acquisition program or grant.

Acquisition and conversion to open space of flood prone properties aligns primarily with the Multi-Jurisdictional Hazard Mitigation Plan's Municipal Goal #4: Increase the use of natural, "green," or "soft" hazard mitigation measures, such as open space preservation and green infrastructure.

FOR MORE INFORMATION

Garrett Daigle
Interim Town Planner
Town of Plainville
One Central Square
Plainville, CT 06062
(860) 793-0221 Ext. 213
Daigle@plainville-ct.gov

MITIGATION SUCCESS STORY

MICROGRID: PARKVILLE NEIGHBORHOOD, HARTFORD

Parkville Fuel Cell; photo by MMI

Parkville microgrid area; photo by MMI

FOR MORE INFORMATION

Microgrid Program
CT Department of Energy and Environmental Protection
Bureau of Energy and Technology
(860) 827-2655
DEEP.EnergyBureau@ct.gov

WHAT IS IT?

A microgrid is a localized electric system that includes both electricity sources (such as power plants, generators, fuel cells, or solar panels) and electricity users. Under normal conditions, a microgrid is connected to regional electric grids, but during regional power outages a microgrid is able to act in "island mode," maintaining power to connected users.

In 2017, the City of Hartford installed an 800-kilowatt microgrid in the Parkville section of the city that, in the event of a power outage, will be able to power the school, senior center, Dwight Branch library, Charter Oak Health Center, a gas station, and a grocery store. The natural gas powered fuel cell that powers the local system feeds excess energy back into the larger regional grid under normal conditions.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Power outages caused by the effects of winter storms, hurricanes, lightning, and other natural hazards is one of the most commonly cited impacts of natural disasters in the region. Such outages can have direct impacts on health, safety, and the economy, as well as indirect impacts on hazard response and recovery efforts.

Developing microgrids that encompass critical facilities such as emergency response, shelter, fuel, and food facilities, can help make a community more resilient to natural disasters. Urgent needs of the community can be met and response and recovery efforts can move forward without delay while the regional grid is repaired.

Microgrid development aligns primarily with the Multi-Jurisdictional Hazard Mitigation Plan Municipal Goal #5: Improve the resilience of local and regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies.

MITIGATION SUCCESS STORY

PUBLIC INFORMATION: MUNICIPAL WEB PAGES

West Hartford Flood Hazard Information web page

Windsor Flood Management web page

WHAT IS IT?

Several Capitol Region municipalities provide detailed information about flood risks on their official web sites. In most cases, the information is for residents to understand how to assess their risks and access the FEMA maps. In some cases, regulations are mentioned. For Community Rating System (CRS) communities such as West Hartford, the web page provides public information that achieves credit and helps the town remain in the CRS program.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Providing information to the public is an important category of hazard mitigation. In the Capitol Region, provision of public information on municipal web sites align primarily with the Multi-Jurisdictional Hazard Mitigation Plan Municipal Goal #6:

- Improve public outreach, education, and warning systems

It also helps achieve progress with the following mitigation goals:

- Goal 1: Minimize the impact of natural hazards on physical buildings and infrastructure
- Goal 3: Improve institutional awareness and understanding of natural hazard impacts and mitigation within municipal governments and other decision-making bodies
- Goal 9: Minimize the economic impact of hazard damages

FOR MORE INFORMATION

Please contact individual municipalities regarding information on their official web sites.

For information about what types of information should be posted on web sites, contact the State National Flood Insurance Program (NFIP) coordinator:

Diane Ifkovic
State NFIP Coordinator
Connecticut Department of Energy and Environmental Protection
79 Elm Street
Hartford, CT 06106
Diane.ifkovic@ct.gov

MITIGATION SUCCESS STORY

DRAINAGE UPGRADES: NEW BRITAIN

Hart Street Drainage System Project

David Murphy, 2018

FOR MORE INFORMATION

Rob Trottier
New Britain City Engineer
New Britain Department of Public Works
860-826-3350
www.newbritainct.gov/

WHAT IS IT?

New Britain replaced and upsized a drainage system on Hart Street. Previously, degraded and undersized storm drains would be overwhelmed by significant rain events, causing water to backup and flood the street. The flooding would make the street impassible, causing at best an inconvenience to residents and travelers, and at worst a dangerous delay for emergency responders.

New Britain intends to continue replacing aged and undersized drainage infrastructure around the city.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Complaints of flash or poor-drainage flooding on roads are very common. The locations of prone areas typically are not represented on FEMA Flood Insurance Rate Maps, but can cause property damage and travel delays during important emergency response situations.

Constructing, upgrading, and maintaining appropriately sized drainage infrastructure is key to mitigating these types of floods. Passing ordinances requiring that drainage systems meet a certain capacity can support these efforts.

Drainage upgrades align primarily with the Multi-Jurisdictional Hazard Mitigation Plan Municipal Goal #5: Improve the resilience of local and regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies.

MITIGATION SUCCESS STORY

CODE PLUS DESIGN: SOUTH WINDSOR EMERGENCY OPERATIONS CENTER

South Windsor EOC
photo courtesy of South Windsor

South Windsor EOC
photo courtesy of South Windsor

WHAT IS IT?

In 2016, South Windsor completed a $2.3 million project ($1.28 million of which came from state grant funds) to install an EOC (Emergency Operations Center) in a renovated municipal building.

During emergency events such as a natural hazard, the EOC will function as a hub for information collection, response coordination, priority-setting, resource management, and communications facilitation. Under non-emergency conditions, the space will be used to conduct emergency responder trainings, community education and awareness workshops, and Neighborhood Emergency Team preparedness programs.

The building renovations made the structure more resilient to hazard events; for example, the new roof was designed to withstand a Category 3 hurricane (130 mph winds).

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Hazards cannot be avoided completely, so a community's ability to respond to emergency situations during and following a hazard event is an essential part of resiliency and hazard mitigation. Critical facilities that are central to emergency response may be vulnerable to natural hazards just like the rest of the community, so protecting these assets from the impacts of those hazards is key:

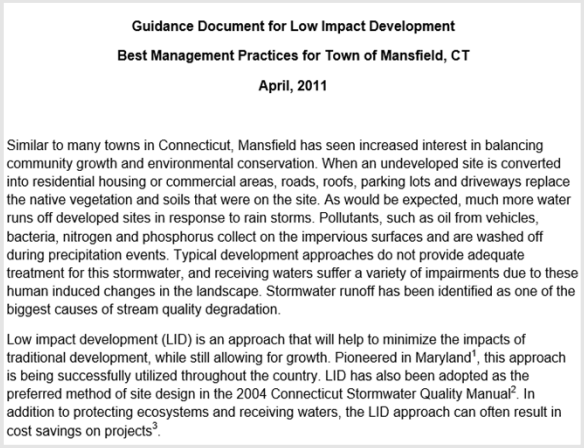
- Mitigate Structural Damage
  - protect against floods, wind, earthquakes, etc.
- Mitigate Operational Interruptions
  - backup power, resilient communications, ensure roads to and from facilities are passable
- Ensure Operational Preparedness
  - Familiarize staff with Emergency Plan, assign roles before event, conduct trainings/exercises.

FOR MORE INFORMATION

Jubenal Gonzalez, MEP, EMT-P
Assistant Director of Emergency Management
South Windsor Office of Emergency Management
1530 Sullivan Avenue
South Windsor, CT 06074

MITIGATION SUCCESS STORY

STORMWATER MANAGEMENT: LOW IMPACT DEVELOPMENT



Guidance Document for Low Impact Development

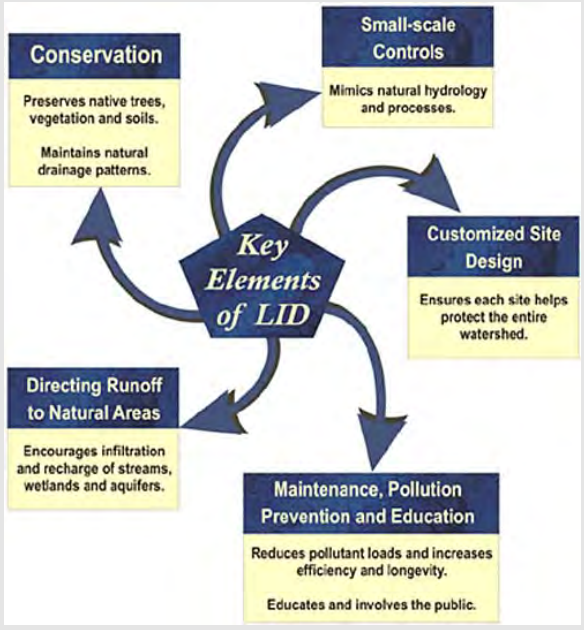
Best Management Practices for Town of Mansfield, CT

April, 2011

Similar to many towns in Connecticut, Mansfield has seen increased interest in balancing community growth and environmental conservation. When an undeveloped site is converted into residential housing or commercial areas, roads, roofs, parking lots and driveways replace the native vegetation and soils that were on the site. As would be expected, much more water runs off developed sites in response to rain storms. Pollutants, such as oil from vehicles, bacteria, nitrogen and phosphorus collect on the impervious surfaces and are washed off during precipitation events. Typical development approaches do not provide adequate treatment for this stormwater, and receiving waters suffer a variety of impairments due to these human induced changes in the landscape. Stormwater runoff has been identified as one of the biggest causes of stream quality degradation.

Low impact development (LID) is an approach that will help to minimize the impacts of traditional development, while still allowing for growth. Pioneered in Maryland[1], this approach is being successfully utilized throughout the country. LID has also been adopted as the preferred method of site design in the 2004 Connecticut Stormwater Quality Manual[2]. In addition to protecting ecosystems and receiving waters, the LID approach can often result in cost savings on projects[3].

Mansfield LID-Regulation Guidance



Key Elements of LID, From The CT Stormwater Quality Manual, 2011

FOR MORE INFORMATION

Department of Energy & Environmental Protection
79 Elm Street
Hartford, CT 06106-5127
860-424-3297

Amanda Ryan
Municipal Stormwater Educator
UConn CLEAR
Middlesex County Extension
PO Box 70, 1066 Saybrook Road
Haddam, CT 06438
860-345-5231

WHAT IS IT?

Low Impact Development (LID) is an approach to development that uses runoff-reducing site design principles and small-scale non-structural treatment practices distributed throughout a site to manage stormwater runoff. The technique provides on-site retention, detention, and infiltration of runoff in a way that mimics nature, reducing load to streams and municipal treatment plants.

The Town of Mansfield has adopted stormwater management requirements into its Zoning Regulations that promote the use of LID practices. The purpose of the stormwater management requirements are to improve water quality and decrease peak runoff. The Town has also published guidance that includes LID best management practices, in order to assist developers to be in compliance with the new regulations.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

In addition to improving water quality, lowering maintenance costs, improving aesthetics and providing local ecological benefits, Low Impact Development helps mitigate hazards, primarily those posed by inland flooding. Reducing the rate of runoff directly into waterways can lower the elevation of flood crests.

Examples of LID practices include:

- Bioretention Areas or Rain Gardens
- Vegetated Swales
- Water Harvesting
- Pervious Pavements
- Green Roofs

MITIGATION SUCCESS STORY

STREAM CULVERT UPSIZING: FARMINGTON

Two views of the undersized culvert and nearby, potentially-affected properties. Photo by MMI

WHAT IS IT?

Bridges and culverts (pipes that convey water under a roadway) must be sized appropriately to ensure water can pass through during high flow events. An undersized culvert or bridge can back-up water and flood upstream areas, while acting as a pressure-hose causing erosion downstream. If water overtops the road or seeps through the fill below it, it can wash-out the road, cause additional damage downstream, and hamper transportation and hazard response along that route.

An appropriately-sized structure allows water and debris to flow through it during storms without significant changes to velocity or power.

This new, upsized culvert in Farmington has decreased the risk of flooding upstream, the risk of erosion downstream, and the risk of road failure.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

It is important to address the many undersized bridges and culverts in this region proactively:

1. Identify, prioritize and replace undersized structures
2. Require larger structures during new construction or replacements.
3. Consider the impacts that climate change will have on the appropriate sizes of structures.

Many culverts in the region were likely designed based on "Technical Paper No. 40," published by the U.S. Weather Bureau in 1961. In 2015, CT DOT put out bulletin EB-2015-2, directing that precipitation estimates from *NOAA Atlas 14* (9/30/2015) be used in culvert planning and design. Extreme precipitation data from the Northeast Regional Climate Center (NRCC; http://precip.eas.cornell.edu/) is also a good tool to use to model appropriate culvert sizes.

FOR MORE INFORMATION

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MITIGATION SUCCESS STORY

WET FLOODPROOFING: HARTFORD BOATHOUSE

Hartford Boat House

Images from Public Domain

WHAT IS IT?

The Hartford-based nonprofit Riverfront Recapture's mission is "to connect people with the Connecticut River." As part of this effort, the organization constructed a boathouse in 2002 to house boats and a community and function room.

The building was designed to allow flood waters into the lower level, where boats are stored, through flood grates. Concrete siding and walls withstand water damage and are easy to clean after a flood, but are designed to look like wooden clapboard. Mechanical and electrical systems are located on the second level to avoid flood damage.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Properties that must be in flood prone areas because they require proximity to water in order to function are called water-dependent use properties.

Limiting development in flood hazard zones to water-dependent uses and floodable uses such as parks and open space allows a community to balance economic and hazard mitigation interests.

Construction of a wet-floodproofed water-dependent use building like a boat house in a flood hazard area aligns primarily with the Multi-Jurisdictional Hazard Mitigation Plan's Municipal Goal # 1: Minimize the impact of natural hazards on physical buildings and infrastructure.

FOR MORE INFORMATION

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www.riverfront.org/

While much has been accomplished to implement natural hazard mitigation throughout the region, resources may not be applied to natural hazard mitigation at a level that allows the communities to accomplish all their proposed mitigation actions within the timeframes proposed. This is due to local governments' broad range of responsibilities and financial limitations. Networks for collaboration among government agencies at the local, state, and federal level, as well as with regional agencies and various organizations, also have been established and are effective in supporting and supplementing the capabilities of individual communities. The ability of communities and the CRCOG to receive state and federal grants and other assistance also improves the effectiveness of local and regional hazard mitigation efforts.

Resources

The following sources of funding and technical assistance may be available for the mitigation projects identified by each community.

General Hazard Mitigation

- ☐ FEMA Hazard Mitigation Grant Program (HMGP) – funding for hazard mitigation projects following a presidentially declared disaster. More information on the HMGP program can be found at: *http://www.fema.gov/hazard-mitigation-grant-program* and at *http://www.ct.gov/demhs/cwp/view.asp?a=4062&q=515030*

- ☐ FEMA Pre-Disaster Mitigation Grant Program (PDM) – funding for hazard mitigation projects on a nationally competitive basis. More information on the PDM program can be found at: *http://www.fema.gov/pre-disaster-mitigation-grant-program*

- ☐ U.S. Small Business Administration – Disaster Loan Program – provides funding to individuals, businesses, and nonprofits including relocation loans. More information can be found at: *http://www.sba.gov/content/disaster-loan-program*

- ☐ U.S. Economic Development Administration-Disaster Recovery – EDA assists local governments affected by disasters. More information can be found at: *https://www.eda.gov/programs/disaster-recovery/*

- ☐ U.S. Department of Housing and Urban Development – CDBG Disaster Recovery Assistance-HUD provides flexible grants to help cities, counties, and states recover from presidentially declared disasters, especially in low-income areas, subject to availability of supplemental appropriations. More information can be found at: *https://www.hudexchange.info/programs/cdbg-dr/*

- ☐ U.S. Department of Housing and Urban Development – CDBG Program – generally CDBG funds to municipalities can be used as local match for other federal assistance granted for disaster mitigation provided the activity meets all applicable CDBG requirements. More information can be found at: *http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs*

- ☐ Connecticut Department of Housing CDBG Small Cities Program – This federally funded program provides funding to municipalities with populations of less than 50,000 for a variety of activities including acquisition of property, relocation, public facilities and improvements, code enforcement, planning and capacity building, among other uses. More information can be found at: *https://www.ct.gov/doh/cwp/view.asp?a=4513&Q=596970&PM=1*

- ☐ Connecticut Department of Energy & Environmental Protection (DEEP) Open Space and Watershed Land Acquisition Grant Program – provides financial assistance to municipalities and nonprofit land conservation organizations to acquire open space. More information can be found at: *http://www.ct.gov/deep///cwp/view.asp?q=323834&deepNav_GID=1642*

- ☐ Connecticut Department of Energy & Environmental Protection (DEEP) Nonpoint Source Management Grant Program – provides grants for the prevention, control, and/or abatement of nonpoint source pollution. Funded under Section 319(h) of the Federal Clean Water Act. More information can be found at: http://www.ct.gov/deep/cwp/view.asp?a=2719&q=325594&deepNav_GID=1654

- ☐ Connecticut Department of Emergency Services and Public Protection, Division of Emergency Management and Homeland Security – provides strategic planning and grant assistance. More information can be found at*: http://www.ct.gov/demhs/cwp/*

- ☐ Connecticut Land Conservation Council – can provide funding and advice on additional sources of funding to local land trusts for open space acquisition. More information can be found at: *http://www.ctconservation.org/funding-programs*

- ☐ AmeriCorps – service project teams may be available to assist with projects such as surveying, tree planting, restoration, construction, and environmental education. More information on AmeriCorps can be found at: *http://www.americorps.gov/for_organizations/overview/index.asp* and at *https://www.nationalservice.gov/impact-our-nation/state-profiles/ct*

- ☐ Capitol Region Council of Governments – Assistance to municipalities for road and bridge projects, brownfield remediation, and other projects that could include hazard mitigation outcomes. Funding for this assistance is through federal and state sources and subject to specific program requirements. More information can be found at *http://crcog.org/funding-opportunities-2/*

