U.S. Department of Homeland Security
FEMA Region I
99 High Street, Sixth Floor
Boston, MA 02110-2132

FEMA

January 24, 2022

Ken Dumais, State Hazard Mitigation Officer
Connecticut Division of Emergency Management and Homeland Security
1111 Country Club Road
Middletown, Connecticut 06457

Dear Mr. Dumais:

The U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA) Region I Mitigation Division has approved the Naugatuck Valley Council of Governments Hazard Mitigation Plan Update effective **January 20, 2022** through **January 19, 2027** in accordance with the planning requirements of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended, the National Flood Insurance Act of 1968, as amended, and Title 44 Code of Federal Regulations (CFR) Part 201.

This plan approval includes the following participating jurisdictions that provided copies of their resolutions adopting the plan.

- Ansonia
- Beacon Falls
- Bethlehem
- Bristol
- Cheshire
- Derby
- Middlebury
- Naugatuck
- Oxford
- Plymouth
- Prospect
- Seymour
- Shelton
- Southbury
- Thomaston
- Waterbury
- Watertown
- Wolcott
- Woodbury

With this plan approval, the communities listed above are eligible to apply to the Connecticut Division of Emergency Management and Homeland Security (DEMHS) for mitigation grants administered by FEMA. Requests for funding will be evaluated according to the eligibility requirements identified for each of these programs. A specific mitigation activity or project identified in the community's plan may not meet the eligibility requirements for FEMA funding; even eligible mitigation activities or projects are not automatically approved.

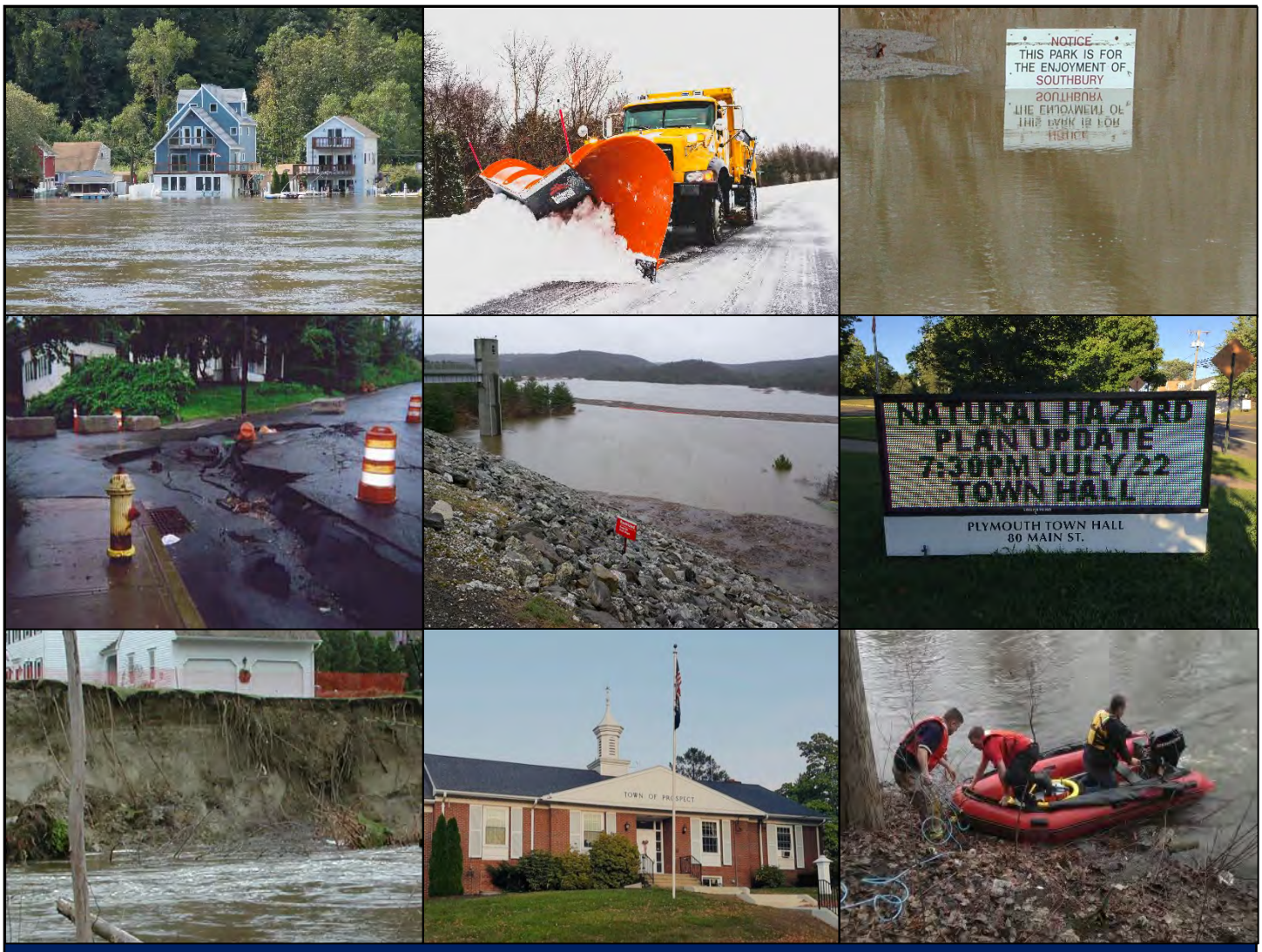
The plan must be updated and resubmitted to the FEMA Region I Mitigation Division for approval every five years to remain eligible for FEMA mitigation grant funding.

Thank you for your continued commitment and dedication to risk reduction demonstrated by preparing and adopting a strategy for reducing future disaster losses. Should you have any questions, please contact Sean Loughlin at (617) 832-4923 or Sean.Loughlin@fema.dhs.gov.

Sincerely,

Paul F. Ford
Acting Regional Administrator
DHS, FEMA Region I

PFF:sl



Naugatuck Valley Council of Governments

Hazard Mitigation Plan Update

2021 – 2026

Submitted to FEMA: August 30, 2021
FEMA Approved: January 20, 2022

Prepared by:
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Notice to Readers

This document was prepared under a grant from FEMA's National Preparedness Directorate, U.S. Department of Homeland Security. Points of view, opinions, and findings expressed in this document are those of the authors and do not necessarily represent the official position or policies of FEMA's National Preparedness Directorate, the U.S. Department of Homeland Security, or the Naugatuck Valley Council of Governments.

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Changes to Planning Process and Plan Document

This document represents the first multi-jurisdiction hazard mitigation plan to concurrently cover all 19 municipalities in the Naugatuck Valley region served by NVCOG. Previously, the 13 municipalities that were formerly part of the Council of Governments of the Central Naugatuck Valley each had standalone single-jurisdiction hazard mitigation plans, while the 4 municipalities that were formerly part of the Valley Council of Governments were covered under a multi-jurisdictional plan, and Bristol and Plymouth were part of the multi-jurisdictional plan for the former Central Connecticut Regional Planning Area. In order to streamline the HMP, NVCOG adopted a "Regional Plan-Municipal Annex" format similar to that used by other multi-jurisdictional hazard mitigation plans in Connecticut. In this manner, information pertinent to the entire region may be provided once in the regional plan, while the municipal annexes provide detailed information regarding each NVCOG municipality. Thus, while information in this hazard mitigation plan presents much of the information in the previous plans for the region, it has been reformatted.

As part of this planning process, each municipality updated its list of critical facilities, provided updates regarding its capabilities, provided updates regarding areas of hazard risk, and noted mitigation successes. The mitigation strategies developed for each municipality under previous planning efforts were reviewed and updated. Finally, new Statewide and regional mitigation strategies have been developed and incorporated.

For the first time, the hazard mitigation planning process considered the potential impact to historic resources within an exposure analysis. This inclusion is based on recent efforts by the State Historic Preservation Office to identify and digitize historic resources in the four coastal counties of Connecticut.

Updated loss estimates are presented by municipality herein. The current version of HAZUS-MH (version 4.2) was utilized to generate loss estimates for floods, hurricane wind, and earthquake hazards. The datasets and methodology used within HAZUS differs slightly in the current version than in previous versions such that the loss estimates herein may differ from those presented in previous hazard mitigation plans for the region. Other loss estimates herein are derived from county-wide damages tabulated and presented in the 2019 *Connecticut Natural Hazards Mitigation Plan Update*, while previous estimates were drawn from earlier versions of the state hazard mitigation plan.

This hazard mitigation plan adds "Fact Sheets" to make the document livelier and give community planners the flexibility to pull standalone pages out of the plan document when pursuing specific projects, grants, goals, etc. These are interspersed throughout the document and include new initiatives, impacts of climate change, regional challenges, mitigation success stories, and other considerations.

With the planning process taking place entirely in 2020 and 2021, the precautions necessary to minimize spread of the coronavirus responsible for COVID-19 caused considerable challenges. All public engagement was virtual, from an online survey to virtual public meetings that focused on individual municipalities and small groups of municipalities. Public meetings were recorded and posted to YouTube for public viewing. Because all of the NVCOG municipalities have developed prior hazard mitigation plans, NVCOG believes that this level of public engagement was appropriate given the limitations.

Executive Summary

Introduction

This document represents the first multi-jurisdiction hazard mitigation plan to concurrently cover all 19 municipalities in the Naugatuck Valley region served by NVCOG. Previously, the 13 municipalities that were formerly part of the Council of Governments of the Central Naugatuck Valley each had standalone single-jurisdiction hazard mitigation plans, while the 4 municipalities that were formerly part of the Valley Council of Governments were covered under a multi-jurisdictional plan, and Bristol and Plymouth were part of the multi-jurisdictional plan for the former Central Connecticut Regional Planning Area. This hazard mitigation plan uses the "Regional Plan-Municipal Annex" format to provide information pertinent to the entire region in one document, with an annex for each member municipality that provides information specific to that community.

As part of this planning process, each municipality identified a Local Coordinator to lead the local planning process, updated its list of critical facilities, provided updates regarding its capabilities, provided updates regarding areas of hazard risk, and noted mitigation successes. The mitigation strategies developed for each municipality under previous planning efforts were reviewed and updated. Finally, new Statewide and regional mitigation strategies have been developed and incorporated.

This hazard mitigation plan adds "Fact Sheets" to make the document livelier and give community planners the flexibility to pull standalone pages out of the plan document when pursuing specific projects, grants, goals, etc. These are interspersed throughout the document and include new initiatives, impacts of climate change, regional challenges, mitigation success stories, and other considerations.

Hazards Impacting the Naugatuck Valley Region

The NVCOG region experiences a variety of weather and related incidents each year. Certain events rise to the level of being considered hazards due to their risk to people, property, and other resources. Natural hazards that affect the region include high intensity storms such as hurricanes, severe thunderstorms, and severe winter storms. The effect of such severe storms can include related hazards such as flooding, severe winds, and tornadoes. Other natural hazards that may affect the region include the potential flooding impacts from dam failure, droughts, earthquakes, landslides, and wildfires.

Annualized loss estimates from natural hazards have been prepared for each jurisdiction based on analyses using FEMA's HAZUS-MH software, local loss data, or information presented in the 2019 *Connecticut Natural Hazards Mitigation Plan Update*. These estimates are summarized for each community in Table ES-1 below and range from approximately $128,000 per year in Bethlehem to nearly $3.5 million per year in Waterbury. Details regarding these loss estimates are provided in Section 3.3 and each municipal annex of this Plan.

Table ES-1: Annualized Loss Estimates by Natural Hazard for NVCOG Municipalities (Thousands of Dollars)

Town	Dam Failure	Drought	Earthquake	Flood	Hurricane / Tropical Storm	Landslide	Thunderstorm	Tornado	Wildfire	Winter Storm	Total
Ansonia	$1	<$1	$57	<$1	$409	$8	$3	$187	$3	$30	$699
Beacon Falls	<$1	<$1	$20	<$1	$107	<$1	$1	$61	$16	$13	$220
Bethlehem	<$1	$3	$11	<$1	$50	<$1	$3	$30	$24	$6	$128
Bristol	<$1	$107	$171	$109	$1,103	<$1	$20	$898	$1	$251	$2,661
Cheshire	$1	$1	$104	$7	$640	<$1	$5	$291	$12	$70	$1,131
Derby	$1	<$1	$41	$3	$300	$8	$2	$124	$4	$22	$505
Middlebury	<$1	<$1	$32	$6	$104	<$1	$1	$77	$24	$40	$285
Naugatuck	$1	$1	$76	$2	$470	<$1	$5	$312	$5	$55	$927
Oxford	$1	<$1	$36	$20	$193	<$1	$2	$130	$26	$32	$441
Plymouth	<$1	$10	$31	$9	$170	<$1	$9	$101	$8	$41	$380
Prospect	<$1	<$1	$24	<$1	$142	<$1	$2	$97	$15	$39	$321
Seymour	$1	<$1	$52	$7	$330	$3	$3	$165	$9	$30	$600
Shelton	$5	$22	$135	$40	$885	$5	$25	$6	$6	$13	$1,142
Southbury	$1	<$1	$69	$43	$320	<$1	$3	$196	$20	$64	$717
Thomaston	<$1	$6	$26	$1	$118	<$1	$6	$66	$7	$10	$241
Waterbury	$5	$2	$340	$22	$1,848	$18	$17	$1,079	$3	$135	$3,469
Watertown	<$1	$18	$67	$17	$340	<$1	$17	$188	$6	$26	$680
Wolcott	$1	<$1	$42	$7	$235	<$1	$3	$166	$13	$47	$515
Woodbury	<$1	$8	$32	$3	$133	<$1	$7	$83	$16	$20	$303
NVCOG	**$18**	**$181**	**$1,364**	**$296**	**$7,896**	**$40**	**$133**	**$4,258**	**$218**	**$944**	**$15,348**

Mitigation Goals, Strategies, and Actions

NVCOG and its member municipalities identified a variety of strategies and actions aimed at reducing the risk and/or vulnerability of the region to hazards over the next five years. While the intended strategies and actions for each municipality are included with the municipal annex, Section 5 of the Regional Plan includes summary tables of these municipal actions to help NVCOG potentially assist multiple communities in implementing common strategies and actions. Furthermore, a table of potential strategies and action for NVCOG to perform over the next five years is provided.

Planning Process, Plan Implementation, and Plan Maintenance

The Local Coordinators and NVCOG intend to collaborate over the next five years to annually review the plan, enact strategies and actions, and incorporate the lessons learned during this planning process into other community and regional planning efforts. The availability of a current, FEMA-approved hazard mitigation plan enables NVCOG municipalities to apply for certain types of FEMA grant funding opportunities. NVCOG intends to regionally coordinate the next plan update prior to the expiration of this plan (anticipated to be in 2026) to ensure that the hazard mitigation plan remains up to date and that its member municipalities remain eligible for these grant opportunities.

Table of Contents

List of Figures

List of Tables

List of Fact Sheets

List of Appendices

List of Municipal Annexes

List of Acronyms

ARC	American Red Cross
BCA	Benefit-Cost Analysis
BCR	Benefit-Cost Ratio
BFE	Base Flood Elevation
BRIC	Building Resilient Infrastructure and Communities
CDC	Center for Disease Control and Prevention
CEQ	Council on Environmental Quality
CIRCA	Connecticut Institute for Resilience and Climate Adaptation
CLEAR	Center for Land Use Education and Research
cm	Centimeter
CT NHMP	Connecticut Natural Hazards Mitigation Plan
CRS	Community Rating System
CTSDC	Connecticut State Data Center
CTDOT	Connecticut Department of Transportation
DEEP	Connecticut Department of Energy and Environmental Protection
DEMHS	Division of Emergency Management & Homeland Security
DESPP	Department of Emergency Services and Public Protection
DMA	Disaster Mitigation Act
EF	Enhanced Fujita
EAP	Emergency Action Plan
EOP	Emergency Operations Plan
EWP	Emergency Watershed Protection
F	Fujita
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
GIS	Geographic Information System
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HVA	Housatonic Valley Association
LID	Low Impact Development
m/s	Meters per second
MMI	Milone & MacBroom, Inc.[1]
mph	Miles per hour
NCDC	National Climatic Data Center
NCEI	National Centers for Environmental Information
NFIP	National Flood Insurance Program
NIFC	National Interagency Fire Center
NOAA	National Oceanic & Atmospheric Administration
NPDP	National Performance of Dams Program
NRCC	Northeast Regional Climate Center
NRCS	National Resource Conservation Service
NVCOG	Naugatuck Valley Council of Governments
NWS	National Weather Service
POCD	Plan of Conservation and Development
psf	Pounds per square foot
PURA	Public Utility Regulatory Authority
RLP	Repetitive Loss Property
RSI	Regional Snowfall Index
RWIS	Roadway Weather Information System
SFHA	Special Flood Hazard Area
SHPO	State Historic Preservation Office
SRLP	Severe Repetitive Loss Property
STEAP	Small Town Economic Assistance Program
SVI	Social Vulnerability Index
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WUI	Wildland Urban Interface

[1] Note that Milone & MacBroom, Inc. was acquired by SLR Consulting, and completed its transition to SLR Consulting while completing this project. The consultant is referred to as Milone & MacBroom, Inc. (MMI) within the plan narrative, but as SLR Consulting on the cover and acknowledgements pages, and so on.

1.0 Introduction

The Naugatuck Valley Council of Governments (NVCOG) region is comprised of 19 municipalities in the vicinity of the Naugatuck River Valley in western Connecticut. Each municipality has a previously adopted Hazard Mitigation Plan (HMP or "Plan"). The purpose of the hazard mitigation planning process is to encourage assessment of natural hazard risks at the regional and local levels as well as the completion of mitigation actions that will reduce that risk.

Natural hazard events and disasters can and do inflict damage on the same locations year after year, requiring repeated reconstruction efforts that become more expensive as the years go by. Hazard mitigation breaks this expensive cycle of recurrent damage and escalating reconstruction costs by preventing damage up front and taking a long-term view of rebuilding and recovery following natural disasters. This requires long-term strategies including planning, policymaking, programs, projects, and other activities.

According to the Federal Emergency Management Agency (FEMA) March 2013 *Local Mitigation Planning Handbook*, "a mitigation action is a specific action, project, activity, or process taken to reduce or eliminate long-term risk to people and property from hazards and their impacts. Implementing mitigation actions helps to achieve the Plan's missions and goals. The actions to reduce vulnerability to threats and hazards form the core of the Plan and are a key outcome of the planning process. Types of mitigation actions to reduce long-term vulnerability include local plans and regulations, structure and infrastructure projects, natural systems protection, and education and awareness programs."

1.1 Background, Authority, and Purpose

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. The DMA 2000 requires that local governments have an approved HMP to be eligible to receive Hazard Mitigation Assistance (HMA) project funding. Once approved by FEMA and adopted locally, this multi-jurisdictional plan will fulfill that requirement.

Hazard mitigation planning in the region began in the early 2000s. For 4 communities, this HMP update ("Plan update") will be their first HMP update; for the others, this will be their second HMP update. Table 1-1 presents the years each previous HMP was developed. FEMA requires that local HMPs be updated every five years in order to ensure that the HMP remains current.

Table 1-1:
Hazard Mitigation Plan Approval Dates

Municipality	Initial Plan	1st Update
Ansonia	2012	
Beacon Falls	2009	2015
Bethlehem	2009	2015
Bristol	2011	2016
Cheshire	2008	2014
Derby	2012	
Middlebury	2009	2014
Naugatuck	2009	2015
Oxford	2006	2014
Plymouth	2011	2016
Prospect	2008	2015
Seymour	2012	
Shelton	2012	
Southbury	2009	2014
Thomaston	2009	2015
Waterbury	2007	2014
Watertown	2006	2014
Wolcott	2008	2014
Woodbury	2006	2014

Funding for this Plan Update was provided by FEMA (as administered by the Connecticut Division of Emergency Management & Homeland Security (DEMHS)) under DEMHS Grant Number PDMC-PL-01-CT-2018-003 with the required grant match from NVCOG via its 19 municipalities.

The purpose of this HMP is to identify natural hazards likely to affect the NVCOG region, assess the region's vulnerabilities to these hazards, review existing mitigation strategies and capabilities, and set forth new 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 emergency management plans already adopted in the region, this HMP focuses on reducing or eliminating the impacts of natural hazards.

This HMP evaluates the risk of the region for damage due to flooding, winter storms, tropical cyclones, tornadoes, thunderstorms, wildfires, drought, earthquakes, and dam failure. Furthermore, localized hazards are evaluated within the annexes for Cheshire (sinkholes) and Waterbury (landslides). This does not preclude the possibility that other natural hazards will affect the region. However, in general any other potential natural hazards are of overall low or negligible risk that they need not be considered in detail for the NVCOG region.

The NVCOG 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. Mitigation strategies will be enacted as staff time, budgets, property availability, property owner permission, and the availability of grant funding allow.

1.2 Hazard Mitigation Vision, Goals, Objectives, and Strategies

Each of the 19 NVCOG municipalities had similar goals in their previous HMPs. In general, each municipal goal was to reduce the loss of life and property, and the economic and cultural consequences as a result of natural disasters. Several communities had additional goals which were generally consistent with the above but directed towards one or more specific hazard such as flooding or drought.

When the NVCOG regional planning area was formed in 2014, its member municipalities were either part of a multi-jurisdictional HMP or had single-jurisdiction plans prepared. In preparing this HMP Update, one of NVCOG's objectives is to standardize the hazard mitigation planning process and plan maintenance schedule for each of its 19 member municipalities.

NVCOG's goal for this planning process is presented below. Consistent with this goal, each municipality developed objectives that could be met through the implementation of various strategies and actions. These objectives, strategies, and actions are presented in each municipal annex.

> NVCOG's goal for this HMP is to reduce loss of life, damage to property and infrastructure, costs to residents and businesses, and municipal service costs due to the effects of natural hazards and disasters. Education of residents and policymakers and the connection of hazard mitigation planning to other community planning efforts are key to achieving this goal, as is the enhancement and preservation of natural resource systems in each member community.

1.3 Document Overview

This plan update builds on the existing 2012 *Valley Council of Governments Multi-Jurisdictional Hazard Mitigation Plan*, the *Hazard Mitigation Plan for the Former Central Connecticut Region 2016-2021 Update, as* well as single jurisdiction plans prepared for the remaining 13 NVCOG municipalities.

This introductory section contains a brief overview of the plan's purpose and discusses the planning process used to develop the HMP. Section 2 introduces the region and its current conditions and emergency response capabilities. Section 3 profiles and evaluates the natural hazards that affect the NVCOG region. Section 4 discusses federal, state, regional, and municipal capabilities related to hazard mitigation. Section 5 presents the types of potential mitigation strategies, challenges for implementation, and presents the ranking methodology used to prioritize strategies and actions for implementation. Regional mitigation strategies that are for NVCOG's consideration over the next five years are also presented in Section 5. Section 6 presents the plan implementation process necessary to keep the HMP current. Section 7 presents a variety of technical and financial resources to assist with implementation as well as documenting the references used in preparation of this HMP. Finally, the appendices provide further details on the planning process, critical facilities, historic and cultural

resources, loss estimates, and the records of local adoption.

Annexes were developed for each of the 19 NVCOG municipalities. The annexes present detailed information for each member municipality including capabilities, vulnerabilities, progress on previous mitigation actions, and new objectives, strategies, and actions to be undertaken over the next five years.

1.4 Updates from Previous Plans

As noted above, the previous HMPs developed for the NVCOG municipalities were comprised of various single-jurisdictional HMPs and multi-jurisdictional HMPs. In order to develop one HMP for the entire NVCOG region, the information in the previous HMPs were necessarily consolidated into one document. Including detailed text for all 19 communities within the main body of this HMP document would make the document difficult to use. Therefore, specific details pertinent to each individual municipality are included within a dedicated annex at the end of this document.

While much of the background data for the region is relatively unchanged since development of the previous HMPs for each municipality, this Plan update provides more recent information regarding the extent of hazards, the impacts of hazards, and an updated historical record. All of the hazards evaluated in detail in the initial plans are updated herein. These hazards are all addressed in the 2019 *Connecticut Natural Hazards Mitigation Plan Update* (CT NHMP) with the exception of the localized hazards noted above. Each of these hazards is evaluated for location, extent, and impact including likelihood of occurrence and potential for loss of life and property.

Municipalities in the region continue to possess and maintain a variety of formal and informal hazard mitigation strategies, often known as capabilities. The Plan update identifies and assesses these existing capabilities and proposes new strategies that address identified gaps in current mitigation efforts. Each community also updated its list of mitigation strategies and actions that each community will attempt to achieve over the next five years. The Plan update prioritizes these mitigation strategies for each community and proposes an overall implementation strategy. At a minimum, each community must participate in an annual plan maintenance process (Section 6.3) to review the stated goal, community objectives, and strategies and actions.

1.5 Planning Process for Plan Update

NVCOG determined that the planning area for this multi-jurisdictional HMP would be the 19 municipalities that comprise the NVCOG region. After securing grant funding via application to Connecticut DEMHS, NVCOG identified Local Coordinators for each municipality to assist in coordinating the planning process for each municipality. Table 1-2 presents the local coordinators.

Table 1-2: Municipal Local Coordinators

Municipality	Local Coordinator(s)	Title
Ansonia	Jared Heon	Emer. Mgmt. Dir.
Beacon Falls	Kerry McAndrew	1st Selectman's Office
Bethlehem	Leonard Assard	First Selectman
Bristol	Ray Rogozinski	Public Works Director
Cheshire	Suzanne Simone	Environ. Planner
Derby	Mark Neuendorf	Emer. Mgmt. Dir.
Middlebury	Ed St. John	First Selectman
Naugatuck	Jim Stewart	Dir. of Public Works
Oxford	Scott Pelletier	Emer. Mgmt. Dir.
Plymouth	Charles Wiegert	Public Works Director
Prospect	Robert Chatfield	Mayor
Seymour	Thomas Eighmie	Emer. Mgmt. Dir.
Shelton	Michael Maglione	Dir. of Public Safety
Southbury	Steve Schnell	Emer. Mgmt. Dir.
Thomaston	Glenn Clark	Supt. of Highways
Waterbury	David Simpson	Dir. of Public Works
Watertown	Mark Massoud	Admin. of Land Use
Wolcott	Mark Gerrigus	Inland Wetland Chair
Woodbury	David Lampart	Emer. Mgmt. Dir.

The local coordinators serve as municipal liaisons to ensure municipal needs and objectives continue to be identified throughout the 5-year timeframe of the HMP. Local coordinators provided key input for plan development via local planning meetings, workshops, local public meetings, and throughout the process in general. In addition to the local coordinators, other municipal staff played a vital role in the development of this HMP. Such individuals were invited to participate in meetings and workshops throughout the planning

process to provide input on municipal capabilities and vulnerabilities.

1.5.1 Local Planning Meetings

To begin the plan update process for each municipality, a local planning meeting was held to discuss several topics with both the local coordinator and other invited staff. Due to the COVID-19 pandemic, meetings were held remotely using a virtual platform.

Milone & MacBroom, Inc. (MMI) gave a brief presentation on the importance and need for hazard mitigation planning, changes to the HMA grant programs, types of hazard mitigation strategies and actions, and recent mitigation successes in the region. Next, MMI lead a discussion geared toward collecting pertinent information regarding past natural hazards and their impacts, changes in emergency response capabilities and critical facilities, progress on previous hazard mitigation plan actions, and potential strategies the municipality would like to pursue by way of mitigation.

Table 1-3 identifies the dates for each of the local planning meetings conducted. In total, eighteen of the nineteen municipalities participated in the virtual local planning meetings led by MMI One municipality, the town of Seymour, chose to provide comments and feedback directly to MMI, addressing similar information requested at the virtual meetings.

Table 1-3: Local Planning Meeting Dates

Municipality	Date or Information
Ansonia	October 29, 2020
Beacon Falls	September 22, 2020
Bethlehem	October 13, 2020
Bristol	October 16, 2020
Cheshire	October 19, 2020
Derby	September 24, 2020
Middlebury	December 9, 2020
Naugatuck	November 10, 2020
Oxford	September 23, 2020
Plymouth	January 20, 2021
Prospect	December 2, 2020
Seymour	Provided comments and feedback via email
Shelton	November 5, 2020
Southbury	November 2, 2020
Thomaston	November 16, 2020
Waterbury	October 23, 2020
Watertown	October 2, 2020
Wolcott	November 11, 2020
Woodbury	September 28, 2020

The presentation used during these meetings and the meeting minutes can be found in Appendix A.

1.5.2 First Regional Workshop

A regional workshop was held virtually on November 18, 2020 to present preliminary findings to municipalities. Local coordinators and municipal staff were invited to attend and participate in the workshop.

A brief overview of background information was presented to participants, similar to the of the information presented during the local coordination meetings. In addition, MMI presented on various topics including changes in risk and capabilities throughout the region, effects of climate change on natural hazards, and loss estimates based on FEMA Public Assistance, National Centers for Environmental Information (NCEI), and National Flood Insurance Program (NFIP) data.

Three breakout sessions were offered during this workshop to discuss riverine flood and dam failure risks, wind and snow events resulting in power outages, and geologic hazards such as landslides, the Cheshire sinkholes, and earthquakes. Appendix B includes documentation from this workshop including the presentation, list of attendees, and breakout session minutes.

1.5.3 Public Workshops

Regional virtual public workshops were held on November 18, 2020 and February 10, 2021 to encourage public involvement in the hazard mitigation planning process. MMI worked with NVCOG to develop an informational flyer to promote the meetings. A press release was sent to all local news outlets, and social media posts were made by NVCOG and local communities when possible. Announcements were posted in the *Shelton Herald*, the *Town Times*, the *Waterbury Republican*, and local editions of the Patch newspaper (www.patch.com). Each meeting provided an overview of the planning process, updated attendees regarding the various grant

programs and other State initiatives related to hazard mitigation planning in Connecticut, and provided time for open discussion regarding specific mitigation needs.

In addition to the regional workshops, presentations were offered to local planning commissions as part of regularly scheduled meetings to discuss the planning process and issues of potential concern for that community. Six local planning commissions requested presentations. The dates of these local meetings are presented in Table 1-4

Table 1-4: Local Public Meeting Dates

Municipality	Date or Information
Plymouth	December 10, 2020
Naugatuck	February 1, 2021
Thomaston	March 3, 2021
Waterbury	March 10, 2021
Derby	March 16, 2021
Beacon Falls	March 18, 2021

Appendix C contains public meeting materials including meeting notes, presentation, promotional flyers, and the press release. Attendees of the public information meetings were primarily concerned with detention basin maintenance, the availability of grant funding, the availability of regional mapping showing electric utility tree trimming overlaid with power outages, and bolstering resources and infrastructure for shelters.

1.5.4 Second Regional Workshop

A second regional workshop was held virtually on February 3, 2021 to present preliminary hazard mitigation strategies and actions to the local planning teams. Local coordinators and municipal staff were invited to attend and participate in the workshop.

Topics discussed at the meeting included a brief risk assessment update, the public comments received, and hazard mitigation goals, objectives, and strategies. Guest presentations were provided regarding the Sustainable CT program and the Resilient Connecticut project; and statewide mitigation initiatives were discussed. Fact sheets describing the Sustainable CT program and the Resilient Connecticut project can be found after this page. These are two of the primary new hazard mitigation initiatives incorporated by NVCOG for its communities.