- ☐ Connecticut State Historic Preservation Office – grants available to support identification, preservation, protection, and restoration of historic buildings and sites. *https://www.ct.gov/cct/cwp/view.asp?a=3948&q=293806*

Flood Mitigation

- ☐ FEMA Flood Mitigation Assistance (FMA) Program – grants for flood hazard mitigation planning and projects such as property acquisition, relocation of residents, and flood retrofitting. More information can be found at: *http://www.fema.gov/flood-mitigation-assistance-program*

- ☐ FEMA National Flood Insurance Program Community Rating System, *http://www.fema.gov/national-flood-insurance-program-community-rating-system*

- ☐ U.S. Army Corps of Engineers Flood Risk Management Program – 50/50 match funding for floodproofing and flood preparedness projects. More information can be found at: *http://www.iwr.usace.army.mil/Missions/FloodRiskManagement/FloodRiskManagementProgram.aspx*

- ☐ U.S. Department of Agriculture Natural Resources Conservation Service Emergency Watershed Protection and Watershed and Flood Prevention Operations Programs – technical and financial assistance to reduce or prevent flood damage, reduce soil erosion, and improve water quality. More information can be found at: *http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wfpo/* and at *http://www.nrcs.usda.gov/wps/portal/nrcs/main/ct/programs/financial/ewp/*

Hurricane Mitigation

- ☐ FEMA Mitigation Assessment Team Program – technical assistance to state and local governments provided through reports and technical manuals based on assessments of building performance in response to disasters. More information can be found at: *http://www.fema.gov/mitigation-assessment-team-program*

Wildfire Mitigation

- ☐ Assistance to Firefighters Grant Program – grants are provided to fire departments to enhance their ability to protect the public and fire service personnel from fire and related hazards**.** More information can be found at: *http://www.fema.gov/welcome-assistance-firefighters-grant-program*

Dams and Levees

- ☐ Association of State Dam Safety Officials – website with advice and information on dam safety. More information can be found at: *http://www.damsafety.org/*

- ☐ Connecticut Department of Energy & Environmental Protection (DEEP) Dam Safety Program – more information can be found at: *http://www.ct.gov/deep/cwp/view.asp?a=2720&q=325634&deepNav_GID=1654*

- ☐ U.S. Army Corps of Engineers Levee Program – information on levee safety, risk assessment, and risk reduction. More information can be found at: *http://www.usace.army.mil/Missions/CivilWorks/LeveeSafetyProgram/USACEProgramLevees.aspx*

Power Outages

- ☐ State of Connecticut, Microgrid Program – originally created in 2012 upon passage of Public Act 12-148, the Connecticut Microgrid Program supports local distributed energy generation for critical facilities. Grants can be awarded to any number of recipients and are generally split between small, medium, and large municipalities. Grants are not to exceed $15 million a year. The state closed the window of its fourth round of applications in January 2018 with eight applicants. More information can be found at: *http://www.ct.gov/deep/cwp/view.asp?a=4405&Q=508780*

- ☐ FEMA Hazard Mitigation Grant Program (HMGP) – funding for hazard mitigation projects following a presidentially declared disaster including for the purchase and installation of generators for critical facilities. More information on the HMGP program can be found at: *http://www.fema.gov/hazard-mitigation-grant-program* and at *http://www.ct.gov/demhs/cwp/view.asp?a=4062&q=515030*

Vulnerable Populations

The information on the following pages is provided courtesy of Shirley Bergert, Connecticut Legal Services, Inc.

Resources for Planning and Responding Effectively: Vulnerable Populations

Prepared by Shirley Bergert, CT Legal Services, Inc., PO Box 258, Willimantic, CT 06226, 860.786.6375

June 19, 2012

For planning purposes in a utility outage:

- assume all systems are interrupted, including water, fuel, transportation and communications, and the medical infrastructure (access to care, medical records, medication) and care providing facilities are compromised; and
- understand planning will ultimately result in an effective response only if all responders, from utility crews to private emergency and government responders, plan together and respond with common expectations regarding roles and procedures.

The following is a list of ***practical*** resources with some overlap in terms of information and planning, particularly planning for needs of various vulnerable populations (*e.g.*, disabled, elderly, linguistic minorities), so the subset titles are for general guidance only. Where available, computer links are provided to the information referenced, along with other contact information, to allow ready access. Funding listed is largely for individual relief needs (not for planning), though some funding resources for planning also exist.

Federal Emergency Management Agency (FEMA) National Incident Management System:

FEMA is responsible for providing and coordinating emergency services in Presidentially declared disaster areas, working with federal, state and local governments and voluntary organizations. In a disaster, assistance is only provided when a governor requests it, and when the response needed is certified to be beyond the capabilities of the state (http://www.fema.gov/hazard/guidance.shtm - 42 USC §5121-5206 and 44 CFR 206).

Under Stafford Disaster Relief and Emergency Assistance Act, 42 USC §5174, FEMA's Individuals and Households Program (IHP) can provide financial assistance and direct services to people in the area with necessary expenses and serious needs related to the disaster not covered through other means (*e.g.*, medical, dental, funeral, personal property, transportation, moving and storage expenses). Limited assistance, including grants, can be provided to individuals to obtain a safe, sanitary, and secure place to live, make emergency home repairs (including structural repairs and heating, ventilating, air conditioning, electrical, plumbing, and gas systems), and for up to 18 months of rental assistance, and commodities (*e.g.*, food and water) can be brought in (not via individual grants). Special assistance is available for the elderly, crisis counseling services and legal assistance may be available for low income households. Assistance provided does not count in determining eligibility for needs-based welfare assistance programs and grants do not have to be repaid. Individual assistance is not available to undocumented immigrants unless living in a household with a citizen or qualified alien.

Emergency assistance: http://www.fema.gov/emergency/nims/, FEMA Helpline: 1-800-621-3362 (TTY 1-800-462-7585 for the hearing impaired); FEMA, US Department of Homeland Security, 500 C Street SW, Washington, D.C. 20472, 202-646-2500.

US Department of Health and Human Services:

- **Emergency Support Functions** (ESFs) is the grouping of governmental and certain private sector capabilities into an organizational structure to provide support, resources, program implementation, and services likely needed to save lives, protect property and the environment, restore essential services and critical infrastructure, and help victims and communities return to normal following disasters. http://www.phe.gov/Preparedness/support/emergencypreparedness/Pages/default.aspx , Assistant Secretary for Preparedness and Response (ASPR), US Department of Health and Human Services, 200 Independence Ave., SW, Washington, DC 20201.

- **Office of Human Services Emergency Preparedness and Response** has information available on services needed in response to disasters, including specific information on planning for **children and the range of people with special needs**: http://www.acf.hhs.gov/ohsepr/. OHSEPR, 370 L'Enfant Promenade, SW 6th Fl. West, Washington, D.C. 20447, 202-401-9306.

- **Needs of special populations**: Planning and assistance information is available regarding a range of special populations in disasters, including **persons with disabilities, elderly, hearing impaired, visually impaired, pregnant women, persons with diabetes, children, Native Americans, Latinos and other cultures**. http://sis.nlm.nih.gov/outreach/specialpopulationsanddisasters.html.

- **Center for Medicaid and Medicare Services (CMS)** oversees the administration of Medicaid and Medicare. It has the capability to take steps to ensure **medical care continuity in disasters**. http://www.cms.gov/About-CMS/Agency-Information/Emergency/index.html?redirect=/Emergency/01_overview.asp. It has a pamphlet regarding accessing medical care and prescriptions in an emergency: http://www.medicare.gov/Publications/Pubs/pdf/11377.pdf. For lost plan information, accessing alternate medical care, and other problems related to Medicare: 1-800-633-4227 (TTY: 1-877-486-2048).

- **Substance Use and Mental Health**: Disaster Technical Assistance Center (DTAC) – part of the Substance Abuse and Mental Health Services Administration (SAMHSA) at the US Department of Health and Human Services -- free services, including technical assistance, training and consultation provided to states, territories, federally recognized Tribes, and local entities to prepare for delivery of **behavioral health services** in response to disasters. There are materials on the website regarding particular problems and different types of affected populations, and a free newsletter. samhsa.gov/dtac/ and DTAC@samhsa.hhs.gov; 4350 East West Highway Suite 1100, Bethesda, MD 20814, 1-800-308-3515, fax: 240-744-7005.

Elderly:

- **AARP, 2006**. ***We can do better: Lessons Learned for Protecting Older Persons in Disasters,*** http://assets.aarp.org/rgcenter/il/better.pdf [PDF - 120 Kb]. This free publication provides information and practical planning guidance regarding **elderly and disabled populations in the**

community and in institutional settings, covering: planning and communications; identification of those needing help and the kind of help needed, including registries, tracking and medications; and evacuation, including transportation issues and "special needs" shelters.

- **Alzheimer's Association** has information on preparing for care of **individuals with dementia** in disasters. http://www.alz.org/safetycenter/we_can_help_safety_disaster.asp. Alzheimer's Association National Office, 225 N. Michigan Ave. Fl. 17, Chicago, IL 60601, 1-800-272-3900.

- **US Administration on Aging (AoA):**

    - **Planning and response information**: AoA has information on planning for disasters impacting the **elderly**, including information for individuals and the networks serving them: http://www.aoa.gov/AoARoot/Preparedness/index.aspx; http://www.aoa.gov/AoARoot/Preparedness/Resources_Individuals/index.aspx; http://www.aoa.gov/AoARoot/Preparedness/Resources_Network/index.aspx.

    - **Disaster assistance funding**: AoA sets aside grant funding under the Older Americans Act (42 USC § 3030) for state Agencies on Aging and Title VI tribal organizations impacted by Presidentially declared national disasters. Funding can be used for **"gap-filling" services for the elderly and immediate needs** including food, supplies, home delivered meals, home clean up and safety, emergency medications, transportation, and outreach, information and assistance, counseling, case management and advocacy. http://www.aoa.gov/AoARoot/Grants/Funding/index.aspx, 202-357-3585.

Persons with Disabilities:

- **Interagency Coordinating Council on Emergency Preparedness and Individuals with Disabilities,** was established by Presidential Executive Order 13347 (Fed. Reg., Vol. 69, No. 142, p. 44573, 7/26/2004) to address the needs of persons with disabilities and ensure the federal government appropriately supports safety and security for individuals with disabilities in disaster situations, www.dhs.gov/disabilitypreparedness, US Department of Homeland Security, Office for Civil Rights and Civil Liberties, Interagency Coordinating Council on Emergency Preparedness and Individuals with Disabilities, Building 410, Mail Stop #0190, Washington, D.C. 20528, 202-401-1474 or 1-866-644-8360, 202-401-0470 or TTY: 1-866-644-8361, fax: 202-401-4708, disability.preparedness@dhs.gov.

- **US Department of Justice** has created a practical guide regarding plans for assisting **people with disabilities and their families** in case of disaster: "ADA Guide for Local Governments: Making Community Emergency Preparedness and Response Programs Accessible to People with Disabilities". www.usdoj.gov/crt/ada/emergencyprep.htm.

- **Disability.gov** is the federal government web portal for accessing comprehensive information on disability programs, services and resources from federal, state and local government agencies, academic institutions and nonprofits. It has links focused on emergency preparedness resources for **persons with disabilities** which allow you to link to federal and state-by-state resources: https://www.disability.gov/emergency_preparedness. The lists include extensive links to information directed to planners, facilities, responders and individuals.

- **National Council on Disability** (small federal agency), has analysis to assist in development of evidence-based policies, programs and practices regarding emergency preparedness and disaster relief for **people with disabilities**, "Effective Emergency Management: Making Improvements for Communities and People with Disabilities," 2009: http://www.ncd.gov/policy/emergency_management, National Council on Disability, 1331 F Street, NW, Suite 850, Washington, DC 20004, 202-272-2004, (TTY: 202-272-2074), fax: 202-272-2022.

- **National Organization on Disability** (NOD) has information regarding planning for persons with disabilities before, during and after emergencies, including specific materials for planners and responders, and **people with mobility, sensory, and developmental or cognitive disabilities and issues involving pets or service animals**: http://nod.org/research_publications/emergency_preparedness_materials/, NOD, 5 East 86th St., NY, NY 10028, 646-505-1191, 202-293-5960.

Medical Care and Infrastructure:

- **Center for Disease Control has information on:**
  - planning and assistance for **persons with chronic conditions:** http://emergency.cdc.gov/disasters/chronic.asp.
  - dealing with **extreme heat:** http://emergency.cdc.gov/disasters/extremeheat/.
  - dealing with hypothermia, wind chill, frostbite and **extreme cold:** http://emergency.cdc.gov/disasters/winter/.
  - planning information for **schools:** http://emergency.cdc.gov/schools/.
  - planning for **healthcare facilities including hospitals, long-term, acute and chronic care facilities, doctor offices and clinics**: http://emergency.cdc.gov/healthcare/.

  CDC, 1600 Clifton Rd., Atlanta, GA 30333, 800-232-4636, TTY: 888-232-6348.

- **Association of State and Territorial Health Officials (ASTHO) has materials on responding to disasters from a public health perspective**: http://www.astho.org/Search.aspx?s=disaster%20planning

- **The Joint Commission** handles accreditation of health care organizations, including hospitals, doctor's offices, nursing homes, office-based surgery centers, behavioral health treatment facilities and providers of home care services. They have resources for **planning for medical needs** in case of disasters: http://www.jointcommission.org/search/default.aspx?Keywords=disaster+planning&f=sitename&sitename=Joint+Commission.

Emergency Food

The Food Research Action Center (FRAC) has information on disaster related food assistance (Supplemental Nutrition Assistance Program or SNAP) – the webpage listing resources: http://frac.org/federal-foodnutrition-programs/snapfood-stamps/disaster-snapfood-stamps/. These resources include FRAC's advocates' guide with details on the types of food disaster assistance available

and accessing such assistance, which must be requested by state officials: http://frac.org/newsite/wp-content/uploads/2009/09/dfsoguide06.pdf. Programs covered in the guide include the following:

- **Disaster Food Stamp Program**: When large numbers of people are affected, a state can ask the US Department of Agriculture's Food and Nutrition Service (USDA/FNS) to approve replacement food stamps and expand eligibility to households not ordinarily eligible for food stamps.
- **Food stamp waivers**: In situations involving fewer numbers of households, a state can ask USDA for a waiver expanding the time period food stamp recipients have to ask for replacement food stamps in emergencies, relaxing verification requirements and expanding eligibility.
- **Commodity food distribution**: With USDA permission, a state can use commodities provided for school lunches at mass feeding sites; in a Presidentially declared disaster, the commodities can be provided to individual households.
- **School meal programs**: USDA can waive requirements regarding eligibility and food options to remove barriers to children accessing needed food.
- **Child and Adult Care Food Program**: USDA can waive program requirements in CACFP, which reimburses for food served in child care and adult care homes and centers to protect the health and safety of those in care.
- **Supplemental Nutrition Program for Women, Infants and Children** (WIC): States can develop plans for WIC continuity in disasters in advance. If such a plan is not in place, USDA can approve alternate procedures.

FRAC, 1875 Connecticut Ave. NW, Suite 540, Washington, DC 20009, 202-986-2200, http://www.frac.org.

Emergency Energy Assistance:

States have a great deal of flexibility in determining how to expend federal block grant funding under the Low Income Home Energy Assistance Program. However, assistance under state plans filed with US Department of Health and Human Services has to be related to energy needs and statutory restrictions cannot be waived. States can provide assistance to households up to 60% of state median income, can define crisis and emergency benefits, and can use some energy assistance for weatherization. The following are some of the types of emergency help that can be made available: costs for temporary shelter where homes have been destroyed or damaged, transportation costs to move individuals away from the crisis area to shelters when health and safety is endangered by loss of access to heating or cooling, utility deposits and reconnection costs, repair or replacement costs for furnaces and air conditioners, purchase of fans, air conditioners and generators, insulation repair, and coats and blankets to keep individuals warm. Note however that, to the extent LIHEAP funding is used for these purposes, less funding is available to meet energy expenses for households.
http://www.acf.hhs.gov/programs/ocs/liheap/guidance/special_topics/disaster_relief.html ,
Administration for Children and Families, 370 L'Enfant Promenade, S.W., Washington, D.C. 20447.

Note: States have numerous block grants, where, similar to LIHEAP, the state can modify the plan approved by the federal government to provide for individual emergency relief. These include the Temporary Assistance to Needy Families, Social Services Block Grant, and Community Development Block Grant.

Mitigation Challenges

Three regional challenges were identified in the plan update process from 2017 through 2018.

- The first challenge – the issue of crumbling foundations – is one that has been affecting communities in the eastern part of the Capitol Region since the previous hazard mitigation plan was approved in 2014. CRCOG has taken steps to provide an information clearinghouse for residents and business owners affected by crumbling foundations. Despite the lack of FEMA recognition of a direct connection to natural hazard mitigation, CRCOG and its communities believe that an acknowledgement in this plan update is prudent. The information sheet on page 39 of this section can be used by local planners, emergency management directors, and engineers to disseminate information to residents and business owners in their communities.

- The second challenge is how to appropriately address repetitive loss (RL) properties. The Capitol Region communities do not typically directly address issues of repetitive flood claims at specific properties but may be more inclined to do so if the lists of RL properties are accurate and provide a reasonable flood risk profile. Toward that end, RL list validations are recommended for each community with RL properties. The information sheet on page 40 of this section can be used by local planners, emergency management directors, and engineers to begin the process.

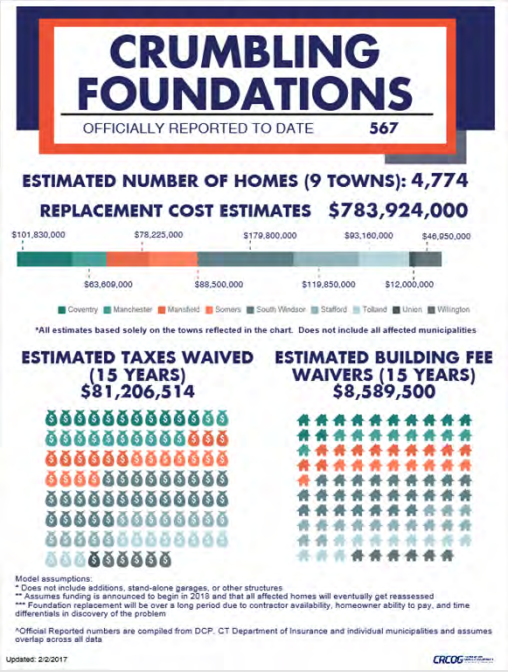
- The third challenge is the treatment of critical facilities of regional significance. This priority was added to help achieve more regional and multijurisdictional cooperation across the region as it relates to hazard mitigation and resiliency planning for major infrastructure, critical facilities, and other assets of regional significance. Over the next planning horizon, CRCOG municipalities should begin viewing regional critical facilities owned and operated by other entities as "their" critical facilities when mitigation projects are considered. The quantitative benefits of mitigation projects can often be bolstered by considering how local and regional critical facilities are protected by a specific mitigation action. The information sheet on page 41 of this section can be used by local planners, emergency management directors, and engineers to initiative ideas about how to protect regional critical facilities.

Implementation Challenges

The following challenges faced by local communities in implementing hazard mitigation measures are common to most municipalities in the region. In the listing of municipal mitigation strategies that follows, some additional challenges unique to certain communities may be included; however, the following challenges apply to most Capitol Region municipalities. These challenges can impact the effectiveness of existing authorities, policies, programs, and resources; however, it should be noted that local governments have a number of procedures and tools available that can allow them to adjust, over time, their programs, procedures, and resources to more effectively mitigate natural hazards.

REGIONAL CHALLENGES

CRUMBLING FOUNDATIONS



crcog.org/ crumbling-foundations

CT-gov

FOR MORE INFORMATION

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WHAT IS THE CHALLENGE?

Crumbling building foundations are a problem in central and north-eastern Connecticut. The foundations in question are concrete made with stone aggregate originating from a specific quarry, and poured from the early 1980s to 2015. While the issue has primarily impacted homes, commercial buildings have also been affected.

In 2016, CRCOG formed an ad-hoc committee to provide towns and homeowners with assistance to address the impacts associated with the concrete, including helping to determine avenues for financial relief for homeowners affected by the situation.

The committee worked to establish guidelines for municipalities for tax assessments for affected properties, as well as suggestions for permit fee waivers for properties being remediated. CRCOG also compiled information and resources for affected property owners on qualified contractors for testing and remediation services, and is administering a reimbursement program, through the CT Department of Housing, for inspections and testing for failing concrete foundations (https://foundationtesting.org/).

CRCOG has compiled a list of documents and resources for affected homeowners and the 41 municipalities where the issues are occurring, including communities within and outside the Capitol Region. The documentation can be found at http://crcog.org/crumbling-foundations.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Property owners are directly affected by crumbling foundations. Also, decreases in property values affect grand lists, impacting the fiscal health of municipalities. Proactively addressing the problem will help to reduce long-term fiscal impacts, which could impact the long-term economic health of the region. Specific to natural hazards, a house with a high percentage of pyrrhotite in the concrete is more vulnerable to destruction due to flooding than a house with a low percentage. Thus, repairing foundations helps mitigate potential damage from flooding.

The steps taken to date illustrate a proactive response to addressing the impacts of unforeseen hazards, which could happen anywhere and have regional consequences and a negative ripple effect across the state's economic recovery. Coordinated actions can significantly reduce the long term implications.

Although the crumbling foundation problem does not fit FEMA's definition of a natural hazard, the incurred losses have been significant and affected foundations are more susceptible to damage during flooding. CRCOG will continue to provide referrals and information to people seeking assistance in this matter.

REGIONAL CHALLENGES

REPETITIVE LOSS PROPERTIES

Vacant land where an RL property was once located
Photograph by MMI

Source of flooding for a group of RL properties in West Hartford
Photograph by MMI

FOR MORE INFORMATION

Diane Ifkovic
State NFIP Coordinator
Connecticut Department of Energy and Environmental Protection
79 Elm Street
Hartford, CT 06106
Diane.ifkovic@ct.gov

WHAT IS THE CHALLENGE?

According to FEMA, a Repetitive Loss (RL) property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A total of 144 RL properties are listed in the 38 municipalities that comprise the Capitol Region.

If a property is not insured against flood losses, or is insured but the owner does not submit claims, then the property cannot appear on the RL list. Therefore, the RL list is not an absolute reflection of flood risk in a community. Nevertheless, the RL list can provide a starting point for evaluating flood risk in a community, and it may indicate that flooding may be a problem in a specific area even when not obvious upon a cursory review of the setting.

Of the 144 RL properties listed in the Capitol Region, two are erroneously listed in the region (properties in Milford and Windham) and one is a duplicate (a property in Simsbury is listed in Simsbury *and* Plainville), for a current total of 141 RL properties. One property attributed to Hartford is located in West Hartford. The Town of West Hartford has the most listed properties, at 34. Other communities with at least ten each are New Britain, Simsbury, and Southington. A total of 12 communities in the Capitol Region do not host any RL properties.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

As noted above, examination of the RL list may indicate that flooding is a problem in a specific area. For a risk evaluation to be effective, each RL first must be accurate. Communities must carefully check and offer corrections to their individual RL lists. Misplaced properties (such as Milford and Windham) must be formally transferred to the correct municipality, duplicates must be cleared, and mitigation status should updated to ensure that resources are directed to the properties with most risk and highest flood losses. For example, the RL list indicates that of six RL properties in Plainville, only one is mitigated. However, a reconnaissance of the properties shows that an additional four properties were mitigated through acquisitions followed by removal of insured buildings.

It is important for Capitol Region communities to further reduce flood losses, including the RL property losses that have represented a strain on the NFIP. Before targeting specific properties for technical assistance, each municipality must know with certainty which RL properties are accurately represented by the information on the list. **This plan therefore recommends that each municipality with RL properties should work with DEEP to conduct a list validation.**

REGIONAL CHALLENGES

CRITICAL FACILITIES OF REGIONAL SIGNIFICANCE

Patch.com

MDC

FOR MORE INFORMATION

Contact individual owners of regional critical facilities such as MDC, CT DOT, and Eversource.

WHAT IS THE CHALLENGE?

During the hazard mitigation planning process, local communities provide lists or descriptions of their "critical facilities." According to FEMA's Local Mitigation Planning Handbook (2013), "Critical facilities are structures and institutions necessary for a community's response to and recovery from emergencies. Critical facilities must continue to operate during and following a disaster to reduce the severity of impacts and accelerate recovery," and "Outreach programs that increase risk awareness, **projects to protect critical facilities**, and the removal of structures from flood hazard areas are all examples of mitigation actions" (bold text added for emphasis).

Oftentimes, communities are not inclined to list critical facilities that are owned by State or regional entities, despite the fact they the local community is often required to provide emergency response, access, and egress to these facilities; or shares in the benefits provided by these facilities. Furthermore, when these facilities are considered critical and listed in hazard mitigation plans, local communities sometimes are hesitant to offer potential mitigation actions to protect them. This barrier should be addressed when possible, as effective hazard mitigation is often a partnership between communities and critical facility owners.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

In the Capitol Region, the Metropolitan District Commission (MDC, or "the District") provides water and sewer service to eight member communities (Hartford, West Hartford, East Hartford, Bloomfield, Wethersfield, Windsor, Newington, and Rocky Hill) and parts of Farmington, Glastonbury, and South Windsor. MDC owns and operates water treatment plants in West Hartford and Bloomfield; water pollution control facilities (WPCFs) in Hartford, East Hartford, Windsor, and Rocky Hill; and about 70 sanitary sewer pumping stations that direct sewage to the WPCFs. MDC also maintains some drainage infrastructure in Hartford. These facilities are considered critical facilities in this natural hazard mitigation plan update.

Other critical facilities of regional significant are located in the Capitol Region. Examples include Bradley International Airport in Windsor Locks, Amtrak and CT Rail facilities such as passenger stations, the CTfastrak busway stations, power generator facilities, CT DOT operations and maintenance facilities, Eversource facilities, and numerous State agency facilities. These facilities are considered critical facilities in this natural hazard mitigation plan update, though they may not be individual listed or mapped.

Limited Resources

Local communities, as well as state and federal governments, private enterprise, nonprofit organizations, and households, all face financial limitations, which can restrict their ability to fully implement measures and activities that are in their best interest. At the local level, most financial resources are provided through property tax revenue with additional support from state and federal governments through various programs and grants. The lingering effects of the Great Recession have severely tightened most local budgets. State budget limitations also affect local resources.

Through the local political and planning processes and budget deliberations, municipalities routinely reevaluate local programs and policies and adjust spending priorities. Expenditures on programs that support natural hazard mitigation may not always be considered by a community and its citizens as high priority as expenditures related to schools or other local initiatives as well as those related to mandated programs and expenditures. The lack of or limits on funding can lead to reduced effectiveness in a municipality's capability to accomplish hazard mitigation. At the regional level, CRCOG's ability to implement mitigation activities is also tied to financial limitations. Our funding is derived primarily from state and federal grants and programs and municipal dues. As these various levels of governments face financial cutbacks and changes in spending priorities, financial support to CRCOG can be impacted.

Multiple Jurisdictions

Hazard mitigation requires coordination among the multiple federal, state, and local agencies that influence development, maintenance, and emergency response activities. At the local level, some municipalities have difficulties getting their inland wetlands commissions and public works staff to agree on the appropriateness of drainage maintenance activities to reduce flooding risk. In addition, some communities face flooding risks from natural and/or man-made influences located in other communities, requiring interlocal coordination and communication. Finally, it can be difficult for a community to take full advantage of available federal and state resources for mitigation activities because programs are spread among different departments and agencies such as FEMA, the U.S. Department of Agriculture, DEEP, and DEMHS.

Most communities are active in regional organizations such as CRCOG, the Connecticut Conference of Municipalities (CCM), and the Connecticut Council of Small Towns (COST), which provide a variety of services such as management and technical assistance, training, and coordination among various agencies; lobbying for changes in state legislation; use of shared resources; and negotiating for competitive contracts for a variety of goods and services. These organizations can help improve the effectiveness of many local efforts including hazard mitigation.

State Infrastructure

When the initial plan was developed, most Capitol Region municipalities identified stormwater management as a high priority natural hazard mitigation concern. This concern continues. Many communities have specific locations subject to periodic flooding that result from state road drainage systems. Resolving minor flooding problems on state roads is difficult for towns because they have no purview over improvements on state infrastructure. Some such flooding areas pose emergency access risks while others present minor property damage concerns. Several towns also identified difficulties with the state's response to storm, snow, and accident cleanup on state roads.

In the aftermath of the two storms of 2011, Irene and Alfred, the Governor appointed a Two Storm Panel to review how the storms were handled and to make recommendations for future disaster preparedness and response. Among the panel's recommendations were a number calling for

improvements in state infrastructure and disaster preparedness including developing "new engineering standards that will better protect the built environment from the effects of extreme weather," improved GIS mapping and analysis, and planning for the issues rising sea levels will have on combined sewer overflows and dam safety.

Vulnerability to Power Outages

The widespread and lengthy power outages resulting from downed wires and damages to transmission lines due to Irene and the October snowstorm in 2011 brought attention to the need for tree maintenance in utility rights-of-way and along roadways and the need for better coordination and communication between Eversource and municipal officials. Among the Two Storm Panel's recommendations were calls for improved coordination among electric and telecommunications utilities, municipalities, and state agencies in dealing with tree maintenance; a comprehensive study of the feasibility, cost, and reliability of undergrounding utilities; and the establishment of a state working group to improve municipal and utility collaborations.

Clean Water Project

The Metropolitan District Commission (MDC) provides water supply, water pollution control, mapping, and household hazardous waste collection to eight member municipalities – Bloomfield, East Hartford, Hartford, Newington, Rocky Hill, West Hartford, Wethersfield, and Windsor. The MDC also provides water and/or sewer services to portions of several other towns in the region. The MDC has undertaken its Clean Water Project in response to both federal and state consent orders to achieve Federal Clean Water Act goals by 2029. The project, estimated at $2.4 billion, will reduce Combined Sewer Overflows (CSO), eliminate Sanitary Sewer Overflows (SSO), and increase nitrogen removal from system discharges. The challenge, and significant opportunity, presented by the Clean Water Project is for the MDC and its member municipalities to ensure that the design of infrastructure improvements reduces or at least, does not increase flooding risks. Because the MDC is pursuing funding for the project from several state and federal sources, FEMA Hazard Mitigation program funding is not a likely source of funding (federal funds cannot be used to match other federal funds). Nevertheless, it is important for MDC municipalities to remain active participants in Clean Water Project planning.

New Mitigation Initiatives

Several new mitigation initiatives were raised earlier in this plan in the context of climate change and existing hazard mitigation strategies. These are the Hartford Climate Action Plan, the incorporation of green infrastructure into Hartford's Zoning Regulations, and LID for Rural Resiliency. These three strategies can be viewed as sets of actions that can be considered by other Capitol Region communities. They are examples of new mitigation "initiatives" for the region, or mitigation themes that appear successful where implemented and therefore may be applicable in other communities.

Several additional new mitigation initiatives were raised by communities and state agencies during the 2017-2018 planning process with the intent of leading to mitigation actions for the 2019-2024 timeframe. These are risks to historic and cultural resources, mitigation of hazardous spills from small businesses, participation in the new *Sustainable CT* program, and continued assistance with municipal separate storm sewer permit registration and compliance. Information sheets for these four initiatives are provided on the following four pages.

- ***Protecting historic and cultural resources with support from CT SHPO*** was discussed during the planning process to leverage existing efforts and resources being made available to the state in support of increasing the resilience of historic and cultural resources to natural hazards and climate change through the Connecticut Department of Economic and Community Development's (DECD) CT SHPO. In making this a priority for the region, CRCOG and the participating jurisdictions have agreed to eventually focus on some or all of the following eight categories of resilience strategies from SHPO's planning efforts in the four coastal counties, which did not include CRCOG but which generated applicable ideas statewide:

    - Identify Historic Resources
    - Revisit Historic Preservation Regulations and Ordinances
    - Coordinate Regionally and with the State
    - Revisit Floodplain Regulations and Ordinances
    - Incorporate Historic Preservation into Planning Documents
    - Strengthen Recovery Planning
    - Adaptation Measures
    - Educate

    To provide an entry into this new initiative, this plan promotes a mitigation action for all Capitol Region communities that focuses on the initial strategy – *identifying historic resources*.

- ***Helping small businesses mitigate impacts of natural hazards with support from CT DEEP*** was discussed during the planning process to include strategies for small businesses in natural hazard mitigation plans by leveraging technical assistance from DEEP. In making this a priority for the region, CRCOG and the participating jurisdictions have agreed to coordinate with DEEP to help small businesses mitigate the impacts of natural hazards, and more specifically, to improve chemical safety practices by small businesses throughout the region to prevent disruption of economic activity and protect the environment and public health during and following natural hazard events. This plan promotes a mitigation action for all Capitol Region communities that focuses on outreach and technical assistance to small businesses.

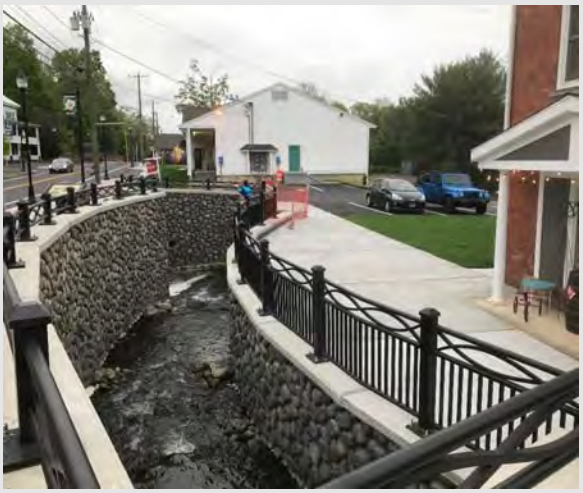
- ***Participation in the new Sustainable CT program*** was raised in the planning process as a way for CRCOG communities to help track sustainability goals and actions, make progress with achieving these goals, and determine which *Sustainable CT* actions may achieve parallel hazard mitigation actions. This plan promotes a mitigation action for all Capitol Region communities that focuses on enrollment in the program, with the exception of those communities that are already enrolled.

- ***Assistance with municipal separate storm sewer permit registrations and compliance*** was raised in the 2014 edition of this plan and repeatedly raised during the planning process for this update. Because it remains an important concern for communities, and because compliance may achieve parallel hazard mitigation actions, MS4 compliance remains an important initiative in this plan. This plan promotes a mitigation action for all Capitol Region communities that focuses on obtaining technical assistance as needed. Rural municipalities that are not otherwise regulated under the MS4 program (i.e., Coventry) have reached agreement with DEEP to conduct certain activities to reduce stormwater pollution; therefore, these towns may also seek technical assistance if desired.

NEW INITIATIVES

MITIGATION OF RISKS TO HISTORIC RESOURCES

Old Wethersfield



South Coventry Historic District
Photo by MMI

FOR MORE INFORMATION

State Historic Preservation Office (SHPO)
450 Columbus Blvd
Suite 5
Hartford, CT 06103
860-500-2300

WHAT IS IT?