Three breakout sessions were offered during this workshop to again discuss potential actions to address riverine flood risks, wind and snow events resulting in power outages, and the Sustainable CT program. Appendix B includes documentation from this workshop including the presentation, list of attendees, and breakout session minutes.

1.5.5 Additional Public Outreach

Additional public outreach efforts in this planning process included an online survey (Section 3.2) and an ArcGIS Story Map. The Story Map provided information about the planning process, specifics regarding various natural hazards in the region that would be included in this HMP and acted as an additional portal for the public survey. The Story Map was hosted on the NVCOG website and also promulgated at the public meeting events above and the regional workshops. Both residents and municipal staff were encouraged to view the map and to share the resource with others. The usage reports for the Story Map identify approximately 60 views.

In addition to the opportunity provided to the general public to participate in the online survey for this planning process, communities adjacent to the NVCOG region were invited to provide comment on this process by letter dated November 30, 2020. This letter was addressed to adjacent regional councils of government in Connecticut. A copy of this letter is provided in Appendix C.

1.5.6 Review of Draft Plan

The initial draft HMP and municipal annexes were made available to local coordinators for review and comment in June 2021. Comments were provided in July 2021, and addressed for the final draft HMP.

The final draft HMP including all municipal annexes was made available for public review and comment on August 5, 2021. The HMP was publicly posted on the NVCOG website. Member municipalities were requested to provide a link to the NVCOG site from their home page to encourage public review. Reviewers were requested to

OUTREACH EFFORTS

INTERACTIVE STORY MAP

Clips from the Story Map

FOR MORE INFORMATION

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WHAT WAS ACCOMPLISHED?

NVCOG created an online, interactive website for members of the public to learn about hazard mitigation planning and provide feedback about hazard concerns and possible mitigation actions. The website was created using the ESRI "Story Map" platform and includes interactive maps of the region.

The website includes information on the hazard mitigation planning process, all of the natural hazards covered in the plan update, strategies for mitigating hazards, and hazard mitigation resources. It also includes a public survey.

The Story Map will remain "live" after the planning process ends, continuing to serve as an engagement tool for regional residents, workers, and decision-makers.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Public engagement is essential to effective, long-term hazard mitigation. Tools like the Story Map can be used to educate the public about hazard risks, learn from the public about local hazard concerns and mitigation preferences, secure buy-in for mitigation projects, and develop a community that actively participates in decision-making.

Successful engagement often requires utilizing a variety of different approaches in order to reach the many different members of a community. Story Maps are available as another tool to complement traditional approaches like public meetings and online surveys. Story Maps allow for sharing spatial information that may be hard to convey otherwise.

Visit the Story Map at https://arcg.is/1LOKrz.

submit comments through a dedicated link on the NVCOG website.

Following incorporation of public comments, the HMP was submitted to Connecticut DEMHS for review and comment. Following review by Connecticut DEMHS, that agency submitted the HMP to FEMA for review and comment. Once the document is approved by FEMA pending adoption, NVCOG coordinates adoption by local governing bodies (Section 6.1). Copies of local adoption resolutions are included in Appendix E. As required by FEMA, Plan submission and approval dates are included on the cover of this HMP.

2.0 Regional Profile

The NVCOG region is comprised of 19 municipalities which extend along the Naugatuck River Valley and the Housatonic River Valley as shown on Figure 2-1. This region is a compilation of the former Valley Council of Governments, Central Connecticut Regional Planning Area, and Council of Governments of the Central Naugatuck Valley planning regions. The NVCOG member municipalities include:

City of Ansonia
Town of Beacon Falls
Town of Bethlehem
City of Bristol
Town of Cheshire
City of Derby
Town of Middlebury
Borough of Naugatuck
Town of Oxford
Town of Plymouth
Town of Prospect
Town of Seymour
City of Shelton
Town of Southbury
Town of Thomaston
City of Waterbury
Town of Watertown
Town of Wolcott
Town of Woodbury

These 19 municipalities are diverse in many ways, varying between urban, suburban, and rural; hilly and flat; and densely and sparsely populated. They have differing levels of economic activity, educational attainment, and ethnic diversity. They enjoy varying levels of accessibility via highways, rail lines, and bus routes. However, they share many common goals, including a strong commitment to protecting their populations, economic interests, and businesses from the ravages of natural hazards.

The geographic setting has an influence on the frequency and types of natural hazards that can affect the region as discussed in the next section.

2.1 Geographic Setting

2.1.1 Physical Setting

The region is located in the northeastern portion of the Greater New York City metropolitan area and is located along primary transportation corridors linking New York to central Connecticut. It is bounded to the southwest by the Metropolitan Council of Governments, to the west by the Western Connecticut Council of Governments, to the north by the Northwest Hills Council of Governments, to the northeast by the Capitol Region Council of Governments, and to the southeast by the South Central Connecticut Council of Governments communities.

Many municipalities in the region have hilly topography and forested slopes. Other towns are relatively flat, with higher concentrations of prime and statewide-important farmland soils. Topography in the region ranges from nearly sea level along the Housatonic River in Shelton to more than 1,130 feet on Todd Hill in Bethlehem. The change in topography means that the higher elevation communities experience significantly different weather and hazard event impacts during certain storms compared to the lower elevation communities.

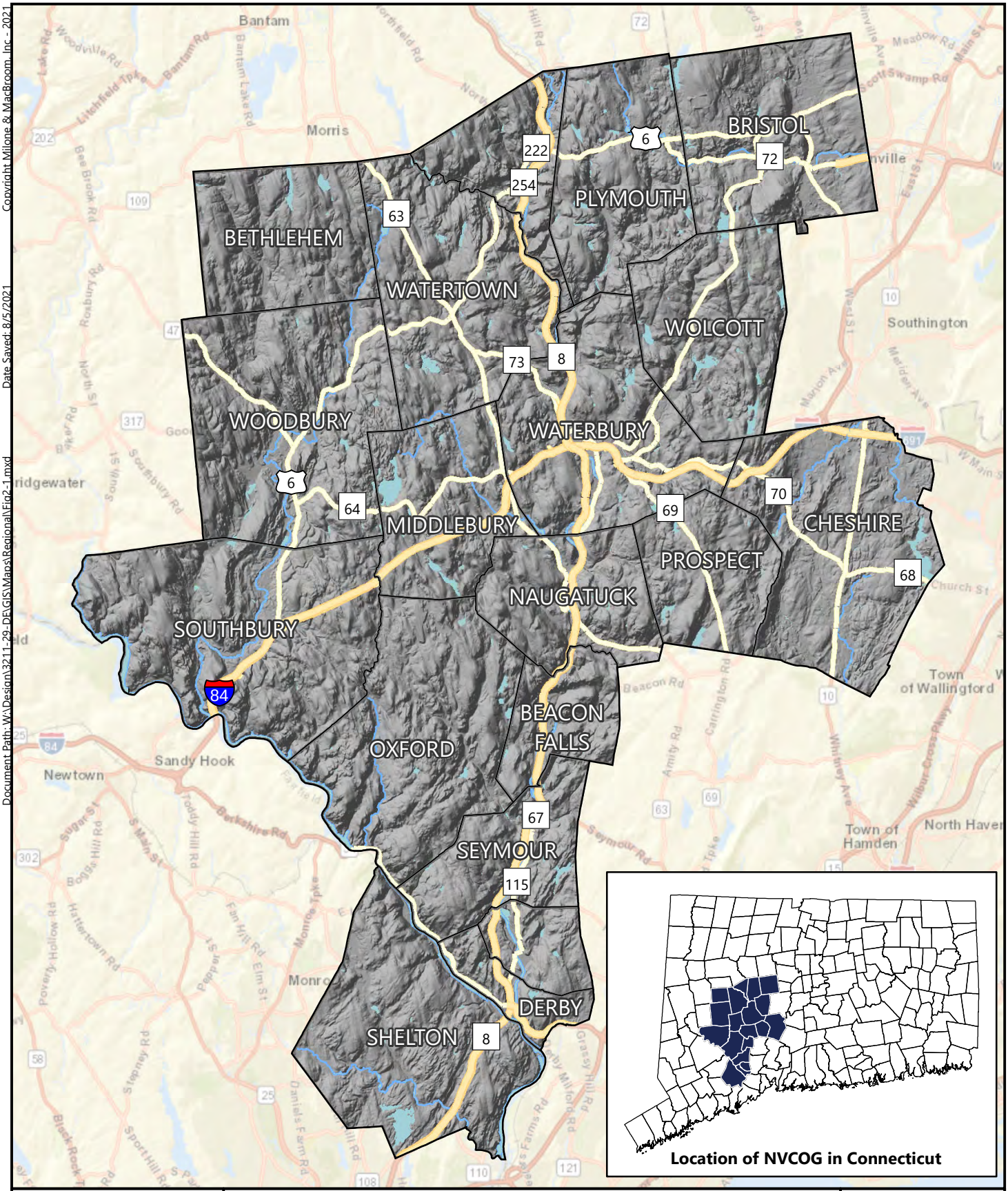
Major transportation routes in the region include Route 6 extending from Southbury to Bristol across the northern part of the region, Route 8 extending from Bridgeport north to Torrington through Waterbury, Interstate 84 extending from Danbury generally northeast to Hartford through Waterbury, and Interstate 691 which connects Interstate 84 in Cheshire with Interstate 91 in Meriden. All municipalities in the region access these major routes through local and state highways.

2.1.2 Geology

Geology is important to the occurrence and relative effects of natural hazards such as floods and earthquakes. Thus, it is important to understand the geologic setting and variation of bedrock and surficial formations in the NVCOG region. Geologic information discussed in the following section was acquired in Geographic Information System (GIS) format from the United States Geological Survey and the Connecticut Department of Energy and Environmental Protection (DEEP).

Bedrock Geology

The NVCOG region is located in the northeastern part of the Appalachian Orogenic Belt or the "Appalachian Highlands", with the easternmost parts of the region associated with the Hartford Basin. Bedrock is characterized by deformed sedimentary rocks cut through by numerous high-angle faults, the most significant being the Western Border Fault in Bristol and the East Derby Fault in Shelton, Derby, and Ansonia. Figure 2-2 presents bedrock geology in the region. In general, these faults are



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LOCATION MAP

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FIG. 2-1

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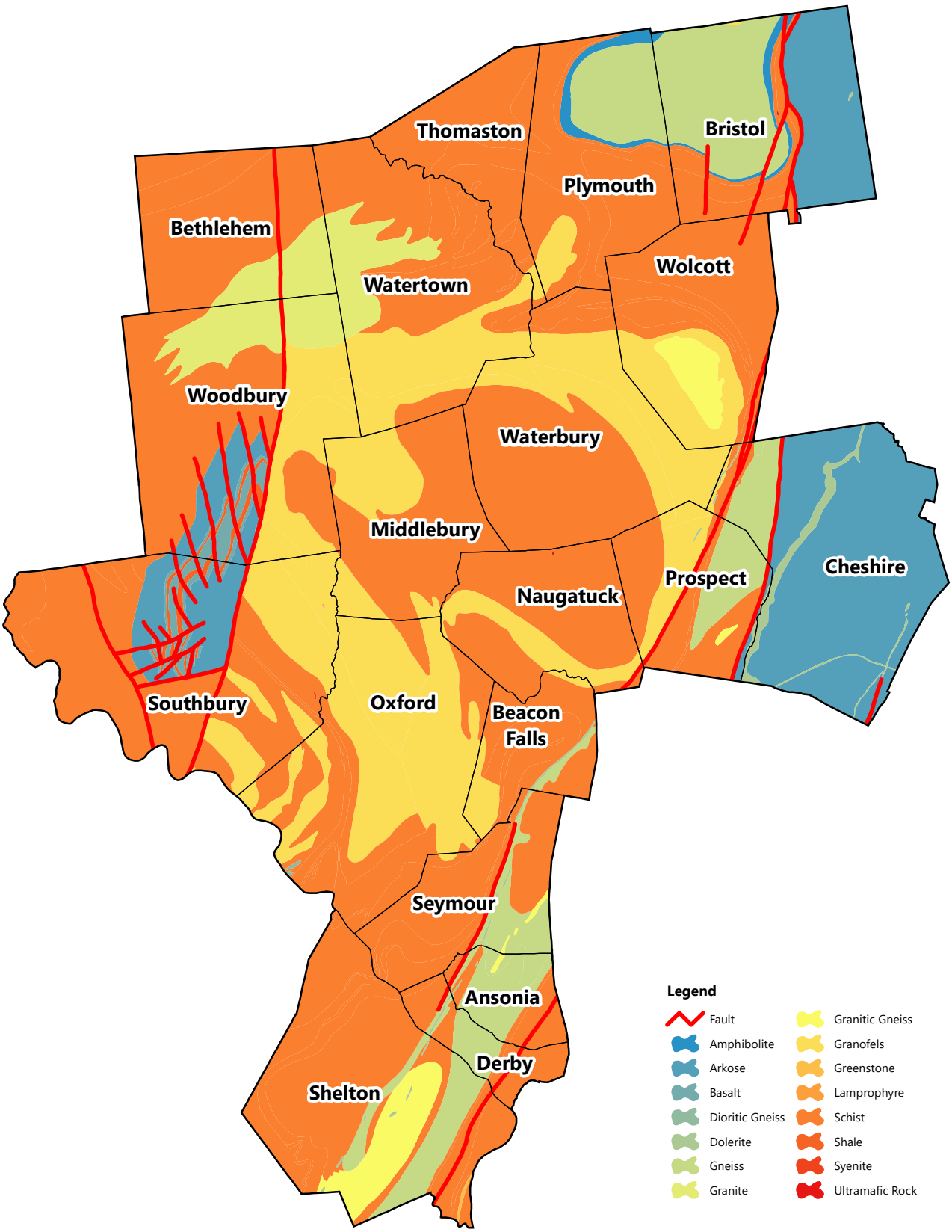

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BEDROCK GEOLOGY

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FIG. 2-2

no longer active and believed to pose little earthquake hazard.

Surficial Geology

Continental ice sheets moved across Connecticut at least twice in the late Pleistocene era. As a result, the NVCOG regional surficial geology is characteristic of the depositional environments that occurred during glacial and postglacial periods.

The NVCOG region is covered primarily by glacial till (Figure 2-3). Glacial till contains an unsorted mixture of clay, silt, sand, gravel, and boulders deposited by glaciers as a ground moraine. The deposits are generally less than 50 feet thick, although deeper glacial meltwater deposits are present in Bristol and Cheshire, and deeper deposits of till are scattered across the region. The stratified glaciofluvial deposits present in the region are generally coincident with stream corridors in each community.

Stratified Glacial Meltwater Deposits

Stratified glacial meltwater deposits are generally coincident with riverine floodplains. These materials were deposited in valleys by glacial streams, and these valleys were later inherited by the larger of our present-day streams and rivers. Large deposits are often associated with public water supply aquifers or wetland areas that provide significant floodplain storage. The smaller glacial till watercourses throughout the region can also cause flooding.

The amount of stratified drift also has bearing on the relative intensity of earthquakes.

Soil Types

The type of soil present affects the ability of precipitation to infiltrate the ground, which in turn affects the timing and magnitude of flooding. According to the United States Department of Agriculture (USDA), soils in the region primarily range from being well-drained to excessively drained, with. poorly drained and very poorly drained wetland soils occupying low lying areas. The ability of soils to encourage infiltration is reduced due to the presence of impervious surfaces that restrict or prevent infiltration.

2.1.3 Climate and Climate Change

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 35^0 to 40^0 in winter to 80^0 to 85^0 in summer. Average annual precipitation is about 46 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.

Climate change is expected to impact 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 rainstorms. 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, including the potential for increased heavy snowfall during the winter months, must be accounted for in regional planning. Sea level rise may also have some impact on communities along the tidal Housatonic and Naugatuck Rivers.

The 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.

According to the Connecticut *State Water Plan* (2018) climate change analysis, climate models project a year-round increase in temperature. Projected temperature

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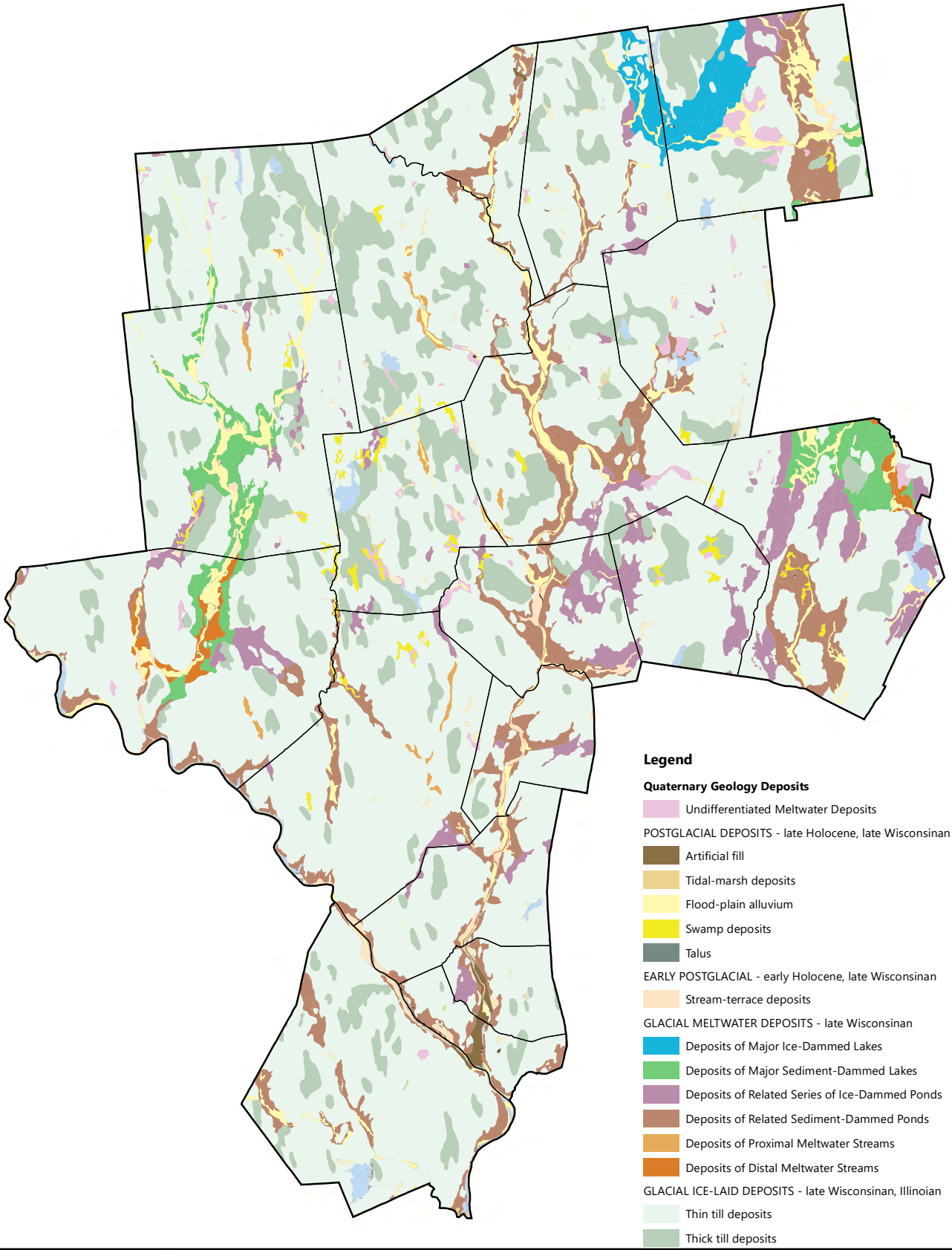

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SURFICIAL GEOLOGY

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FIG. 2-3

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, 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.

As climate continues to change, NVCOG 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 Connecticut Institute for Resilience & Climate Adaptation (CIRCA) has conducted a number of key studies over the last few years related to climate change. 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, by contributing funding to local hazard mitigation planning. Some of CIRCA's research relevant to the NVCOG region is highlighted on Fact Sheets in the appropriate risk sections for flooding and droughts. These pages are designed to be removed as needed by the NVCOG region's community leaders and used to support initiatives related to climate change.

2.1.4 Hydrology

One concern raised by continued development in the region is its impact on natural systems, particularly hydrologic systems. Due to its geographic location and topographic variability, actions taken in the region have the potential to impact areas that are quite distant, and actions in upstream communities have the potential to impact downstream communities.

Several rivers run through the region, including the Housatonic, Little, Mad, Mill, Naugatuck, Nonewaug, Pequabuck, Poland, Pomperaug, Quinnipiac, Ten Mile, and Weekeepeemee. These rivers along with myriad streams and brooks feed into and flow from several lakes, ponds, and reservoirs. Lake Zoar (an impoundment of the Housatonic River) in Oxford and Southbury is the largest lake in the region. Stream corridors are presented in Figure 2-4.

Water from the region drains into four of the state's major watershed basins: Southwest Coast, South Central Coast, Housatonic, and Connecticut. On route to its final destination in Long Island Sound, water may navigate any of 8 regional basins as shown on Figure 2-4.

The concentration of development next to bodies of water introduces increased risk of flooding and erosion. Flooding from rivers already has dramatic impacts on the region's municipalities, rendering roads impassable and flooding homes and businesses. Catastrophic flood events punctuate the region's historical record and have left indelible marks on the natural and built environment. Flooding is discussed in more detail in Section 3.3.1.

2.2 Cultural Setting

Many municipalities in the NVCOG region exhibit a typical development pattern for New England: dense population centers (often more than one per municipality) clustered around rivers or the shoreline, where mills and other businesses were once located. These population centers may have a rich mix of uses, with additional residential development spiraling outward, creating relatively compact villages. While this historic pattern can result in picturesque community centers, it has also in many cases increased the potential for flood damage. Development in recent decades has largely abandoned the traditional

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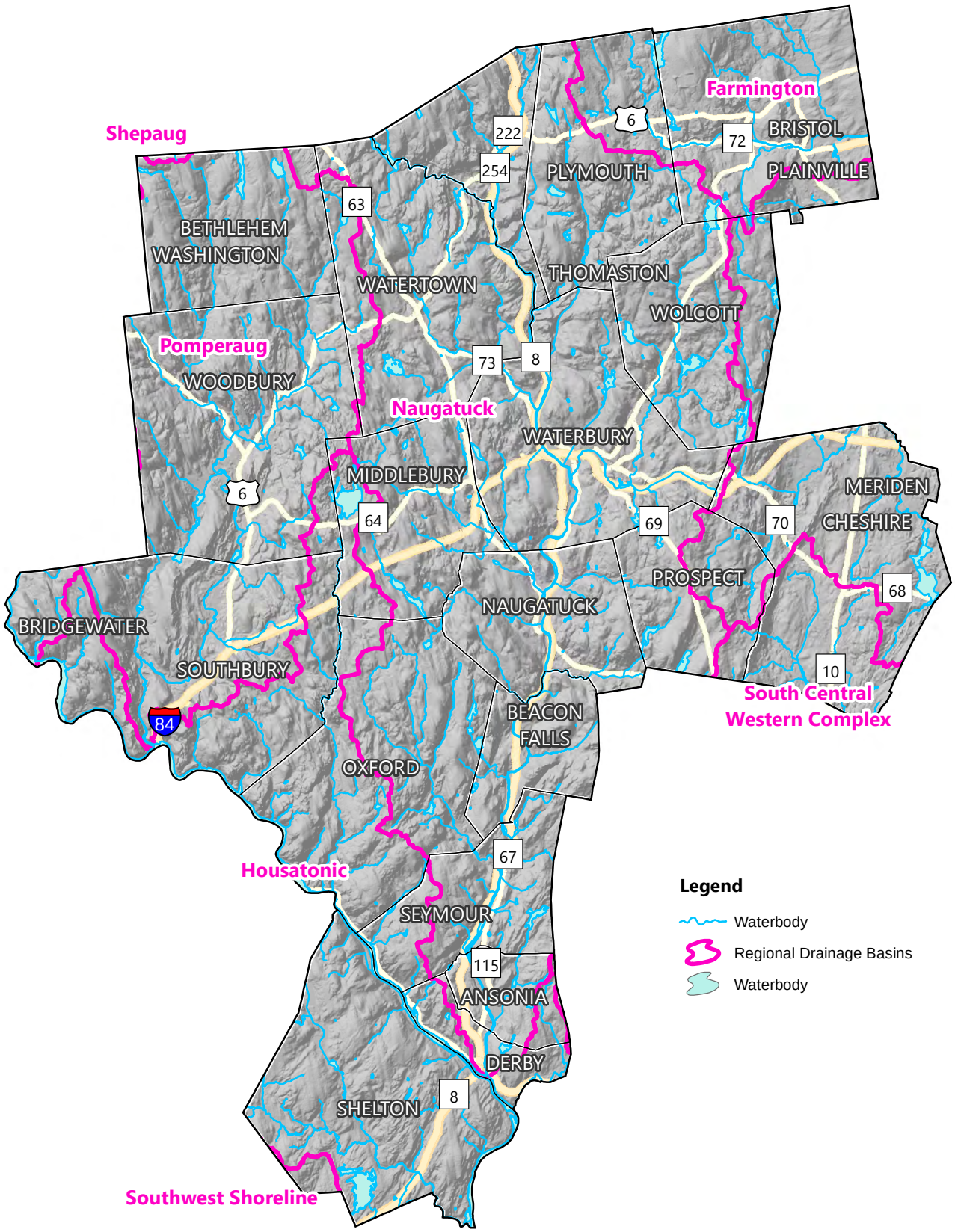

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FIG. 2-4

centralized pattern and followed a more sprawling pattern, with new development radiating out ever further from traditional population centers and filling in the open space and former agricultural fields that once separated village centers.

2.2.1 Demographic Setting and Trends

Population and Aging

The NVCOG region is comprised of a mix of densely populated and rural areas. According to the 2010 U.S. Census, the total population for the NVCOG region was 448,738 or approximately 12.6% of the State's total population. Table 2-1 presents the population and population density for each NVCOG municipality. Figure 2-5 presents population density by Census tract.

Table 2-1: 2010 Census Population and Density

Municipality	Population	Land Area (sq. mi.)	Population Density
Ansonia	19,249	6.0	3,197.5
Beacon Falls	6,049	9.8	617.2
Bethlehem	3,607	19.4	185.9
Bristol	60,477	26.4	2,289.9
Cheshire	29,261	33.1	884.0
Derby	12,902	5.1	2,549.8
Middlebury	7,575	17.8	425.6
Naugatuck	31,862	16.3	1,954.7
Oxford	12,683	32.7	387.9
Plymouth	12,243	21.7	564.2
Prospect	9,405	14.3	657.7
Seymour	16,540	14.6	1,132.9
Shelton	39,559	30.6	1,291.5
Southbury	19,904	39.0	510.4
Thomaston	7,887	12.0	657.3
Waterbury	110,366	28.5	3,869.8
Watertown	22,514	29.0	776.3
Wolcott	16,680	20.4	817.6
Woodbury	9,975	36.4	274.0
NVCOG	**448,738**	**413.1**	**1,086.2**
State of CT	**3,574,097**	**4,842.4**	**738.1**

Source: U.S. Census Bureau

Since 2010, the population of the region has decreased by about 0.8% according to the 2019 American Community Survey 5-Year U.S. Census estimates (Table 2-2). The fastest growth was seen in Shelton (4.0% increase). The slowest growth was in Bethlehem (4.8% decrease in its population).

Table 2-2: Population Growth

Municipality	2010 Population	2019 Estimate	Percent Change
Ansonia	19,249	18,802	-2.3%
Beacon Falls	6,049	6,168	2.0%
Bethlehem	3,607	3,433	-4.8%
Bristol	60,477	60,218	-0.4%
Cheshire	29,261	29,147	-0.4%
Derby	12,902	12,485	-3.2%
Middlebury	7,575	7,739	2.2%
Naugatuck	31,862	31,347	-1.6%
Oxford	12,683	13,086	3.2%
Plymouth	12,243	11,711	-4.3%
Prospect	9,405	9,705	3.2%
Seymour	16,540	16,508	-0.2%
Shelton	39,559	41,141	4.0%
Southbury	19,904	19,681	-1.1%
Thomaston	7,887	7,599	-3.7%
Waterbury	110,366	108,276	-1.9%
Watertown	22,514	21,751	-3.4%
Wolcott	16,680	16,615	-0.4%
Woodbury	9,975	9,562	-4.1%
NVCOG	**448,738**	**444,974**	**-0.8%**
State of CT	**3,574,097**	**3,565,287**	**-0.2%**

Source: U.S. Census Bureau 2019 American Community Survey

According to the Connecticut State Data Center (CTSDC), the population in the NVCOG region is projected to slightly increase by 1.7% over the next 5 years, a rate slightly higher than Connecticut as a whole. While the overall NVCOG region is expected to gain population, projections for individual municipalities vary as shown in Table 2-3. The population of Oxford is projected to grow by 19.9% over this timeframe, while Shelton (-8.8%), Prospect (-7.5%), and Cheshire (-7.1%) are projected to noticeably lose population.

The population of Connecticut has been aging over the past two decades, and projections suggest that this trend will continue. According to the U.S. Census, approximately 17% of the region's total population is 65 years old or older. The CTSDC projects that the population aged 65 and older in the NVCOG region will increase by 7.2% by 2025, faster than the statewide average of 3.3% (Table 2-4). The total population of the NVCOG region in 2025 is projected to be 452,628, of which 83,301 or 18% will be 65 or older. The greatest percentage increases in this age category are projected to occur in Oxford (77.2%) Bethlehem (50.3%), Watertown (23.3%), Seymour (21.9%), and Woodbury (20.8%).