Recognizing that historic and cultural resources are increasingly at risk to natural hazards and climate change, the State Historic Preservation Office (SHPO) conducted a resiliency planning study for historic and cultural resources from 2016 through 2018. Working with the State's Councils of Government and municipalities, numerous examples were identified where historic and cultural resources were at risk now and could be at risk in the future due to climate change and the identification of more historic resources. Historic resources are difficult to floodproof, elevate, or relocate without potential loss of their historicity. Therefore, a thorough understanding of the options for each set of historic resources is necessary prior to disasters that could damage these resources, in order to avoid irreversible damage during recovery. SHPO's planning process identified eight strategies that can be employed to make historic and cultural resources more resilient:

- Identify Historic Resources
- Revisit Historic District Zoning Regulations
- Strengthen Recovery Planning
- Incorporate Historic Preservation into Planning Documents
- Revisit Floodplain Regulations and Ordinances
- Coordinate Regionally and with the State
- Structural Adaptation Measures
- Educate

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

SHPO has produced three sets of resources that can be used to inform hazard mitigation planning:

- Individual reports produced for coastal communities include detailed recommendations that are application in the Capitol Region.
- A best practices guide for planning techniques to make historic resources more resilient was completed in 2017 and will be made available in 2018.
- The State Historic Preservation Plan is being updated and will provide policy direction to communities.

Because community planners often do not know which resources may be historic or cultural, or which are most likely to be considered historic in the next decade as structures built in the 1950s and 1960s become eligible, it can be difficult to evaluate risks to flooding and other hazards. Therefore, this plan suggests as a mitigation action that each Capitol Region municipality should conduct a survey of potential historic resources in cooperation with SHPO.

NEW INITIATIVES

Helping Small Businesses Mitigate Impacts of Natural Hazards

Ct.deep.gov

WHAT IS IT?

In an effort to assist small business with reduction of property damage or loss due to natural hazards, CT DEEP has proposed strategies for towns to implement educational programs with recommendations for best management practices (BMPs) to prevent pollution from chemicals from getting out into the environment.

According to FEMA, 40% of businesses affected by disaster never reopen, and 25% that do reopen fail; other studies show that 90% of businesses fail within two years of being struck by a disaster. Damage during storm events result in property damage, loss of inventory, and environmental contamination and liabilities resulting from chemical releases into the environment.

The sample mitigation objectives for municipalities is to increase awareness by small businesses of any chemicals and toxic products they use, store and/or sell, and to use BMPs to improve safety. On a regional scale, the objectives are to improve chemical safety practices to prevent disruption of economic activity and protect the environment and public health.

Strategies for educational programs include providing information on municipal websites, social media, brochures and posters, or through workshops.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

The benefits of reducing damage to small businesses during a disaster are a reduction in property damage and losses, avoiding expensive cleanups, reducing liability and risk to public health, and a more rapid recovery and continued operations that result in less impacts to the municipality's economic base.

The municipalities of the Capitol Region can benefit from mitigation actions related to mitigating flood impacts to small businesses. DEEP has recommended that hazard mitigation plan strategic actions list the municipality as the lead agency, with assistance from CT DEEP, where DEEP would develop information for dissemination. Suggested action priority is on a medium scale, with a completion time frame of one year.

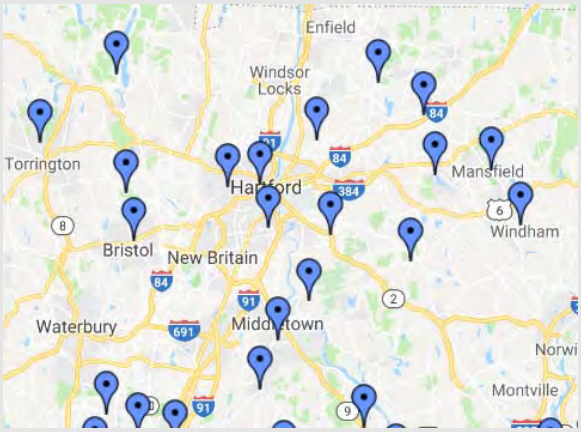
FOR MORE INFORMATION

Connie Mendolia
Department of Energy & Environmental Protection
79 Elm Street
Hartford, CT 06106-5127
860-424-3297
www.ct.gov/deep

NEW INITIATIVES

"SUSTAINABLE CT"

Sustainable CT
Local Actions. Statewide Impact.



Images courtesy of Sustainable CT

FOR MORE INFORMATION

Sustainable CT Office:
372 High St
Willimantic, CT 06226
860-465-2813

Sustainable CT Mailing Address:
83 Windham St
Willimantic, CT 06226

https://sustainablect.org/about/contact-us/

WHAT IS IT?

Sustainable CT is a voluntary certification program to recognize thriving and resilient Connecticut municipalities. An independently funded, grassroots, municipal effort, Sustainable CT provides a wide-ranging menu of best practices. Municipalities choose Sustainable CT actions, implement them, and earn points toward certification.

Sustainable CT also provides opportunities for grant funding to help communities promote economic well-being and enhance equity, all while respecting the finite capacity of the natural environment. The program is designed to support all Connecticut municipalities, regardless of size, geography or resources. Sustainable CT empowers municipalities to create high collective impact for current and future residents.

The mission statement is:

To provide municipalities with a menu of coordinated, voluntary actions, to continually become more sustainable; to provide resources and tools to assist municipalities in implementing sustainability actions and advancing their programs for the benefit of all residents; and to certify and recognize municipalities for their ongoing sustainability achievements.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Sustainable CT provides a "Master Action List" to serve as a resource as communities track progress towards certification. Many actions are consistent with the goals of hazard mitigation and, if accomplished, may demonstrate progress with hazard mitigation. Examples include:

- Identify, or create and disseminate, a toolkit for pre-disaster business preparedness and for post-disaster conditions.
- Develop a drought communications plan to inform residents about voluntary and mandatory drought restrictions.
- Review and revise regulations to encourage and promote LID.
- Review the POCD and adopt a revised POCD that includes the Hazard Mitigation Plan goals and at least three other sustainability concepts.
- Conduct a Climate Vulnerability Assessment, identify how the impacts of climate change will likely affect the community, and demonstrate consideration has been given to low-income residents and their vulnerability to extreme weather events.

NEW INITIATIVES

Revised Municipal Separate Stormwater System (MS4) General Permit

http://nemo.uconn.edu/ms4/index.htm

FOR MORE INFORMATION

Department of Energy & Environmental Protection
79 Elm Street
Hartford, CT 06106-5127
860-424-3297

Amanda Ryan
Municipal Stormwater Educator
UConn CLEAR
Middlesex County Extension
PO Box 70, 1066 Saybrook Road
Haddam, CT 06438
860-345-5231

WHAT IS IT?

The General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 General Permit) is the product of a mandate by the U.S. EPA as part of its Stormwater Phase II rules in 1999. This general permit requires municipalities to manage stormwater entering its storm sewer systems to protect watercourses.

DEEP issued a new General Permit in July 2017 that applies to 121 towns and all state and federal institutions that operate a stormwater system. All municipalities within an "urbanized area" are required to comply with the General Permit. In the Capitol Region, only four towns (Stafford, Columbia, Coventry, and Andover) are not required to comply.

Given the complexities of the new permit, the UConn Center For Land Use Education and Research (CLEAR) was charged with providing technical assistance to municipalities. The CLEAR web site (http://nemo.uconn.edu/ms4/index.htm) contains valuable information to help municipal staff navigate permit compliance.

CRCOG has also provided assistance related to the MS4 permit, including information distribution to its member municipalities and referrals when requests for assistance are received.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Because watershed boundaries do not coincide with political boundaries, the actions of municipalities upstream can have a significant impact on the downstream municipality's land and water resources. Stormwater management throughout an entire watershed, with commitment from all municipalities, is critical to protecting the health of the State's resources. MS4 compliance is there both community-specific and regional at the same time.

The basic requirements of the permit are to (1) submit a Stormwater Management Plan (SMP) identifying six minimum control measures to prevent and/or treat polluted runoff; (2) submit annual reports indicating implementation progress; and (3) monitor the quality of water. Many municipal planners and engineers have noted that the objectives of the MS4 permit are aligned with the objectives of flood hazard mitigation. Therefore, MS4 compliance is expected to help communities achieve progress with hazard mitigation.

Regional Goals, Objectives, and Strategic Actions

This section describes regional goals. Specifically, these are goals that guide CRCOG's leadership and participation in hazard mitigation. Uniform regional goals were also developed for the 38 Capitol Region communities for the first time in this plan update to guide their mitigation actions for 2019-2023. These regional goals are described after this section on page 56.

Review of 2008 Regional Strategy

In developing the Capitol Region's 2008 Pre-Disaster Natural Hazard Mitigation Plan, a single overarching goal of "Minimizing the loss of life and property, and economic disruptions that can result from natural hazards" was proposed to guide regional efforts in natural hazard mitigation. Four objectives and a number of mitigation strategies that were judged to be best addressed on a regional level were identified as means to accomplish this goal.

Review of 2014-2019 Regional Strategy

The regional goals, objectives, and strategies from 2008 were reexamined in the course of the 2014 update to the plan. The goal was not changed and remained **Minimize the loss of life and property and economic disruptions that can result from natural hazards.**

Objective 1 was modified from "Improve stormwater management throughout the region to prevent increased flooding and lessen the effects of drought" (2008) to "Improve stormwater management and ground water recharge throughout the region to prevent increased flooding and lessen the effects of drought" (2014). The status of each supporting action is reviewed below.

1.1 Encourage all municipalities in the region to adopt regulations that incorporate or refer to recommended practices from the most current Connecticut *Stormwater Quality Manual*, Connecticut *Guidelines for Erosion and Sedimentation Control,* and in particular, those which promote low impact development and green infrastructure techniques.

Status: This is a continuous activity that occurs through the development review referrals. Many of the municipalities in the Capitol Region have adopted low impact development policies and regulations including a diverse cross section of communities such as Avon, Hartford, Bolton, and Mansfield. To shift part of this action from CRCOG to the municipalities, new mitigation actions have been developed for the municipalities. Going forward, this action will be combined with 1.2 (below) and reworded to emphasize the development review aspect.

1.2 Encourage development that is in harmony with natural drainage systems in all municipalities through reviews of development referrals.

Status: This is a continuous activity that occurs through the development review referrals. Going forward, this action will be combined with 1.1 (above) and reworded to emphasize the development review aspect.

1.3 Foster improved understanding of the importance stream management, maintenance of natural drainage channels, and use of green infrastructure practices among municipal staff, inland wetlands commissions, and planning and zoning commissions through education.

Status: UConn CLEAR, CIRCA, The Nature Conservancy, and other agencies and entities have become leaders in education regarding these topics. Going forward, CRCOG will continue to provide referrals as needed for educational opportunities.

1.4. Continue participation with other regional planning agencies in Connecticut and Massachusetts in the Connecticut River Bi-State Partnership and, in particular, in the development of a Connecticut River Bi-State Corridor Management Plan.

Status: CRCOG has continued to work with other regional planning organizations along the Connecticut River and attended a workshop of the Northeast Climate Center on Connecticut River Watershed Issues. In particular, CRCOG works with the Connecticut River Conservancy (formerly the Connecticut River Watershed Council). Going forward, CRCOG will continue its participation in regional efforts; however, the Connecticut River Bi-State Partnership (a project of the Massachusetts Pioneer Valley Planning Commission) is no longer active. This action is considered a capability of CRCOG and can be retired as a mitigation action.

Objective 2 was not modified in 2014 and remained "Assist municipalities in implementing hazard mitigation strategies." The status of each action is reviewed below.

2.1 Work with member municipalities to maintain this regional natural hazard mitigation plan with updates at least every 5 years.

Status: CRCOG has continued this action and maintains a current natural hazard mitigation plan. This action will be continued.

2.2 Work with member municipalities and state and federal agencies to improve availability of relevant data including but not limited to current land uses, vulnerable building stock inventories and values, and hazardous materials inventories.

Status: CRCOG maintains and augments several data sets as needed for its planning projects. This is a capability of CRCOG and can be retired as a mitigation action.

2.3 Train CRCOG staff in HAZUS-MH software.

Status: CRCOG has elected to outsource HAZUS as the program is continuously updated by FEMA. The action can be removed.

2.4 Assist member municipalities in pursuing federal and state funds to implement mitigation measures.

Status: CRCOG is limited in what it can do to assist municipalities with pursuing mitigation funds. However, CRCOG is able to disseminate information about grants and provide letters of support and other types of indirect assistance. Going forward, the action will be reworded to be more specific.

2.5 Incorporate natural hazard mitigation concerns into the regional Plan of Conservation and Development and encourage municipalities to address natural hazard mitigation in local Plans of Conservation and Development.

Status: This is a continuous activity that has resulted in an increased presence of hazard mitigation elements in local Plans of Conservation and Development. Going forward, CRCOG will continue to critically assess the appropriateness of hazard mitigation elements in local plans, and recommend enhancements as needed.

2.6 Encourage municipalities to participate in the National Flood Insurance Program's Community Rating System (CRS).

Status: CRCOG coordinated an informational workshop in September 2016 for its municipalities to learn about the CRS program subsequent to adoption of the 2014 edition of this plan. West Hartford remains the only Capitol Region community in the CRS program, but several other communities remain interested. Going forward, CRCOG may host one additional information session.

2.7 Work with municipalities to facilitate a process for improved communications with upstream communities to provide timely downstream notifications regarding water levels and releases from dams.

Status: CRCOG has not made progress in this area as it can be challenging to identify the appropriate dam owners and operators to communicate with community leaders. This action will be removed.

2.8 Encourage municipalities to increase their citizens' awareness and use of the Get Ready Capitol Region website (http://www.getreadycapitolregion.org/).

Status: This is a continuous activity. This is also a capability of CRCOG and can be retired as a mitigation action.

2.9 Encourage FEMA to recognize the cumulative effect of winter storm events.

Status: CRCOG has not made progress in this area. However, FEMA has, in the past, recognized cumulative winter storms as presidentially declared disasters such as the heavy snowfalls of January and February 2011. The action can be removed.

2.10 Assist member communities in efforts to develop and maintain lists of functional needs populations and in improving involvement of functional needs persons in planning and training for hazard mitigation.

Status: This is a continuous activity through CREPC. This is also a capability of CRCOG and can be retired as a specific mitigation action.

Objective 3 was not modified in 2014 and remained "Assist municipalities in minimizing risks associated with power disruptions." The status of each action is reviewed below.

3.1 Monitor state efforts to assist municipalities in working with Eversource and concerns over appropriate utility right-of-way maintenance, emergency response, and the burial of transmission lines.

Status: Most Capitol Region municipalities report favorable to adequate interactions with their designated Eversource liaisons. These liaisons coordinate utility right-of-way maintenance, emergency response, and the burial of transmission lines. CRCOG does not need to undertake this action, and it can be retired as a specific mitigation action.

3.2 Encourage the installation of generators at critical facilities and in developments serving the elderly or special need populations through outreach and associated work with local officials.

Status: This is a continuous activity undertaken primarily through the meetings and actions of CREPC. In 2017, CREPC recommended to DEMHS that portable generators be provided to Canton, East Hartford, Manchester, Vernon, and Southington under a grant program administered through DEMHS. Going forward, CRCOG will focus on those facilities that still lack standby power.

Objective 4 was not modified in 2014 and remained "Assist municipalities in minimizing risks associated with droughts." The status of each action is reviewed below.

4.1 Assist municipalities that do not currently have drought ordinances in enacting such ordinances to enable the enforcement of water conservation.

Status: There has been minimal progress in this area, with Simsbury as one example of a Capitol Region community that has attempted to adopt a drought ordinance. Going forward, CRCOG should monitor the status of the Connecticut Drought Preparedness and Response Plan, implementation of the State Water Plan, and implementation of the Coordinated Water System Plan to determine the best means of assisting communities with drought ordinances. This action will be combined with 4.2 below.

4.2 Assist in disseminating drought-related information by encouraging municipalities to post drought-related information released by the Connecticut Division of Emergency Management and Homeland Security or Connecticut Department of Public Health through their websites and/or newsletter and by posting drought-related information on the Get Ready Capitol Region website.

Status: There has been minimal progress in this area. Going forward, CRCOG should monitor the status of the Connecticut Drought Preparedness and Response Plan, implementation of the State Water Plan, and implementation of the Coordinated Water System Plan to determine the best means of assisting communities with drought-related messaging and notifications. This action will be combined with 4.1 above.

Proposal for 2019-2024 Regional Strategy

The regional goal will remain **Minimize the loss of life and property and economic disruptions that can result from natural hazards.** Actions have been modified as noted above.

The Capitol Region's Proposed Mitigation Strategy for the 2019-2024 Natural Hazard Mitigation Plan
Regional Activities

Goal: Minimize the loss of life and property and economic disruptions that can result from natural hazards.

Objective 1: Improve stormwater management and groundwater recharge throughout the region to prevent increased flooding and lessen the effects of drought.

Mitigation Actions:

1.1 Encourage all municipalities in the Capitol Region to adopt regulations that incorporate or refer to recommended practices from the most current Connecticut *Stormwater Quality Manual*, Connecticut *Guidelines for Erosion and Sedimentation Control* and, in particular, those that promote low impact development and green infrastructure techniques to encourage development that is in harmony with natural drainage systems.

Lead:	Capitol Region Council of Governments
Priority:	High
Potential Funding:	CRCOG operating budget, future grant
Timeframe:	During the continuous zoning/development referral process

1.2 Foster improved understanding of the importance of stream management, maintenance of natural drainage, and use of green infrastructure practices among municipal staff, inland wetlands commissions, and planning and zoning commissions through education.

Lead:	Capitol Region Council of Governments and Municipalities
Priority:	Medium
Potential Funding:	CRCOG operating budget
Timeframe:	Outreach to commissions will be conducted on an annual basis.

Objective 2: Assist municipalities in implementing hazard mitigation strategies.

Mitigation Actions:

2.1 Work with member municipalities to maintain this regional natural hazard mitigation plan with updates at least every 5 years.

Lead:	Capitol Region Council of Governments
Priority:	High
Potential Funding:	FEMA grant, local and regional resources
Timeframe:	Will seek FEMA grant funding through the state for the next update beginning in 2021 if such program funding is available

2.2 Annually notify communities of the opportunities to apply for mitigation funds under the PDM and FMA programs, and notify communities of HMGP opportunities as applicable. Provide letters of support when appropriate.