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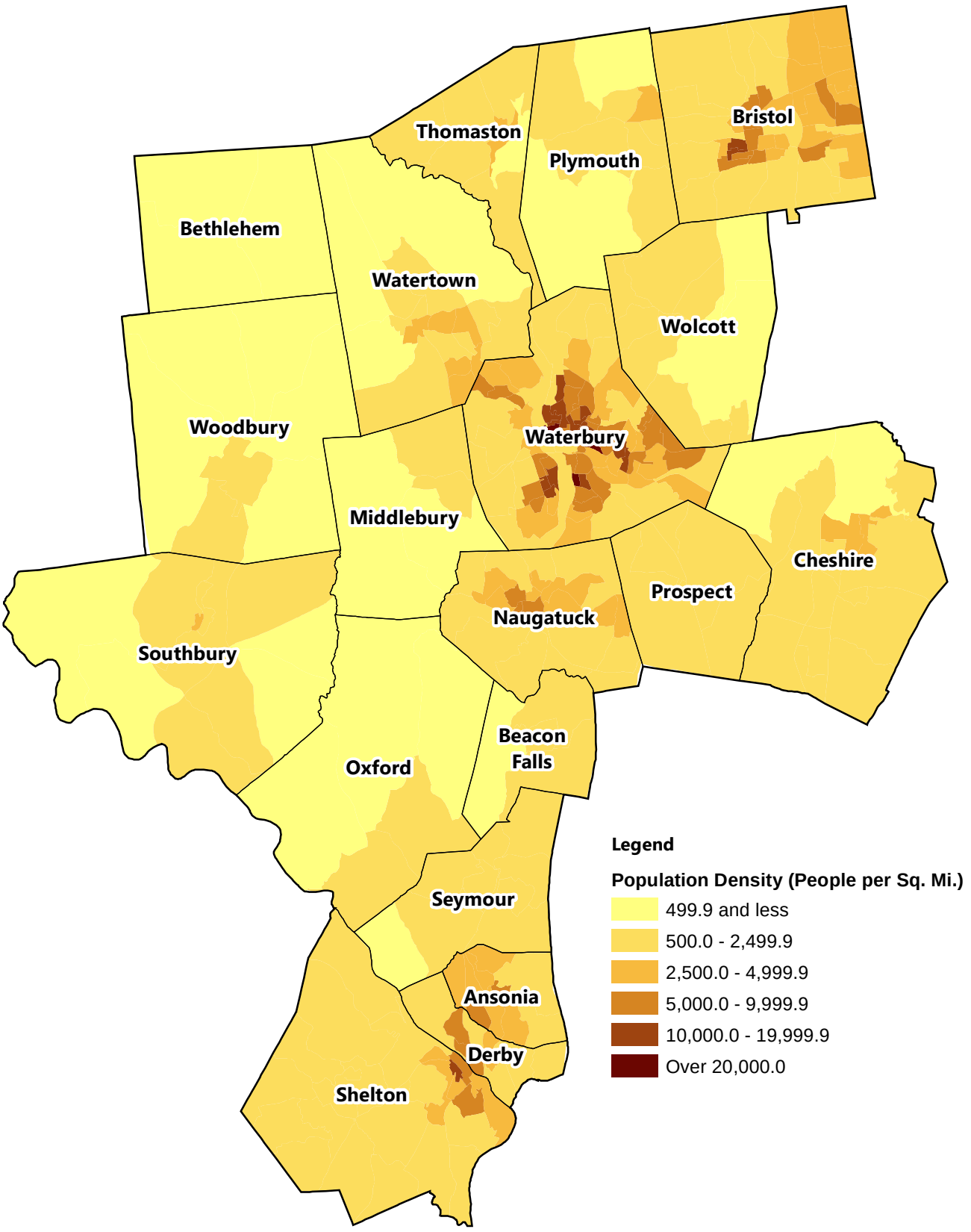

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POPULATION DENSITY BY CENSUS BLOCK GROUP

HAZARD MITIGATION PLAN UPDATE
NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS
49 LEAVENWORTH STREET, 3RD FLOOR
WATERBURY, CT 06702

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PROJ. NO. 3211-29

FIG. 2-5

Table 2-3: Population Projections

Municipality	2019 Estimate	2025 Estimate	Percent Change
Ansonia	18,802	20,265	7.8%
Beacon Falls	6,168	6,532	5.9%
Bethlehem	3,433	3,596	4.7%
Bristol	60,218	59,359	-1.4%
Cheshire	29,147	27,087	-7.1%
Derby	12,485	13,553	8.6%
Middlebury	7,739	8,412	8.7%
Naugatuck	31,347	32,537	3.8%
Oxford	13,086	15,695	19.9%
Plymouth	11,711	12,156	3.8%
Prospect	9,705	8,979	-7.5%
Seymour	16,508	16,880	2.3%
Shelton	41,141	37,508	-8.8%
Southbury	19,681	19,164	-2.6%
Thomaston	7,599	7,781	2.4%
Waterbury	108,276	114,896	6.1%
Watertown	21,751	21,640	-0.5%
Wolcott	16,615	16,885	1.6%
Woodbury	9,562	9,703	1.5%
NVCOG	**444,974**	**452,628**	**1.7%**
State of CT	**3,565,287**	**3,618,755**	**1.5%**

Source: U.S. Census Bureau (2019) and Connecticut State Data Center (2025)

This demographic shift presents potential difficulties in mitigating and responding to hazardous conditions. Older populations may be less mobile, more dependent on neighbors and family, and less able to evacuate or survive in isolation. They may also be unable to endure extended periods without heat or electricity. Facilities caring for the older populations need to be equipped with supplies that can allow residents to shelter in place. Municipalities must consider added need for medical sheltering. Therefore, resilience plans for an aging population must address protection of critical facilities and vulnerable populations to ensure that all residents are able to weather natural hazard events. However, the projected reduction in population (and by extension, potential municipal revenue) for certain municipalities may reduce community capabilities to assist these populations.

Table 2-4: Current and Projected Population Aged 65 and Above

Municipality	2019 Estimate	2025 Estimate	Percent Change
Ansonia	3,053	2,912	-4.6%
Beacon Falls	1,300	1,335	2.7%
Bethlehem	618	929	50.3%
Bristol	9,961	10,219	2.6%
Cheshire	5,412	5,333	-1.5%
Derby	2,118	2,264	6.9%
Middlebury	1,703	1,576	-7.5%
Naugatuck	4,600	4,979	8.2%
Oxford	2,569	4,551	77.2%
Plymouth	2,125	2,248	5.8%
Prospect	1,914	1,884	-1.6%
Seymour	2,527	3,080	21.9%
Shelton	8,689	8,389	-3.5%
Southbury	5,864	6,640	13.2%
Thomaston	1,312	1,460	11.3%
Waterbury	14,426	14,274	-1.1%
Watertown	4,159	5,129	23.3%
Wolcott	3,144	3,435	9.3%
Woodbury	2,206	2,664	20.8%
NVCOG	**77,700**	**83,301**	**7.2%**
State of CT	**601,053**	**620,868**	**3.3%**

Source: U.S. Census Bureau, Connecticut State Data Center

Vulnerable Populations

Vulnerable populations may include not only senior citizens and persons who are less mobile, but also low-income and minority populations, some of whom may have difficulty evacuating or protecting their homes or may miss critical information due to limited ability to speak and understand English. According to the 2010 U.S. Census, more than 5% of the population in two of the region's municipalities do not speak English "very well" (Table 2-5). Public education efforts must consider each municipality's particular language groups and make sure that information is made available to them, so that mitigation planning efforts do not systematically discriminate against non-English speaking communities.

Table 2-5: Percentage of English Speakers

Municipality	Households Where at Least One Member 14 or Older Speaks English "Very Well"	Households where Everyone Speaks English Less Than "Very Well"
Ansonia	96.4%	3.6%
Beacon Falls	98.6%	1.4%
Bethlehem	100.0%	0.0%
Bristol	96.0%	4.0%
Cheshire	98.7%	1.3%
Derby	93.5%	6.5%

Municipality	Households Where at Least One Member 14 or Older Speaks English "Very Well"	Households where Everyone Speaks English Less Than "Very Well"
Middlebury	98.3%	1.7%
Naugatuck	95.9%	4.1%
Oxford	98.4%	1.6%
Plymouth	99.2%	0.8%
Prospect	97.8%	2.2%
Seymour	99.3%	0.7%
Shelton	97.2%	2.8%
Southbury	99.6%	0.4%
Thomaston	100.0%	0.0%
Waterbury	91.0%	9.0%
Watertown	97.5%	2.5%
Wolcott	99.4%	0.6%
Woodbury	99.3%	0.7%

Source: U.S. Census Bureau

Low-income households and individuals may be at greater risk to natural hazards than more affluent neighbors. These populations are more likely to rely on public transit for transportation (which can be problematic when a disaster hits), have fewer resources to devote to disaster preparation, and have fewer resources to draw on to aid in recovery. According to the 2019 5-Year American Community Survey, the per capita income for the United States was $34,103. In Connecticut it was $44,496 (Table 2-6), but several communities in the NVCOG region have per capita incomes below the state average. The percentage of people below the poverty level is generally lower than the state average for most NVCOG municipalities, with only Ansonia, Derby, and Waterbury being significantly above the state average of 10%.

Table 2-6: Income Statistics

Municipality	Median Household Income	Per Capita Income	Percent of People Below Poverty Level
Ansonia	$54,901	$30,160	13.7%
Beacon Falls	$85,024	$42,296	6.9%
Bethlehem	$98,409	$45,399	4.6%
Bristol	$67,507	$36,351	10.1%
Cheshire	$120,546	$52,013	2.0%
Derby	$56,357	$31,936	13.0%
Middlebury	$121,122	$54,148	4.0%
Naugatuck	$74,944	$36,465	7.9%
Oxford	$110,111	$47,773	2.5%
Plymouth	$82,063	$41,194	4.9%
Prospect	$101,134	$41,895	1.0%
Seymour	$76,195	$37,429	5.2%
Shelton	$97,131	$49,200	5.1%
Southbury	$98,790	$51,446	4.6%
Thomaston	$68,539	$36,950	6.7%
Waterbury	$42,401	$23,128	23.4%
Watertown	$79,576	$41,419	5.4%
Wolcott	$95,257	$39,732	3.9%
Woodbury	$81,362	$52,930	5.5%
State of CT	**$78,444**	**$44,496**	**9.9%**

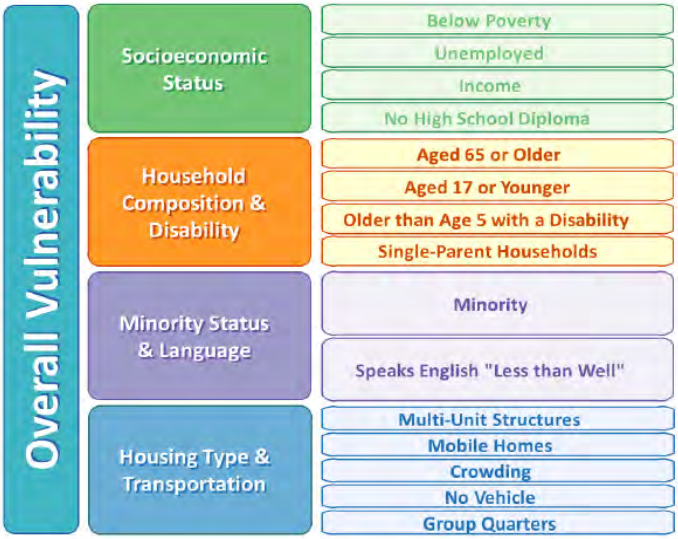
Source: U.S. Census Bureau

Social Vulnerability Index

The demographics of each NVCOG municipality varies and therefore impacts to these populations will also vary. To better understand the potential impacts and societal vulnerability of the NVCOG region, the Center the Center for Disease Control and Prevention (CDC) Social Vulnerability Index (SVI) was used to identify areas with vulnerable populations. This index was developed to supplement a community's natural hazard preparation actions. In order to evaluate social vulnerability, the CDC incorporates 15 factors (Figure 2-6) into the overall calculation under the categories of: socioeconomic status, household composition and disability, minority status and language, and housing type and transportation. These categories and their ranking are based on census statistics. By evaluating these factors and determining a level of social vulnerability, a community can identify specific needs for before, during, and after an event. Such needs may include sheltering capacity, evacuation routes, or to decide how many emergency personnel may be required to respond after an event.

Each census tract in the NVCOG region was ranked for overall vulnerability, and category vulnerability, in comparison to other census tracts in Connecticut. This rank, 0 to 1, is based on the percentile rank among all tracts within the State of Connecticut. A value closer to 0 indicates a lower vulnerability, while a value closer to 1 indicates a higher vulnerability in comparison to the statewide assessment. Table 2-7 summarizes the overall vulnerability for each NVCOG municipality as well as by category. Figure 2-7 presents this information graphically by census tract.

Figure 2-6: CDC Social Vulnerability Index Factors



Source: CDC

Table 2-7: Social Vulnerability Index

Municipality	Overall	SE	HC&D	M&L	H&T
Ansonia	0.69	0.76	0.75	0.59	0.52
Beacon Falls	0.37	0.46	0.46	0.20	0.39
Bethlehem	0.12	0.25	0.40	0.02	0.13
Bristol	0.59	0.62	0.62	0.52	0.48
Cheshire	0.21	0.18	0.26	0.38	0.31
Derby	0.76	0.76	0.68	0.69	0.69
Middlebury	0.26	0.30	0.27	0.34	0.27
Naugatuck	0.64	0.61	0.65	0.55	0.57
Oxford	0.11	0.34	0.40	0.13	0.08
Plymouth	0.34	0.42	0.45	0.21	0.40
Prospect	0.30	0.35	0.33	0.19	0.40
Seymour	0.51	0.50	0.56	0.44	0.50
Shelton	0.44	0.39	0.35	0.47	0.55
Southbury	0.37	0.35	0.58	0.12	0.46
Thomaston	0.44	0.57	0.40	0.07	0.51
Waterbury	0.82	0.85	0.77	0.80	0.65
Watertown	0.32	0.51	0.39	0.30	0.23
Wolcott	0.32	0.41	0.53	0.36	0.16
Woodbury	0.28	0.20	0.48	0.27	0.36

Notes: SE = Socioeconomic, HC&D = Household Composition & Disability, M&L = Minority Status & Language, H&T = Housing Type & Transportation

Source: CDC

Consider the following:

- Communities with a high socioeconomic vulnerability such as Waterbury and Ansonia may find it challenging in assisting lower income residents with recovery efforts, dispersing information, or keeping residents and families housed after a large event.

- Communities with vulnerable populations in relation to composition and disability such as Waterbury and Ansonia may find challenges in evacuating populations, maintaining adequate shelters for those with special needs, and ensuring family support services are available for single-parent households during and in the wake of an event.

- Municipalities with vulnerable populations who identify as a minority and speak English "less than well" such as Waterbury and Derby may face the issue of information distribution or access to resources. Multi-language resources and emergency notifications should be developed to disseminate to those communities.

- In addition, some minority populations may also face other socioeconomic issues which ultimately results in challenges such as access to evacuation transportation, safe sheltering during an event, and the financial means for property recovery and repairs.

- Vulnerabilities associated with housing type and transportation capabilities can present challenges due to high density housing and evacuation efforts or emergency response, lack of transportation for preparation and evacuation, or vulnerability in constructions type such as mobile homes.

It is important for municipalities to identify and locate these populations to ensure they are aware of hazards and are able to access the necessary resources for response and recovery.

The EPA defines Environmental Justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." An Environmental Justice community is one where socioeconomic and geographic stressors intersect to increase environmental risk. Such communities are more likely to be exposed to, and less likely to withstand,

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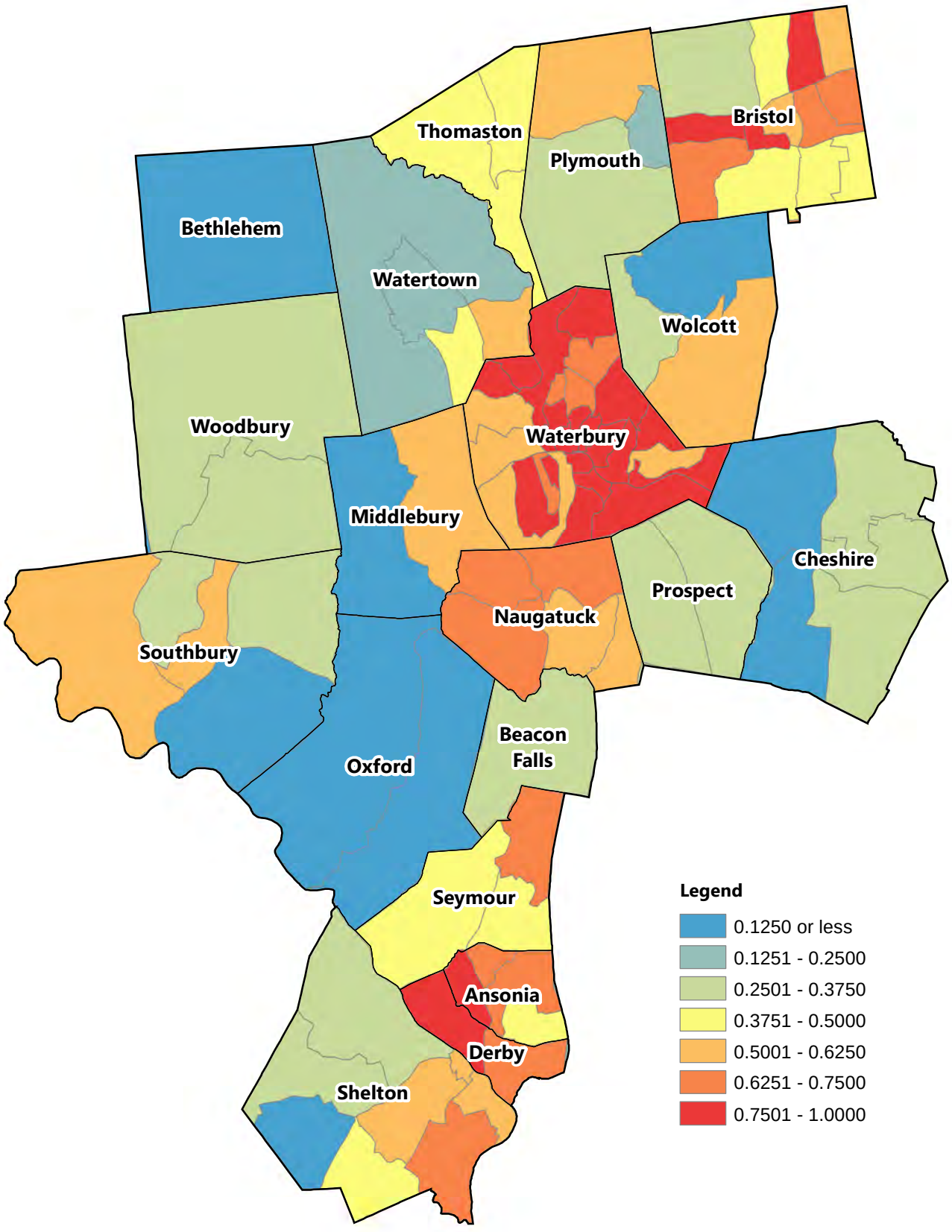

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CDC SOCIAL VULNERABILITY INDEX (SVI)

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FIG. 2-7

adapt to and recover from natural hazards. A Fact Sheet discussing Environmental Justice follows this page.

2.2.2 Economic Profile and Trends

Many NVCOG municipalities have roots dating back to the pre-Revolutionary War era. Agricultural settlements formed near a village or parish center typically located near a major waterway to support a mill. As the industrial revolution took hold, factories were built, watercourses were dammed for water supply, and housing developments were built to support workers. Railroads were eventually built to facilitate transport of goods and materials to and from coastal ports. Industries (such as the brass industry in Waterbury) which employed significant percentages of the region's workforce in the 19th century eventually gave way to the current economic profile of today.

Economic Advantages

The NVCOG region is currently endowed with many economic assets and competitive advantages and is home to the headquarters and branches of many large national enterprises that bring recognition to the region. The primary economic strength of the region is its proximity to the New York and Boston major metropolitan areas with connectivity via major highways. The region's cities are well-positioned to support major employers, while the region's larger corporate office parks provide vital professional and managerial services as well as serving as corporate headquarters for many employers.

According to the *Naugatuck Valley Regional Profile 2020*, the five major industries in the region in terms of percent of estimated employment include health-care and social assistance, manufacturing, and government (including educators). The Connecticut Department of Labor (CTDOL) reports that major employers employing more than 1,000 employees include Bristol Hospital, ESPN, and Lake Compounce in Bristol; Bozzuto's Inc. in Cheshire; Griffin Hospital in Derby; Nicard Enterprises in Plymouth; BIC Corp. and Perkinelmer Inc. in Shelton; Southbury Training School in Southbury; Grandview Adult Behavioral Health, Naugatuck Valley Community College, St. Mary's Hospital, and Waterbury Hospital in Waterbury; and the Siemon Company in Watertown. The greatest concentrations of employment are in Bristol, Cheshire, Shelton, and Waterbury, with new employment opportunities tending to occur in communities outside of the traditional urban core of Bristol, Waterbury and Naugatuck, and Ansonia and Derby, thereby limiting redevelopment of the urban cores. Commerce and industry both provide employment and heavily support local government services which enables municipalities to reduce the burden of property taxes on homeowners. Over the last 10 years the region has gained back 97% of the jobs it lost during the 2007 to 2011 economic downturn, which is slower than the state average of 147%.

According to the 2020 Regional Profile, there are only enough jobs in the region to employ 72% of working residents. The region therefore exports over 63,000 workers each day to other regions such as New Haven, Hartford, Bridgeport, Danbury, and lower Fairfield County. Commuters into the region typically transit to Bristol, Cheshire, and Shelton for work. Based on the general success that many industries have had with employees working from home during the COVID-19 pandemic in 2020, it is unclear at this point what percentage of workers will continue to commute and what percentage will work primarily from home in the future.

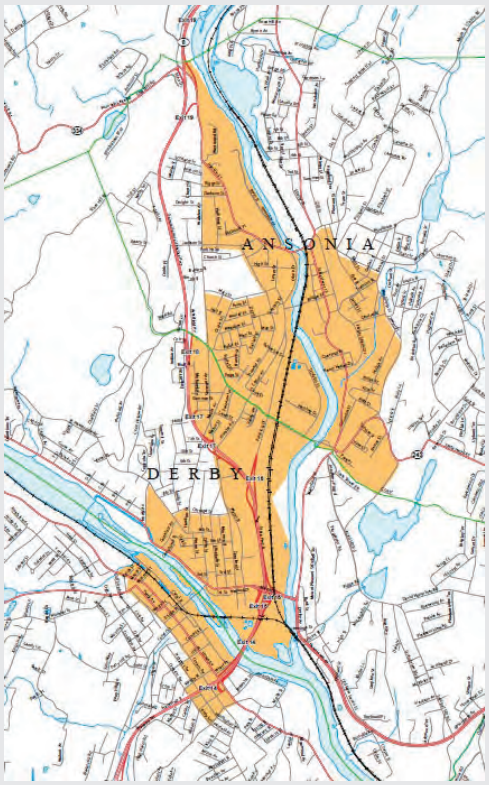
Economic Challenges

Regional challenges related to employment include highway congestion along Route 8 and Interstate 84, and the occurrence of jobs either distant from, or requiring more skills than the unemployed population presently has acquired.

According to the 2020 Regional Profile, unemployment in the region was 4.2% in 2019. A major factor in continued unemployment in the region was related to the 2007 to 2011 economic downtown where the fact that older workers did not retire, combined with slow job growth, led to high unemployment among young people. According to the CTDOL, NVCOG municipalities are part of the Hartford-West-Hartford-East-Hartford, Waterbury, New Haven, or Bridgeport-Stamford-Norwalk labor markets. According to the CTDOL, the unemployment rate in these markets ranged from 4.4% and 5.5%, in January 2020 prior to the COVID-19 pandemic and increased to a range of 7.4 to 9.1% in December 2020, with peak unemployment of 10.1 to 12.0 % in July 2020. In general, unemployment in Connecticut tends to be equal or less than the nationwide unemployment rate, with the regional unemployment rate being above the state average.

REGIONAL CHALLENGES

ENVIRONMENTAL JUSTICE AND HAZARD MITIGATION



Low-Income areas: Shelton, Derby, Ansonia
Extracted from a 2009 map by CT DEEP

FOR MORE INFORMATION

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CT DEEP Environmental Justice Program
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WHAT IS THE CHALLENGE?

The EPA defines Environmental Justice (EJ) as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."

An EJ community (EJC) is one where socioeconomic and geographic stressors intersect to increase environmental risk. Minority, low-income, non-English-speaking, or immigrant status may contribute to an EJC designation. EJCs are more likely to be exposed to, and less likely to withstand, adapt to, and recover from natural hazards.

Hazard mitigation efforts often overlook, or even harm, EJCs. EJCs may be displaced, or their risk increased, in order to decrease risk elsewhere. Protection may disproportionately help higher-income areas. Adaptation may be framed as a private responsibility rather than a public good, leaving it in the hands (and wallets) of individual residents, and therefore less accessible to lower-income people.

Mitigation actions that do protect EJCs can drive up property values because of the very protection they provide, leaving low-income residents with no choice but to relocate.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

NVCOG municipalities should strive to protect EJCs from hazards without causing undue burden or displacement:

Strengthen Communities: building social equity and community resilience before a hazard event will help communities be resilient to that event.

Reframe Goals: Hazard mitigation aims to protect people and communities; completion of a mitigation project should never cause harm to the community.

Increase Social Service Resilience: like wellness checks, public transit, and healthcare, food, and affordable housing. Support community-based organizations, often the first lines of defense against disasters.

Increase Participation & Awareness: Solicit participation from EJ communities in hazard planning. Including more voices helps address the needs of all populations and raising awareness and appreciation of risks enables people to protect themselves.

Support the Local Economy. A mitigation project is an opportunity to bring state and federal funding into the local economy. Hire local contractors that pay a living wage. Train residents to perform the work, giving them marketable skills.

Focus on Large Scale Projects: Large-scale mitigation infrastructure is less likely to increase property values than a property-specific retrofit project.

Distribute Resources: Incorporate equity into plans and funding mechanisms. Make funding and permitting more accessible. Revisit cost-benefit analyses; conventional methods undervalue low-income areas, discouraging investment.

Highways and electric power, the life blood of modern production, can be shut down from an extreme weather event thereby halting economic activity. If a business is forced to close because of weather, physical damages, or other emergency event, the forfeited production and forgone wages often represent a permanent economic loss. Anecdotal evidence from local chambers of commerce and business leaders indicates that for a small or medium sized business even a couple days of lost production can be enough to lead to closure. The proportion of local enterprises and jobs that are located in flood zones represent an easily identifiable economic risk.

While the region is well connected with a variety of transportation routes traversing its 19 municipalities, it is essential that these routes remain passable during and following a disaster to allow residents to access shelters and also provide efficient and timely recovery of the region's businesses. Evacuation assistance for critical and special needs populations in the 19 municipalities is handled differently each community.

The *2021 Comprehensive Economic Development Strategy - Naugatuck Valley Corridor* seeks to remedy employment challenges in the region. The seven major goals for the strategy include: utilize and identify industry clusters and private investment opportunities to provide opportunities for job growth, advancement, and training; develop local infrastructure that supports economic expansion while maintaining and protecting the environment; assist the Regional Brownfields Partnership to reclaim industrial legacy sites and support the management, capacity, and financial resources for municipal members; improve overall transportation and communications systems; sustain economic expansion while reinforcing and complimenting regional land use and quality of life; encourage growth and participation in philanthropy efforts in the Naugatuck Valley; and supporting the designation of the Naugatuck Valley Corridor as a National Heritage Area under the National Park Service. Priority projects associated with the strategy invest in the region's economic future with selections made based on the ability to create and retain jobs, protect the environment, and have a positive regional economic impact.

2.2.3 Development Trends

The NVCOG region hosts significant commercial, industrial, and public properties including regional employment centers, airports., commercial and industrial parks and areas, and major retail developments. According to 2019 equalized net grand list data, the region contains $32.7 billion in taxable real, personal, and motor vehicle property (see Table 2-8 below).

Table 2-8: 2019 Grand List Data by Municipality

Municipality	Total Equalized Net Grand List	Residential	Non-Residential	Personal Property	Other
Ansonia	$998 M	72.6%	11.0%	16.4%	0.0%
Beacon Falls	$489 M	73.0%	9.2%	15.7%	2.1%
Bethlehem	$370 M	77.1%	7.8%	12.8%	2.3%
Bristol	$3,999 M	62.4%	18.5%	18.5%	0.6%
Cheshire	$2,844 M	71.0%	13.5%	14.7%	0.8%
Derby	$738 M	66.2%	15.1%	17.1%	1.7%
Middlebury	$971 M	73.1%	10.7%	13.4%	2.8%
Naugatuck	$1,729 M	68.1%	13.3%	17.6%	1.1%
Oxford	$1,559 M	72.0%	8.8%	16.7%	2.5%
Plymouth	$759 M	70.0%	7.8%	17.3%	4.9%
Prospect	$872 M	77.6%	7.2%	14.2%	0.9%
Seymour	$1,221 M	73.9%	9.8%	14.8%	1.4%
Shelton	$4,820 M	65.7%	18.3%	15.8%	0.3%
Southbury	$2,150 M	72.6%	12.5%	13.4%	1.5%
Thomaston	$572 M	64.3%	12.3%	20.1%	3.4%
Waterbury	$4,466 M	51.2%	27.0%	21.8%	0.0%
Watertown	$1,842 M	69.2%	12.4%	17.0%	1.3%
Wolcott	$1,256 M	77.9%	6.3%	14.1%	1.8%
Woodbury	$1,076 M	78.1%	7.6%	11.7%	2.6%
NVCOG	**$32,731 M**	**67.1%**	**15.1%**	**16.7%**	**1.1%**

Source: Connecticut Office of Policy and Management

Not all properties are equally vulnerable to any given natural hazard 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. According to the 2019 5-year American Community Survey, 189,493 housing units are in the NVCOG region. Of those, the vast majority are single unit buildings (Table 2-9). The percentage of single-unit buildings varies considerably from town to town, with

a low of 39.7% in Waterbury and a high of 98.6% in Oxford. Statewide, 64.3% of housing structures are single unit.

Table 2-9: Housing Stock

Municipality	1-Unit	2-Units	3+ Units	Mobile or Other
Ansonia	55.9%	24.5%	19.4%	0.2%
Beacon Falls	70.8%	8.9%	12.1%	8.2%
Bethlehem	95.9%	1.6%	2.5%	0.0%
Bristol	59.4%	11.0%	29.0%	0.6%
Cheshire	83.3%	2.1%	14.6%	0.0%
Derby	57.5%	15.6%	26.9%	0.0%
Middlebury	92.8%	0.4%	6.5%	0.3%
Naugatuck	62.3%	12.9%	21.3%	3.5%
Oxford	98.6%	1.1%	0.3%	0.0%
Plymouth	77.9%	6.8%	13.7%	1.6%
Prospect	87.8%	5.0%	3.6%	3.6%
Seymour	66.6%	11.1%	22.3%	0.0%
Shelton	78.1%	3.5%	16.4%	2.0%
Southbury	72.8%	8.7%	18.2%	0.3%
Thomaston	69.8%	7.4%	22.2%	0.6%
Waterbury	39.7%	11.7%	48.4%	0.2%
Watertown	80.8%	6.9%	12.3%	0.0%
Wolcott	91.4%	1.4%	7.2%	0.0%
Woodbury	80.6%	3.2%	15.6%	0.6%

Source: U.S. Census Bureau

The number of housing units in the region has grown at a faster pace than the population. From 2010 to 2019, the number of housing units increased by 0.7% (Table 2-10). The fastest growth occurred in Ansonia, Prospect, and Shelton, which saw greater than 6% increases. Several municipalities appeared to reduce housing units, although this may be within the margin of error for the survey. Meanwhile, as noted above, the population of the region shrank by 0.8%.

Table 2-10: Change in Housing Units

Municipality	2010 Housing Units	2019 Housing Units	Percent Change
Ansonia	8,148	8,728	6.6%
Beacon Falls	2,509	2,636	4.8%
Bethlehem	1,575	1,577	0.1%
Bristol	27,011	26,546	-1.8%
Cheshire	10,424	10,958	4.9%
Derby	5,849	5,837	-0.2%
Middlebury	2,892	3,046	5.1%
Naugatuck	13,061	12,402	-5.3%
Oxford	4,746	4,902	3.2%
Plymouth	5,109	5,382	5.1%
Prospect	3,474	3,742	7.2%
Seymour	6,968	6,573	-6.0%
Shelton	16,146	17,208	6.2%
Southbury	9,091	8,779	-3.6%
Thomaston	3,276	3,353	2.3%
Waterbury	47,991	47,830	-0.3%
Watertown	9,096	9,013	-0.9%
Wolcott	6,276	6,329	0.8%
Woodbury	4,564	4,652	1.9%
NVCOG	**188,206**	**189,493**	**0.7%**
Connecticut	**1,487,891**	**1,512,305**	**1.6%**

Source: U.S. Census Bureau

The household structure is changing in many NVCOG communities (Table 2-11). Smaller households, including singles, non-cohabitating couples, single parents, families with fewer children, and empty nesters are becoming more common. Overall, household sizes in the NVCOG region declined from 2000 to 2019.

Table 2-11: Average Household Size

Municipality	2000	2010	2019 Estimate
Ansonia	2.34	2.36	2.15
Beacon Falls	2.49	2.41	2.34
Bethlehem	2.47	2.29	2.18
Bristol	2.30	2.24	2.27
Cheshire	2.97	2.81	2.66
Derby	2.23	2.21	2.14
Middlebury	2.59	2.62	2.54
Naugatuck	2.51	2.44	2.53
Oxford	2.87	2.67	2.67
Plymouth	2.50	2.40	2.18
Prospect	2.81	2.71	2.59
Seymour	2.43	2.37	2.51
Shelton	2.59	2.45	2.39
Southbury	2.38	2.19	2.24
Thomaston	2.49	2.41	2.27
Waterbury	2.29	2.30	2.26
Watertown	2.61	2.48	2.41
Wolcott	2.74	2.66	2.63
Woodbury	2.38	2.19	2.06
NVCOG	**N/A**	**2.38**	**2.35**
Connecticut	**2.53**	**2.40**	**2.36**

Source: U.S. Census Bureau

As households get smaller, more units are needed to house the same total population. Not only does this increase the amount of land needed for housing, it spreads the population over a greater area, potentially impacting emergency response times. Such a shift in household formation dynamics impacts the way the NVCOG communities respond to disasters. A greater number of households generally equates to a greater amount of impervious surface cover, which can have negative repercussions for flooding. More households mean more structures that can be damaged during hurricanes or which contribute to runoff. Furthermore, the population is now spread among a greater number of structures, potentially making rescue operations more difficult.

In 2020 and 2021, the global COVID-19 pandemic led to a high demand for housing in rural and suburban areas, and a decrease in demand in urban hubs. It is unclear what the long-term impacts of this trend will be.

To provide a narrative characterization of development trends in the NVCOG 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 are presented in Table 2-12.

Table 2-12: Notable Developments or Redevelopments

Community	Development or Redevelopment
Ansonia	New Police Station/Emergency Operations Center, added elderly/disabled apartments
Beacon Falls	Continued residential buildout in large developments
Bethlehem	Minimal development and redevelopment
Bristol	A few 10-20 lot subdivisions, new elderly housing development, and many residential and commercial redevelopment projects
Cheshire	Four residential subdivisions, many single-family homes and renovations, several large lot commercial developments and additions
Derby	Single family homes, lots of mixed use proposed for future development
Middlebury	Significant residential development, new commercial development on Rt. 63 corridor
Naugatuck	Small subdivisions, reopening of commuter rail line expected to spur redevelopment
Oxford	Lots of commercial and industrial development in Industrial Park, proposed airport expansion, buildout of residential developments (some age restricted)
Plymouth	None of note
Prospect	None of note
Seymour	None of note
Shelton	500 new apartments downtown, new subdivisions (100 residences), commercial development including new retail shopping center, $1 billion total in new development
Southbury	Small subdivisions, some redevelopment, expansion of Comsat satellite facility
Thomaston	Buildout of one residential development, some single-family homes, commercial redevelopment / minor industrial expansion
Waterbury	Brownfield redevelopment, south end development, renewed interest in long-dormant subdivisions
Watertown	Buildout and infill of existing subdivisions, commercial redevelopment on Straits Tnpk.
Wolcott	Renewed interest in long-dormant subdivisions
Woodbury	Mostly single-family homes

In summary, based on meetings with local planning teams, Cheshire, Middlebury, Oxford, and Shelton have experienced the most significant development in the last few years and have the most noteworthy projects approved or pending approval. The communities of Bristol, Naugatuck, Southbury, Thomaston, Waterbury, and Watertown have experienced a somewhat lesser level of development and redevelopment. The remaining NVCOG communities have experienced nominal development or redevelopment of single properties and parcels.

2.2.4 Land Cover and Land Use

Much of the development the NVCOG region has seen since 1985 has come at the cost (mainly) of its agricultural land and deciduous and coniferous forests. Figure 2-8, derived from the UConn Center for Land-Use Education and Research (CLEAR), shows a snapshot of current (2015) land cover. The rate of land cover change in the NVCOG region can be seen in Table 2-13 below. As the table shows, the most endangered land, by far, is agricultural land, with approximately 21% being lost to development over the last 30 years.

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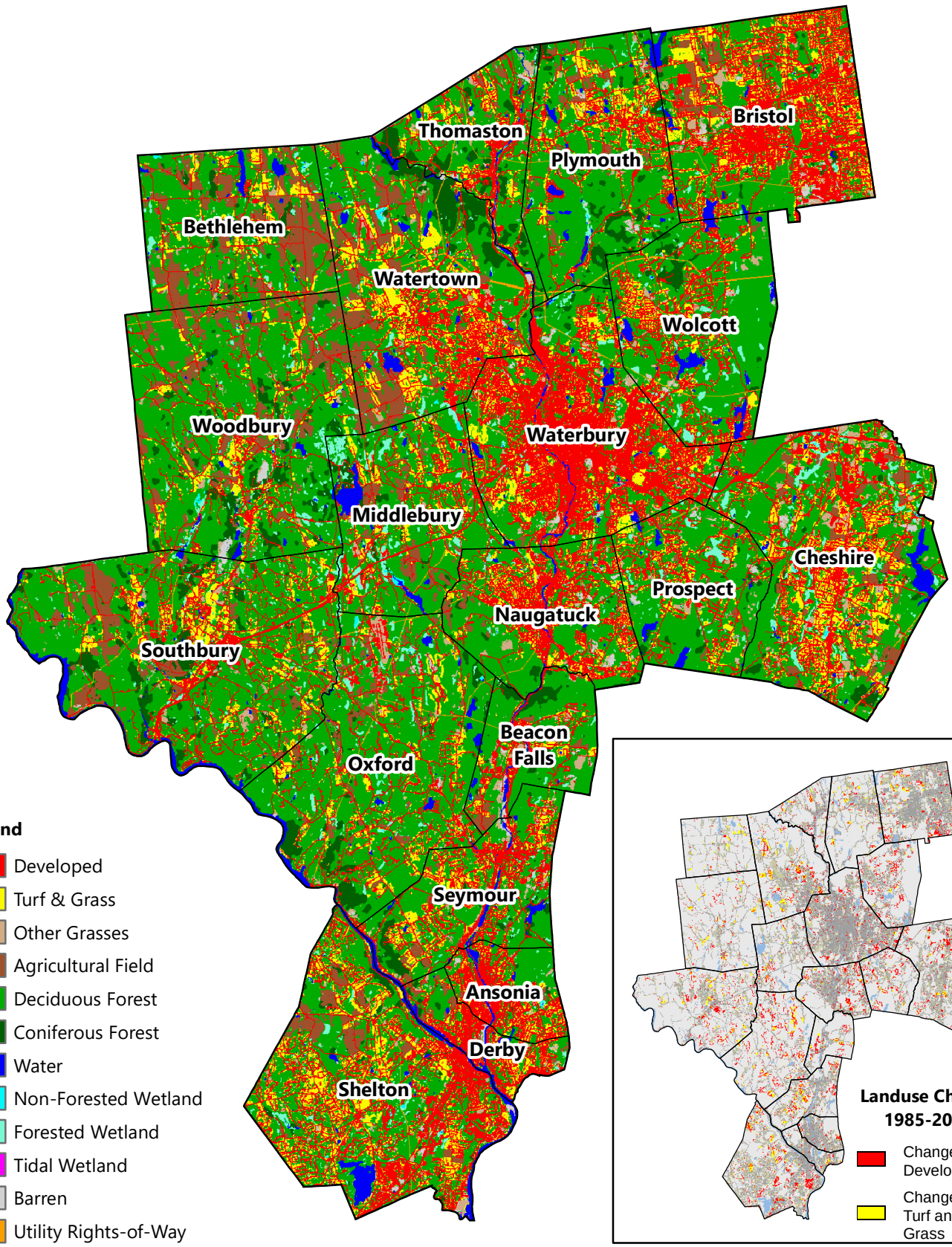

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2015 LAND COVER CLASSES

HAZARD MITIGATION PLAN UPDATE
NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS
49 LEAVENWORTH STREET, 3RD FLOOR
WATERBURY, CT 06702

N

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Feet

SCALE 1 " = 20,000 '
DATE 8/6/2021
PROJ. NO. 3211-29

FIG. 2-8

Between 1985 and 2015, the region increased its developed area by 26%. During that same period, turf (lawns) increased by 24%. At the same time, agricultural land decreased by 21%, forests lost 8% of their area, and other land types (including wetlands) lost 8% of their area.

Table 2-13: Change in Land Cover

Category	1985 Acreage	2015 Acreage	Percent Change
Developed	53,171	67,105	26.2%
Turf	19,938	24,799	24.4%
Other Grass	5,298	5,103	-3.7%
Agriculture	21,462	16,882	-21.3%
Forest	160,058	146,816	-8.3%
Other	9,860	9,077	-7.9%

Source: UConn CLEAR

As development in the region increases, the magnitude of the damage caused by disasters also increases. Total damages increase for two reasons. First, as noted above for population, because there are more homes, businesses, and other assets in a given area, more homes, businesses, and assets are potentially affected by the disaster. Second, impervious surfaces (represented in the table above as "Developed") are linked to more severe and rapid flash flooding events. Continued development results in the amount of impervious surfaces within the region increasing. Therefore, when heavy rain events occur in the region the resulting stormwater quickly flows through storm drains and across parking lots and lawns and into brooks and rivers leading to a higher peak elevation flood surge. This phenomenon, created by development, has likely increased the risk of damage associated with severe weather conditions.

2.2.5 Historic and Cultural Resources

The NVCOG region is rich in historic and cultural assets. Efforts have been taken by many to recognize, preserve, and protect these assets. NVCOG developed an historic resources Story Map that includes all national register sites and history museums (nvcogct.gov/historymap_rev). In 2015 the State of Connecticut launched an initiative aimed at protecting historic resources from natural hazards and climate change. Historic and cultural assets should be considered in 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 numerous structures, sites, and districts listed on the State and National Registers of Historic Places in the NVCOG region attest to the importance of historic preservation to our communities. Sites on the Registers are significant to our culture. Figure 2-9 displays sites designated as National Historic Landmarks or properties listed on the National Register of Historic Places, the State Register of Historic Places, or local historic districts/local historic properties. The State Historic Preservation Office (SHPO) also maintains a list of State Archaeological Preserves, although none are located in the region.

SHPO should be consulted regarding any mitigation projects that could affect buildings or sites on the Registers. Recent efforts by SHPO to identify the risk of historic resources to natural hazards is discussed on the Fact Sheet following this page. Risks to historic and cultural resources are further discussed in Section 3.

2.3 Planning and Regulatory Capabilities

2.3.1 Governmental Structure

NVCOG is a regional planning organization established by the Connecticut Office of Policy and Management that represents its 19 member municipalities. NVCOG provides technical and planning assistance and expertise and provides a forum for its member municipalities to communicate and collaborate on inter-municipal issues and needs.

NVCOG is governed by a council consisting of mayors and first selectmen with one vote each. Services and programs are implemented by the Executive Director and staff with funding from the federal government, state government, and local sources. Grants and local contributions are used to fund special projects supported by the council.

The 19 NVCOG municipalities have 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, water mains, sewers, drainage, and utilities. Table 2-14 presents the government structure for each municipality.

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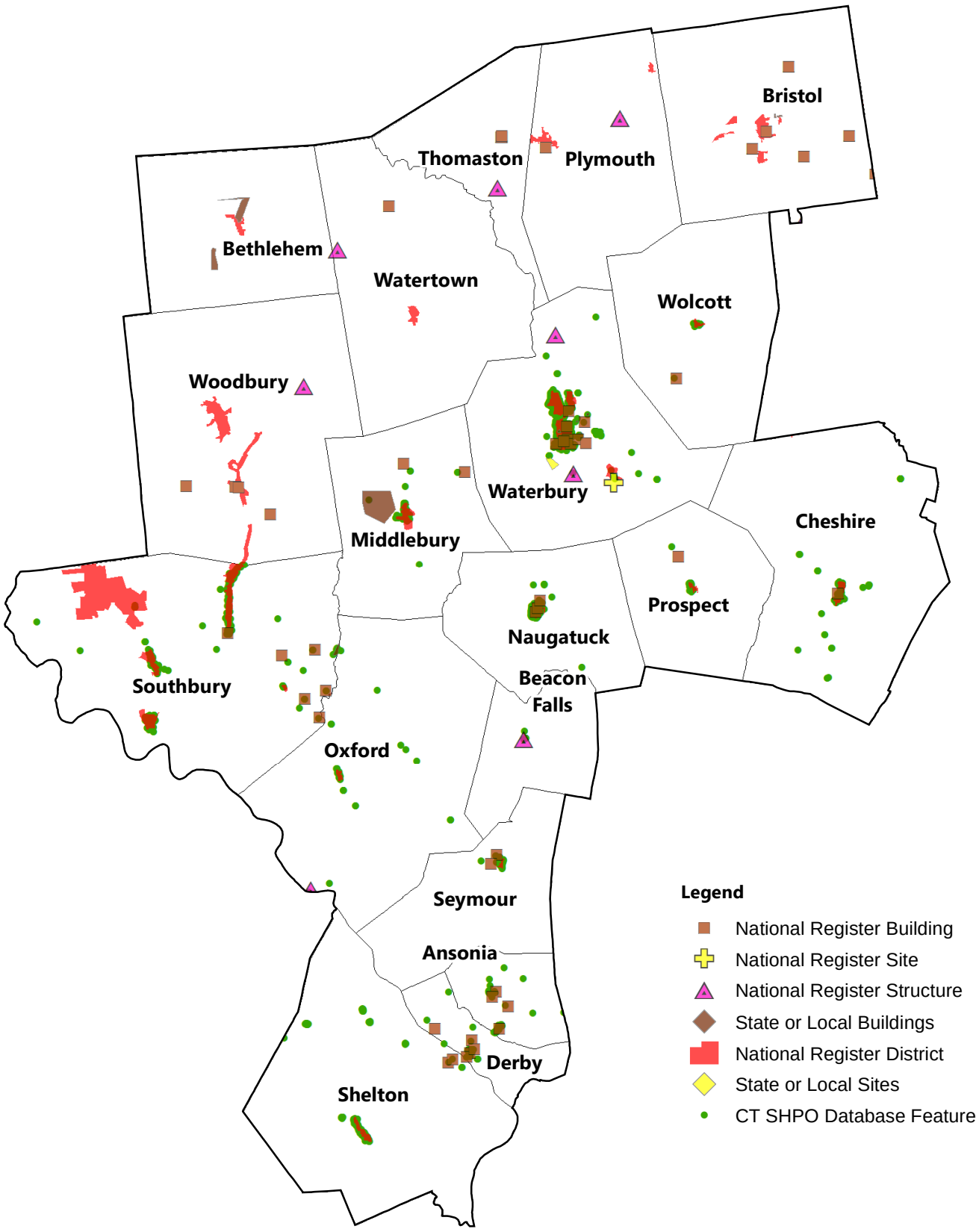

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HISTORIC RESOURCES

HAZARD MITIGATION PLAN UPDATE
NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS
49 LEAVENWORTH STREET, 3RD FLOOR
WATERBURY, CT 06702

N

0 10,000 20,000
Feet

SCALE 1 " = 20,000 '
DATE 8/6/2021
PROJ. NO. 3211-29

FIG. 2-9

NEW INITIATIVES

MITIGATION OF RISKS TO HISTORIC RESOURCES

Naugatuck Train Station
Photo by SLR

Downtown Waterbury
Photo by SLR

FOR MORE INFORMATION

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WHAT IS THE INITIATIVE?

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:

- Reports produced for coastal communities include detailed recommendations that are applicable throughout the state, including NVCOG.
- A best practices guide for planning techniques to make historic resources more resilient was made available in 2018.
- The State Historic Preservation Plan was updated in 2018 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 a mitigation action for most NVCOG municipalities to conduct a survey of potential historic resources, focusing on areas within natural hazard risk zones, in cooperation with SHPO. Informing historic-property owners of hazard-resilient retrofitting methods that do not conflict with historic preservation goals is another action suggested for some municipalities.

Each NVCOG municipality has staff and personnel resources that mitigate and / or respond to the impacts of natural hazards within their professional capacities. Table 2-15 summarizes typical resources and positions.

Table 2-14: Municipal Government Structure

Municipality	Legislative Body	Chief Executive Officer
Ansonia	Board of Aldermen	Mayor
Beacon Falls	Town Meeting	First Selectman
Bethlehem	Town Meeting	First Selectman
Bristol	City Council	Mayor
Cheshire	Town Council	Town Manager
Derby	Board of Aldermen	Mayor
Middlebury	Town Meeting	First Selectman
Naugatuck	Board of Mayor & Burgesses	Mayor
Oxford	Town Meeting	First Selectman
Plymouth	Town Council	Mayor
Prospect	Town Council	Mayor
Seymour	Town Meeting	First Selectman
Shelton	Board of Aldermen	Mayor
Southbury	Town Meeting	First Selectman
Thomaston	Town Meeting	First Selectman
Waterbury	Board of Aldermen	Mayor
Watertown	Town Council	Town Manager
Wolcott	Town Council	Mayor
Woodbury	Town Meeting	First Selectman

Source: Connecticut Secretary of State

Table 2-15: Local Administrative and Technical Resources

Skill	Available	Position
Land Development and Management	Yes	Planning & Zoning, NVCOG
Building Construction	Yes	Building Official
Infrastructure Construction	Yes	Municipal Engineer, Public Works
Understanding of Natural Hazards	Yes	Emergency Management Director, Municipal Engineer, NVCOG
Floodplain Manager	Yes	Planning & Zoning, Municipal Engineer, Building Official
Surveyor	Usually Not	Rarely as part of Public Works or Engineering
GIS Applications	Yes	Planning & Zoning, NVCOG
Emergency Management	Yes	Emergency Management Director
Grant Writers	Yes	Grant Writer, Staff, NVCOG
Benefit-Cost Analysis for FEMA Grant Programs	Usually Not	Typically contracted out

NVCOG municipalities rely upon a variety of codes, ordinances, and other requirements that help mitigate the potential impacts of natural hazards. Table 2-16 summarizes the typical regulatory requirements of NVCOG communities.

Table 2-16: Types of Codes, Ordinances, and Requirements

Type	Local Authority	State Mandated	Comment
Building Code	Yes	Yes	State Building Code
Zoning Regulations	Yes	No	No Zoning in Bethlehem
Flood Damage Prevention	Yes	No	Typically in zoning and/or municipal code of ordinances
Subdivision Regulations	Yes	No	
Inland Wetland Regulations	Yes	Yes	
Post Disaster Recovery Regulations	Yes	No	
Real Estate Disclosures	Yes	Yes	State Requirement
Site Plan Review	Yes	No	
Special Purpose Regulations (Flood Management, Critical Areas)	Yes	Yes	State Flood Management Statutes and Regulations

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 and have enacted inland wetlands and

watercourses regulations. According to CEQ, municipal agencies, which issue 95 percent of all inland wetlands permits in the state, have become more responsive to conserving wetlands in recent years. CEQ attributes this to the completion of wetlands training programs by municipal agency members and staff.

Lastly, NVCOG municipalities rely on a variety of funding streams that allow them to operate and perform natural hazard mitigation actions. These may include, but are not necessarily limited to, the following:

- Authority to levy taxes for specific purposes
- User fees for water, sewer, gas, or electric service
- Incur debt through general obligation bonds
- Incur debt through special tax bonds
- Incur debt through private activity bonds
- Capital improvement project funding
- Community development block grants
- State sponsored grant programs
- Federal grant programs
- Withhold public expenditures in hazard prone areas (allowed by State)
- Development impact fees for homebuyers or developers

2.3.2 Regional and Local Plans

NVCOG municipalities rely upon a variety of planning documents that provide guidance related to natural hazard planning. Table 2-17 presents a summary of the typical plans utilized by NVCOG municipalities.

Table 2-17: Types of Local Planning Documents

Type	Local Authority	State Mandated	Comment
Plan of Conservation and Development	Yes	Yes	POCD Update Every 10 Years
Floodplain or Basin Plan	No	No	
Stormwater Plan	Yes	Yes	MS4
Capital Improvement Plan	Yes	No	
Habitat Conservation Plan	No	No	
Economic Development Plan	Yes	No	
Emergency Operations Plan	Yes	Yes	LEOP template from DEMHS
Shoreline Management Plan	No	No	
Post Disaster Recovery Plan	Yes	Yes	Templates from DEHMS

NVCOG currently has three Regional POCDs held over from its previous planning areas. These documents provide guidance on responsible growth strategies, coordination of water and sewer utilities between municipalities, marketing portions of the region as a coordinated jurisdiction, assisting private investment studies, meeting the mandate for land use and transportation coordination, addressing regional inputs to the State POCD, addressing coordination along boundaries, coordinating various aspects of land use regulation, and establishing the fiscal basis for regional management of collectively shared infrastructure. A Regional POCD for the NVCOG region will likely be completed within the next five years and will address current challenges facing the region over the next decade with specific goals and objectives presented to meet those challenges.

Regional planning agencies and municipalities are required by state law (Chapter 127, Section 8-35a and Chapter 126, Sec. 8-23, respectively) to update POCDs every 10 years. These plans outline the policies and goals for physical and economic development of the region or municipality. Table 2-18 lists the status of each municipal POCD for the 19 municipalities in the NVCOG region as of March 2021. The 13 municipalities with POCD updates occurring in the next five to six years (by 2026) should incorporate information from this HMP into their analysis and recommendations as noted in Section 6.2.

Table 2-18: Municipal Plan of Conservation and Development Status

Municipality	POCD Date	Plan Update in Next Five Years?
Ansonia	7/30/2018	No
Beacon Falls	7/18/2013	Yes
Bethlehem	1/14/2010	Yes
Bristol	2/28/2018	No
Cheshire	6/27/2016	Will be started
Derby	5/24/2016	Will be started

Municipality	POCD Date	Plan Update in Next Five Years?
Middlebury	10/1/2015	Yes
Naugatuck	1/1/2013	Yes
Oxford	9/4/2018	No
Plymouth	6/11/2015	Yes
Prospect	2/1/2014	Yes
Seymour	9/8/2016	Will be started
Shelton	5/24/2017	No
Southbury	12/11/2012	Yes
Thomaston	10/1/2014	Yes
Waterbury	9/14/2016	Will be started
Watertown	12/19/2017	No
Wolcott	1/10/2011	Yes
Woodbury	1/8/2020	No

Source: Connecticut Office of Policy and Management

Many NVCOG municipalities are considered to be "urbanized areas" that must comply with US EPA rules for stormwater management. The MS4 General Permit is used by Connecticut DEEP to track compliance in the region as noted on the Fact Sheet included later in this document.

2.3.3 Public Information

A variety of means are used in the NVCOG region to inform the public of about natural hazards, areas and issues of concern, and mitigation measures. These specific outreach efforts are described below.

Reports and Presentations to Local Officials

Municipal local coordinators and other department heads routinely provide briefings to the local legislative body regarding the impact of natural hazards, areas of concern, and new projects that may be necessary to address related issues. Discussions of a regional nature are also held before the NVCOG council. These meetings are public meetings with meeting notices, agendas, and minutes published on the local or regional web site.

Web Pages

NVCOG maintains a Natural Hazard Mitigation Plan page on its website to ensure that all local HMPs are available for download. In addition, many NVCOG communities maintain information on their website with guidance on how to prepare for natural disasters and how to sign up for emergency notifications. Press releases are also posted on most municipal websites that may include information related to natural hazards or mitigation.

Social Media and Traditional Media

Many NVCOG communities have embraced the use of social media to inform their residents. Most municipalities have a Facebook account, and some have Twitter feeds. As many residents now have smart phones, social media is an excellent means of disseminating emergency information such as road closures, shelter locations, and evacuation needs. However, the use of social media cannot fully replace the need to disseminate information via traditional media.

Press releases, newspaper articles, emergency notification system broadcasts and sirens, and television and radio announcements have been traditionally used to reach a majority of residents before, during, and after emergencies and natural hazard events. All NVCOG communities have these capabilities.

2.4 Critical Facilities

Numerous public and private facilities and infrastructure are critical to the assessment of risks from natural hazards and are important in mitigating the possible effects of events. According to FEMA, critical facilities include essential facilities, transportation systems, lifeline utility systems, high potential loss facilities, and hazardous material facilities. In the NVCOG region, critical facilities include facilities that support responses and recovery efforts, such as governmental offices and public works facilities. In addition, facilities that house vulnerable populations are considered in this category. This includes long-term care facilities, as these house populations of individuals that would require special assistance during an emergency.

Critical infrastructure located in areas of flood risk are subject to flooding and therefore vulnerable to closure in the event of a natural disaster. Flooding is not the only concern, as infrastructure can be directly damaged by wind, fire, or earthquakes or impacted by downed powerlines, trees, and other debris. Critical Facilities of Regional Significance are discussed on the following Fact Sheet.

REGIONAL CHALLENGES

CRITICAL FACILITIES OF REGIONAL SIGNIFICANCE

Ansonia Metro-North Train Station
Photo: Stamford Advocate

CPV Towantic Energy Center
Photo: CPV Towantic

FOR MORE INFORMATION

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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."

Oftentimes, communities are not inclined to list critical facilities that are owned by State or regional entities, despite the fact that 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

Many critical facilities of regional significance are located in the NVCOG Region. Examples include the CPV Towantic Energy Center in Oxford, Waterbury-Oxford Airport in Oxford, rail facilities for Amtrak, CT Rail, and Metro-North, water and wastewater 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.

Communities can improve their hazard mitigation capabilities by leveraging the presence of regionally-significant critical facilities, and by including those facilities within their planning.

- Coordinate with facility operators on emergency response planning
- Consider facilities in emergency operations plans
- Work with facilities to secure funding for mitigation actions

2.4.1 Essential Facilities

FEMA defines essential facilities as those necessary for the health and welfare of the whole population. These include hospitals, police stations, fire stations, schools, emergency operations centers, and evacuation shelters. The four hospitals in the region include Bristol Hospital, Griffin Hospital in Derby, and Saint Mary's Hospital and Waterbury Hospital in Waterbury. Furthermore, each NVCOG municipality includes at least one police station, fire station, and emergency operations center, although in smaller communities some facilities are combined into one building.

Places where impacted populations can go before or during a natural hazard event and while recovery occurs are essential during an emergency. Most often, schools are used as public shelters as they have gymnasiums that can accommodate large numbers of residents and are structurally capable of withstanding the forces endured during an event. In addition to structural rigidity, schools maintain the necessary facilities such as lavatories, showers, and food service areas as well as other spaces for recreation. Many municipalities also have smaller facilities that are designated as the primary shelter for smaller events that only require housing a few people. Backup generators are usually available, but in some instances may not provide sufficient power for the entire building.

The American Red Cross (ARC) has been chartered by the U.S. Congress to respond to all disasters and be the lead agency for mass care and sheltering. It coordinates emergency services at the local level through its regional chapters. Many NVCOG municipalities certify that their shelters comply with ARC guidelines. However, in most cases municipal staff and volunteers operate local shelters, potentially with or without ARC assistance. During a catastrophic regional event, ARC may provide more oversight and coordination for shelter management including migrating evacuees from harder hit areas into shelters in other communities.

2.4.2 Transportation Systems

The availability of major transportation infrastructure is critical for evacuation and response and to ensure that emergencies are addressed while day to day management of the each NVCOG municipality continues. These include highways, railways, airports, and waterways. In general, none of the waterways in the region are used for commercial navigation.

Major highways in the region include Route 8, Interstate 84, and Interstate 691. These are maintained by the Connecticut Department of Transportation. Other numbered routes in the region are also managed by the Connecticut Department of Transportation (CTDOT), and many of these routes are the principal transportation arteries in the NVCOG municipalities. For example, Route 6 links Southbury and Bristol across the northern part of the region. Local roads are also important, and each NVCOG municipality identifies its public works facility as a critical facility as this facility is needed to ensure that roads are cleared and maintained in the timely manner.

Principal airports in the region include Waterbury-Oxford Airport in Oxford which functions as a general aviation airport, and Waterbury Airport in Plymouth that functions as an "other public use" airport. The private use airports in the region include the Green Acres Airport in Bristol and the Irish Hills Farm, Thomson Field, and Whelan Farms Airports in Bethlehem.

The Metro North Railroad provides passenger service between Waterbury and Milford, with the New Haven Line providing parallel freight service from Milford to Derby Junction. The New Naugatuck Railroad operates an excursion and freight railroad line from Waterbury to Torrington, with freight service two days per week and seasonal passenger service. An additional freight line exists between Derby Junction and Danbury, while additional freight lines exist between Waterbury and Berlin and from Cheshire to Plainville. In addition to providing an essential mode of transportation under normal conditions, the availability of passenger and freight rail in the region are of critical importance for the movement of people and supplies following a disaster.

In terms of evacuation, most NVCOG communities do not have set large-scale evacuation plans. Instead, evacuation parameters and guidelines are provided within Local Emergency Operations Plans. This provides local emergency personnel the flexibility to respond as situations warrant. For example, along the Housatonic River the predicted flood stage may vary based on the intensity of a storm which may affect what roads must be

evacuated and what routes will be necessary. Certain facilities, such as schools, typically have evacuation plans in order to ensure that students are safely taken to another location if an evacuation is needed during the school day.

2.4.3 Lifeline Utility Systems

Lifeline utility systems may include electric power, potable water, wastewater, oil, natural gas, and communication systems. In general, there are no major oil pipelines in the NVCOG region.

- Eversource provides electric power to the majority of the NVCOG region, with United Illuminating providing electric service to Ansonia, Derby, and Shelton. Transmission and distribution service is typically provided via overhead lines. Both utilities purchase electricity and move it through their distribution network to customers in their service areas.