Lead:	Capitol Region Council of Governments
Priority:	High
Potential Funding:	CRCOG operating budget
Timeframe:	Annually (or more frequently) as grant opportunities become available

2.3 Incorporate additional natural hazard mitigation concerns into the regional Plan of Conservation and Development if it is updated in the 2019-2024 timeframe, and provide specific instructions to municipalities to address natural hazard mitigation in local Plans of Conservation and Development as they are updated.

Lead:	Capitol Region Council of Governments
Priority:	High
Potential Funding:	CRCOG operating budget
Timeframe:	During referral process throughout 2019-2024 plan period for municipal plans

2.4 Encourage municipalities to participate in the National Flood Insurance Program's Community Rating System by hosting an information workshop.

Lead:	Capitol Region Council of Governments
Priority:	Medium
Potential Funding:	CRCOG operating budget with FEMA and CT DEEP cooperation
Timeframe:	A workshop is to be organized in 2020.

Objective 3: Assist municipalities in minimizing risks associated with power disruptions.

Mitigation Actions:

3.1 Encourage the installation of generators at critical facilities and in developments serving the elderly or special needs populations, or development of microgrids to serve the same purpose, through outreach and associated work with local officials to determine which facilities still do not possess standby power but require it.

Lead:	Capitol Region Council of Governments / CREPC
Priority:	Medium
Potential Funding:	CRCOG operating budget
Timeframe:	2019-2024

Objective 4: Assist municipalities in minimizing risks associated with droughts.

Mitigation Actions:

4.1 Assist municipalities that do not currently have drought ordinances in enacting such ordinances to enable the enforcement of water conservation, and assist with messaging and notifications regarding droughts. These actions should be consistent with guidance resulting from implementation of the State Water Plan (2018) and the Coordinated Water System Plan (2018) as well as the updated Connecticut Drought Preparedness and Response Plan.

Lead:	Capitol Region Council of Governments
Priority:	Medium
Potential Funding:	CRCOG operating budget
Timeframe:	2019-2024

Municipal Goals, Objectives, and Strategic Actions

Municipal Goals and Objectives

During the development of the 2014 plan update, the 30 municipalities in the Capitol Region collectively identified over 400 mitigation strategies to include in the plan. These 400+ mitigation actions were organized among municipal goals and objectives that largely originated in the 2008 edition of the plan and were carried forward to the 2014 edition of the plan with revisions as directed by the local planning teams. Many of the goals and objectives were similarly worded but contained slight differences. A word cloud generated from prior goals is presented below.

To promote uniformity throughout this update and ensure that communities select appropriate mitigation actions in light of the new initiatives and challenges described earlier, CRCOG worked with its communities in 2017 and 2018 to develop a standard list of municipal goals from which each community would identify those that are locally relevant. Nine municipal hazard mitigation goals were identified and used to inform each community's respective hazard mitigation strategies and actions. The nine region-wide municipal goals are described below. These goals are region-wide only in the sense that they are common throughout the region; they are not to be confused with the CRCOG goals described earlier.

Goal 1: Minimize the impact of natural hazards on physical buildings and infrastructure.

Mitigation actions that address this goal are intended to protect or adapt structures and infrastructures from the physical impacts of hazards. Actions might include floodproofing structures, elevating structures above flood elevations, constructing fire breaks, or assessing wind-load capacities of critical facilities.

Goal 2: Ensure municipal codes and regulations support hazard mitigation.

Mitigation actions that address this goal focus on strengthening the regulatory frameworks of communities to avoid the creation or exacerbation of hazardous conditions. Actions might include requiring buildings be elevated above the flood elevation or requiring new developments have multiple modes of egress.

Goal 3: Improve institutional awareness and understanding of natural hazard impacts and mitigation within municipal governments and other decision-making bodies.

Mitigation actions that address this goal focus on education and training of municipal or regional staff, first responders, and elected officials.

Goal 4: Increase the use of natural, "green," or "soft" hazard mitigation measures such as open space preservation and green infrastructure.

Mitigation actions that address this goal focus on utilizing the beneficial functions of natural systems and features. Actions might include wetland protection, low impact development, and use of green infrastructure similar to recent actions in the City of Hartford.

Goal 5: Improve the resilience of local and regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies.

Mitigation actions that address this goal focus on maintaining critical services through hazard events. Actions might include burying power lines, developing microgrids, or protecting a wastewater treatment plant.

Goal 6: Improve public outreach, education, and warning systems.

Mitigation actions that address this goal focus on educating and alerting the public. Actions may include sending informational mailers, providing information on the municipal website, or implementing a reverse 9-1-1 system.

Goal 7: Improve the emergency response capabilities of the region and its communities.

Mitigation actions that address this goal focus on developing a community's ability to respond to a hazard event. Actions may include upgrading shelters or the Emergency Operations Center, reviewing evacuation routes, or improving the ability of emergency responders to communicate with one another during events.

Goal 8: Ensure community character and social equity are addressed in mitigation activities.

Mitigation actions that address this goal focus on protecting features of a community that may otherwise be overlooked when considering only the most critical features. Actions may include those that protect historic, cultural, and recreational resources or those that specifically address low-moderate income or underserved populations.

Goal 9: Minimize the economic impact of hazard damages.

Mitigation actions that address this goal focus on limiting economic impacts of damages that do occur regardless of actions taken to mitigate the physical impacts of the damages themselves. Actions may include educating landowners about flood insurance, joining CRS, improving the community CRS score, or setting up recovery funding mechanisms.

Not every community adopted every goal, but every goal was adopted by at least one community. Many of the actions adopted by communities will lead toward achievement of multiple goals.

Mitigation Action Categories

Individual mitigation projects and actions proposed by the Capitol Region municipalities were categorized into the following types of measures:

- **Education and Awareness –** Projects include measures to inform and educate local residents and businesses, elected and appointed officials, and other stakeholders. Types of outreach include general public informational outreach efforts such as the use of local websites to post information, mailings with tax statements, newspaper advertisements, press releases, email blasts, etc. Other measures in this category include targeted outreach efforts to specific groups, which could include more direct contact such as meetings. Also included are workshops, forums, fairs, seminars, and the like.

- **Natural Resource Protection –** Actions include those that not only minimize hazard losses but also preserve or restore functions of natural systems such as stream corridor restoration, watershed management, wetlands preservation and restoration, and timber management.

- **Preparedness and Emergency Response –** Actions in this category may not be thought of as directly tied to mitigation of damage due to natural disasters, but they are measures vital to public safety and the restoration of normalcy in a community. In this regard, they play an important role in the reduction of losses a community will experience. Measures include improving working relationships and coordination between agencies; securing new equipment, facilities, supplies, and personnel to aid in emergency response; improving procedures related to emergency response; conducting emergency response training; and improving communications systems.

- **Prevention –** Activities in this category generally include government actions or processes that influence the way land and buildings are developed such as zoning regulations, floodplain regulations, building codes, open space preservation, and stormwater regulations. Also included are studies and assessments of risks and vulnerabilities including identifying and improving a community's ability to contact vulnerable populations; improving mapping and data analysis capabilities; and undertaking engineering studies to address drainage, flooding, and power outage issues. Other government actions and programs, such as implementing procedures for improving operations, using tax incentives, and capital improvement programming, are also included in this category.

- **Structural Projects –** Measures in this category include construction projects to reduce the impact of hazards such as installation of improved drainage facilities, culverts, and other stormwater controls as well as undergrounding utilities.

- **Property Protection –** Activities in this category include modifications and retrofits of existing buildings, structures, and infrastructure to protect or remove them from harm such as acquisition, relocation, elevation, floodproofing, installation of shatterproof glass, strengthening roofs, etc. Expanding sheltering capacity and installation of backup power to critical facilities are other measures included in this category.

A number of specific measures could be classified into one or more of these types/categories. For example, strengthening a shelter is property protection as well as a preparedness action. For the purposes of this planning effort, we chose to identify specific measures as being within only one of these categories. It is important to note that the 2014 edition of this plan aggregated structural projects and property protection projects.

Municipal Strategies and Actions

As noted above, during the development of the 2014 plan update, the 30 municipalities in the Capitol Region collectively identified over 400 mitigation strategies to include in the plan. While many were unique to the individual communities, there were commonalities among the actions proposed, and all communities have proposed a range of activities including public education and awareness; natural resource protection; plans, studies, and regulatory actions; and structural projects and modifications to buildings, facilities, and infrastructure as well as measures to improve preparedness and emergency response.

Most activities proposed in the 2014 Plan Update were not exclusive to the plan. Some activities such as strengthening and enforcing regulations and public outreach efforts are routine, long-term, sustained activities and established practices and procedures that will be conducted with an additional emphasis on hazard mitigation. Others were projects that may have also been previously identified in capital improvements programs, annual budgets, and various local plans. Other activities were newly identified as a result of the planning effort. A word cloud generated from municipal strategies (in this case, objectives and actions together) is presented below.

A blueprint for implementing all proposed projects in the 2014 Plan Update was provided in that plan; departments and agencies that will be responsible for carrying out the activities, potential funding

sources, and the timeframes for conducting the projects were identified for each mitigation activity. During the course of the 2012-2014 update process, municipal officials evaluated progress made on the mitigation activities proposed in the 2008 Plan. From this effort, insights into means in which to ensure project implementation were gained.

A similar process was followed for this update. During the course of the 2017-2018 update process, municipal planning team members evaluated progress made on the mitigation activities proposed in the 2014 Plan. The 38 municipalities in the Capitol Region collectively identified over 700 new mitigation actions to include in this plan update along with some to carry forward from the 2014 plan. While many actions are unique to the individual communities, there are commonalities among the actions proposed. As in 2014, some activities may have also been previously identified in capital improvements programs, annual budgets, and various local plans. Many activities have been newly identified as a result of this planning effort while others were identified for the previous edition of this plan but for various reasons were not fully completed.

The tables below summarize and categorize the municipal hazard mitigation strategies and actions.

- Table 44 and Table 45 on the following pages summarize which municipalities have proposed measures in each of the six categories and corresponding to the nine goals. As can be seen, all communities have proposed a variety of actions to mitigate the damages natural hazards can cause. Most communities have proposed to undertake one or more public education/outreach projects and one or more projects aimed at improving emergency preparedness and response. Most communities have also proposed to undertake structural projects to construct, modify, or relocate buildings, infrastructure, or critical facilities in order to strengthen them or protect them or their functions from the effects of natural disasters. All communities have proposed one or more activities designed to prevent or lessen the impacts of natural hazards. A number of communities have proposed projects designed to protect or restore natural resources or natural functions.

- Details of each proposed local mitigation activity or project, including responsible agencies, project priorities, project statuses, potential funding sources, and anticipated timeframes, are provided in Section IV: Municipal Plans.

This Plan helps to focus attention on efforts that can reduce or eliminate the long-term risk to human life or property from natural hazards; however, there are no mandates to undertake these specific activities. The mitigation strategies that follow focus on actions that can be achieved within the 5-year plan period although some activities/projects may require a longer timeframe to be fully implemented. The availability of resources to fund and carry out these activities is crucial to their successful implementation.

Table 44: Summary of Types of Mitigation Projects Proposed by Community

	Education and Awareness	Natural Resources Protection	Preparedness and Emergency Response	Prevention	Structural Projects	Property Protection
Andover	5	1	7	3	2	1
Avon	2	1	5	4	1	3
Berlin	2	1	2	3	2	4
Bloomfield	7	2	5	5	0	4
Bolton	5	1	8	5	7	1
Canton	3	1	4	2	1	4
Columbia	3	2	2	1	4	2
Coventry	3	1	7	11	8	2
East Granby	3	2	5	4	0	2
East Hartford	4	1	4	6	1	4
East Windsor	4	2	5	3	3	2
Ellington	2	1	2	3	1	1
Enfield	3	1	1	2	1	3
Farmington	3	1	3	3	2	4
Glastonbury	5	1	0	5	2	3
Granby	7	4	5	9	3	2
Hartford	3	1	3	2	2	3
Hebron	2	1	1	5	1	1
Manchester	4	1	1	1	2	5
Mansfield	8	1	7	6	3	3
Marlborough	2	1	3	2	1	2
New Britain	6	1	3	4	5	3
Newington	2	1	2	5	0	3
Plainville	6	2	9	12	6	3
Rocky Hill	2	0	0	1	1	3
Simsbury	4	2	2	7	8	4
Somers	5	1	5	2	3	2
South Windsor	4	1	7	3	1	4
Southington	4	1	5	3	1	3
Stafford	2	1	6	1	3	1
Suffield	4	1	1	4	0	1
Tolland	6	1	4	3	6	1
Vernon	2	1	3	1	2	4

	Education and Awareness	Natural Resources Protection	Preparedness and Emergency Response	Prevention	Structural Projects	Property Protection
West Hartford	4	1	10	6	3	5
Wethersfield	2	1	3	3	11	5
Willington	4	1	5	7	2	1
Windsor	3	0	4	5	2	4
Windsor Locks	5	1	3	3	10	3

Table 45: Summary by Community of Mitigation Projects for Each Goal

	Minimize the impact of natural hazards on physical buildings and infrastructure.	Ensure municipal codes and regulations support hazard mitigation.	Improve institutional awareness and understanding of natural hazard impacts and mitigation within municipal governments and other decision-making bodies.	Increase the use of natural, "green," or "soft" hazard mitigation measures such as open space preservation and green infrastructure.	Improve the resilience of local and regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies.	Improve public outreach, education, and warning systems.	Improve the emergency response capabilities of the region and its communities.	Ensure community character and social equity are addressed in mitigation activities.	Minimize the economic impact of hazard damages.
Andover	2	0	3	1	2	3	6	2	0
Avon	2	0	1	1	4	2	4	2	0
Berlin	4	2	1	1	2	1	2	1	0
Bloomfield	3	1	3	2	2	6	5	1	0
Bolton	12	0	1	1	4	5	4	1	0
Canton	6	0	1	1	0	2	4	1	0
Columbia	6	0	1	1	1	2	2	1	0
Coventry	6	0	4	2	8	1	8	3	0
East Granby	1	0	3	2	3	1	5	1	0
East Hartford	6	0	5	1	1	2	4	1	0

	Minimize the impact of natural hazards on physical buildings and infrastructure.	Ensure municipal codes and regulations support hazard mitigation.	Improve institutional awareness and understanding of natural hazard impacts and mitigation within municipal governments and other decision-making bodies.	Increase the use of natural, "green," or "soft" hazard mitigation measures such as open space preservation and green infrastructure.	Improve the resilience of local and regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies.	Improve public outreach, education, and warning systems.	Improve the emergency response capabilities of the region and its communities.	Ensure community character and social equity are addressed in mitigation activities.	Minimize the economic impact of hazard damages.
East Windsor	4	0	2	3	0	2	6	2	0
Ellington	1	0	2	1	2	1	2	1	0
Enfield	4	0	1	1	1	2	1	1	0
Farmington	5	0	3	1	1	1	3	2	0
Glastonbury	3	4	1	2	1	4	0	1	0
Granby	5	5	3	3	3	4	5	2	0
Hartford	5	0	1	1	1	1	3	2	0
Hebron	3	1	1	1	0	1	3	1	0
Manchester	4	1	2	1	2	3	0	1	0
Mansfield	6	1	3	3	3	8	3	1	0
Marlborough	3	0	1	1	1	1	3	1	0
New Britain	8	1	2	2	2	4	1	2	0
Newington	3	0	1	1	2	1	4	1	0
Plainville	8	4	4	4	4	5	8	1	0
Rocky Hill	2	0	1	0	2	1	0	1	0
Simsbury	10	3	2	2	3	1	2	2	2
Somers	2	2	1	1	2	5	3	1	1
South Windsor	4	0	2	1	4	3	5	1	0
Southington	3	2	1	1	0	2	6	2	0
Stafford	2	0	1	2	1	3	4	1	0
Suffield	2	1	1	1	1	3	1	1	0
Tolland	4	1	2	1	3	4	5	1	0
Vernon	5	0	1	1	0	1	3	1	1
West Hartford	7	1	3	1	2	2	10	2	1

	Minimize the impact of natural hazards on physical buildings and infrastructure.	Ensure municipal codes and regulations support hazard mitigation.	Improve institutional awareness and understanding of natural hazard impacts and mitigation within municipal governments and other decision-making bodies.	Increase the use of natural, "green," or "soft" hazard mitigation measures such as open space preservation and green infrastructure.	Improve the resilience of local and regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies.	Improve public outreach, education, and warning systems.	Improve the emergency response capabilities of the region and its communities.	Ensure community character and social equity are addressed in mitigation activities.	Minimize the economic impact of hazard damages.
Wethersfield	16	0	1	1	1	1	3	1	1
Willington	5	2	2	2	2	2	4	1	0
Windsor	4	2	2	0	4	2	4	0	0
Windsor Locks	2	1	1	1	12	3	4	1	0

Analysis of Mitigation Actions

In considering which projects, processes, and other measures to undertake in the upcoming plan period, municipal and regional officials evaluated the need to address problems and vulnerabilities in their communities against the communities' resources and capabilities. To prioritize mitigation strategies, a set of criteria commonly used by public administration officials and planners was applied to each proposed strategy. The method, called STAPLEE, is outlined in FEMA planning documents such as Developing the Mitigation Plan (FEMA 386-3) and Using Benefit-Cost Review in Mitigation Planning (FEMA 386-5). STAPLEE stands for the "Social, Technical, Administrative, Political, Legal, Economic, and Environmental" criteria for making planning decisions.

Benefit-cost review was emphasized in the prioritization process. Criteria were divided into potential benefits (pros) and potential costs (cons) for each mitigation strategy. The following questions were asked about the proposed mitigation strategies:

- **Social**:
  - Benefits: Is the proposed strategy socially acceptable to the community?
  - Costs: Are there any equity issues involved that would mean that one segment of the community could be treated unfairly? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower-income people? Is the action compatible with present and future community values?