- The NVCOG region is served by various public water systems ranging in size from serving single parcels and small subdivisions to extensive developed areas. The Aquarion Water Company serves Beacon Falls, Seymour, Shelton and parts of Oxford and Woodbury. The Connecticut Water Company provides service to parts of Middlebury, Naugatuck, Plymouth, Prospect, Southbury, and Thomaston. The South Central Connecticut Regional Water Authority provides service to Ansonia, Derby, and Cheshire and parts of Seymour. Other substantial public water systems include the municipally owned Bristol Water Department, Watertown Fire District, Watertown Water & Sewer, Wolcott Water & Sewer, and the Waterbury Water Department. Supply sources include extensive reservoir systems, stratified drift wells, and bedrock wells. Areas not served by public water systems are generally served by private wells.

- Natural gas service is also provided by Eversource throughout the entire region, although distribution lines for natural gas are not as extensive as those for electric power. Major natural gas transmission mains owned by Algonquin Gas and Tennessee Gas traverse the region in a generally northeasterly direction.

- There are 12 major water pollution control facilities in the NVCOG region. These include facilities in Ansonia, Beacon Falls, Bristol, Cheshire, Derby, Heritage Village (Southbury), Naugatuck, Plymouth, Seymour, Shelton, Southbury Training School, Thomaston, and Waterbury. Sewer service is also provided in parts of Middlebury, Oxford, Watertown, and Wolcott with treatment occurring in a nearby municipality. Pumping stations with backup power supplies are essential to successful operation of the sewer systems.

- Private communication carriers in the region as well as utilities such as Eversource rely upon communication towers which are overseen by the Connecticut Siting Council. These range from rooftop-mounted towers to standalone monopoles. While many towers have battery backups and standby power supplies, loss of power to these facilities can greatly hamper emergency response and restoration activities following a natural disaster as was seen widely in Connecticut following Tropical Storm Irene and Winter Storm Alfred in 2011. The Comsat facility in Southbury is a major satellite telecommunications provider in the region.

2.4.4 High Potential Loss Facilities

High potential loss facilities include nuclear power plants, high hazard dams, and military installations. There are no nuclear power plants or military installations in the NVCOG region, although there are various military training and recruitment centers in Waterbury.

High hazard dams are therefore the primary type of high potential loss facilities in the region. The potential impacts of dam failure are presented in Section 3.3.10 and in each municipal annex.

2.4.5 Hazardous Materials Facilities

Hazardous materials facilities include producers of corrosives, explosives, flammable materials, radioactive materials, and toxins. Additionally, these facilities may include those industries and businesses which store and use such materials as process chemicals. These facilities are of particular concern for emergency responders in the region. Most emergency management directors maintain

lists of all private facilities that house such chemicals in order to be prepared for specialized fire or emergency response. However, as these are typically privately owned facilities, they are not typically listed in the lists of critical facilities provided in each municipal annex.

The Connecticut DEEP has proposed strategies for municipalities to implement in order to recommend best management practices to prevent pollution from chemicals from being released following a flood or disaster. This is discussed on the Fact Sheet following this page.

NEW INITIATIVES

HELPING SMALL BUSINESSES MITIGATE IMPACTS OF NATURAL HAZARDS

Flooding in Bristol
Photo Bristolnews.blogspot

Ct.deep.gov

FOR MORE INFORMATION

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WHAT IS THE INITIATIVE?

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. Natural disasters can result in property damage, loss of inventory, and business interruption; another important risk that many small businesses face is that of environmental contamination and legal liabilities resulting from toxic chemical releases into the environment during or following a disaster.

In an effort to assist small business with natural hazard mitigation, CT DEEP has proposed strategies for towns to implement education and awareness programs with recommendations for best management practices (BMPs) to help business owners and municipalities prevent commercial pollutants from entering the environment.

Such education and awareness programs may help small businesses and the municipalities in which they are located avoid expensive cleanups, reduce legal liability challenges, mitigate potential risks to public health, and accelerate business recovery and reopening – reducing negative impacts to the municipality's economic base.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

The municipalities of the NVCOG Region can benefit from mitigation actions related to mitigating flood impacts to small businesses that use toxic chemicals. A selection from the following actions has been included in each of the municipal annexes, depending on the needs of each community:

- Provide information on the municipal website about CT DEEP training and information around small business chemical management for hazard resilience.
- Use the CT Toxics Users and Climate Resilience Map to identify toxic users located in hazard zones within your community. Contact those users to inform them about the CT DEEP small business chemical management initiative.
- Host a CT DEEP presentation for municipal staff and local businesses about business chemical management for hazard resilience.

CT DEEP has recommended that each municipality be listed as the lead agency for each of these actions, with assistance from CT DEEP noted (CT DEEP will develop information for dissemination). The suggested action priority is "medium", with a completion time frame of one year.

3.0 Hazard Identification and Risk Assessment

3.1 Natural Hazards Impacting the Region

The 2019 CT NHMP includes a risk assessment of dam failure, winter weather (blizzards, freezing rain, ice storms, nor'easters, sleet, snow, and winter storms), flood-related hazards (riverine, coastal, flash, and shallow flooding), sea level rise, earthquakes, drought, thunderstorms (wind, hail, and lightning), tornadoes, tropical cyclones (hurricanes and tropical storms), and wildland fires. This HMP addresses each of these hazards (except coastal flooding and storm surge which are not applicable to the NVCOG region). In addition, landslide risk is evaluated in the region. The risk of sinkholes is also included in the annex for Cheshire as discussed in previous planning efforts in the region.

3.1.1 Disaster Declarations

FEMA defines disasters in its Local Mitigation Planning Handbook (2013) as events that "can cause loss of life; damage buildings and infrastructure; and have devastating consequences for a community's economic, social, and environmental well-being." The NVCOG region has experienced a range of disasters in recent years. Note that some communities were damaged by disasters even though declarations were not made for the counties as presented in Table 3-1.

Table 3-1: Federal Disaster and Emergency Declarations

Number	Event Date	Incident Description	Counties Designated
DR-4580 EM-3535	8/4/2020	Tropical Storm "Isaias"	F, H, L, NH
DR-4500 EM-3439	1/20/2020, ongoing	COVID-19 Pandemic	F, H, L, NH
DR-4385	5/15/2018	Severe Storms, Tornadoes, and Straight-Line Winds	F, NH
DR-4213	1/26 to 1/28/2015	Severe Winter Storm and Snowstorm	NH
DR-4106 EM-3361	2/8 to 2/11/2013	Severe Winter Storm and Snowstorm	F, H, L, NH
DR-4087 EM-3353	10/27 to 11/8/2012	Hurricane Sandy	F, L, NH
DR-4046 EM-3342	10/29 to 10/30/2011	Severe Storm "Alfred"	F, H, L, NH
DR-4023 EM-3331	8/26 to 9/1/2011	Hurricane "Irene"	F, H, L, NH
DR-1958	1/11 to 1/12/2011	Snowstorms	F, H, L, NH
DR-1904	3/12 to 5/17/2010	Severe Storms and Flooding	F, NH
DR-1700	4/15 to 4/27/2007	Severe Storms and Flooding	F, H, L, NH
EM-3266	2/11 to 2/12/2006	Snow	F, H, NH
DR-1619	10/14 to 10/15/2005	Severe Storms and Flooding	H, L
EM-3200	1/22 to 1/23/2005	Record Snow	F, H, L, NH
EM-3192	12/5 to 12/7/2003	Snow	F, H, L, NH
EM-3176	2/17 to 2/18/2003	Snowstorm	F, H, L, NH
DR-1302	9/16 to 9/21/1999	Hurricane "Floyd"	F, H L
DR-1092	1/7 to 1/13/1996	Blizzard of '96	F, H, L, NH
EM-3098	3/13 to 3/17/1993	Severe Winds & Blizzard, Record Snowfall	F, H, L, NH
DR-972	12/10 to 12/13/1992	Coastal Flooding, Winter Storm	F, NH
DR-916	8/19/1991	Hurricane "Bob"	H, NH
DR-837	7/10/1989	Severe Storms and Tornadoes	L, NH
DR-747	9/27/1985	Hurricane "Gloria"	F, H, L, NH
DR-711	5/27 to 6/2/1984	Severe Storms & Flooding	F, H, L, NH
DR-661	6/14/1982	Severe Storms & Flooding	F, H, L, NH
DR-608	10/4/1979	Tornado, Severe Storms	H
EM-3060	2/7/1978	Blizzard & Snowstorms	F, H, L, NH
DR-42	8/20/1955	Hurricane, Torrential Rain & Floods "Connie" & Diane"	F, H, L, NH
DR-25	9/17/1954	Hurricane "Carol"	F, H, L, NH

Note: F = Fairfield, H = Hartford, L = Litchfield, NH = New Haven County

Source: FEMA

Severe winter storms, hurricanes and tropical storms, tornadoes, and nor'easters contributed to the disaster declarations.

3.1.2 FEMA Public Assistance Reimbursements

Public Assistance reimbursements are maintained by FEMA and are 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 3-2: Damages Since 1998 Based on FEMA Public Assistance Reimbursements

Municipality	Flood	Winter Storm	Wind Event
Ansonia	$0	$636,053	$459,954
Beacon Falls	$0	$267,558	$668,044
Bethlehem	$1,255	$119,632	$74,617
Bristol	$442,252	$5,266,736	$494,527
Cheshire	$0	$1,478,351	$300,614
Derby	$0	$472,425	$241,157
Middlebury	$0	$843,660	$808,432
Naugatuck	$0	$1,156,368	$426,046
Oxford	$0	$673,586	$1,311,740
Plymouth	$77,265	$851,631	$416,260
Prospect	$0	$823,755	$103,349
Seymour	$0	$630,625	$634,544
Shelton	$33,091	$283,474	$251,189
Southbury	$0	$1,333,867	$1,844,337
Thomaston	$1,134	$201,568	$64,895
Waterbury	$0	$2,827,123	$701,040
Watertown	$13,833	$548,770	$379,872
Wolcott	$0	$982,209	$342,798
Woodbury	$21,673	$418,579	$154,272
NVCOG	**$590,503**	**$19,815,970**	**$9,677,687**

Source: FEMA

Annualized loss estimates were prepared based on the Public Assistance data. The damage for each NVCOG municipality due to flooding, wind, and winter storms was summed and divided by the 22 years of available data. The annualized loss for flooding in the region based on these data is $26,841, while the annualized loss due to wind from tornadoes and tropical cyclones is higher at $439,895, and the annualized loss due to winter storm damage in the region is even higher at $900,726. These figures suggest that for public property and property managed by non-profits, the region as a whole is at a much lower risk of damage from floods than from winter storms and wind. This annualized loss information is carried forward into the risk assessment in Section 3.3 as part of the potential loss estimates for each community.

3.2 Local Public Perception of Natural Hazard Risk

A public survey was developed using surveymonkey.com and made available to residents and businesses in the NVCOG region from October 26, 2020 through April 23, 2021. The primary goal of the survey was to educate local officials of the general public awareness regarding natural hazards, with the secondary goal being to collect information that may lead to potential mitigation strategies. A total of 17 people participated in the 17-question survey. The responses provide an indication of the public perception regarding the level of risk, awareness of natural hazard mitigation planning, and emergency response in the NVCOG municipalities. Some write-in responses were accepted for publication, although some were inapplicable to needs of the planning process and were not carried forward to this document.

Question 1 asked "In which community do you live, work, or own property?" Results are presented in Table 3-3.

Table 3-3:
In Which Community Do You Live or Own Property?

Municipality	Response Count	Response Percentage
Beacon Falls	2	12%
Derby	2	12%
Naugatuck	5	29%
Prospect	1	6%
Shelton	2	12%
Southbury	2	12%
Watertown	1	6%
Woodbury	1	6%
Out of Region	1	6%
Total	**17**	**100%**

The majority of respondents identified with the communities of Beacon Falls, Derby, Naugatuck, Shelton, and Southbury.

Question 2 asked "In which community do you work?" Results are presented in Table 3-4. The majority of respondents worked or went to school in the communities of Naugatuck, Shelton, and Southbury, or outside of the NVCOG region.

Table 3-4: In Which Community Do You Work or Attend School?

Municipality	Response Count	Response Percentage
Bethlehem	1	6%
Derby	1	6%
Naugatuck	2	12%
Prospect	1	6%
Shelton	2	12%
Southbury	2	12%
Thomaston	1	6%
Waterbury	1	6%
Watertown	1	6%
Woodbury	1	6%
Out of Region	4	24%
Total	**18**	**100%**

Question 3 was for informational purposes, asking "please enter your street of residence or place of business." This information was requested to cross-reference later responses related to a vulnerability for the particular area near the respondents' residence or business. A total of 15 people responded to this question.

Question 4 asked "For how many years have you lived or worked in the region?" Figure 3-1 presents the results. The majority of respondents have lived or worked in the region for more than 10 years.

Question 5 asked "Did you know that the community where you live or work is covered by an HMP?" Only 36% of respondents were aware that their community had an HMP.

Question 6 asked "Which of the following natural hazards have impacted you?" Responses are summarized in Table 3-5.

Figure 3-1: For how many years have you lived or worked in the Region?

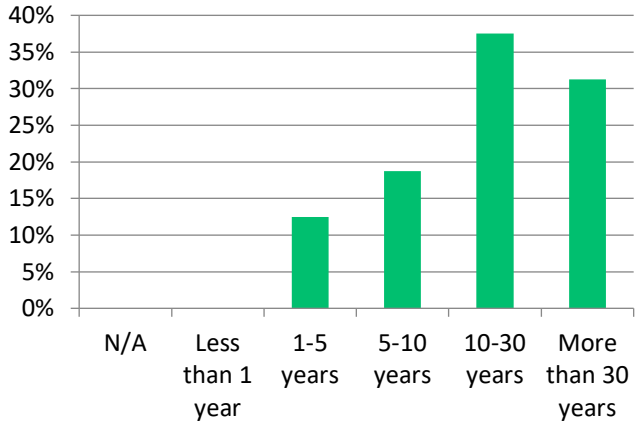


Table 3-5: Which of the Following Natural Hazards Have Impacted You?

Hazard	Response Count	Response Percentage
River or lake flooding	3	18%
Poor drainage flooding	3	18%
Dam failure	1	6%
Ice jams in rivers	1	6%
Hurricanes and tropical storms	9	53%
Tornadoes or other high wind	8	47%
Severe thunderstorms	12	71%
Winter Storms and Blizzards	12	71%
Extreme cold	4	24%
Extreme heat	2	12%
Drought	2	12%
Landslides	1	6%
No response	3	18%
Total	**17**	**100%**

Most respondents also mentioned being impacted by severe thunderstorms, winter storms and blizzards, and hurricanes and tropical storms. One respondent provided details regarding landslide concerns.

Question 7 asked "In what way have natural hazards affected you or your home or place of work/study?" All respondents noted the loss of power and utilities services as noted in Table 3-6. Wind storms, ice dams, and the May 2018 tornado were all mentioned by respondents as damaging incidents.

Table 3-6: In What Way Have Natural Hazards Affected You or Your Home or Place of Work/Study?

Hazard	Response Count	Response Percentage
Lost power or utility services	13	76%
Interrupted travel or access	6	35%
Lost work or productivity	5	29%
Damage to property or assets	5	29%
Personal injury or health impacts	1	6%
No response	4	24%
Total	**17**	**100%**

Question 8 asked "How concerned are you about each of those hazards happening in the future?" Table 3-7 summarizes the responses. The hazards considered to pose the highest threat or concern to the majority of respondents include winter storms and blizzards, severe thunderstorms, hurricanes and tropical storms, tornadoes and high winds, and extreme heat.

Table 3-7: How Concerned Are You About Each of Those Hazards Happening in the Future?

Hazard	Low (1)	Moderate (2)	High (3)	Average Rating
River or lake flooding	7	4	3	1.7
Poor drainage flooding	5	5	3	1.9
Dam Failure	7	4	3	1.7
Hurricanes and tropical storms	2	3	9	2.5
Tornadoes or other high wind	1	5	7	2.5
Severe thunderstorms	1	3	10	2.6
Winter storms and blizzards	1	2	10	2.7
Ice jams in rivers	8	4	1	1.5
Extreme cold	5	5	2	1.8
Extreme heat	3	5	3	2.0
Drought	4	5	3	1.9
Wildfires and brush fires	6	6	0	1.5
Landslides	8	4	0	1.3
Rising sea level in Housatonic River downstream of Derby	8	1	3	1.6
Other	2	0	0	1.0

Question 9 requested specific areas that were vulnerable to natural hazards. Responses included the following:

- *The Maples and Birchbank Road in Shelton*
- *Intersection of Main Street North and Main Street South* (Could be in Bethlehem, Southbury, or Woodbury)
- *Hop Brook Lake* (note that this is a USACE flood-control dam; it is intended to be impacted by flooding when needed)
- *Breen Field in Naugatuck*

Question 10 asked "Have you taken any actions to protect your family, home, or business?" Table 3-8 presents the responses. The actions most commonly performed by respondents include taking measures to reduce built-up snow on roofs, cutting back or removing vegetation from overhead utility lines or roofs, and maintaining a disaster supply kit.

Table 3-8: Have you taken any actions to protect your family, home, or business?

Hazard	Response Count	Response Percentage
Elevated or floodproofed to reduce flood damage	2	12%
Taken measures to reduce snow build-up on roofs	5	29%
Cut back or removed vegetation from overhead utility lines or roof	5	29%
Replaced overhead utility lines with underground lines	2	12%
Managed vegetation to reduce risk of wildfire	1	6%
Developed a disaster plan	2	12%
Maintain a disaster supply kit	3	18%
Purchased hazard insurance	1	6%
No response	6	35%

Question 11 asked respondents to identify whether certain strategies were important to mitigate natural hazards, if those strategies have been successfully used by their communities in the past, and if they should be a priority moving forward. Table 3-9 presents the results. Most respondents believed that the most important mitigation actions included identification of hazard risk areas, regulations that reduce risk, and training for municipal staff. However, the current implementation of

those strategies was generally not widely considered to be successful. Respondents generally considered projects that facilitated emergency information and alerts, improved firefighting capabilities, and upsized bridge and culvert infrastructure to be the most successful mitigation projects in their communities. In terms of future mitigation strategies, respondents were most interested in projects to protect power lines from trees and wind damage, identify areas at risk of hazards, assist vulnerable populations, provide backup power for critical facilities, and improve emergency information and alerts.

Table 3-9: Mitigation Tools in Your Community

Mitigation Strategy	Important	Successful	Priority
Identification of areas with risk from hazards	42%	8%	67%
Regulations that reduce risks	33%	25%	25%
Flood insurance	17%	8%	8%
Removal of buildings from areas of risk	17%	8%	33%
Protecting powerlines from trees and wind	25%	17%	75%
Backup power for critical facilities	8%	25%	50%
"Hardening" critical facilities to make them less vulnerable	25%	17%	25%
"Upsizing" bridges or stream culverts	25%	33%	17%
Public outreach and education	25%	25%	25%
Emergency information and alerts	25%	42%	50%
Maintaining disaster plans and kits	17%	25%	42%
Assisting vulnerable populations	8%	17%	58%
Emergency response and floodplain management training for municipal staff	33%	8%	42%
Improve firefighting capabilities	25%	42%	17%

Question 12 asked respondents about what resources they believed were available to support or assist with hazard preparation, response, or recovery, and what resources they believed are useful or important. Table 3-10 presents the results. Most respondents believed that emergency responders, neighbors, local governments, and local schools were the most available resources to support or assist with hazard preparation, response, or recovery, and that additional resources for emergency responders and at the local government level would be both useful and important for improving hazard mitigation efforts.

Table 3-10: What Local Resources are Available to Support or Assist with Hazard Preparation, Response, or Recovery? What Resources are or Would be Useful or Important?

Local Resources	Available	Useful / Important
State government	36%	45%
Local government	45%	55%
Local schools	45%	36%
Emergency responders	73%	55%
Nonprofit organizations	36%	27%
Community groups or neighborhood associations	36%	27%
Higher education institutions	9%	9%
Religious institutions	18%	36%
Individual community members or neighbors	55%	27%

Question 13 asked respondents to rank the importance of certain actions typically taken by local communities following a natural hazard event. Results are presented in Figure 3-2. Respondents believed that reopening roads, restoring damaged utilities, and addressing injuries and casualties were the most important restoration measures.

Question 14 noted that scientists expect increased rainfall and frequency of storm events due to climate change and asked respondents to opine on which statement about planning for future changes they were in most agreement. The majority (82%) of respondents indicated that it is appropriate to plan for storm events to become more severe and more frequent in the future.

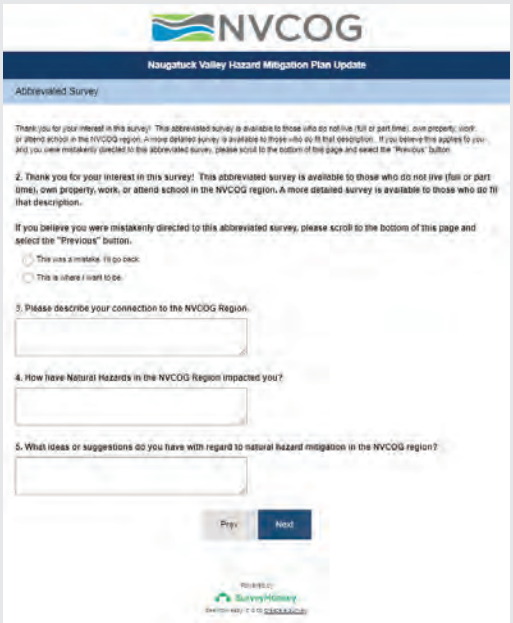
Question 15 asked respondents to write in one action to reduce risks from natural hazards in their community. Responses sought to mitigate hazards such as flooding and wind damage, and also to improve public education and hazard preparation. Responses included:

- *Controlling water levels at dams*
- *Storm mitigation*
- *Removing homes from floodplains*
- *Moving powerlines underground*

OUTREACH EFFORTS

PUBLIC ENGAGEMENT SURVEY

Keywords in Open-Ended Question Responses



Screenshot of a Survey Page

FOR MORE INFORMATION

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WHAT WAS ACCOMPLISHED?

A survey was posted online in the fall and winter of 2020 to solicit input from the public on local mitigation activities and strategies. The survey was opened on September 7 and closed on February 7, 2021. Press releases were carried in numerous news media outlets and municipal web sites. 17 individuals responded.

The survey provided an opportunity for members of the public to participate in the planning process on their own schedules. The survey was comprehensive, asking questions about hazards of concern, vulnerable areas, local capabilities and actions already completed, and preferences in terms of future mitigation actions performed. The survey consisted of a combination of multiple-choice questions and open-ended response questions that allowed respondents to provide any comments they wished.

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 are summarized in the list below.

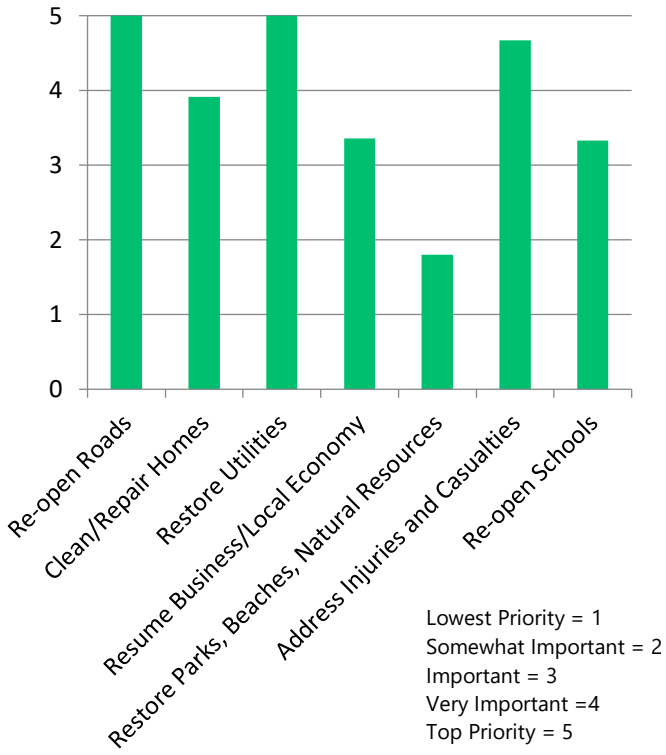
Primary Concerns:

- Severe Thunderstorms
- Winter Storms
- Downed Trees and Limbs
- Power Outages

High Priority Actions:

- Identification of Risk Areas
- Protecting Power Lines from Trees and Wind
- Emergency Response & Floodplain Management Training for Municipal Staff

Figure 3-2: How important is each of the following activities to recovering from a hazard event?



- *Replacement of infrastructure designed with outdated specifications for storm frequency and intensity*
- *Improved planning and preparation for natural hazard event response*
- *Improved education regarding climate change*

Question 16 requested additional comments or questions to be addressed as the HMP is updated. Three comments were received:

- *I am concerned about the ability of state, local and emergency services to coordinate action with emergency responders, hospitals, National Guard etc in an environment where the electric is down, the phones are out and the various services which should provide assistance find it difficult to coordinate efforts in an emergency situation. Is there anything out there in the internet or elsewhere which can provide seamless coordination among agencies?*

- *Does this already "live" on the town's website? Improved outreach of the plan, when published, would be helpful- I didn't know such a thing existed for our town.*

- *Stop cutting healthy trees that hold back mudslides. Put powerlines underground.*

Finally, Question 17 asked respondents to provide their email address if they wished to receive updates regarding the status of this planning effort. Five respondents provided their email addresses. These members of the public were included on announcements related to the Plan update.

3.3 Risk Assessment

The following discussion provides an overview of the types of natural hazards that are likely to impact the NVCOG municipalities. The section includes a description of each hazard type, discusses the location that can be affected by each hazard, discusses the potential extent of each hazard, provides an historic look at recent disasters and the effects of hazards on the region, analyzes the probability the hazard will strike again, and assesses the impact of each. Specific impacts to each NVCOG municipality are presented in each municipal annex. Emphasis is given to floods, severe winter storms, and tropical cyclones (hurricanes and tropical storms) as these hazards are frequent and/or damaging in the region. Throughout the following sections all estimates of costs and damages given in dollars are not inflation adjusted.

According to the 2019 CT NHMP, "climate change is both a present threat and a slow-onset disaster" that "acts as an amplifier of existing hazards." Extreme weather events appear to be becoming more frequent over recent years and there is no indication that this trend will not continue. Higher hurricane wind speeds and increased rainfall intensity are expected to increase the impact of wind damage and flooding on the NVCOG region. Additionally, more intense heat waves may mean droughts and wildfires could be intensified or made more frequent. The impact of climate change on each hazard is discussed in appropriate sections of this Plan update.

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.

Source: FEMA Local Mitigation Handbook, 2013

Comprehensive estimates of the losses each community faces from specific natural hazards are generally not available and must be developed as part of this planning process. The costs incurred by local communities as a result of the federal disasters shown in Table 3-2 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 2-7) provides an estimate of the market value of all taxable property in each community and can give an indication of the total value of property exposed to natural disasters of a town-wide or region-wide scope. County-wide damages developed in the 2019 CT NHMP are applied in many cases herein by population percentage in order to estimate the potential annualized loss in a community due to a particular natural hazard.

Computer modeling is another means of analyzing risks from natural disasters. FEMA's HAZUS-MH model version 4.2 was used to evaluate the risks and estimate the losses the region might face to life and property 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. Level 1 (default data) were used for the analysis as this level of analysis is appropriate for a regional HMP. The HAZUS-MH model uses 2010 Census data and block boundaries as a baseline for analyzing losses along with 10-meter National Elevation Dataset digital elevation model grids to generate flood depths. 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.

Note that HAZUS-MH Level 2 and Level 3 Analyses require more extensive and site-specific structure inventory data, hydraulic modeling results, and potentially participation by a wide variety of stakeholders such as utilities and state agencies that is typically not appropriate at a regional scale. For example, higher-level analysis can be used to evaluate the potential benefits of flood mitigation projects to specific neighborhoods. HAZUS-MH Level 2 and Level 3 Analyses were therefore beyond the scope of this HMP.

3.3.1 Exposure Analysis

Whereas certain hazards such as hurricanes may affect the entire NVCOG region, other hazards such as flooding typically affect defined areas. Thus, the extent of exposure

to a particular natural hazard may vary depending upon the extent of the hazard.

Vulnerable assets were identified by intersecting GIS-based asset inventories and demographic data with hazard risk boundaries to determine the number of parcels, buildings, critical facilities, historic resources, and populations exposed to each hazard. This results in an estimation of exposure by hazard. The exposure analysis for each municipality is presented in the subsections that follow. The following inventories were used to conduct the exposure analysis:

- Dam failure exposure was determined based on dam failure inundation mapping available from Connecticut DEEP for the high and significant hazard dams in the planning area. If inundation mapping was not available, exposure was not estimated.
- Flooding exposure was based on existing digital flood insurance rate maps (FIRMs) for each community.
- Historic resources were mapped using spatial point data developed by SHPO in 2015-2017, except for Bethlehem, Bristol, Plymouth, Thomaston, Watertown, and Woodbury where existing polygons from State data were used.
- Wildfire exposure was determined using recent mapping developed by the USDA Forest Service and University of Wisconsin-Madison that depict the areas (as of 2010) that intermix or interface with wildland vegetation types. The mapping considers varying densities of vegetation and housing development.
- For the remaining hazards (earthquakes, hurricanes, thunderstorms, tornadoes, winter storms, and terrorism/mass casualty), it was assumed that all buildings and populations were at equal risk. The exposure values are equal to the total exposure of the community.

Table 3-11 presents the exposure analysis for the entire NVCOG region. The NVCOG region contains a total of 158,175 parcels valuing $44.2 billion. Significant numbers of buildings are vulnerable to flooding, including at least 55 critical facilities and 67 historic assets.

Note that drought is not considered in the exposure analysis because this hazard typically does not affect built infrastructure in the same way that other hazards may, and landslides were not included due to the lack of regional risk mapping.

3.3.2 Flooding

Flooding is the most common natural hazard encountered in the NVCOG region. Triggered by a variety of events, floods can occur during any season. Heavy precipitation is common throughout the year, and each season brings its own source of floods: From mid-summer through fall, hurricanes bring wind and torrential rain; winter nor'easters pound the region with snow and rain; in spring snowmelt inundates local hydrologic systems; and summer thunderstorms can bring flash floods in minutes. Historical development patterns encouraged dense construction of town centers near water bodies; consequently, many areas with chronic flooding problems are in population centers.

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 including the shoreline. 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

The NVCOG region is affected by riverine, flash, and shallow or nuisance flooding.

Riverine Flooding

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

Table 3-11: Exposure Summary for NVCOG Region (Number, or Value in Billions of Dollars)

Hazard	Number of Parcels	Value of At-Risk Parcels	Number of Buildings	Number of Critical Facilities	Number of Historic Assets
Dam Failure	6,509	$3.50	10,095	95	161
Earthquake	158,501	$44.18	214,179	507	2,842
Flooding					
1% Annual	5,799	$3.64	10,816	55	67
0.2% Annual	6,849	$3.60	12,229	87	98
Storm Surge					
Category 1	57	$0.05	134	3	0
Category 2	85	$0.10	177	5	0
Category 3	114	$0.12	225	7	0
Category 4	163	$0.13	281	8	0
Thunderstorm	158,501	$44.18	214,179	507	2,842
Tornado	158,501	$44.18	214,179	507	2,842
Tropical Cyclone	158,501	$44.18	214,179	507	2,842
Winter Storm	158,501	$44.18	214,179	507	2,842
Wildfire	132,817	$40.40	187,861	466	2,632

- **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.

While riverine or flash flooding are typically confined to defined channels and adjacent overbank areas, nuisance flooding can occur nearly anywhere as a result of shallow flooding or due to clogged or overwhelmed drainage systems. When drainage systems overflow near areas with steep slopes, or when heavy rainfall occurs on steep slopes, mass wasting events (landslides, mudslides) may occur as has happened in steeper sections of Waterbury.

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.

Flood Zone Descriptions

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 known informally as 100-year and 500-year floods, respectively. The area that has a 1% annual chance to flood each year is delineated as the SFHA for the purposes of the NFIP. The 0.2% annual

chance floodplain indicates areas of moderate flood hazard.

However, because the 1% annual chance floodplain (or any percent annual chance 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 and the USACE note 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. Note that the same home has only a 1% chance of being damaged by fire in the same 30-year period. The USACE has prepared a flood frequency chart (Table 3-12) that demonstrates the percent chance of flooding at various flood frequencies. Note that in many areas, the difference in flood heights between a 10% annual chance event and a 1% annual chance event is less than one foot.

Table 3-12: Description of Flooding Terminology

Flood Frequency (Years)	Chance of Flooding in Any Given Year	Percent Chance of Flooding during 30-Year Mortgage
10-Year	10%	96%
50-Year	2%	46%
100-Year	1%	26%
500-Year	0.2%	6%

Source: USACE Flood Risk Management Program

Furthermore, the 1% flood plain is based on empirical evidence. If more or less floods of a certain magnitude are observed, FEMA may restudy the flood plains 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 3-13.

SFHAs in the NVCOG region are delineated on a FIRM delineated as part of a Flood Insurance Study (FIS). Major watercourses 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 3-14 presents the flood hazard zones mapped on FIRM panels in the NVCOG region.

Table 3-13: Recurrence Interval vs. Annual Percent Chance

Recurrence Interval	Annual Percent Chance
2-Year	50%
10-Year	10%
25-Year	4%
50-Year	2%
100-Year	1%
500-Year	0.2%

Table 3-14: Flood Insurance Rate Map Zone Descriptions

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 BFEs have been determined. This area may include a mapped floodway.
AO	Flood depths of one to three feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
X (Shaded)	An area with a 0.2% chance of flooding in any given year, for which no base flood elevations have been determined. This designation includes areas protected from the 1% annual chance flood by a levee.
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.

Thus, the recurrence interval level of a precipitation event also generally differs from the recurrence interval level of the associated flood. An example would be Tropical Storm Floyd in 1999, which caused rainfall on the order of a 0.4% annual chance event while flood frequencies were only

slightly greater than a 10% annual chance event on the Naugatuck River in Beacon Falls, Connecticut. 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 historic record.

NFIP Participation

Each NVCOG municipality participates in the NFIP and plans to continue its participation. A more detailed description of this program is provided in Section 4.1.1. The number of policies and the insurance in force for each NVCOG municipality is presented in Table 3-15. The average insurance in force per policy in the region is $226,784.

Table 3-15: National Flood Insurance Program Policies and Insurance in Force

Municipality	Policies in Force	Insurance in Force	Average Insurance Per Policy
Ansonia	18	$4,865,900	$270,328
Beacon Falls	19	$5,727,100	$301,426
Bethlehem	11	$2,451,500	$222,864
Bristol	194	$41,452,200	$213,671
Cheshire	88	$26,492,300	$301,049
Derby	26	$6,694,500	$257,481
Middlebury	36	$8,884,700	$246,797
Naugatuck	93	$15,037,300	$161,691
Oxford	45	$11,298,900	$251,087
Plymouth	26	$6,952,700	$267,412
Prospect	7	$2,350,000	$335,714
Seymour	58	$12,340,200	$212,762
Shelton	244	$57,801,200	$236,890
Southbury	64	$15,484,100	$241,939
Thomaston	8	$3,269,900	$408,738
Waterbury	207	$34,647,800	$167,381
Watertown	83	$22,198,500	$267,452
Wolcott	26	$5,702,800	$219,338
Woodbury	45	$10,714,600	$238,102
NVCOG	**1,298**	**$294,366,200**	**$226,784**

Source: FEMA

Previous Occurrences

Historically, the region has experienced numerous flooding events. According to the FEMA FIS for New Haven County, major floods have occurred in 1815, 1893, 1927, 1936, 1938, 1949, 1955, 1978, 1982, 1987, and 1992. The August 1955 flood was the most severe in the region (estimated recurrence interval of 250 years) which resulted in extensive loss of life throughout the region (including in Waterbury, Ansonia, Naugatuck, Seymour, and Thomaston) and industrial losses of $21.5 million (1955 dollars). The heavily industrialized and commercial areas in Beacon Falls, Naugatuck, Seymour, and Waterbury all experienced flooding at the first or second story levels. Industrial damage in Naugatuck was approximately $10.5 million and municipal damage was approximately $40 million (1955 dollars). Industrial damage to 84 establishments in Waterbury was estimated at $14.3 million and municipal damage was estimated at approximately $39 million (1955 dollars). These sums do not include the staggering loss of personal property, business property, payrolls, and cleanup and rehabilitation costs, nor does it account for the 24 deaths in Waterbury. Watertown also experienced extensive damage. Along the Pequabuck River in Plymouth, the August 1955 flood had a less severe recurrence interval of 50 to 100 years. Large quantities of debris blocked the upper portion of the Main Street bridge and caused floodwaters to reach two to three feet above the road in the adjacent business district and resulted in the partial destruction of the bridge and flooding of 22 properties.

More recent floods noted by the FEMA FIS for New Haven County include:

- An unnamed winter storm in March 2011 produced two to four inches of snow and caused the Housatonic River to swell to two feet above flood stage. Several empty cars and trucks and around 20 houses were swept into the rain-swollen river and dozens of people were evacuated.

The National Climatic Data Center's (NCDC) Storm Events Database lists numbers of riverine and flash flood events for Fairfield, Hartford, New Haven, and Litchfield Counties, with records dating back to 1996. The storms listed in NCDC's database present only notable storm events, but unlisted storms also have a significant impact on the region. According to the database, riverine and flash flood events in these countries have resulted in 0 deaths and $75,000 in reported damages since 1996.

Focusing on the period of time occurring after the adoption of the most recent hazard mitigation plans

covering NVCOG communities, the following information characterizes recent floods in the region:

- October 24, 2017: A slow-moving cold front produced 3-6 inches of rain and flash flooding in the region. Running floodwaters 6 inches deep were reported flowing across a gas station parking lot in Naugatuck. Route 8 northbound was closed in Shelton with traffic being diverted at Exit 13.

- October 30, 2017: The remnants of Tropical Storm Phillippe produced 3-6 inches of rain across the state. King Street (Route 229) near Page Park in Bristol was closed due to a stream overtopping the road.

- September 25, 2018: Widespread rainfall amounts of 4 inches or more were reported across southern Connecticut with flash flooding resulting in numerous water rescues. Certain areas such as Hamden (outside the region) measured up to 8.6 inches of rainfall. There were multiple road closures across Ansonia due to flooding, including Crescent Street which caved in.

Probability of Future Events

Riverine and Flash Flooding

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 NCDC.

Like many areas in the United States, the NVCOG 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 [NWS]) (Hershfield, 1961). The rainfall data in this document dates from the years 1938 through 1958. These figures were the engineering standard in Connecticut many years and still widely used through 2015. This engineering standard was based on the now disproven premise that extreme rainfall series in Connecticut do not change through time such that the older analyses reflect current conditions. This challenge is discussed on the following Fact Sheet.

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.

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. This effort spurred recent work by the National Oceanic & Atmospheric Administration (NOAA) to update its precipitation recurrence figures as published in NOAA Atlas 14. As shown in Table 3-16, the 24-hour storm has increased in magnitude since the previous figures were published by the National Weather Service in 1961, with some variability in the estimates for the more extreme storms.

Table 3-16:
Increase in Total Rainfall (inches) for 24-Hour Storm

Total Rainfall by Storm Recurrence Interval	TP-40 (1961)	NRCC (2008)	NOAA (2019)
2-Year (50% Annual Chance)	3.3	3.4	3.5
10-Year (10% Annual Chance)	5.0	5.1	5.4
25-Year (4% Annual Chance)	5.6	6.4	6.6
50-Year (2% Annual Chance)	6.4	7.6	7.5
100-Year (1% Annual Chance)	7.5	9.1	8.4
500-Year (0.2% Annual Chance)	N/A	13.6	11.2

The National Climate Assessment estimates 5-20% 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.

REGIONAL CHALLENGES

INTENSE PRECIPITATION

Flooding in Waterbury. 2009
Photo: Jamison C. Bazinet

Radar image of thunderstorm line that caused flooding in September 2018

FOR MORE INFORMATION

Connecticut Institute for Resilience and Climate Adaptation (CRICA)
University of Connecticut
Avery Point Campus
1080 Shennecossett Rd
Groton, CT 06340
860-405-9214
circa@uconn.edu

WHAT IS THE CHALLENGE?

As the climate changes, the total precipitation received by Connecticut over the course of the year is increasing, as is the number of events with total precipitable moisture over 2 inches. Average 1% annual-chance 24-hour rainfall amounts have increased by 1 to 2 inches in southern New England since the 1960s.

This means that storms are becoming more intense, while aging infrastructure has not been, or can not always be, updated in a timely manner to reduce the rising flood risk. As a result, incidences of flash flooding have become a more common occurrence.

For example, on September 26, 2018, a severe thunderstorm complex lingered over Connecticut, dropping as much as 6 inches of rain in the span of several hours. This led to heavy localized flash flooding in several areas of the state.

Many drainage structures have been designed using the U.S. Weather Bureau (now the NWS) "Technical Paper No. 40" (TP-40). The precipitation figures used in this paper are based on historic rainfalls between 1938 and 1958. Both precipitation amounts and the extent of impervious surfaces (which increase runoff) have increased since TP-40 was published.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

This hazard mitigation plan update contains actions that the communities plan to take for reducing losses associated with intense precipitation events. One action recommended for most communities is to consider severe precipitation figures that have been updated since the standard (TP-40) figures were developed. Sources include the Northeast Regional Climate Center (NRCC) and the NOAA Atlas 14.

24-hour rainfall amounts for a 4% annual-chance storm (a "25-year storm) in each of these sources is presented in the table to the right (in inches).

Community	TP-40	NRCC	NOAA
Ansonia	5.6	6.2	6.9
Beacon Falls	5.6	6.2	6.9
Bethlehem	5.5	6.1	7.0
Bristol	5.5	6.4	7.1
Cheshire	5.6	6.3	6.7
Derby	5.6	6.2	6.9
Middlebury	5.6	6.2	6.9
Naugatuck	5.6	6.2	6.8
Oxford	5.6	6.2	6.9
Plymouth	5.5	6.2	7.1
Prospect	5.6	6.2	6.9
Seymour	5.6	6.2	6.9
Shelton	5.7	6.3	6.9
Southbury	5.6	6.2	6.9
Thomaston	5.5	6.2	7.1
Waterbury	5.6	6.2	6.8
Watertown	5.5	6.2	7.0
Wolcott	5.6	6.3	7.0
Woodbury	5.5	6.2	6.9

Ice Jams

Ice jam events are most likely to occur during the late winter and early spring months as temperatures begin to warm and there are periods of thawing. With the warming temperatures and increasing precipitation event intensity expected with climate change, conditions that enable ice jams may occur more frequently. This is noted on the following Fact Sheet.

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. The five forces of flooding as described by FEMA include hydrodynamic forces, debris impact, hydrostatic forces, soaking, and sediments and contaminants.

- **Hydrodynamic forces:** These are damages created by moving waters. The three ways these forces can damage a structure include frontal impact (water striking the walls of a structure), drag effect (water running alongside the walls), and eddies or negative pressure (water passing the downstream side of a structure).

- **Debris impact:** These are damages caused by the direct impact of any object that floodwaters can pick up and move to another location.

- **Hydrostatic forces:** This includes the pressure, both downwards and sideways, which standing water exerts on the floor and walls of a structure. Hydrostatic pressure can also cause damage due to buoyancy and floatation which can occur with flood waters.

- **Soaking:** This includes the warping, swelling, and changes to the form of materials and structures as a result of being submerged in floodwaters.

- **Sediments and contaminants:** The sand, sediments, chemicals, and biological contaminants (such as untreated sewage) that floodwaters can move and leave behind after the flood subsides.

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, deteriorate municipal drainage systems, and divert 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 by floodwaters and soak into soil, building components, and furniture.

Affected Population

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 19 municipalities in the region are impacted by floods on a regular basis. Impacts from flooding vary according to the severity of each flood event but can range from temporary road closures; to minor damage of personal property, to dam, septic, and sewer system failure; and even the destruction of homes and businesses and loss of lives.

While populations in floodplains or nuisance flooding areas are directly impacted by flooding, indirect impacts are more widespread. When flooding overtops and closes a roadway or an area is affected by a mudslide, it affects larger traffic patterns. When flooding overwhelms a combined sewer system and the capacity of the downstream wastewater treatment plant, the loss of capacity (and potential water quality impacts) can affect an entire community.

Repetitive Loss Properties

Flood damage is often predictable in its location. All but five municipalities in the region have one or more specific properties that are insured and have submitted claims under the NFIP multiple times. These properties are defined by the NFIP as repetitive loss properties (RLPs) or severe repetitive flood loss properties (SRLPs). A Fact Sheet about RLPs follows.

REGIONAL CHALLENGES

CLIMATE CHANGE AND ICE JAMS

1994 Pomperaug Ice Jams, Southbury
Photo: NBC Connecticut

2014 Pomperaug Ice Jam, Woodbury
Photo: Bob Falcetti

FOR MORE INFORMATION

The Northeast States Emergency Consortium (NESEC)
1 West Water Street, Suite 205,
Wakefield MA 01880
(781) 224-9876
http://nesec.org/ice-jams/

WHAT IS THE CHALLENGE?

Ice jams occur when heavy rain, warm temperatures and snow melt causes rivers to rise and break the surface layer of ice that lies on top. This broken ice then floats downstream until obstructions or constrictions such as bridges, bends, and narrow channels cause it to pile up and form a dam.

Ice jams can cause severe flooding upstream. If suddenly breached, flooding, riverbed and riverbank scouring, and damage to roads and bridges can occur downstream. The presence of floating chunks of ice, as well as cold temperatures, can exacerbate the impacts of any flooding.

Ice jam events are most likely to occur during the late winter and early spring months as temperatures begin to warm and there are periods of thawing. With the warming temperatures and increasing precipitation event intensity expected with continued climate change, conditions that enable ice jams may occur more frequently.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Ice jams are known to occur along the Housatonic River and the Pomperaug River, and can also occur along smaller streams. Southbury experienced a damaging ice jam along the Pomperaug in 1994, and another ice jam that did not end up causing damage in 2018.

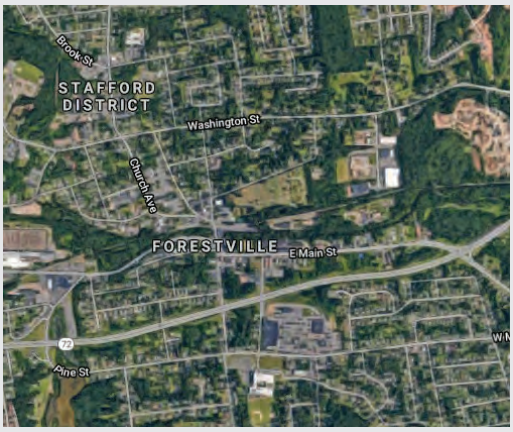
Many NVCOG communities are potentially susceptible to ice jam flooding, and should be aware of the risks and mitigation strategies.

Mitigation strategies can include:

- Identification of locations where ice jams may form (such as bridges, culverts, and stream constrictions).
- Continuous monitoring of streams (particularly ice-jam risk locations as identified above) during early spring months.
- Creation or preservation of open space along streams in areas that may be potentially impacted by ice jam flooding.
- Evaluate options for structural projects such as *tension weirs* or *sloped-block ice control structures*.

REGIONAL CHALLENGES

REPETITIVE LOSS PROPERTIES



Bristol RL Area

Flooding from the Housatonic
Photo Patch

FOR MORE INFORMATION

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WHAT IS THE CHALLENGE?

FEMA defines a Repetitive Loss (RL) property as 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.

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 is a problem in a specific area even when not obvious upon a cursory review of the setting.

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 list must be accurate. Communities must carefully check and offer corrections to their individual RL lists. Misplaced properties must be formally transferred to the correct municipality, duplicates must be cleared, and mitigation status should be updated to ensure that resources are directed to the properties with most risk and highest flood losses.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

A total of 93 RL properties are listed in the Naugatuck Valley region. A breakdown is as follows:

Community	RL Properties	Community	RL Properties
Bristol	26	Southbury	17
Cheshire	4	Thomaston	1
Derby	3	Waterbury	5
Middlebury	2	Watertown	3
Oxford	11	Wolcott	3
Plymouth	3	Woodbury	1
Shelton	14		

It is important for NVCOG communities to further reduce flood losses, and these efforts must include 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 municipalities with RL properties should work with DEEP to conduct a list validation, making corrections as needed and removing incorrect listings.

As of 2018, the NVCOG region had 93 RLPs and six (6) SRLPs, with the majority lying within Bristol, Oxford, Shelton, and Southbury. Four of these are noted as having been mitigated. Most of these properties appear to be residential. Losses reported to the NIFP as of December 14, 2020 are presented in Table 3-17.

Table 3-17: Repetitive Loss Properties and NFIP Payments

Municipality	Number of Properties	Number of Losses	Total Payments
Ansonia	0	0	$11,798
Beacon Falls	0	0	$14,529
Bethlehem	0	0	$9,660
Bristol	26	95	$3,713,059
Cheshire	4	10	$294,715
Derby	3	12	$138,385
Middlebury	2	4	$266,032
Naugatuck	0	0	$78,742
Oxford	10	70	$831,080
Plymouth	3	7	$223,230
Prospect	0	0	$2,552
Seymour	0	2	$295,158
Shelton	13	65	$1,604,506
Southbury	15	64	$1,792,674
Thomaston	1	2	$19,663
Waterbury	5	11	$914,281
Watertown	3	11	$682,643
Wolcott	3	8	$279,878
Woodbury	1	3	$98,694
NVCOG	**93**	**364**	**$11,271,279**

Source: FEMA

Loss Estimates from HAZUS-MH

Potential impacts from flooding events were evaluated using FEMA's HAZUS-MH loss estimation program. HAZUS-MH can be performed at three levels of analysis each with an increasing level of detail but at the cost of user effort and data sophistication. The analysis herein is a Level 1 analysis which uses the default HAZUS-MH data. Although studies have shown that the Level 1 analysis typically strongly overestimates the amount of damage to a community for flooding (Rozelle, et. al.), the data generated is nonetheless useful for planning purposes. In future updates to this plan, it may be possible to use a higher level of analysis if digital parcel data and building footprints are available, and funding is available to perform the additional effort. HAZUS-MH output is presented in Appendix D.

Building damage from flooding was based on a flood depth grid created using HEC-RAS software along major streams and the shoreline in the region. The flood depth was then applied to depth-damage curves and inventory data within HAZUS-MH to estimate damages to buildings expressed as the percent of the building damaged. Table 3-18 presents the results for the region. Local results are presented in each municipal annex.

Table 3-18: Building Damage from Flood

Damage	10-Year	25-Year	50-Year	100-Year	500-Year
1-10%	4,280	5,065	5,592	6,487	8,256
11-20%	3,622	4,236	4,454	5,024	6,690
21-30%	1,115	1,568	1,856	2,085	2,722
31-40%	507	657	823	951	1,548
41-50%	322	535	598	679	1,253
> 50%	735	1,249	1,639	2,122	3,858
Total	**10,581**	**13,310**	**14,962**	**17,348**	**24,327**

Source: HAZUS-MH

Economic loss was calculated in HAZUS-MH from both direct property damage and business interruption. Table 3-19 summarizes the combined economic loss for each NVCOG municipality.

Table 3-19:
Economic Loss Due to Flood (in Millions of Dollars)

Municipality	10-Year	25-Year	50-Year	100-Year	500-Year
Ansonia	$447	$598	$676	$747	$985
Beacon Falls	$122	$180	$215	$247	$337
Bethlehem	$4	$5	$6	$7	$13
Bristol	$233	$322	$388	$466	$736
Cheshire	$67	$108	$136	$171	$276
Derby	$306	$401	$455	$510	$685
Middlebury	$17	$23	$26	$29	$54
Naugatuck	$252	$348	$419	$492	$714
Oxford	$82	$107	$119	$133	$174
Plymouth	$83	$110	$130	$151	$215
Prospect	$0	$0	$1	$1	$3
Seymour	$211	$297	$334	$371	$499
Shelton	$370	$474	$527	$593	$847
Southbury	$143	$217	$274	$336	$582
Thomaston	$133	$246	$305	$370	$533
Waterbury	$674	$1,018	$1,263	$1,755	$3,258
Watertown	$54	$86	$100	$117	$176
Wolcott	$24	$34	$46	$55	$86
Woodbury	$94	$140	$167	$197	$306

Source: HAZUS-MH

Finally, the economic losses presented above were used to generate an annualized loss estimate for each NVCOG municipality due to flooding. Annualized loss estimates from HAZUS-MH are presented in Table 3-20. The economic loss and annualized loss estimates appear to be greater than what would be expected (particularly for the 10-year event) consistent with the assessment at the beginning of this section. As such, reported loss estimates will be used to estimate annualized losses as presented in the next section.

Table 3-20:
Annualized Loss Due to Flood (in Millions of Dollars)

Municipality	Building & Contents Loss	Business Disruption	Annualized Loss
Ansonia	$60.1	$62.9	$123.0
Beacon Falls	$18.3	$22.7	$41.0
Bethlehem	$0.5	$0.6	$1.1
Bristol	$34.3	$77.2	$111.5
Cheshire	$11.6	$23.0	$34.6
Derby	$40.8	$44.8	$85.6
Middlebury	$2.4	$5.3	$7.7
Naugatuck	$36.5	$55.7	$92.2
Oxford	$10.7	$8.9	$19.6
Plymouth	$11.5	$17.1	$28.6
Prospect	$0.1	$0.1	$0.2
Seymour	$29.5	$36.5	$66.0
Shelton	$48.4	$45.1	$93.5
Southbury	$23.6	$26.0	$49.6
Thomaston	$24.9	$27.6	$52.5
Waterbury	$115.2	$252.4	$367.6
Watertown	$8.7	$18.1	$26.8
Wolcott	$3.8	$8.5	$12.3
Woodbury	$14.5	$25.3	$39.8
NVCOG	**$495.4**	**$757.8**	**$1,253.2**

Source: HAZUS-MH

Other Loss Estimates

The NFIP losses track damage to individual (usually private) properties since 1978, while the FEMA Public Assistance reimbursements track damage to municipality and non-profits with records dating back to 1998. These two data sources may be added together to develop an estimated annualized loss to flooding for the region as presented in Table 3-21. The estimated annualized loss for the NVCOG region due to flooding is $0.3 million, which is reflective of the highly flood-controlled nature of the Naugatuck River valley communities.

Table 3-21: Annualized Flood Loss from NFIP and FEMA Public Assistance Reimbursements

Municipality	NFIP Losses Paid	PA Losses Paid	Annualized Loss
Ansonia	$11,798	$0	$281
Beacon Falls	$14,529	$0	$346
Bethlehem	$9,660	$1,255	$290
Bristol	$3,713,059	$442,252	$109,466
Cheshire	$294,715	$0	$7,017
Derby	$138,385	$0	$3,295
Middlebury	$266,032	$0	$6,334
Naugatuck	$78,742	$0	$1,875
Oxford	$831,080	$0	$19,788
Plymouth	$223,230	$77,265	$8,994
Prospect	$2,552	$0	$61
Seymour	$295,158	$0	$7,028
Shelton	$1,604,506	$33,091	$39,778
Southbury	$1,792,674	$0	$42,683
Thomaston	$19,663	$1,134	$522
Waterbury	$914,281	$0	$21,769
Watertown	$682,643	$13,833	$16,912
Wolcott	$279,878	$0	$6,664
Woodbury	$98,694	$21,673	$3,382
NVCOG	**$11,271,279**	**$590,503**	**$296,483**

Source: Connecticut NFIP Coordinator, FEMA

3.3.3 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, other winter storms 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 NVCOG region are susceptible to winter storms. Areas of the region at higher elevations experience more frequent effects of 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 miles per hour (mph) or greater that cause major blowing and drifting of snow, reducing visibility to less than one-quarter mile for three 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 build-ups 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 rain drops 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 six inches in 12 hours or more than 12 inches in a 24-hour period.

The Regional Snowfall Index (RSI) is used by NOAA to rank snowstorms that impact the eastern two thirds of the United States by 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. The use of population in evaluating impacts provides a measure of societal impact from the event. Table 3-22 presents the RSI categories, their corresponding RSI values, and a descriptive adjective.

Table 3-22: Regional Snowfall Index 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 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 the end of 2019.

Previous Occurrences

According to FEMA's disaster history, 6 major winter storms in the NVCOG region since 1954 have resulted in major disaster declarations. The most severe ice storm in Connecticut on record was Ice Storm Felix on December 18, 1973. This storm resulted in two deaths and widespread power outages throughout the state. The Blizzard of February 1978 brought record snowfall amounts to several areas of Connecticut as heavy snow continued unabated for an unprecedented 33 straight hours. The state was essentially shut down for three days when all roads were ordered closed except for emergency travel. The storm was responsible for over 100 deaths, 4,500 injuries, and $520 million in damages (1978 United

States Dollars, or USD). This storm is rated 4th overall in the RSI as an "Extreme" storm.

Overall, a total of nine extreme, crippling, and major winter storms have occurred in Connecticut during the past 30 years. One is listed for each of the years 1993, 1996, 2003, 2007, 2010, 2013, and 2015. Two are listed in the calendar year 2010 along with two more significant storms, a significant storm in 2011, and a single major storm in 2013 and 2015. Considering nor'easters only, 11 major winter nor'easters have occurred in Connecticut during the past 30 years (in 1988, 1992, 1996, 2003, 2006, 2009, 2010, two in 2011, 2013 and 2015). Alarmingly, the historic record appears to show more frequent occurrence of severe winter storms or nor'easters over time in the past 30 years.

The following information from NOAA provides an overview of major winter weather events in recent history:

- 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 15-16, 1994: A Siberian air mass brought record to near-record low temperatures across Connecticut. Strong northwest winds accompanied the cold and drove wind chill values to 30 to 50 degrees below zero.

- December 23, 1994: An unusual snowless late December storm caused gale force winds across the state. The high winds caused widespread power outages affecting up to 130,000 customers statewide. Numerous trees and limbs were blown down, damaging property, vehicles, and power lines to a total of $5 million in damages. Peak wind gusts of up to 64 mph were reported.

- January 7-8, 1996: Winter Storm Ginger was one of the most significant winter storms to hit southern New England in the past 30 years. Snowfall across the north and northeast portions of the state ranged from 15 to 23 inches. This storm disrupted transportation systems and closed schools and businesses. Connecticut received a federal major disaster declaration. The storm has an RSI rating of "Extreme" and is currently ranked 3rd on the RSI.

- December 7, 1996: This storm brought heavy, wet snow and resulted in widespread power outages. A total of 225,000 electric customers lost power statewide. 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 repair fallen wires. 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.

- 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.

- February 12-13, 2006: This nor'easter is ranked 35th overall as a "Significant" storm on the RSI scale. The storm produced 18 to 24 inches of snow across Connecticut, with ten to 16 inches of snow accumulating across southern Litchfield County. Five Connecticut counties received a federal emergency declaration.

- December 11, 2008: Freezing rain created treacherous travel conditions for the evening commute across portions of southern Litchfield County, with ice accretions up to 0.2 inches. An estimated 5,000 customers lost power and many schools and businesses were closed the following day.

- December 2010 through February 2011: A series of significant heavy snow events occurred between December 26, 2010 and February 2, 2011. From

February 1st through the 2nd, a total of 6-11 inches of snow fell across Hartford County, with upwards of a quarter inch of ice accumulation for isolated locations. Across Connecticut, numerous roof collapses due to heavy snow load occurred. Snow for the winter season totaled 86.4 inches.

- October 29, 2011: Winter Storm "Alfred" produced high winds and 12 to 18 inches of heavy wet snow across Connecticut. The combination of heavy snow on tree limbs and on fairly saturated ground caused widespread snapping and uprooting of trees and tree limbs. Over 830,000 customers were without power with some outages lasting 11 days or more. The storm resulted in ten deaths and caused over $3 billion in damage in Connecticut. Homes were without electricity for approximately one week or more in many areas, with tree damage and power line damage being the biggest impact in the communities.

- February 7-9, 2013: An historic blizzard deposited tremendous amounts of snow over southern New England. Most locations received 20 to 33 inches of snow. Isolated thunderstorms were common across the region during the height of the storm. During the night, rates of accumulation reaching 2 to 3 inch per hour were common throughout the region. The Connecticut Department of Agriculture reported that more than 140 agricultural structures were damaged or destroyed throughout the state because of the weight of the snow. This event was classified as a "Major" storm and is listed 18th in the RSI ranking.

- January 25-26, 2015: A strong nor'easter brought strong winds and deposited tremendous amounts of snow over southern New England. Most locations received at least a foot of snow; some received up to three feet. During the night, rates of accumulation reaching 2 to 3 inch per hour were common throughout the region. Snow removal in parts of Connecticut took two to three days. This event was classified as a "Major" storm and is listed 28th in the RSI ranking. This January storm resulted in a federal disaster declaration for the entire state.

- March 14-15, 2017: A very significant snowstorm impacted southern Litchfield County featuring extremely heavy snowfall and blizzard conditions. Storm total reports of 16 to 20 inches were received. The snow fell at 1 to 4 inches per hour for much of the day. There was a widespread extreme public impact, with many roads severely impacted and schools closed. The governor issued a statewide travel ban on state roads. In addition to the snowfall, gusty winds up to 50 mph resulted in near-zero visibility and blizzard conditions across the county. The winds brought considerable blowing and drifting of snow.

Probability of Future Events

Winter storms of varying levels of severity are fairly common in the region as seen in the historic record. Data from the weather station in Woodbury reveals that in an average year it snows approximately 43 inches. A record of 36 inches in 24 hours was set at the Ansonia station in February 2013. Winter storms are most likely to occur during December through March. Wintry precipitation such as sleet and freezing rain occurs on additional days each year. These data demonstrate that the NVCOG region should expect several heavy snows per year and therefore its municipalities should be adequately prepared for these storms.

According to the 2019 CT NHMP, recent climate change studies predict a shorter winter season for Connecticut (by as much as two 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.

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.

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.