- **Technical**:
  - Benefits: Will the proposed strategy work? Will it reduce losses in the long term with minimal secondary impacts?
  - Costs: Is the action technically feasible? Will it create more problems than it will solve? Does it solve the problem or only a symptom?

- **Administrative**:
  - Benefits: Does the project make it easier for the community to administrate future mitigation or emergency response actions?
  - Costs: Does the community have the capability (staff, technical experts, and/or funding) to implement the action, or can it be readily obtained? Can the community perform the necessary maintenance? Can the project be accomplished in a timely manner?

- **Political**:
  - Benefits: Is the strategy politically beneficial? Is there public support both to implement and maintain the project? Is there a local champion willing to see the project to completion? Can the mitigation objectives be accomplished at the lowest cost to the community (grants, etc.)?
  - Costs: Have political leaders participated in the planning process? Do project stakeholders support the project enough to ensure success? Have the stakeholders been offered the opportunity to participate in the planning process?

- **Legal**:
  - Benefits: Is there a technical, scientific, or legal basis for the mitigation action? Are the proper laws, ordinances, and resolutions in place to implement the action?

- Costs: Does the community have the authority to implement the proposed action? Are there any potential legal consequences? Will the community be liable for the actions or support of actions or for lack of action? Is the action likely to be challenged by stakeholders who may be negatively affected?

- **Economic**:
  - Benefits: Are there currently sources of funds that can be used to implement the action? What benefits will the action provide? Does the action contribute to community goals such as capital improvements or economic development?
  - Costs: Does the cost seem reasonable for the size of the problem and the likely benefits? What burden will be placed on the tax base or local economy to implement this action? What proposed actions should be considered but be tabled for implementation until outside sources of funding are available?

- **Environmental**:
  - Benefits: Will this action beneficially affect the environment (land, water, endangered species)?
  - Costs: Will this action comply with local, state, and federal environmental laws and regulations? Is the action consistent with community environmental goals?

Each proposed mitigation strategy presented in this plan was evaluated and quantitatively assigned a "benefit" score and a "cost" score for each of the seven STAPLEE criteria as outlined below:

- For potential benefits, a score of "1" was assigned if the project will have a beneficial effect for that particular criterion or a "0" if the project would have a negligible effect or if the questions were not applicable to the strategy.

- For potential costs, a score of "-1" was assigned if the project would have an unfavorable impact for that particular criterion or a "0" if the project would have a negligible impact or if the questions were not applicable to the strategy.

- Technical and Economic criteria were double weighted (multiplied by two) in the final sum of scores.

- The total benefit score and cost score for each mitigation strategy was summed to determine each strategy's final STAPLEE score.

An evaluation matrix with the total scores from each strategy can be found as Appendix E. While higher-scoring strategies are generally considered to be more achievable and/or important than lower-scoring strategies economically, socially, environmentally, and politically, the priorities of local communities are also considered in the final prioritization of actions. A diversity of scores may be found within specific categories of mitigation actions. For example, one community may find joining the Sustainable CT program to be administratively burdensome while another may not; this will lead to different scores for the same action.

Although a community may implement recommendations as prioritized by the STAPLEE method, an additional consideration is important for those recommendations that may be funded under the FEMA mitigation grant programs. To receive federal funding, the mitigation action must have a benefit-cost ratio (BCR) that exceeds a value of 1.0. Calculation of the BCR is conducted using FEMA's Benefit Cost Analysis (BCA) toolkit. The calculation method may be complex and vary with the mitigation action of

interest. Calculations are dependent on detailed information such as property value appraisals, design and construction costs for structural projects, and tabulations of previous damages or NFIP claims.

The BCR scoring system used is outlined in the table below:

Table 46: Benefit-Cost Ratio Scoring Definitions

Scoring	Benefits	Costs
Low: 0-1 points	Few would benefit; the impacts being addressed are not severe; benefits may be short term	Likely to be done by existing personnel with little impact on budget; not complicated to accomplish. Costs to implement are likely to be under $10,000.
Medium: 2-3 points	Benefits may be felt by many in the community; the action may solve a problem or otherwise benefit the community for a number of years	May need additional funding or studies; may require change in practices; costs to implement may be between $10,000 and $100,000
High: 4-5 points	Benefits would accrue to many in the community; benefits may accrue to the most vulnerable or those not able to recover on their own; benefits would be long term and may permanently protect from damages	Likely to cost over $100,000 and require obtaining funding outside of operating budget; complicated, lengthy process to implement

The STAPLEE method accounts for cost-benefit considerations both directly (through the "Economic" category) and indirectly (through general consideration of costs and benefits of actions). Additionally, the range of estimated costs of each strategy are included in the STAPLEE table. The assumed costs of projects and generalized presentation of the benefits accruing from them are not based on specific detailed cost estimates as that level of analysis is not appropriate for this type of planning effort. For some projects, such as routine or recurring operations that are established practices and conducted with municipal general operating funds and existing staff, the STAPLEE results can be the only explicit comparison of costs and benefits. For projects for which bonding and/or grant funding will be sought, more in-depth evaluations of costs and benefits will be required. As project scopes are detailed, benefits and costs can be identified with more precision, and the benefit-cost ratio which results from a full benefit-cost analysis may differ from the planning-level STAPLEE results presented here.

It should be noted that higher BCRs do not necessarily correspond to high priorities, nor do low BCRs or BCRs under 1.0 correspond to low-priority projects. An important project with a high priority to the community may have a lower BCR because of its complexity, assumed high expense, and other costs. Communities should not be discouraged or deterred from further consideration of projects that have low BCRs or BCRs less than 1.0 until additional, more specific evaluations of the costs and benefits have been undertaken.

Section IV: Planning Process

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Planning Process for 2019 Natural Hazard Mitigation Plan Update

The planning processes for the 2014 Capitol Region Natural Hazard Mitigation Plan Update, the 2015 Hazard Mitigation Plan Update for the Former Windham Region, and the 2016 Hazard Mitigation Plan Update for the Former Central Connecticut Region are described in Appendix F.

The planning process for the subject Plan Update began in 2017 when FEMA awarded CRCOG a Pre-Disaster Mitigation Planning Grant to update its multi-jurisdiction natural hazard mitigation plan. This Plan Update was developed in collaboration with the Capitol Region Emergency Planning Commission (CREPC), the region's 38 municipalities, and DESPP/DEMHS. As in 2013-2014, ESF-5 Emergency Management served as the planning committee for the update process and provided guidance to the project. A consultant (Milone & MacBroom, Inc. of Cheshire, Connecticut) was retained to provide technical support and coordinate efforts to involve officials from each town. Milone & MacBroom, Inc. assembled a team of subconsultants working on state and local hazard mitigation plans in Connecticut in parallel with the CRCOG planning process (Dewberry, Jamie Caplan Consulting, and Punchard Consulting) to provide their expertise and input.

Finally, local planning teams and members of the public were provided opportunities to provide input throughout the development of the Plan Update. Documentation that supports this narrative description can be found in Appendix G as follows:

- G1 – Typical *PowerPoint* slides used for local planning meetings followed by 38 sets of meeting notes (one set for each community)
- G2 – Sign-in sheets, presentation materials, and other documentation associated with the five region-wide planning team meetings spanning October 2017 through September 2018
- G3 – Press release, press announcements, CRCOG web announcements and related, community web page announcements, public meeting presentation materials, and meeting notes related to the five public information meetings held in May 2018
- G4 – Internet-based survey results
- G5 – Press release, press announcements, CRCOG web announcements and related, community web page announcements, public meeting presentation materials, and meeting notes related to the public information meeting and drop-in session held in November 2018 to present the draft plan

Hazards Identification for 2019 Natural Hazard Mitigation Plan Update

The hazards included in the planning process in 2017-2018 were those profiled and analyzed 5 years earlier. Importantly, they were the same as the hazards included in the 2014 Connecticut Natural Hazard Mitigation Plan and its update (to be adopted in 2019).

Data Collection and Analysis/Risk Assessment for 2019 Natural Hazard Mitigation Plan Update

The consultant teams collected and analyzed the hazards and loss data for participating municipalities to reduce duplication of efforts and to provide a common ground for evaluating mitigation strategies. The data came from a wide variety of sources including FEMA, DEEP, the National Weather Service, regional newspapers, the United States Geological Survey, United States Census Bureau, municipalities, and CRCOG's internal geographic information system as well as other resources. The data were used to

evaluate natural disasters in terms of frequency, magnitude, areas of impact, and economic loss. The collected data were analyzed using ESRI *ArcMap 10* and *HAZUS-MH.* Municipal and regional Plans of Conservation and Development, municipal zoning and floodplain regulations, municipal budget and capital improvement program documents, and flood management studies were also reviewed during the course of the update. New resources include the State Water Plan (2018) and various studies performed by CIRCA.

Municipal Plans Review/Update for 2019 Natural Hazard Mitigation Plan Update

As the hazards analyses were undertaken, the consultant team led meetings with municipal officials to initiate updates to individual city and town plans. These meetings were held in each of the 38 municipalities and included local staff from a variety of departments including administration, planning, emergency management, police, fire, public health, public works, and engineering. In some towns, citizens and elected officials also participated. The consultant team conducted the following meetings locally over a 5-month period (November 2017 through March 2018) with municipal officials to initiate the local update process:

Table 47: Local Planning Meetings and Coordinators

Municipality	Local Planning Meeting Date	Meeting Coordinator	*Local Coordinator
Andover	3/29/2018	Joe Higgins, Town Administrator	Joe Higgins, Town Administrator
Avon	1/16/2018	James DiPace, Emergency Management Director	James DiPace, Emergency Management Director
Berlin	11/9/2017	John (Jack) Healy, PE, Temporary Town Manager	Matt Odishoo, Emergency Management Director
Bloomfield	12/20/2017	Jonathan Thiesse, Town Engineer	Jonathan Thiesse, Town Engineer
Bolton	2/16/2018	Patrice L. Carson, AICP, Consulting Director of Community Development	Patrice L. Carson, AICP, Consulting Director of Community Development
Canton	12/6/2017	Robert Skinner, Chief Admin. Officer	Chris Arciero, Emergency Management Director
Columbia	2/16/2018	Jennifer LaVoie, Executive Assistant	Mark B. Walter, Town Administrator
Coventry	12/18/2017	Eric Trott, Director of Land Use	Eric Trott, Director of Land Use
East Granby	12/14/2017	First Selectman, James M. Hayden and Gary Haynes, Director of Community Development	Gary Haynes, Director of Community Development
East Hartford	1/18/2018	Jessica Carerro, Mayor's Office	Brian Jennes, Emergency Management
East Windsor	11/28/2017	Roger Hart, Deputy Chief of Police and Laurie Whitten, Town Planner	Roger Hart, Deputy Chief of Police
Ellington	1/16/2018	Lisa Houlihan, AICP, Town Planner	Lisa Houlihan, AICP, Town Planner

Municipality	Local Planning Meeting Date	Meeting Coordinator	*Local Coordinator
Enfield	2/26/2018	Steven Hall, Emergency Management Director	Steven Hall, Emergency Management Director
Farmington	1/12/2018	Town Manager's Assistant	Paul Melanson
Glastonbury	12/20/2017	Michael Bisi, Superintendent of Sanitation	Michael Bisi, Superintendent of Sanitation
Granby	12/14/2017	Francis Armentano, Community Development Director	Abigail St. Peter Kenyon, AICP
Hartford	12/13/2017	Frank Dellaripa, City Engineer	Fire Chief Freeman, Emergency Management Director
Hebron	2/13/2018	Sean C. Shoemaker, Emergency Management Director	Sean C. Shoemaker, Emergency Management Director
Manchester	12/20/2017	Matt Bordeaux, Environmental Planner	Matt Bordeaux, Environmental Planner
Mansfield	12/13/2017	Adam Libros	Adam Libros, EM Director
Marlborough	2/6/2018	Peter Hughes, Town Planner	Peter Hughes, Town Planner
New Britain	11/27/2017	Jodi Latina, Chief of Staff	Michael Berry, ER Operations Coordinator
Newington	11/9/2017	Tanya Lane, Town Manager	Chris Schroeder, Fire Marshal and Emergency Management Director
Plainville	11/6/2017	Town Manager	Mark S. DeVoe, AICP
Rocky Hill	11/10/2017	John Mehr, Town Manager	Raymond A. Carpentino, Economic Development Director
Simsbury	12/19/2017	Michael Glidden, Director of Planning and Community Development	Michael Glidden, Director of Planning and Community Development
Somers	11/20/2017	Tim Kradas, Emergency Management Director	Tim Kradas, Emergency Management Director
South Windsor	12/20/2017	Jubenal "Jay" Gonzalez, Asst. EM Dir.	Jubenal "Jay" Gonzalez, Asst. Emergency Management Director
Southington	11/14/2017	Jennifer Montone	Rob Phillips
Stafford	3/29/2018	Rick Zulick, DPW	Rick Zulick, DPW
Suffield	11/28/2017	Art Groux, Emergency Management Director	Art Groux, Emergency Management Director
Tolland	1/10/2018	Kevin Berger, Assistant Planner	Kevin Berger, Assistant Planner
Vernon	1/11/2018	Dianne Wheelock, Executive Assistant	Michael Purcaro, Town Manager
West Hartford	11/29/2017	Matt Hart, Town Manager	Gary Allyn, Emergency Management Director
Wethersfield	12/5/2017	Jeff Bridges, Town Manager	James Ritter, Emergency Management Director
Willington	2/13/2018	Robin Campbell, Office Manager	Stuart Cobb, Emergency Management Director
Windsor	12/18/2017	Paul Goldberg, Fire Administrator and EMD	Paul Goldberg, Fire Administrator and Emergency Management Director

Municipality	Local Planning Meeting Date	Meeting Coordinator	*Local Coordinator
Windsor Locks	12/11/2017	Susan R. Barsanti, First Selectman's Office	Jen Rodriguez, Town Planner

** Local Coordinator at the time of the meeting; current local coordinator may be a different individual.*

Following these municipal meetings, the consultant team worked with the municipally designated staff contacts to incorporate the updates prepared by the municipalities.

Strategy Analysis and Prioritization for 2019 Natural Hazard Mitigation Plan Update

To review prior goals, objectives, and actions and strategize about new mitigation initiatives, CRCOG and the consultant team sought the advice of the CREPC planning committee at workshops held on January 23, 2018, and March 27, 2018. The meetings were attended by municipal officials from most of the Capitol Region communities as well as representatives from DEEP, SHPO, and CIRCA. The consultant team presented and described mitigation success stories and a number of proposed mitigation initiatives with assistance from DEEP, SHPO, and CIRCA and reported on additional strategies/actions based on our findings and discussions with local officials at the individual municipal meetings. These meetings led to the new initiatives described in this update such as the historic resources resiliency, addressing spills from small businesses, MS4 stormwater registration compliance, regional critical facilities, etc. Further discussion of the proposed regional and common municipal strategies was held at a workshop on September 12, 2018.

Public Participation for 2019 Natural Hazard Mitigation Plan Update

A variety of means were used to inform the public of the planning process and to gain public input on hazards, areas and issues of concern, and mitigation measures. These specific outreach efforts are described below.

Reports and Presentations to Local Officials

These included regular reports to the CRCOG Policy Board and CREPC; presentation to CREPC on October 19, 2017; presentation to the ES-5 committee on November 2, 2017; and the January, March, and September 2018 workshops described above. Also, articles describing update activities and progress were included in CRCOG newsletters. A presentation on the Plan Update was also made to the Regional Planning Commission on May 10, 2018, and to the CRCOG Municipal Services committee on October 16, 2018. Policy Board, Regional Planning Commission, Municipal Services Committee, and CREPC meetings are public meetings with meeting notices, agendas, and minutes published on CRCOG's website.

Web Pages

CRCOG's web page related to the Natural Hazard Mitigation Plan was updated throughout the planning process. Translations of CRCOG's web pages are available in over 70 languages. Additional links to the Natural Hazard Mitigation Plan page were also added from other web pages on CRCOG's site. The draft for public review was posted in November 2018.

Public Meetings and Workshops

The consultant team and CRCOG staff conducted five public meetings in May 2018 (listed below) to solicit feedback from residents and other stakeholders. CRCOG sent meeting notices to various municipal officials. Press releases were emailed to all daily and weekly newspapers in the Capitol Region and posted to the Patch.com news website for each community in the Capitol Region with a Patch.com presence. Meeting notices and summaries were also posted on the CRCOG website and most of the municipal websites. WDRC radio announced the meetings on the locally-popular "Brad Davis Show."

Subregion: Northeast
Date: May 5, 2018
Location: Ellington Town Hall

Subregion: Southeast
Date: May 16, 2018
Location: Coventry Parks & Recreation "Mill Brook Place"

Subregion: Northwest
Date: May 22, 2018
Location: Simsbury Public Library

Subregion: Central
Date: May 24, 2018
Location: Hartford Emergency Operations Center

Subregion: Southwest
Date: May 29, 2018
Location: Plainville Public Library

The fact sheet on the following page describes aspects of the public meeting process.

Opinion Survey

A survey was developed to solicit input from the public on local mitigation activities and strategies. The survey was opened and posted online in early April 2018 and closed in late May 2018. Links to the survey were available on the CRCOG website, the CRCOG Green Clearinghouse website, and the Get Ready Capitol Region website and publicized at the subregional public workshops. Paper survey forms were also brought to workshops. Survey answers were tabulated by the respondents' hometown, and results were reviewed for consideration in updating the municipal challenges and strategies sections. In all, 172 persons responded to the survey. Most respondents resided in one of the 38 municipalities participating in the Plan Update; however, four lived outside the region. Five respondents work outside the region. Figure 14 shows the general locations in which respondents live (red bed icon) or work (grey building icon).

OUTREACH EFFORTS

PUBLIC INFORMATION MEETINGS

Public Meeting: Natural Hazards Mitigation Plan

Wednesday, May 16

Local planners are seeking public input on preparing for natural disasters at a series of meetings to be held throughout the greater Hartford area. Floods, high winds, winter storms, drought, and wildfires, impact area residents and businesses every year. These events damage property, cause power outages, block roads, and can cause injury and death. Meetings will be held throughout May to discuss what can be done to minimize risks from natural hazards. The Council of Governments is offering five opportunities for the public to attend an informational meeting where local residents and workers can learn about the plan, ask questions, and provide input. Members of the public may attend any of the meetings, regardless of which community they are from. The same information will be presented at each meeting. More more details, see the full press release at https://ct-coventry.civicplus.com/DocumentCenter/View/2477. To share your thoughts, take the survey at the link below.

Examples of Announcements on Municipal Web Sites

WHAT WAS ACCOMPLISHED?

CRCOG held five meetings for local residents and employees of local businesses to learn about the Natural Hazard Mitigation Plan, ask questions, and provide input for the update. Meetings were held in Ellington, Coventry, Simsbury, Hartford, and Plainville throughout the month of May 2018. Attendees came from Avon, Bolton, Coventry, East Windsor, Ellington, Glastonbury, New Britain, Plainville, Simsbury, and Windsor. Some key input is summarized below:

Concerns:

- High Wind Events
- Power Outages & Road Blockages
- Increasing Flood Frequency
- Development and its Impacts on Runoff

Mitigation Needs:

- Increased tree maintenance & debris removal
- Public Education
- Improved Communication with the Public
- Improved Power Grid Resilience
- Hazard Mitigation Incentives for Landlords

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Questions and comments brought by the public during these meetings informed plan development by highlighting hazards of concern, existing community capabilities and gaps in those capabilities, and specific actions recommended for future pursuit. Tornadoes struck Connecticut in mid-May 2018, bringing the hazard back to the forefront in people's minds, which in turn affected meeting discussions. Several outcomes of the meetings include the following:

- A specific area of concern for risk of flooding was identified in Plainville.
- Wind hazards were noted as being a significant concern for residents in all towns.
- New capabilities and needed actions were identified in Bolton, Ellington, Coventry, Simsbury, and New Britain.

FOR MORE INFORMATION

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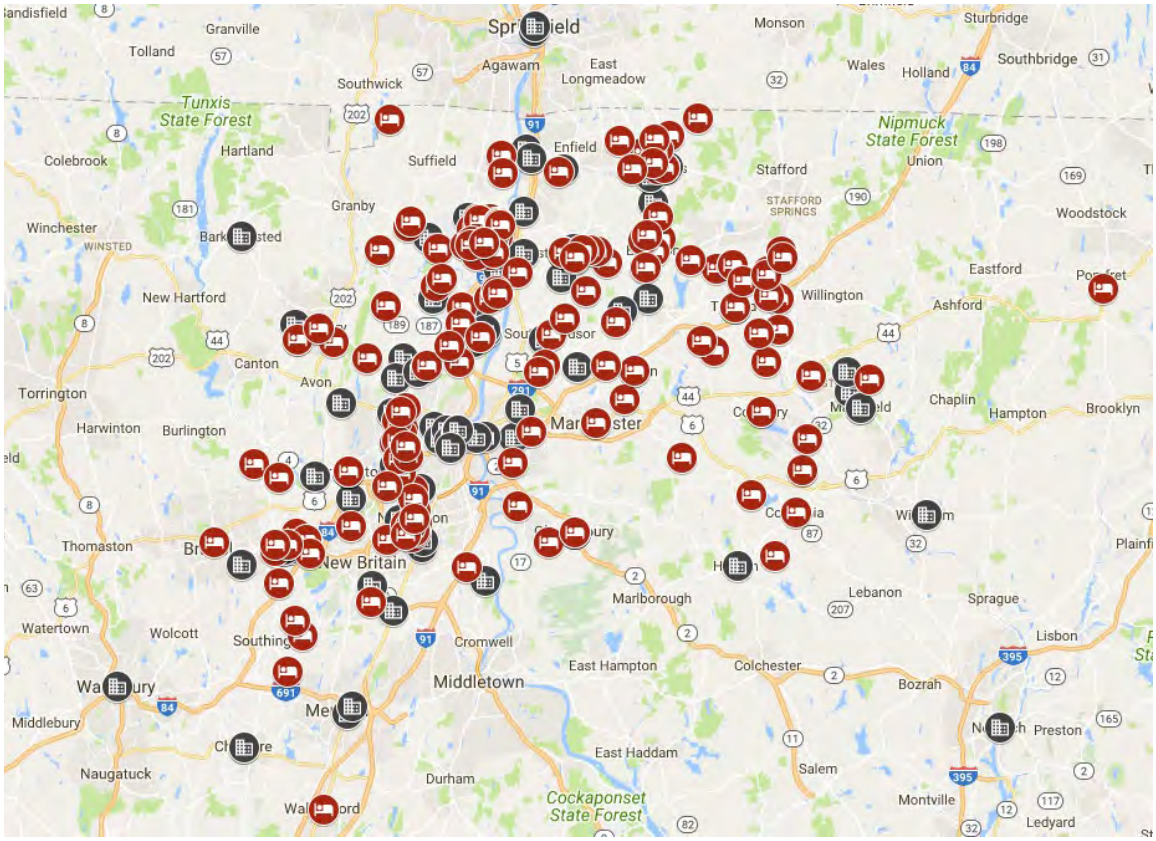


Figure 14: Residences and Workplaces of Survey Respondents

Approximately 45% of respondents have lived in the region for over 30 years, 36% more than 10 years, and 18% less than 10 years.

The survey asked about natural hazard and hazard mitigation awareness. Sixty-four percent (64%) of respondents were not aware of the regional hazard mitigation plan prior to taking the survey although only 5% of respondents indicated a lack of awareness of the danger of natural hazards to the region.

Respondents were asked to rank their concern about different natural hazards as low, moderate, or high. Taking a "weighted average" of the results yields a prioritized list of hazard concerns in the region.

Table 48: Natural Hazards Impacting Homes and Businesses

Natural Hazard	Respondent Level of Concern (Weighted, max. is 3.0)	Historically Impacted Respondent
Winter Storms (including snow or ice) and Blizzards	2.35	89.51%
Severe Thunderstorms (including hail and lightning)	2.03	46.85%
Hurricanes and Tropical Storms	2.02	54.55%
Tornadoes and other High Wind Events	1.91	33.57%
Extreme Cold Weather	1.9	32.17%
Flooding due to Poor Drainage	1.83	24.48%
Drought	1.5	11.19%

Natural Hazard	Respondent Level of Concern (Weighted, max. is 3.0)	Historically Impacted Respondent
Flooding from Rivers	1.46	14.69%
Wildfires and Brush Fires	1.36	1.40%
Sea Level Rise	1.22	0.00%
Dam Failure (could be caused by other hazards)	1.19	0.70%
Earthquakes	1.15	1.40%

Winter Storms, Thunderstorms, and Hurricanes and Tropical Storms are the top concerns for survey respondents.

Respondents were asked to identify specific locations of hazard concern. Specific locations are highlighted in each municipal annex where applicable. General trends in responses are summarized below. Communities that had zero mentions are not included in the table below.

Table 49: Specific Locations of Hazard Concern

Community	Total Number of Mentions	Flood Hazards Mentioned	Fire Hazards Mentioned
Avon	1	1	0
Bloomfield	1	1	0
Bolton	1	0	0
East Hartford	1	1	0
Ellington	1	0	0
Mansfield	1	1	0
New Britain	1	0	0
Southington	1	0	0
Vernon	1	1	0
Columbia	2	1	0
Enfield	2	1	0
Glastonbury	2	1	0
West Hartford	2	1	0
Newington	3	1	0
Coventry	4	3	0
Plainville	5	2	0
Simsbury	5	5	0
Tolland	5	2	0
East Windsor	6	3	0
Hartford	6	2	0
Windsor Locks	6	2	0
Farmington	7	4	0
Windsor	11	6	0
Somers	12	3	1

Respondents tended to be very aware of flood hazard zones, with only one highlighting a different hazard (wildfire).

Respondents noted existing resources available in their communities to help with hazard mitigation.

Table 50: Resources Available to Support or Assist with Hazard Preparation, Response, or Recovery

Resource	Important (percent selecting)	Available (percent selecting)
Emergency Responders	73.87%	70.27%
Local Government	71.55%	68.10%
State Government	71.00%	62.00%
Individual Community Members or Neighbors	70.33%	58.24%
Higher Education Institutions	67.69%	50.77%
Community or Neighborhood Associations	66.67%	50.00%
Local Schools	64.95%	68.04%
Nonprofit Organizations	64.38%	54.79%
Religious Institutions	56.76%	66.22%

Local Community Emergency Response Teams (CERTs) were noted by multiple respondents in additional comments as were local businesses. Emergency responders and both local and state government were noted as the most important resources for hazard preparation, response, and recovery; all three were noted by most respondents as being available. Individual community members, neighbors, and community or neighborhood associations, as well as institutions of higher education, were selected by a majority of survey takers as being important resources, but relatively few respondents marked these resources as being available. This may represent an opportunity for improvement.

The survey asked about actions individuals have taken to reduce the risk to or vulnerabilities of their families, homes, or businesses. Responses are summarized below.

Table 51: Individual Risk Reduction Actions

Action	Percent Selecting
Taken measures to reduce snow buildup on roofs	64.55%
Maintain a disaster supply kit for my family, home, or business	47.27%
Cut back or removed vegetation from my overhead utility lines or roof	38.18%
Developed a disaster plan for my family, home, or business	33.64%
Participated in public meetings to discuss relevant plans and regulations	27.27%
Managed vegetation to reduce risk of wildfire reaching my home or business	18.18%
Elevated or floodproofed my home or business to reduce flood damage	9.09%
Replaced my overhead utility lines with underground lines	3.64%
Installed storm shutters or structural braces to reduce wind damage	0.91%

The most common activities are reducing snow buildup on roofs, maintaining disaster kits, managing vegetation, and developing disaster plans. Other actions listed by respondents include purchasing generators and becoming trained as a local CERT member.

The survey asked participants to review a list of 23 hazard mitigation tools and select whether each (a) is important to hazard mitigation, (b) has been used successfully in the past, and (c) should be a priority moving forward. The table below summarizes the responses of the survey takers to each hazard mitigation action, with the highest-ranked action to implement in the future listed first.

Table 52: Respondent Opinions on Hazard Mitigation Actions

Hazard Mitigation Action	Important To Mitigation	Successful in the Past	Priority Moving Forward
Backup power for critical facilities	48%	35%	68%
Emergency response training	52%	38%	65%
Underground power lines	48%	31%	61%
Vulnerable population assistance	49%	33%	52%
Public outreach and education	59%	34%	52%
Disaster plans and kits	52%	39%	51%
Tree trimming and removal	56%	50%	48%
Emergency alerts	46%	55%	47%
Risk zone identification	56%	29%	46%
Land use regulations	58%	31%	46%
Firefighting water supplies	57%	31%	45%
Drainage improvements	57%	32%	45%
Dam inspection and maintenance	59%	31%	43%
Building acquisition and removal	60%	27%	36%
Snow clearing procedures	52%	49%	34%
Roof snow load analysis	61%	27%	32%
Flood insurance	60%	31%	31%
Floodproofing	64%	32%	26%
Drought ordinance	64%	30%	25%
Building earthquake analysis	63%	22%	21%

The strongest support among all respondents was expressed for installing backup power at critical facilities, training staff in emergency response, and installing underground power lines. Floodproofing, drought ordinances, analyzing building earthquake resistance, flood insurance, and building acquisition and removal were selected as important to hazard mitigation by the largest number of respondents but were all among the least selected as a priority moving forward. A majority of respondents felt that emergency alerts and tree trimming and removal had been successful in the past. Assisting vulnerable populations was also strongly supported.

The survey asked respondents to rank a list of activities on a scale of 1 to 10 in terms of the importance of each to recovering from a hazard event. Average rankings are summarized below.

Table 53: Respondent Opinions on Hazard Mitigation Actions

Emergency Response Activity	Average Score
Address Injuries and Casualties	7.76
Continue Operation of Medical Facilities	7.02
Restore Utilities (electric, water, wastewater, communication)	6.72
Re-open Roads	6.63
Re-open Gas Stations & Grocery Stores	5.24
Clean/Repair Home	3.87
Re-open Schools	3.79
Resume Business/Tourism Activities	2.73
Restore Parks, Beaches, and other Natural Resources	2.04

Following addressing injuries and casualties, the highest-ranked activities are continued operation of medical facilities and restoration of essential public utilities and services, including roads, fuel, and food.

The survey asked respondents for their thoughts about preparing for climate change. Sixty-nine percent of those who responded indicated that they felt it is appropriate to plan for storm events to become more severe and more frequent in the future while a total of 17% felt it is appropriate to plan for either more frequent or severe events but not both. Twelve percent do not feel that planning for changing storm patterns is necessary. Opinions on preparing for sea level rise were more evenly distributed (29% support planning for sea level rise to accelerate dramatically, 42% for sea level rise to accelerate less dramatically, and 29% for sea level rise to remain constant at historical rates); this may be influenced by the fact that the majority of respondents (96%) neither live nor work near the coast.

When asked about flood insurance, 51% of those who responded (56 individuals) indicated that they do not have flood insurance and have no opinions on it. Forty-six percent of those who responded (50 individuals) indicated support for looking for ways to reduce insurance costs for all policy holders. Nineteen people provided additional comments; 14 of those expressed concern that government-subsidized flood insurance encourages floodplain development or redevelopment, is unfair to other tax payers, or a similar related sentiment.

In the final two questions of the survey, respondents were asked to describe one action that they would like to see performed in their communities to reduce risks from natural hazards and to provide any other thoughts or comments. Analysis of the open-ended responses showed concerns about the resilience of the power grid, as well as falling trees and branches were among the most commonly noted. Preparation and planning as well as flood mitigation were also frequently noted. Other commonly cited actions included education and training, improving drainage, and mitigating damage to utilities and infrastructure. Figure 15 depicts a word cloud summarizing the results of these two questions, with larger text indicating words used more frequently in respondent answers.

Figure 15: Word Cloud Showing Commonly Referenced Words in Responses

A total of 24 respondents provided contact information in order to be involved in continued plan development.

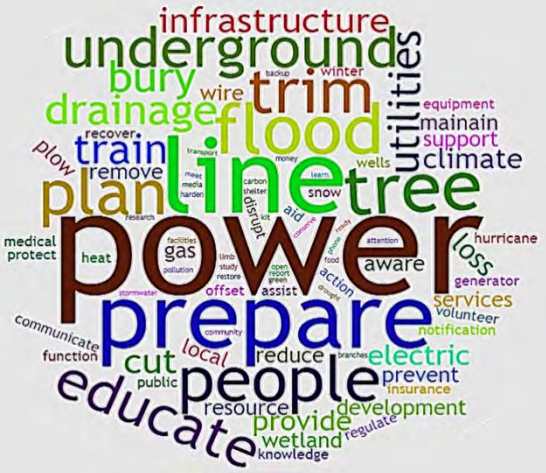
From all these survey responses, the following conclusions can be drawn:

- Respondents strongly support mitigating damage to, and accelerating recovery from, damage to utilities, infrastructure, and critical facilities; especially the power grid.
- Providing assistance to vulnerable populations is important to most respondents.
- Respondents support public education and outreach, public warning system improvements, and emergency response trainings.
- Preparedness activities taken by individual respondents tend to be focused around property maintenance (such as clearing snow from roofs or managing vegetation).
- There is less support among respondents for mitigation actions involving flood insurance, floodproofing, drought ordinances, and building-earthquake analysis.
- Natural and recreational resource recovery, as well as tourism and business recovery, are the lowest priorities for most respondents.

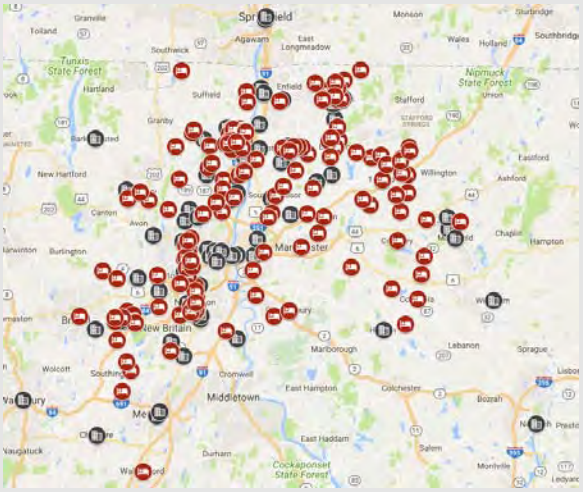
The fact sheet on the following page highlights aspects of the survey.

OUTREACH EFFORTS

PUBLIC ENGAGEMENT SURVEY



Keywords in Open-Ended Question Responses



Residences and Workplaces of Survey Respondents

WHAT WAS ACCOMPLISHED?

A survey was posted online in the spring of 2018 to solicit input from the public on local mitigation activities and strategies. The survey was opened on April 19, 2018 and closed on June 4, 2018. Press releases were carried in numerous news media outlets and municipal web sites. A total of 172 people responded. The following table provides a snapshot of the top three choices from each category. A full description of the survey is in the plan document.