Transportation Impacts

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. Larger and more densely populated cities have the greatest number of miles of roads than rural towns. The potential snow-removal burden is, therefore, much lower in the rural town, as is the magnitude of travel-related impacts due to the lower road capacity. Conversely, the travelers in rural areas face a potentially greater risk of being affected by the winter storm due to the lower density of roads (which provide fewer alternate routes) as well as the often 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 sightlines 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.

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 8th, 2013, Governor Malloy called for a traffic ban on all vehicles except for those emergency response and recovery vehicles with the capacity to maneuver in heavy snow for the following day. Events with large impacts on transit also have major economic impacts, like preventing employees from reaching work and halting or delaying shipments and deliveries.

Roof Collapse

Heavy snow and ice accumulation bring the threat of roof collapse and catastrophic damage to the building's occupants. As seen in Table 3-23, snow alone can put a large burden on roofs, however when coupled with rain and sleet, this load per square foot increases.

Table 3-23: Weight of Snow on a Roof

Type	Equivalent Weight to 1" of Water	Load per Square Foot	Maximum Load for Typical Roof
Fresh Snow	10-12"	5 lbs.	4 feet
Packed Snow	3-5"	5lbs.	2 feet

Source: Insurance Institute for Business & Home Safety

Two feet of old snow and two feet of new snow could weigh as much as 60 pounds per square foot (psf) of roof space, which is beyond the typical snow load capacity of most roofs. One inch of ice is equivalent to one foot of fresh snow. A house should be able to support 20 psf of snow (IIBHS, 2020). In particular, the winter of 2011 saw many buildings across Connecticut condemned due to snow accumulation collapsing their roofs.

Areas with greater levels of development are also at greater risk of business disruptions, loss of life, and damage to structures. Cities have the greatest level of development 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.

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. (IINC, 2014). While there are few records of burst pipes in the region, in nearby 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, 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 it can cause damage to property, disrupt business, and threaten lives if heating systems are impacted.

Affected Population

Winter storms and cold weather typically affect the entire population of a municipality although impacts may vary by location. 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.

According to the NOAA NWS, approximately 70% of winter deaths related to snow and ice occur in automobiles, and approximately 25% of deaths occur from people being caught in the cold. In relation to deaths from exposure to cold, 50% are people over 60 years old, 75% are male, and 20% occur in the home.

Loss Estimates

Snow and ice removal have 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 diverts such staff from other municipal projects. Other municipalities 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 $50,000 and $1 million per year on snow and ice management.

Based on the public assistance reimbursements in Table 3-2, the NVCOG Region has incurred losses of approximately $19.8 million since 1998 (21 years) from impacts due to winter storms. Based on this information, the annualized loss due to winter storms in the NVCOG region is $943,618. Annualized losses due to winter storms for each NVCOG 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 NVCOG region to winter storms.

Table 3-24: Annualized Winter Storm Loss from FEMA Public Assistance Reimbursements

Municipality	PA Losses Paid	Annualized Loss
Ansonia	$636,053	$30,288
Beacon Falls	$267,558	$12,741
Bethlehem	$119,632	$5,697
Bristol	$5,266,736	$250,797
Cheshire	$1,478,351	$70,398
Derby	$472,425	$22,496
Middlebury	$843,660	$40,174
Naugatuck	$1,156,368	$55,065
Oxford	$673,586	$32,076
Plymouth	$851,631	$40,554
Prospect	$823,755	$39,226
Seymour	$630,625	$30,030
Shelton	$283,474	$13,499
Southbury	$1,333,867	$63,517
Thomaston	$201,568	$9,598
Waterbury	$2,827,123	$134,625
Watertown	$548,770	$26,132
Wolcott	$982,209	$46,772
Woodbury	$418,579	$19,932
NVCOG	**$19,815,970**	**$943,618**

Source: FEMA

3.3.4 Tropical Cyclones and Hurricanes

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

The entire NVCOG region is susceptible to wind damage from tropical cyclones. Low lying areas (such as floodplains) can experience additional impacts of tropical cyclones such as flooding.

REGIONAL CHALLENGES

POWER OUTAGES

Destroyed transformer, Nov 2020
Photo: John McKenna

Downed tree on a pole in New Hartford, October 2011
Photo: Mike Agogliati

FOR MORE INFORMATION

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WHAT IS THE CHALLENGE?

Power loss due to natural hazards is a major concern for communities throughout the state. A power outage may:

- Disrupt communication, water, and transportation infrastructure
- Close retail businesses, grocery stores, gas stations, ATMs, banks and other services
- Cause food spoilage and water contamination
- Prevent use of medical devices

These impacts can disrupt daily life, cause business interruptions, lead to property damage, and even have negative health impacts.

Power outages can be caused by a variety of natural hazards, including:

- High wind events or snow events downing tree limbs onto power lines, or downing power lines themselves
- Flooded soils or erosion undermining utility poles
- Flooding of underground powerlines
- Lightning strikes
- Grid failure during energy use surges in severe heat conditions
- Planned outages during extreme drought to mitigate wildfire risk

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Municipalities can mitigate damages and disruption caused by outages by working to increase the resiliency of the power grid, improving outage response, installing emergency generators in critical facilities, developing local power generation and microgrids, and helping residents and businesses prepare for outages.

Some mitigation actions include the following:

- Coordinate with the local energy utility on efforts to improve grid resiliency and outage response.
- Perform public outreach and education about power outage safety and mitigation.
- Maintain public “comfort stations” for residents without power to keep warm or cool, and recharge electronic devices.
- Create a communications plan that considers power loss, and the possible loss of internet and phone capabilities that may result.
- Maintain a list of residents who rely on powered medical devices to facilitate check-ins and response during power outages.
- Install backup power at critical facilities
- Explore development of local power generation (such as solar panels) and microgrids

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 of 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. The NWS defines the 5 categories as follows:

- Category 1: Winds of 74-95 mph will produce some damage. Well-constructed frame homes could have damage to roof, shingles, vinyl siding, and gutters. Damaged expected to unanchored mobile homes (mainly pre-1994 construction). Some damage to poorly constructed signs. Loose outdoor items become projectiles, and persons struck by windborne debris risk injury and possibly death. Numerous large tree branches will snap, and shallowly 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. Hurricane Gloria in 1985 was a Category 1 hurricane at landfall.

- Category 2: Strong winds of 96-110 mph will cause widespread damage. Well-constructed frame homes could sustain major roof and siding damage. Considerable damage to mobile homes and loose outdoor items may become airborne. Persons struck by windborne debris risk injury and possibly death. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss expected with outages that could last from several days to weeks. Hurricane Bob in 1991 was a Category 2 hurricane when it made landfall in Rhode Island.

- Category 3: Dangerous winds of 111-130 mph will cause extensive damage. Well-built frame homes may incur major damage or removal of roof decking and gable ends. Mobile homes and poorly constructed signs likely to be destroyed. Persons struck by windborne debris risk injury and possibly death. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water unavailable for several days to weeks after the storm passes. The 1938 Hurricane was a Category 3 when it made landfall in Connecticut.

- Category 4: Extremely dangerous winds of 131-155 mph will cause devastating damage. Well-built frame homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls, doors, and windows. Complete destruction of mobile homes. Windborne debris will cause extensive damage and persons struck will be injured or killed. 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 months. Most of the area will be uninhabitable for weeks or months.

- Category 5: Catastrophic winds greater than 156 mph will cause widespread destruction. A high percentage of framed homes and mobile homes will be destroyed with total roof failure and wall collapse. Severe injury or death likely for persons struck by windborne debris. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months, and most of the area will be uninhabitable for weeks or months.

Previous Occurrences

Tropical cyclones are the most destructive natural disasters that threaten Connecticut due principally to their accompanying storm surge (being inland, storm surge is not a concern for the NVCOG region). The NVCOG region has experienced damaging tropical cyclones 8 times since 1954 according to Table 3-1. According to NOAA, 34 tropical cyclones have passed within 50 miles of New Haven County from 1851 to 2020, including 3 Category 3 storms (including the 1938 Hurricane and Hurricane Carol in 1954), 2 Category 2 storms (the 1944 Hurricane and Hurricane Donna in 1960), 6 Category 1 hurricanes. Figure 3-3 presents the historical hurricane tracks as presented by NOAA. In general, the tracks trend from the southwest to the northeast across the region.

REGIONAL CHALLENGES

CLIMATE CHANGE AND HURRICANES

Downed tree in Waterbury from Tropical Storm Isaias
Photo: Isabella Gentile

Tree damage from Isaias in Woodbury
Photo: Jennifer O'Brien

FOR MORE INFORMATION

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WHAT IS THE CHALLENGE?

Hurricanes pose a natural hazard risk to both coastal and inland municipalities. Hurricane hazards include storm surge, high winds, and heavy precipitation. Hurricanes can severely impact communities by way of flooding, downed trees or power lines, and other wind related damage.

Researchers have utilized climate change models to evaluate the potential shifts in hurricane occurrences as a result of climate change. It was found that while the number of hurricane events has not increased in recent years, there has been a notable difference in the location. Since 1980, the number of events has been rising in the North Atlantic and Central Pacific and declining in the Western Pacific and South Indian Ocean.

As the climate continues to change, water ocean temperatures are expected to fuel stronger hurricanes, and to enable these storms to retain their strength further northward (Center for Climate and Energy Solutions, www.c2es.org). Connecticut can expect hurricane strikes to occur more frequently and be more severe.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

The NVCOG region is comprised of inland municipalities, with the lower Naugatuck and Housatonic communities somewhat impacted by coastal effects. Hurricane damages tend to be caused primarily by high winds leading to downed trees and power outages; riverine flooding from intense precipitation and storm surge has caused damage as well.

NVCOG communities should be aware of observed and projected shifts in hurricane patterns, identify vulnerabilities, and prepare for future hurricane events.

The hazard mitigation plan update identifies several hazards mitigation strategies that are applicable throughout the region:

- Work with electric utilities to increase the **resiliency of the power grid**, and improve outage response capabilities
- Install **backup power** at critical facilities
- Implement **flood mitigation** measures for infrastructure and critical facilities that are at risk of inundation during a storm event
- Inventory **hazardous trees** and support aggressive trimming and removal efforts
- Utilize up-to-date precipitation figures or stream continuity standards to **upsize undersized culverts** and bridges that are at risk of failure or washout during large flood events

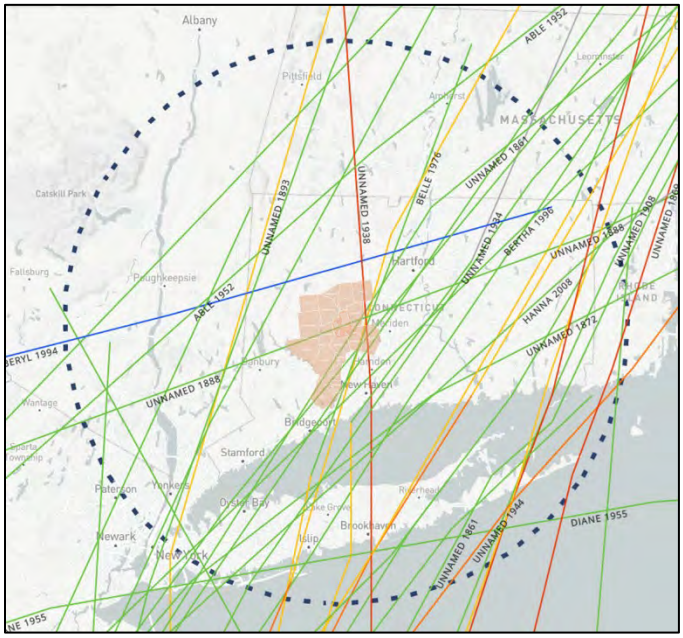


Figure 3-3: Hurricane Historical Tracks
Source: NOAA

The wind and rain brought by historic tropical storms and hurricanes caused flooding, property damage, power outages, and left extensive debris and detritus in their wake. The most destructive and powerful recorded hurricane to hit Connecticut struck on September 21, 1938. Named the Great New England Hurricane of 1938, the strongest winds ever recorded in Southern New England occurred during this storm at the Blue Hill Observatory with sustained winds of 121 mph and a peak gust of 186 mph. The worst damage was concentrated on the coast due to massive storm surges of 14 to 18 feet. However, inland communities were not spared. Rainfall of 10 to 17 inches from the hurricane resulted in severe river flooding across Connecticut, washing away road and sections of the New York, New Haven, and Hartford Railroad lines. The Connecticut River in Hartford reached a level of 35.4 feet, which was 19.4 feet above flood stage. A total of 8,900 homes, cottages and buildings were destroyed, and over 15,000 were damaged by the hurricane. Across Southern New England 564 people died and over 1,700 were injured (NWS Forecast Office, 2005). Due to its destruction, the hurricane of 1938 is often used as a benchmark when assessing the worst-case scenario for future hurricanes to strike the region.

While no other hurricane has caused the level of destruction in Connecticut as the 1938 hurricane, other storms of significance have hit the region. The following provides an overview of these recent storms:

- Hurricane Gloria of September 1985 was a Category Three Hurricane when it made landfall in North Carolina and weakened to a Category 1 Hurricane before its center made landfall near Bridgeport. The hurricane struck at low tide, resulting in low to moderate storm surges along the coast. The storm produced up to six inches of rain in some areas and heavy winds that damaged structures and uprooted thousands of trees. The amount and spread of debris and loss of power were the major impacts from this storm, with over 500,000 people suffering significant power outages. Many residents in the region evacuated to emergency shelters, and New Canaan, Westport, and other municipalities set up emergency water distribution centers to provide clear water to residents who did not have electricity to pump water from their wells.

- September 16-21, 1999: Tropical Storm Floyd dropped an average of four to eight inches of rain across the State. Sixteen buildings in the state were utterly destroyed by the storm. The storm caused $2.2 million in damage, widespread power outages throughout New England, and at least one death in Connecticut.

- August 28, 2011: Irene first made landfall in North Carolina as a Category 1 hurricane before moving north. By the time it reached the New York area, it was downgraded to a tropical storm. Dropping torrential rain on Connecticut, the storm caused widespread flooding, knocked power out to 754,000 customers, and left many roads impassable. According to the 2019 CT NHMP, "2-3 percent of trees within 50 feet of the centerline of state roads were felled by the storm" and the storm caused over $10 million in fiscal impacts to State infrastructure. Ten deaths were attributed to the storm in Connecticut, including one in Prospect caused by a fire started by a falling tree limb.

- October 29, 2012: Tropical Storm Sandy formed in the Caribbean on October 22. Moving up the coast, hitting New Jersey and New York on October 29, 2012, Tropical Storm Sandy caused extensive flooding

and damage on Connecticut's coast. The National Hurricane Center Tropical Cyclone Report estimated the death count from Sandy at 147 deaths, including 5 in Connecticut. Sandy was the deadliest hurricane to hit the United States since Hurricane Katrina in 2005. About 670,000 customers in Connecticut lost power during the storm.

- August 3-4, 2020: Tropical Storm Isaias produced wind gusts of up to 70 mph along the coastline and heavy rain to the region, knocking down trees and causing widespread power outages. A tropical storm warning, flash flood watch, and tornado watch was issued by the NWS for the storm. Many roads were closed due to fallen trees and limbs: Route 132 was closed at Nonewaug Road in Bethlehem due to downed wires; Route 34 in Derby was closed due to downed trees blocking the road; Interstate 691 in Cheshire had a lane closure at Exit 2 due to a tree fallen over the left lane; and a Naugatuck man was killed by a falling tree as he tried to clear debris from his car during the storm.

Probability of Future Events

Return periods can be a helpful tool to put risk in perspective. Resident and business leaders should ask themselves, "How often 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 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 with 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. Based on this, the occurrence of another hurricane to impact the state can be expected within the foreseeable future.

The 2019 CT NHMP 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 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. This is discussed on the following Fact Sheet.

Impacts to Community Assets

According to the 2019 CT NHMP, hurricanes have the greatest destructive potential of any natural disasters in Connecticut due to the potential combination of high winds, storm surge and coastal erosion, heavy rain, and flooding that can accompany the hazard. It is generally believed that New England is long overdue for another major hurricane strike. Factors that influence vulnerability to tropical cyclones in the NVCOG 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),

PAST STORM EVENTS

AUGUST 2020: TROPICAL STORM ISAIAS

Eversource outages post-storm
Photo Republican-American

Wind damage in Bethel
Photo Ctpost.com

Damage in Westport
Photo Ctpost.com

WHAT WAS THE EVENT

On August 4, 202 Tropical Strom Isaias moved through the northeast producing widespread tropical storm conditions. The tropical storm warning included gale forces winds, and possible tornadoes throughout the state. Anticipated rainfall totals were low for the state of Connecticut with expected accumulations of 1 to 3 inches

The storm resulted in wind gusts of up to 70 mph, and sustained winds up to 65 mph. In addition to sever tree and powerline damage, the National Weather Service confirmed an EF1 tornado touched down in the Town of Westport. The tornado likely produced winds between 95 and 105 mph, and traveled roughly 50 yard.

Eversource reported over 632,000 outages, with some customers throughout western Connecticut without power for 9 days.

On August 6, 2020 this event was officially declared a disaster by the federal govenrment for the entire state.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Tropical storms and hurricanes are often tracked long before they make landfall here in Connecticut. These events are typically detected in the southern Atlantic and tracked for days prior to threat in the northeast.

This long-range tracking allows for short term preparation, along with the implementation of long-term mitigation.

Long-term mitigation efforts would include emergency service preparation, flood mitigation, wind mitigation, and public education. It is important a municipality is continuously maintaining and improving emergency services, such as shelters, evacuation plans, and emergency power to critical facilities. Flood mitigation might include implementing measures at critical facilities or assisting residents with executing the necessary property upgrades. In addition, wind damage is a huge concern with this type of event. Wind retrofits are critical facilities should be evaluated, along with tree maintenance to reduce risk to electric infrastructure. Public education might include reminding residents of storm prep at the beginning of hurricane season and disseminating information on where they can receive emergency information and important contact information for the town.

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 too cost-prohibitive to be implemented in a widespread manner.

Affected Population

The population of the entire region is anticipated to be affected when a tropical cyclone strikes. Furthermore, 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

HAZUS-MH was utilized to perform analysis of potential wind events in order to calculate potential annualized loss for tropical storm wind damage. HAZUS-MH uses a hazard-load-resistance-damage-loss methodology to produce wind loss estimations. Expected buildings losses are estimated using wind models and damage probabilities based on building type.

The default building stock in HAZUS-MH was used for the analysis. According to this database, there are 154,783 buildings in the NVCOG region. Table 3-25 presents the numbers of buildings damaged by wind in the region for each probabilistic storm as well as modern recurrences of 1938 hurricane, 1985's Hurricane Gloria, and 2012's Tropical Storm Sandy.

For the NVCOG region, HAZUS-MH did not estimate that any damage would occur for the 10-year wind event, and generally estimated that Gloria and Sandy had effects being less than 100-year wind events. The 1938 hurricane would approximate a 500-year wind event.

Table 3-25:
Number of Buildings Damaged in Region Due to Wind

Return Period or Storm	Minor Damage	Moderate Damage	Severe Damage	Destruction
10-Year	0	0	0	0
20-Year	91	4	0	0
50-Year	386	21	1	0
100-Year	1,980	153	6	0
200-Year	6,598	717	26	2
500-Year	18,448	2,999	156	51
1000-Year	30,808	6,519	456	185
Sandy	43	2	0	0
Gloria	654	43	2	0
1938	19,333	3,077	149	47

Source: HAZUS-MH

Essential facilities in the region included in HAZUS-MH include 5 hospitals, 21 EOCs, 59 fire stations, 23 police stations, and 229 schools. These facilities are geolocated within the HAZUS-MH database such that they are susceptible to differing levels of wind damage based on their position in the region. Table 3-26 summarizes the number of essential facilities damaged for each wind event.

Table 3-26: Average Percent Damage to Essential Facilities Due to Wind

Return Period or Storm	EOC	Fire Depts.	Hospitals	Police Depts.	Schools
10-Year	0%	0%	0%	0%	0%
20-Year	0%	0%	0%	0%	0%
50-Year	0.1%	0.1%	0.4%	0.1%	0.1%
100-Year	0.5%	0.2%	0.7%	0.5%	0.5%
200-Year	1.1%	0.5%	0.8%	1.1%	1.1%
500-Year	2.0%	0.9%	0.9%	2.0%	2.2%
1000-Year	6.4%	3.2%	1.6%	6.3%	6.8%
Sandy	0.0%	0.0%	0.7%	0.0%	0.0%
Gloria	0.2%	0.1%	0.5%	0.2%	0.1%
1938	2.3%	1.0%	1.0%	2.3%	2.5%

Source: HAZUS-MH

The estimates for the amount of debris generated from wind damage is presented in Table 3-27. The NVCOG region is predicted to experience 1.0 million tons of debris in a 100-year wind event and 4.2 million tons of debris in a 1,000-year wind event.

Table 3-27: Debris Generation Due to Wind (Tons)

Return Period or Storm	Brick / Wood	Reinforced Concrete / Steel	Tree Debris	Total
10-Year	0	0	0	0
20-Year	0	0	0	0
50-Year	1,374	0	8,962	10,336
100-Year	22,524	1	1,009,580	1,032,105
200-Year	42,682	5	1,435,521	1,478,208
500-Year	69,285	50	1,710,523	1,779,858
1000-Year	186,829	640	4,017,423	4,204,892
Sandy	83	0	119	202
Gloria	4,219	0	31,402	35,621
1938	79,493	86	1,843,231	1,922,810

Source: HAZUS-MH

The HAZUS-MH simulations suggest that sheltering need will be relatively modest in the region for all but the 1,000-year wind event. Potential shelter requirements are presented in Table 3-28.

Table 3-28: Shelter Requirements Due to Wind

Return Period or Storm	Number of Displaced Households	People Needing Short-Term Shelter
10-Year	0	0
20-Year	0	0
50-Year	0	0
100-Year	34	28
200-Year	253	160
500-Year	952	604
1000-Year	1,897	1,205
Sandy	0	0
Gloria	0	0
1938	1,004	642

Source: HAZUS-MH

HAZUS-MH calculated economic loss based on both direct property damage and business interruption. Direct property damage includes the estimated costs to repair or replace the damaged caused to the buildings and its contents. The business interruption costs are those associated with the inability of a business to function due to the tropical cyclone. Table 3-29 summarizes the economic loss to the region for each scenario.

The probabilistic tropical cyclone scenarios presented above were used to generate an annualized loss estimate for each municipality in the NVCOG region. Results are presented in Table 3-30.

Table 3-29: Economic Losses in Region Due to Wind (Thousands)

Municipality	Property Loss	Business Interruption (Income) Loss	Total Losses
10-Year	$0	$0	$0
20-Year	$61	$8	$69
50-Year	$32,444	$637	$33,081
100-Year	$126,123	$4,178	$130,301
200-Year	$301,401	$19,798	$321,199
500-Year	$766,282	$66,849	$833,131
1000-Year	$1,413,623	$137,033	$1,550,656
Sandy	$3	$486	$489
Gloria	$51,346	$0	$51,346
1938	$779,619	$5,347	$784,966

Source: HAZUS-MH

Table 3-30: Annualized Economic Loss in Region Due to Wind (Thousands)

Municipality	Property Loss	Business Interruption (Income) Loss	Total Annualized Losses
Ansonia	$407	$2	$409
Beacon Falls	$106	$1	$107
Bethlehem	$50	<$1	$50
Bristol	$1,098	$5	$1,103
Cheshire	$636	$3	$640
Derby	$298	$2	$300
Middlebury	$103	$1	$104
Naugatuck	$469	$2	$470
Oxford	$192	$1	$193
Plymouth	$170	<$1	$170
Prospect	$142	<$1	$142
Seymour	$329	$1	$330
Shelton	$880	$5	$885
Southbury	$319	$1	$320
Thomaston	$117	<$1	$118
Waterbury	$1,838	$10	$1,848
Watertown	$339	$1	$340
Wolcott	$234	$1	$235
Woodbury	$133	<$1	$133
NVCOG	**$7,859**	**$37**	**$7,896**

Source: HAZUS-MH

3.3.5 Tornadoes and High Winds

Tornadoes are a rare 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 NVCOG region 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 as shown in Figure 3-4.

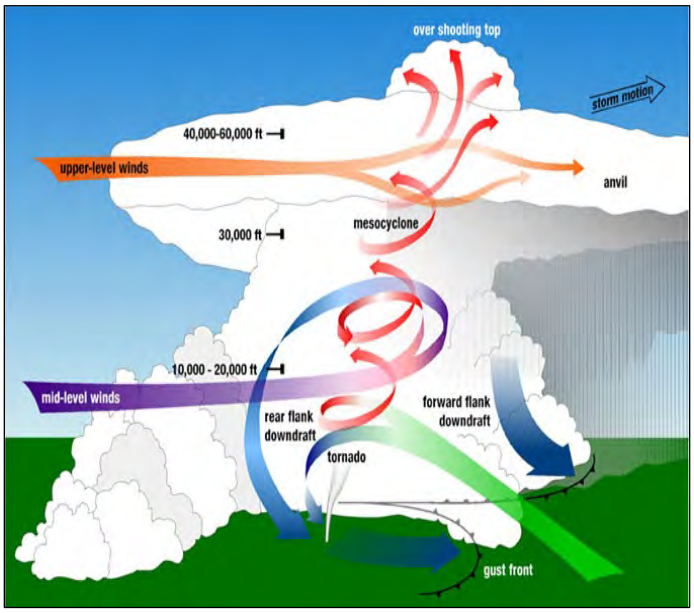


Figure 3-4: Anatomy of a Tornado
Source: NOAA National Severe Storms Laboratory

The strength of tornados 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 three-second gusts estimated at the point of damage based on a judgement of eight levels of damage to 28 specific indicators. Table 3-31 links EF classifications to estimated three-second wind gusts.

Table 3-31: Enhanced Fujita Scale

F-#	F Scale 3-Second Gust (mph)	EF-#	EF Scale 3-Second Gust (mph)
0	45-78	0	65-85
1	79-117	1	86-110
2	118-161	2	111-135
3	1662-209	3	136-165
4	210-261	4	166-200
5	262-317	5	Over 200

Source: NOAA

Previous Occurrences

Sixteen tornadoes have touched down within the NVCOG region in the past seventy years.

An extensively researched list of tornado activity in Connecticut is available on Wikipedia. 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 NVCOG region are noted below:

- June 20, 1682: A violent storm, including one or more likely tornadoes, devastated forests in southern Connecticut. The damage was worst around present-day Shelton, where a path was cut a half-mile wide where there was "scarce a tree left standing".
- August 17, 1784: Two tornadoes struck Connecticut, including one that touched down near present-day Roxbury and travelled through the village of South Britain in Southbury, injuring five people and badly damaging or destroying 10 houses, five barns, and three mills.
- July 22, 1817: A tornado produced tree damage from Woodbury to Watertown.
- July 1865: A tornado may have struck Birmingham (Derby).
- September 15, 1901: A damaging tornado swept through Huntington (Shelton) around 7 pm. One man was killed when his house was torn from its foundation. Several barns were destroyed (one "completely disappeared") and hundreds of trees were leveled on a path from Shelton to Monroe.

- July 26, 1937: A tornado produced F2 damage while passing just south of Terryville (Plymouth) and just north of Bristol.

- September 24, 1942: A tornado destroyed a garage in Bristol along a 3-mile path into Plainville.

- August 21, 1951: A long-tracked F2 tornado touched down in New Milford, passing more than 40 miles (64 km) across the northern part of the NVCOG region and well into Hartford County. Nine people were injured.

- May 24, 1962: An F3 tornado tracked from northern New Haven to southern Hartford County. The tornado produced "near F4 damage" in parts of Waterbury and Southington with more than 200 buildings destroyed and another 600 damaged. One person was killed, fifty injured, and the tornado caused $4 million in damage along its 11.6-mile path.

- July 29, 1971: An F3 tornado (some sources say F2) moved along Main Street in downtown Waterbury, unroofing a factory and damaging some houses. Two people were injured.

- July 12, 1973: An F2 tornado touched down in Watertown.

- July 3, 1974: An F1 tornado tracked 5 miles southeast through Woodbury.

- July 28, 1982: An F1 tornado tracked through Oxford.

- July 5, 1984: An F2 tracked from Bristol to Farmington, injuring one person and causing $500,000 in damage to houses and cars.

- July 10, 1989: The Northeastern United States tornado outbreak of 1989 produced at least three tornadoes casing more than $100 million in damage. The second tornado, an F2, unroofed or severely damaged 50 homes and injured 70 people on a path through Watertown, Oakville, and northern Waterbury. A camper was killed when related straight-line winds blew a tree onto her tent in Watertown.

- May 29, 1995: An F1 tracked 2 miles from South Britain to Southbury, downing many trees and causing minor damage to several homes.

- July 23, 1995: An F0 struck Prospect. A tractor-trailer was thrown 200 yards through the air, but no injuries were reported.

- July 3, 1996: An F1 touched down just north of downtown Waterbury, causing damage to Wilby High School.

- July 31, 2009: Significant wind damage was reported across the state, including two EF1 tornadoes. The first tornado caused tree and minor property damage along a 0.5-mile path through eastern Shelton. Many trees were also snapped and uprooted in Naugatuck.

- July 21, 2010: Several severe storms spawned five brief tornadoes and spread straight-line winds across the state. An EF1 tornado was confirmed in Bristol near Blakeslee and High Streets with a path 1.5 miles long and winds of 90 mph. Touchdowns were also reported in Thomaston near D. Welter Way and in Terryville (Plymouth) near North Street. Tree tops were twisted off and several trees were uprooted.

- July 27, 2014: An EF0 tornado caused minor damage in Wolcott, mostly at and near the high school.

- May 15, 2018: Four tornadoes, three EF1 and one unrated, struck Connecticut. The third tornado (EF1) struck Southbury and Oxford, damaging the roof of Great Oak Middle School, and causing the district to miss five days of school. Many roads were impassible due to downed trees, and several people were trapped in cars.

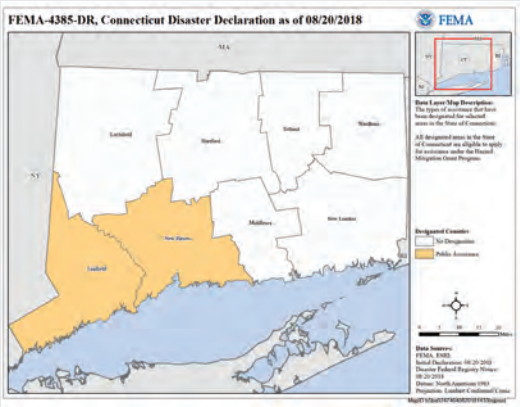
- August 27, 2020: Three tornadoes impacted the state. The second was a brief EF0 that caused tree damage along Quanopaug Trail in Woodbury.

Probability of Future Events

According to the 2019 CT NHMP, "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

PAST STORM EVENTS

MAY 2018: TORNADO & MACROBURST EVENT



FEMA-4385-DR, Connecticut Disaster Declaration as of 8/20/2018
Photo FEMA.gov

Damage in Southbury
Photo wfsb.com

WHAT WAS THE EVENT?