Top Hazard of Concern	Winter Storm	Thunder-storm	Tropical Cyclone
Community Resources	CERT & Emergency Responders	Local Government	Local Schools
Actions Taken by Individuals	Clear Roof of Snow	Disaster Supply Kit	Manage Vegetation
Priority Hazard Mitigation Actions	Emergency Power	Response Training	Underground Power Lines
Priority Recovery Activities	Injuries / Casualties	Medical Facility Operation	Utilities & Infrastructure

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Results were tabulated by town and considered in updating municipal challenges and strategies sections. General points drawn from the survey include:

- High Priorities:
  - Utilities (especially power), infrastructure, and critical facilities
  - Vulnerable population assistance
  - Education, public warning, emergency response training
- Low Priorities:
  - Flood insurance & floodproofing
  - Drought ordinances
  - Building-earthquake analysis
  - Natural & recreational resources, tourism & business

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Review of the Draft Plan Update

Availability of the public draft of the plan update was announced on November 1, 2018 simultaneously with notification of a public meeting about the draft plan to be held on November 15, 2018. CRCOG sent meeting notices to various municipal officials. Press releases were emailed to daily and weekly newspapers in the Capitol Region and posted to the Patch.com news web site for the Greater Hartford region. Meeting notices and summaries were posted on the CRCOG website and most of the municipal web sites beginning on November 1, 2018, notifying members of the public that comments could be submitted through November 30, 2018. Links to the draft plan were provided in all announcements. A second public meeting was held as a "drop-in" session at the office of CRCOG to provide additional opportunities for the public to comment. This second meeting was similarly publicized, and also announced on the *Get Ready Capitol Region* website. Ultimately, each meeting was announced via email to over 300 local officials and citizens, including all the participants of the internet-based survey that voluntarily entered email addresses.

The two meeting opportunities were:

Date: November 15, 2018
Location: West Hartford Town Hall

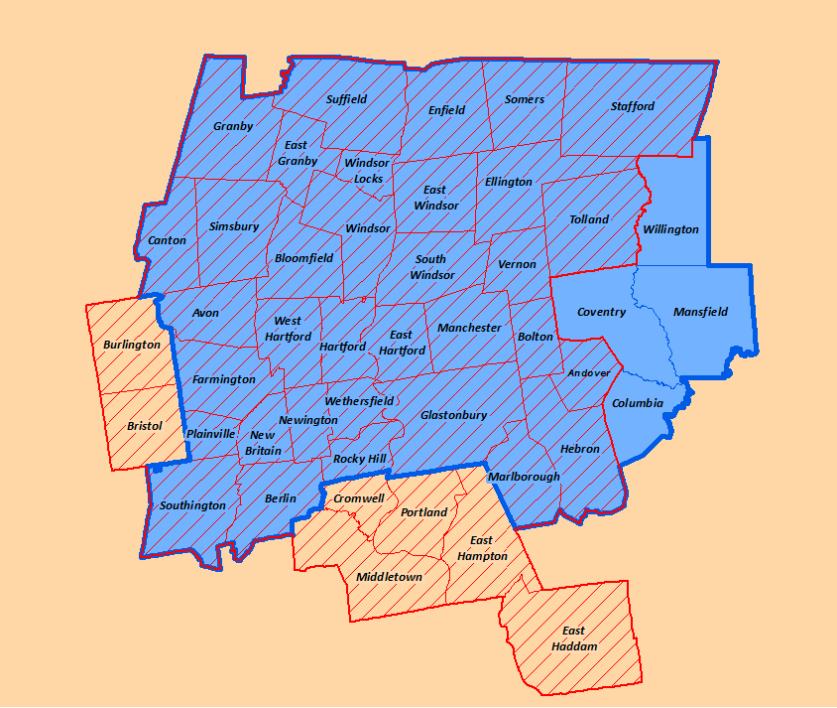
Date: November 27, 2018
Location: Capitol Region Council of Governments Office, Hartford, CT

Public comments regarding the draft plan update were not received.

Coordination with Neighboring Communities and Other Agencies

Opportunities for input from neighboring communities and other regional bodies were provided throughout the update process.

- CREPC plus 11 other neighboring communities in Connecticut were regularly briefed on plan update activities. CREPC member communities correspond to the DEMHS Region 3 communities. The map shows the CRCOG communities in blue and the additional CREPC/DEMHS Region 3 communities in red crosshatch.



Map 11: CRCOG and CREPC Municipalities

Red crosshatch = DEMHS Region 3
Blue = CRCOG

- CREPC's Emergency Support Function 5 (ES5) – Emergency Management serves as the basis for the planning committee, which provides oversight to the Plan Update process. Outreach for the planning committee meetings included ESF-5 members from communities outside CRCOG as well as other regional agencies.

- A meeting was conducted with the Metropolitan District Commission (MDC), the regional water and wastewater agency serving Hartford and neighboring municipalities, on January 31, 2018. During the meeting, CRCOG and the consultant discussed how various goals and strategies for the Capitol Region could dovetail with goals of MDC's ongoing drainage, flood control, and sanitary sewer projects.

- The Connecticut Natural Hazard Mitigation Plan Update was developed in parallel to the Capitol Region Natural Hazard Mitigation Plan, albeit several months behind in sequence. The parallel efforts allowed CRCOG to participate in the update of the Connecticut Natural Hazard Mitigation Plan and bring information from one process to the other. DEMHS, DEEP, and other state agency personnel attending the workshops for the Connecticut Natural Hazard Mitigation Plan Update were made aware that the Capitol Region Natural Hazard Mitigation Plan was being updated.

- A meeting was held with The Nature Conservancy (TNC) on May 18, 2018. During the meeting, CRCOG and the consultant explained how various goals and strategies for the Capitol Region could dovetail with goals of TNC's ongoing statewide conservation and resiliency programs.

- On May 11, 2018, a day-long forum was held in which a poster of all CIRCA-funded projects in the region was displayed. Representatives from communities outside of the Capitol Region were present at the forum.

- Some of the individuals participating in the internet-based survey are residents from communities outside the region.

Municipal planners or other local representatives in communities adjacent to CRCOG, including those in Massachusetts, were e-mailed notices of the public meetings.

Typical Questions to Address in Plan Updates

The following questions were used to guide the update process; ***answers for the Capitol Region are provided in italics.***

- Do the mitigation goals and objectives still reflect the concerns of residents, business owners, and officials? ***They do, but we recognized an opportunity to standardize the goals and consolidate them into nine goals, so that each community could select mitigation options that support the same goals region-wide.***

- Have conditions changed so that findings of the risk and vulnerability assessments should be updated? ***No, conditions have not changed. The hazards are the same and the vulnerabilities are largely the same. Development has not occurred in zones of risk.***

- Are new sources of information available that will improve the risk assessment? ***Yes. Minor FEMA map revisions occurred in several communities, and projections related to climate change have continued to be published over the last few years.***

- If risks and vulnerabilities have changed, do the mitigation goals and objectives still reflect the risk assessment? ***Yes, the goals still reflect the risk assessment.***

- What hazards have caused damage since the last edition of the Plan was developed? Were these anticipated and evaluated in the Plan or should these hazards be added to the Plan? ***Few damaging hazards have occurred since the last edition of the plan.***

- Are current personnel and financial resources sufficient for implementing mitigation actions? ***No. This continues to be a challenge for many of the Capitol Region communities.***

- For each mitigation action that has not been completed, what are the obstacles to implementation? What are potential solutions for overcoming these obstacles? ***Lack of sufficient financial resources has been the primary challenge for mitigation actions that have not been completed.***

- For each mitigation action that has been completed, was the action effective in reducing risk? ***As noted in the mitigation success story pages, the mitigation actions completed in the Capitol Region have reduced risks.***

- What mitigation recommendations should be added to the Plan and proposed for implementation? ***The Capitol Region municipalities have a number of mitigation actions unique to their communities, but they all agreed to include new actions related to several Statewide and region-wide initiatives such as reducing risk to historic resources, reducing risks to small businesses that may release contaminants during disasters, and recognizing critical facilities of regional significance.***

- If any proposed mitigation actions should be deleted from the Plan, what is the rationale? ***Most of the communities that deleted mitigation actions had evidence to demonstrate that the actions were no longer needed. In some cases, the reason the actions were no longer needed was because the assessment of risk was somewhat overstated in the past, but in some cases the communities found that other actions had addressed the risk.***

Section V: Plan Implementation and Maintenance

CRCOG
CAPITOL REGION
COUNCIL OF GOVERNMENTS

CRCOG
CAPITOL REGION
COUNCIL OF GOVERNMENTS

Bringing the Plan to Life

This section describes how this Plan Update will be put into action and how our momentum will be maintained. A Natural Hazard Mitigation Plan is not solely a document but also represents a cyclical process. Revisiting the planning process periodically ensures the mitigation strategies are not overlooked even if there are personnel transitions or organizational changes. Each update process helps to build and strengthen institutional capacity to undertake our mitigation strategies. All projects and activities will be evaluated for their progress and effectiveness and feasibility as mitigation activities during the 5-year cycle (2019-2024) and as work on the next update of this plan is undertaken.

Figure 16: Core Steps in Mitigation Planning Process

Source: http://www.fema.gov/hazard-mitigation-planning-overview

The general schedule and process we will follow to ensure the Capitol Region's 2019-2024 Plan Update is implemented and maintained involves the following steps:

TASK	2019				2020				2021				2022				2023				2024	
2019-2024 Plan Approval & Adoption																						
FEMA Review & Approval	•	•																				
Local & Regional Adoption		•	•	•																		
Plan Distribution				•																		
Implementation Monitoring																						
Annual Status Updates						•				•				•				•				

TASK	2019				2020				2021				2022				2023				2024	
Initiate Update Process																						
Seek Grant Funding											•											
Policy Board Approval											•											
Municipal Commitments											•											
Develop Next Plan Update																						
Risk Assessment Update																•	•					
Mitigation Strategies Update																•	•	•	•			
Document Preparation, Review & Revision																	•	•	•	•	•	•
Public Outreach & Participation																						
ESF-5 Plan Related Meetings			•				•				•				•				•			
Plan Update Activities																•	•	•	•	•	•	•

Questions or comments regarding the implementation of this Plan Update should be directed to:

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Plan Adoption

This plan update was submitted for review by DEMHS in November of 2018. Suggested revisions were made and the State transmitted the Plan Update to FEMA for review in December 2018. Upon receipt of FEMA's conditional approval on March 12, 2019, each municipality's governing body as well as CRCOG's Policy Board formally adopted the Plan Update (with an initial adoption date of April 15, 2019). CREPC has appended this plan to the Regional Emergency Support Plan (RESP) Plan. Copies of the CRCOG and municipal adoption resolutions are included in Appendix H.

Strategy Implementation

Implementation of the strategies contained within this plan will depend largely on the availability of resources. Each municipality and CRCOG will have to consider the costs, availability of funding, and economic and other impacts of each mitigation action individually. In general, preference should be given to accomplishing tasks that have positive benefit-cost ratios, and those that are ranked high priority. The ground work has been set for initiating the proposed mitigation activities: responsible agencies, implementation time frames, and potential funding sources have been identified for each proposed action.

The municipalities' chief executive officials and the designated local coordinators will be responsible for making this plan available to all municipal departments and agencies as a planning tool to be used in conjunction with other municipal plans, regulations, budgets, capital improvements programs, day-to-day operations, and other processes and projects. The CRCOG Policy Development & Planning Department will be responsible for regional strategies and coordination with CRCOG Public Safety staff. CRCOG will also assist municipalities' efforts to implement local projects by notifying municipal officials of grant funding opportunities as we become aware of them and by writing letters of support for grant applications.

It is also CRCOG's intention to append this plan to the Regional Emergency Support Plan (RESP) Plan, upon formal approval by FEMA and adoption by member municipalities. As municipal plans of conservation and development (POCD) are prepared and referred to CRCOG for regional review, the Policy Development & Planning staff will make recommendations for opportunities to incorporate natural hazard mitigation planning into the POCD. CRCOG has made such comments regarding municipal plans of conservation and development reviewed in all those reviewed from 2013 through 2018. Table 43 can be used to help guide the reviews of local POCDs, as it notes how each already addresses hazard mitigation.

The 2014-2024 Capitol Region regional plan of conservation and development has incorporated natural hazard mitigation policy recommendations and future updates will continue to do.

Implementation Monitoring

The planning sub-committee of CREPC (ESF-5), which provided guidance to this project, will monitor progress on its implementation with assistance from CRCOG staff. The sub-committee will conduct annual outreach to municipalities to ascertain progress on proposed mitigation actions. This will be conducted in an annual meeting for review and evaluation of the plan and its implementation. The annual meetings are proposed to be conducted in the spring or summer to allow municipalities the opportunity to prepare for annual federal disaster mitigation grant applications. We will reach out to the primary municipal contacts (the local coordinators) involved in this update (see below) for status updates on mitigation activities. Additionally, CRCOG Public Safety and Policy Development & Planning staff will coordinate with ESF-5 to ensure that all potentially interested municipal officials, including emergency management, public safety, public works and administrative staff, are invited to the meeting at which this plan will be reviewed. At the meeting, each municipality will review hazards that occurred in the previous years, strategic actions that have been implemented and additional efforts that have been undertaken to mitigate the impacts of natural hazards. The CREPC ESF-5 meetings are publicly noticed meetings and the public will be notified of the meetings and afforded the opportunity to participate.

Table 54: Natural Hazard Mitigation Plan Update Primary Municipal Contacts (Local Coordinators)

Municipality	Local Coordinator	Email Address
Andover	Jeffrey Maguire, First Selectman	jmaguire@andoverct.org
Avon	James DiPace, Emergency Management Director	JDIPACE@avonct.gov

Municipality	Local Coordinator	Email Address
Berlin	Matt Odishoo, Emergency Management Director	modishoo@town.berlin.ct.us
Bloomfield	Jonathan Thiesse, Town Engineer	jthiesse@bloomfieldct.org
Bolton	Patrice L. Carson, AICP, Consulting Director of Community Development	patrice.carson@boltonct.org
Canton	Chris Arciero, Emergency Management Director	carciero@townofcantonct.org
Columbia	Mark B. Walter, Town Administrator	townadministrator@columbiaCT.org
Coventry	Eric Trott, Director of Land Use	etrott@coventryct.org
East Granby	Gary Haynes, Director of Community Development	garyh@egtownhall.com
East Hartford	Brian Jennes, Emergency Management	Bjennes@easthartfordct.gov
East Windsor	Roger Hart, Deputy Chief of Police	roger.hart@eastwindsorpd.com
Ellington	Lisa Houlihan, AICP, Town Planner	LHoulihan@ELLINGTON-CT.GOV
Enfield	Steven Hall, Emergency Management Director	shall@enfield.org
Farmington	Paul Melanson, Chief of Police, Emergency Management Director	melansonp@farmington-ct.org
Glastonbury	Michael Bisi, Superintendent of Sanitation	Mike.Bisi@glastonbury-ct.gov
Granby	Abigail St. Peter Kenyon, AICP	akenyon@granby-ct.gov
Hartford	Frank Dellaripa, PE, City Engineer / Assistant Director Public Works	Frank.Dellaripa@hartford.gov
Hebron	Sean C. Shoemaker, Emergency Management Director	sshoemaker@hebronct.com
Manchester	Gary Anderson, Director of Planning and Economic Development	ganderson@manchesterct.gov
Mansfield	Adam Libros, EM Director	LibrosAB@mansfieldct.org
Marlborough	Peter Hughes, Town Planner	planner@marlboroughCT.net
New Britain	Michael Berry, ER Operations Coordinator	michael.berry@newbritainct.gov
Newington	Chris Schroeder, Fire Marshall and Emergency Management Director	cschroeder@newingtonct.gov
Plainville	Garrett Daigle, Town Planner	daigle@plainville-ct.gov
Rocky Hill	Raymond A. Carpentino, Economic Development Director	rcarpentino@rockyhillct.gov
Simsbury	Michael Glidden, Director of Planning and Community Development	mglidden@simsbury-ct.gov
Somers	Jeff Bord, Town Engineer	jbord@somersct.gov
South Windsor	Walter Summers, Fire Marshal	Walter.summers@southwindsor.org
Southington	Rob Phillips, Planning & Community Development Director	phillipsr@southington.org
Stafford	Rick Zulick, Public Works Director	publicworks@staffordct.org
Suffield	Art Groux, Emergency Management Director	agroux@suffieldems.org
Tolland	Heidi Samokar, AICP, Director of Planning & Development	hsamokar@tolland.org
Vernon	Michael Purcaro, Town Administrator	mpurcaro@vernon-ct.gov

Municipality	Local Coordinator	Email Address
West Hartford	Greg Priest, Fire Chief	greg.priest@westhartfordct.gov
Wethersfield	James Ritter, Emergency Management Director	james.ritter@wethersfieldct.gov
Willington	Stuart Cobb, Emergency Management Director	scobb@willingtonfire.org
Windsor	Paul Goldberg, Fire Administrator and Emergency Management Director	Goldberg@townofwindsorct.com
Windsor Locks	Jen Rodriguez, Town Planner	jrodriguez@wlocks.com

Plan Updates

It is anticipated that CRCOG Policy Development & Planning staff in coordination with Public Safety & Homeland Security staff will make updates to the plan at least once every five years. We will seek grant assistance for the update approximately three years prior to the expiration of this update, anticipating that the next update will take about two years to complete. We will initiate the next update process upon approval of the CRCOG Policy Board and will request commitments from each municipal chief executive official agreeing to participate in the update process. We anticipate CRCOG staff will work with municipal groups similar to those convened for the development of the current plan, when making updates. In developing our work program for the next update, we will review our experiences in this update process to identify areas or procedures which can be improved upon. Some of the questions to be asked during the update process are:

- Do the mitigation goals and objectives still reflect the concerns of residents, business owners, and officials?
- Have conditions changed so that findings of the risk and vulnerability assessments should be updated?
- Are new sources of information available that will improve the risk assessment?
- If risks and vulnerabilities have changed, do the mitigation goals and objectives still reflect the risk assessment?
- What hazards have caused damage in the community since the last edition of the Plan was developed? Were these anticipated and evaluated in the Plan or should these hazards be added to the Plan?
- Are current personnel and financial resources sufficient for implementing mitigation actions?
- For each mitigation action that has not been completed, what are the obstacles to implementation? What are potential solutions for overcoming these obstacles?
- For each mitigation action that has been completed, was the action effective in reducing risk?
- What mitigation recommendations should be added to the Plan and proposed for implementation?
- If any proposed mitigation actions should be deleted from the Plan, what is the rationale?

All monitoring and updating activities will incorporate public involvement through open meetings, public notices, posting documents on CRCOG's website and providing ample opportunities for public comment.

Section VI: References

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