On May 15, 2018 a confirmed EF1 tornado touched down in Southbury and traveled roughly 4.2 miles were it ended in Oxford. The path of this event was about 400 yards wide, with an estimated maximum wind speed of 100 mph. The tornado resulted in numerous uprooted and snapped trees and caused room damage to the Great Oak School in Oxford.

A confirmed EF1 tornado also touched don in Beacon Falls and traveled 9.5 miles and ended in Hamden. This tornado have a 600-yard-wide path, with estimated maximum wind speeds of 110 mph. This tornado destroyed a barn in Bethany, and resulted in severe tree damage along the path and at Sleeping Giant State Park.

On this date there were also events in surrounding areas outside of the NVCOG region. A macroburst occurred starting in New Fairfield, traveling roughly 9 miles, and ending in Brookfield. The event had an estimated maximum wind speed of 110 mph, and a path width of approximately 3 miles. There was also a confirmed microburst from Hamden to Wallingford.

Eversource reported 288 miles of power lines down as a result of the storm, with almost 140,000 outages at the height of the storm.

LINK TO HAZARD MITIGATION

Since 2014, the National Centers for Environmental Information (NCEI) only reported losses from one tornado event in the region. While this seems like a potentially less frequent event, the associated risks of this type of hazard are prevalent throughout the year; therefore mitigation efforts can be considered multi-hazard.

High winds are the main destructive force behind a microburst, microburst, or tornado. While these types of winds are different during this even than a normal summer storm, tree maintenance is imperative to reducing risk throughout the region. Removing dead and dying vegetation will reduce the risk of damage to nearby properties.

In addition, ensuring emergency capabilities are continuously maintained, and prepared for response is critical. A tornado or microburst can occur suddenly without notice, therefore having the capability to respond quickly is critical.

Regulations or education can also work to promote wind retrofits in communities that tend to experience these events more frequently. A retrofit, or upgrade, can improve the structural integrity of a building, allowing it to withstand heavy wind activity.

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 2-84 of the 2019 CT NHMP, the NVCOG region could experience approximately 0.32 tornado events per year.

However, based on the historic record presented above, the NVCOG region has likely experienced 3 EF0, 8 EF1, 5 EF2, and 2 EF3 tornadoes over the last 100 years. Therefore, the NVCOG region should anticipate the occurrence of a tornado every 5.6 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, and although property destruction may be unavoidable, loss of life can be minimized through efficient, coordinated response.

Affected Population

Populations in the direct path of a tornado are most likely to experience damage or injury from a tornado. Therefore, the more populated areas in the NVCOG region are more likely to experience damage and casualties than the less densely populated communities. Indirect effects may also be felt by the larger population in an affected municipality due to closed roads, power outage, and loss of services.

Loss Estimates

Although impacts to Connecticut and the NVCOG region from tornadoes are infrequent, tornadoes that have struck the area have had devastating impacts. According to the NCDC Database, 688 people have been injured by tornadoes in Fairfield, Hartford, Litchfield, and New Haven Counties since 1950, and four have died. The total property damage from tornadoes have cost approximately $598.7 million (unadjusted for inflation) since 1950.

Estimates of community impacts have been determined based on data presented in the 2019 CT NHMP. The percentage of the population of each NVCOG municipality as compared to the population of the county was used to adjust the tornado losses reported to the NCDC for each county as presented in Table 2-84 of the 2019 CT NHMP. The annualized loss estimate for tornado damage in each NVCOG municipality is presented in Table 3-32.

Table 3-32: Annualized Tornado Loss Estimates

Municipality	Annualized Loss
Ansonia	$187,416
Beacon Falls	$61,482
Bethlehem	$29,700
Bristol	$897,904
Cheshire	$290,534
Derby	$124,449
Middlebury	$77,141
Naugatuck	$312,463
Oxford	$130,440
Plymouth	$101,315
Prospect	$96,738
Seymour	$164,550
Shelton	$5,724
Southbury	$196,178
Thomaston	$65,741
Waterbury	$1,079,282
Watertown	$188,173
Wolcott	$165,616
Woodbury	$82,723
NVCOG	**$4,257,569**

Source: CT NHMP

3.3.6 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 NVCOG region 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 Section 3.3.5) 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.

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.

Figure 3-5: Lightning Strike
Source: 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 miles per hour) 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 five to 15 minutes, and can cause damaging winds up to 168 mph.

Macrobursts affect an area at least 2.5 miles in diameter, last five 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 nine meters per second (m/s) (20 mph) for a 1-centimeter (cm) diameter hailstone, to 48 m/s (107 mph) for an eight cm, 0.7-kilogram stone.

Previous Occurrences

Previous occurrences of thunderstorm damage since 1993 are reported in the NCDC Storm Events database for the NVCOG region. Recent highlights of this damage are presented below:

- May 27, 2014: A downburst occurred in Southbury from the vicinity of Southbury Training School to the Police Department (approximately 2.5 miles). There was extensive tree damage with numerous trees reported as snapped and/or uprooted. The damage suggested a maximum wind speed of 100 mph. Approximately $8,000 in damage was reported.

- July 7, 2014: Severe thunderstorms resulted in a tree falling through the roof of a garage on Baldwin Street in Waterbury, causing $4,000 in damage. A large tree blocked Byam Road at West Waterbury Road in Cheshire.

- June 23, 2015: Multiple severe thunderstorms passed through southern Connecticut. Multiple trees were reported down along Meadow Woods Road in Seymour, causing $7,500 in damage.

- July 18, 2016: Trees, wires, and utility poles on Fair, Summer, and Woodland Streets in Bristol were downed by thunderstorm winds, causing $40,000 in damage. Trees were reported down on Allen Street and Riverside Avenue in Terryville (Plymouth)

- August 13, 2016: Severe weather impacted southern Connecticut. Wires were reported down on James P. Casey Road and Lawrence Lane due to thunderstorm winds, causing $5,000 in damage.

- March 2, 2017: Gusty winds blew down a tree on Route 68 in Prospect at Center Street, New Haven Road, and Waterbury Road.

- June 30, 2017: Isolated thunderstorms downed numerous trees and powerlines throughout Waterbury. Two trees were reported down in Cheshire including one into a home on Fairview Drive.

- July 13, 2017: Severe thunderstorms produced tree damage throughout Wilton. A tree was reported down along Mountain Road in northern Wilton, and a tree was reported down on a house on September Lane near Cannondale.

- August 2, 2017: Scattered strong to severe thunderstorms knocked down numerous trees and power lines, produced large hail, and caused isolated flash flooding. Multiple trees and wires were reported down along Prospect and Beaver Streets in Ansonia.

- October 24, 2017: Route 69 was closed in Wolcott near the Waterbury town line due to trees down on wires. $50,000 in damage was reported.

- May 15, 2018: A severe supercell thunderstorm caused hail up to two inches in diameter, two confirmed tornadoes, and straight-line wind damage. Numerous power outages and several road closures occurred as a result of the storms. Fallen power lines and 1-inch diameter hail was reported in Ansonia. Multiple large trees were reported down on Sorghum Mill Drive and Mountain Road in Cheshire. Trees and wires were blown down on Brookside Drive in Middlebury, including a tree that fell on a car causing $8.000 in damage. A tree was blown into a house in Oxford and Route 67 was closed due to numerous treefalls, with $15,000 in damage reported. Trees were reported down on a shed in Shelton causing $10,000 in damage. Several trees were reported down on Cobbler Lane in Southbury, causing $6,000 in damage. Trees were reported down on Interstate 84 West in Waterbury.

- August 8, 2019: Severe thunderstorms knocked down multiple trees and wires across the region. Trees and wires were reported down in Watertown.

Probability of Future Events

According to NOAA's National Weather Service, there is an average of 100,000 thunderstorms per year in the United States. An average of 80 people die per year from lightning strikes in the United States according to the 2019 CT NHMP. 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 approximately 25 days each year in Connecticut according to NOAA. According to Table 2-77 in the 2019 CT NHMP, the NVCOG region will receive approximately 7.6 damaging thunderstorms each year. Furthermore, 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. Finally, hailstorms typically occur in at least one part of Connecticut each year during a severe thunderstorm.

Climate change is expected to increase the frequency and impact of thunderstorms in the future. Thunderstorms are likely to produce both more intense rainfall and more rainfall overall, stronger wind gusts (such as through more frequent downbursts) and have a higher potential to lead to the formation of tornadoes. It is possible that hail may also become more frequent in the future.

Impacts to Community Assets,

All areas of the NVCOG region 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 due not cause measurable 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.

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. Finally, while crops are the major victims of hail, larger hail is also a hazard to people, vehicles, and property. 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 reach year.

Affected Population

The entire population of the NVCOG region is anticipated to experience the effects of thunderstorms each year. Damaging impacts are typically confined to smaller areas due to lightning strikes and downbursts. However, an entire community can be affected by impacts from hail, heavy rain, and strong winds, and indirect impacts may also be felt by the entire community if roads or utilities are damaged.

Loss Estimates

Estimates of community impacts have been determined based on data presented in the 2019 CT NHMP. The percentage of the population of each NVCOG municipality as compared to the population of its county was used to adjust the thunderstorm losses reported to the NCDC for each county as presented in Table 2-76 of the 2019 CT NHMP. The annualized loss estimate for thunderstorm damage in each community is presented in Table 3-33.

Table 3-33: Annualized Thunderstorm Loss Estimates

Municipality	Annualized Loss
Ansonia	$2,944
Beacon Falls	$966
Bethlehem	$2,679
Bristol	$20,485
Cheshire	$4,564
Derby	$1,955
Middlebury	$1,212
Naugatuck	$4,909
Oxford	$2,049
Plymouth	$9,140
Prospect	$1,520
Seymour	$2,585
Shelton	$25,358
Southbury	$3,082
Thomaston	$5,931
Waterbury	$16,955
Watertown	$16,976
Wolcott	$2,602
Woodbury	$7,463
NVCOG	**$133,374**

Source: CT NHMP

3.3.7 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. These are defined as areas with one structure per 40 acres with extensive vegetation. 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 areas of the NVCOG region are susceptible to lightning strikes, and all NVCOG municipalities have areas where fires may be set due to arson or occur due to campfires or open burning getting out of control. Unlike the other hazards described in this Plan, the likelihood of damage due to wildfires typically decreases with increasing population density, meaning that less developed communities such as Bethlehem have a greater risk than heavily developed communities such as Waterbury.

Extent

Wildfires are any non-structure 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:
  - Ground Fuels, consisting of organic soils, forest floor duff, stumps, dead roots, and buried fuels
  - Surface Fuels, consisting of the litter layer, downed woody materials, and dead and live plants to two meters in height
  - Ladder Fuels, consisting of vine and draped foliage fuels
  - Canopy Fuels, consisting of tree crowns

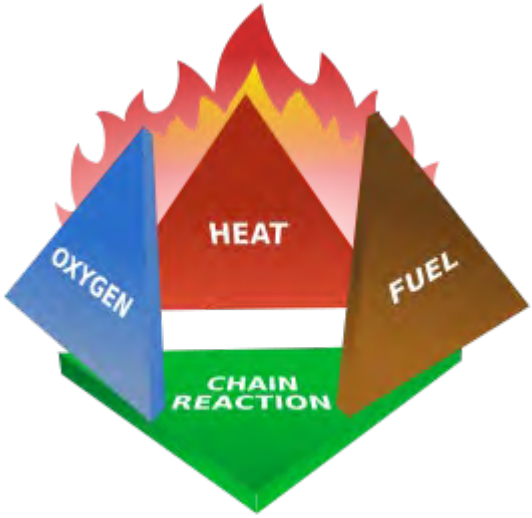


Figure 3-6: The Fire Tetrahedron
Image Provided Wikimedia Commons

- **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 tetrahedron 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 DEEP 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 NWS 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. Open burning is typically not allowed during Red Flag warnings.

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 4.2.6.

In the last 20 years, a handful of fires have occurred in the NVCOG region. Statewide droughts in 1999 and 1995 resulted in fires in the region and in other locations in the state. In 2012, 577 separate fire events occurred throughout Connecticut. Recent large wildfires in Connecticut include:

- The 2016 drought also exacerbated wildfire formation, with over 900 acres burned statewide. A 10-acre fire burned for 3 days in Lovers Leap State Park in New Milford in July. A month-long forest fire smoldered across more than 350 acres in a remote section Cornwall that is the Wyantenock State Forest in September and October. Approximately 100 acres were deliberately set aflame as a "backburn" to manage the blaze. Due to the drought, soil conditions were very dry, and the fire burned underground, resurfacing several times. A smoldering brush fire burned for about a month in Beacon Falls, burning several acres in September and flaring up again in October 2016.

- A brush fire deep in the woods in Beacon Falls near the Seymour town line burned approximately 7 acres of woods between Skokorat Road and Route 8 in April 2020. This followed approximately three acres being burned in the vicinity of Feldspar Avenue in Beacon Falls in March 2020 due to an illegal brush fire.

- In eastern Connecticut, a severe drought in the summer of 2020 caused a September wildfire that burned 94 acres in the Natchaug State Forest. The North Windham Elementary school needed to close due to smoke concerns.

Probability of Future Events

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.

Connecticut experiences three distinct fire seasons: from mid-March to mid-May, prior to leaf-out, when fuels such as grasses, dead leaves, branches and twigs on the forest floor are dried out by the sun; from mid-May to mid-September, depending in precipitation; and from October until the first snowfall, when dead leaves collect on the forest floor. Differences in available fuel and conditions lend different characteristics to fires in different seasons: spring and fall fires tend to spread quickly, burning through readily available fuels on the surface of the forest floor and causing little long-term damage; summer fires burn deeper into the ground and tend to spread less quickly and be more difficult to suppress; they are the most destructive to vegetation.

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 4,873 acres of land burned in

Connecticut from 2002 through 2019 due to 2,918 wildfires, an average of 1.7 acres per fire and 270 acres per year (Table 3-34).

Table 3-34: Wildland Fire Statistics for Connecticut

Year	Number of Wildland Fires	Acres Burned	Average
2019	88	72	0.8
2018	52	50	1.0
2017	97	243	2.5
2016	268	778	2.9
2015	76	159	2.1
2014	28	69	2.5
2013	76	238	3.1
2012	180	417	2.3
2011	196	244	1.2
2010	93	262	2.8
2009	264	246	0.9
2008	330	893	2.7
2007	361	288	0.8
2006	322	419	1.3
2005	316	263	0.8
2004	74	94	1.3
2003	97	138	1.4
2002	101	184	1.8
Total	**2,918**	**4,873**	**1.7**

Source: National Interagency Fire Center

The Connecticut DEEP Forestry Division estimates the average acreage burned per year statewide to currently be much higher (500 acres per year) in the 2019 CT NHMP, likely because not all small fires are reported to the National Interagency Fire Center. 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. 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 162 fires per year from 2002 to 2014, or slightly less than one fire per Connecticut municipality per year), wildfires are a hazard each NVCOG community 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 five acres per fire, while the average acres burned per fire has been 1.7 acres since 2002. These averages are also reasonable for the NVCOG municipalities, although it is expected that larger wildfires could occur, particularly in relatively undeveloped areas such as watershed lands.

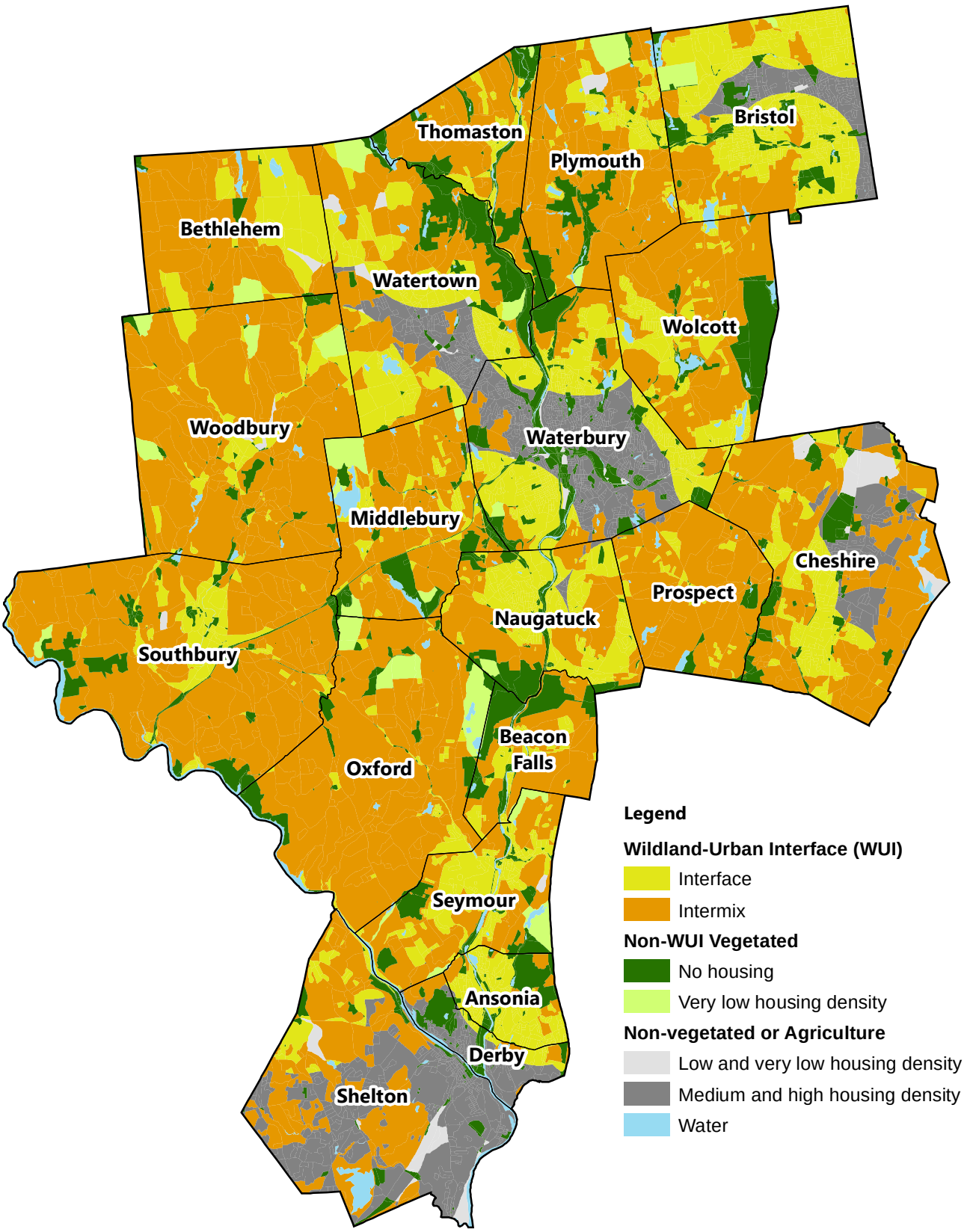
Impacts to Community Assets

The technology used to combat wildfires has significantly improved since the early 20th century. An improved transportation network, coupled with advances in firefighting equipment, communication technology, and training, has improved the ability of firefighters to minimize damage due to wildfires in the state. For example, radio and cellular technologies have greatly improved firefighting command capabilities. Existing mitigation for wildland fire control is typically focused on Fire Department training and maintaining an adequate supply of equipment. Firefighters are typically focused on training for either structural fires or wildland fires and maintain a secondary focus on the opposite category.

Today, most of Connecticut's forested areas are secondary growth forests. According to the Connecticut DEEP, forest has reclaimed over 500,000 acres of land that was used for agriculture in 1914. However, that new forest has been fragmented in the past few decades by residential development. The urban/wildland interface is increasing each year as sprawl extends further out from Connecticut's cities. It is at this interface that the most damage to buildings and infrastructure occurs. The "wildland/urban interface" is where many such fires are fought.

The United States Fire Administration has developed several resources to prepare communities and fire departments for wildfire response. One of these tools, the Wildland Urban Interface (WUI), is a mapping tool used to identify areas in communities where infrastructure and facilities are either intermixed or adjacent to (interface) vegetated areas that are prone to wildfire. Recent WUI maps developed by the USDA Forest Service and University of Wisconsin-Madison, depict the areas in 2010 that intermix or interface wildland vegetation types. These maps consider varying densities of vegetation and housing development.

Based on the WUI mapping, the NVCOG region (Figure 3-7) is comprised primarily of interface, intermix, and non-vegetated or agricultural areas. The suburban and rural areas identified as intermix, which is a majority of the region, are communities that are found to have greater



MILONE & MACBROOM
99 REALTY DRIVE
CHESHIRE, CT 06410
203.271.1773
WWW.MMINC.COM

WILDLAND URBAN INTERFACE (WUI)

HAZARD MITIGATION PLAN UPDATE
NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS
49 LEAVENWORTH STREET, 3RD FLOOR
WATERBURY, CT 06702

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FIG. 3-7

than 50% wildland vegetation distributed throughout residentially developed areas. The areas that are classified as interface throughout the region are developed communities that are within a 1.5-mile distance of vegetated areas comprised of 75% or more wildland vegetation. The remaining areas throughout the region could be considered a lower risk as these areas are either non-vegetated or non-WUI vegetated.

Wildfires are more common in rural areas than in developed areas as most fires in populated areas are quickly noticed and contained. The likelihood of a severe wildfire developing is lessened by the vast network of water features in the state, which create natural breaks likely to stop the spread of a fire. During long periods of drought, these natural features may dry up, increasing the vulnerability of the state to wildfires.

Wildland areas are subject to fires because of weather conditions and fuel supply. An isolated wildland fire may not be a threat, but the combined effect of having residences, businesses, and lifelines near a wildland area causes increased risk to life and property. Thus, a fire that might have been allowed to burn itself out with a minimum of firefighting or containment in the past is now fought to prevent fire damage to surrounding homes and commercial areas as well as smoke threats to health and safety in these areas.

According to the USGS, wildfires can increase the potential for flooding, debris flows, or landslides; increase pollutants in the air; temporarily destroy timber, foliage, habitats, scenic vistas, and watershed areas; and have long-term impacts such as reduced access to recreational areas, destruction of community infrastructure, and reduction of cultural and economic resources. Nevertheless, wildfires are also a natural process, and their suppression is now recognized to have created a larger fire hazard as live and dead vegetation accumulates in areas where fire has been prevented. In addition, the absence of fire has altered or disrupted the cycle of natural plant succession and wildlife habitat in many areas. Consequently, federal, state, and local agencies are committed to finding ways such as prescribed burning to reintroduce fire into natural ecosystems while recognizing that firefighting and suppression are still important.

Affected Population

Within the NVCOG region, some towns experience a greater risk of wildfire than others, as a result of differing amounts of forest from town to town. Many of the region's towns are home to large tracts of forested land such as those owned by water utility companies. Populations along the urban-wildland interface are most likely to be affected by wildfires.

Loss Estimates

The impacts from wildfires on the region have been relatively minimal. According to statistics reported to the National Climatic Data Center, there have been no deaths or injuries, nor damage to property or crops from wildfires in the region from 1996 to 2020. However, it is likely that the relatively small incidents and statistics have gone unreported.

Estimates of annualized loss have been determined based on data presented in the 2014 *Connecticut Natural Hazard Mitigation Plan Update* as the 2019 CT NHMP does not present county-wide data. The inverse of the population density of each municipality 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 Windham region HMP update in eastern Connecticut. 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 NVCOG region due to wildfire are relatively modest, with the largest annualized losses being in the relatively rural communities of Oxford and Bethlehem.

Table 3-35: Annualized Wildfire Loss Estimates

Municipality	Annualized Loss
Ansonia	$3,262
Beacon Falls	$16,241
Bethlehem	$24,246
Bristol	$1,453
Cheshire	$11,608
Derby	$4,175
Middlebury	$23,510
Naugatuck	$5,315

Municipality	Annualized Loss
Oxford	$25,542
Plymouth	$7,950
Prospect	$15,061
Seymour	$9,040
Shelton	$6,137
Southbury	$20,255
Thomaston	$6,776
Waterbury	$2,690
Watertown	$5,721
Wolcott	$12,550
Woodbury	$16,333
NVCOG	**$217,867**

Source: CT NHMP (2014)

3.3.8 Drought

Although Connecticut has a relatively even distribution of precipitation throughout the year, both agricultural and meteorological 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 NVCOG region 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 public water supply. In general, NVCOG municipalities are likely to be part of a larger regional area affected by drought as opposed to being individually affected.

Extent

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

- **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. 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 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 -2.9 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, 2007-2008, 2012, 2015-2016, and 2020. The entire NVCOG region was considered to be abnormally dry as recently as October 2020 after a relatively wet spring season and the Connecticut Interagency Drought Workgroup had assigned a Stage 1 Drought (Below Normal Conditions) to Fairfield County and New Haven County, Stage 2 (Incipient) Drought to Litchfield County, and Stage 3 (Moderate) Drought to Hartford County as of October 5, 2020. Litchfield County was designated as a primary natural disaster area in October 2020 by the USDA.

Recent water supply incidents in Connecticut occurred in the summer of 2010 and 2015-2016 when local public water utilities needed to declare a water supply emergency. High temperatures combined with spotty rainfall created abnormally dry conditions during these years that persisted into the fall. The dry conditions increased demand for water supply.

Probability of Future Events

The 2019 CT NHMP indicates that Connecticut has a medium-high probability of future drought events. In the northeast, short seasonal droughts lasting one to three months usually occur every two or three years. Longer droughts, with durations exceeding three months, are less frequent and occur every twenty to thirty years.

The future frequency of droughts in the region may depend upon the changes in climate and resource use. More details are provided on the following Fact Sheet. 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, which amplify natural hazards and extreme weather events, have become more frequent over the past half century.

Impacts to Community Assets

Drought impacts are typically felt through economic and environmental consequences rather than as a direct risk to life and property. As an example, a drought may destroy crops, affecting farmers and businesses that depend on farming. 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 may 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.

Climate change can bring more intense heat waves, which may result in more droughts. 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 non-drought periods.

According to CIRCA studies, heat vulnerability is significant in Waterbury, Naugatuck, Derby, and Ansonia.

Affected Population

Farmers and other growers who depend on rainfall are the most likely populations to be affected by drought. During severe droughts, impacts may become more widespread due to private well failures or the need to enact mandatory water restrictions on end users due to public water supply limitations. Such restrictions are becoming more commonplace for public water supply users throughout Connecticut due to historically high irrigation demands in the summer months in many areas.

Loss Estimates

Based on information reported to the NCDC, drought has not caused any damages in the NVCOG region. However, this may simply be because drought is a persistent hazard when it occurs, and losses occur gradually over time.

According to the Hartford Business Journal, Aquarion Water Company reported $9.5 million in costs incurred by its systems in southwestern Connecticut due to drought conditions in 2015-2016. These costs included upgrades to improve the capacity to transfer water between its systems and increase access to its emergency supplies. No other drought losses have been recently reported in online newspaper archives. Therefore, an estimated annualized loss for drought in the region would be a minimum of $47,500 per year if a 20-year period is considered for the above damages.

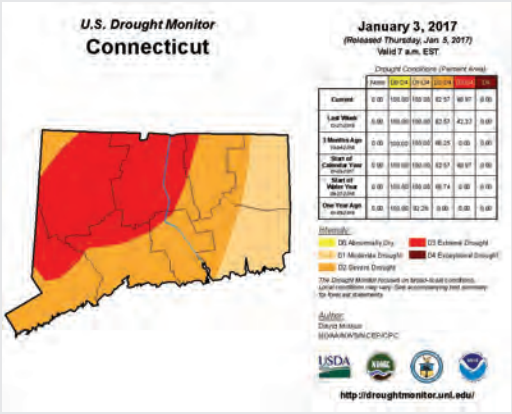
Estimates of community impacts have been determined based on data presented in the 2019 CT NHMP. The percentage of the population of each NVCOG municipality as compared to the population of its county was used to adjust the drought losses in the form of crop insurance claims reported to the USDA for each county as presented in Table 2-71 of the 2019 CT NHMP. The costs incurred by Aquarion Water Company above have been included in the damages for Fairfield County. The annualized loss estimate for drought damage in each community is presented in Table 3-36.

The highest risk of drought derived from this method occurs in Bristol due to its presence in Hartford County (which has high reported losses). Losses due to drought in the remainder of the NVCOG region are relatively minimal on an annualized basis due to the relatively limited crop losses reported for Litchfield and New Haven Counties.

REGIONAL CHALLENGES

CLIMATE CHANGE AND DROUGHTS

Old Marsh Reservoir, 2016
Photo waterburyobserver.org



The US Drought Monitor
Source droughtmonitor.unl.edu

FOR MORE INFORMATION

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410 Capitol Avenue, MS#12DWS
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Hartford, CT 06134

WHAT IS THE CHALLENGE?

Hydrologists typically consider a drought to be a period of decrease in both precipitation and streamflow. Droughts can have negative affects on agriculture, the economy, utilities, and the environment. Droughts can also create conditions that enable the ignition and spread of wildfires, while limiting the availability of firefighting water sources.

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 water loss through evapotranspiration. 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 and more severe.

In recent years Connecticut has experienced shorter but more intense "flash droughts," with some resulting in record-breaking low stream flows. Extreme drought conditions occurred in the region between 2001 and 2003, in 2010, from 2015 into early 2017, and in the summer and fall of 2020. Between June and November 2016 the Housatonic River in Falls Village experienced flows below the 107-year median daily statistic.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

The Naugatuck Valley region is urban and suburban with rural and agricultural areas spread throughout. The public water system profile in the NVCOG region is very diverse, with water utilities ranging from very small apartment and condominium complexes to large systems such as Regional Water Authority and CT Water Company.

Drought mitigation actions may include the following:

- Promoting the use of drought-resistant vegetation in landscaping
- Installing stormwater control systems that contribute to groundwater recharge rather than overland runoff (such as vegetated swales)
- Incorporating climate change projections into drinking water supply plans
- Implementing voluntary or mandatory water conservation measures as needed

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 Western Water Utility Coordinating Committee (WUCC), NVCOG can work with municipalities and water utilities that may need communications and coordination assistance during a drought event.

Table 3-36: Annualized Drought Loss Estimates

Municipality	Annualized Loss
Ansonia	$396
Beacon Falls	$130
Bethlehem	$2,908
Bristol	$107,461
Cheshire	$614
Derby	$263
Middlebury	$163
Naugatuck	$660
Oxford	$276
Plymouth	$9,920
Prospect	$204
Seymour	$348
Shelton	$21,863
Southbury	$415
Thomaston	$6,437
Waterbury	$2,281
Watertown	$18,425
Wolcott	$350
Woodbury	$8,100
NVCOG	**$181,213**

Source: CT NHMP

3.3.9 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 NVCOG region are susceptible to earthquakes, although the likelihood of a damaging earthquake having its epicenter directly below the region is relatively small. In general, the NVCOG region is likely to be part of a larger regional area affected by a damaging earthquake as opposed to individual municipalities being 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. The magnitude and intensity of an earthquake are determined using various descendants of the Richter scale and the Mercalli scale, respectively.

Magnitude 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. In particular, the Moment Magnitude Scale was developed in the 1970s to replace the Richter Scale and has been in official use by the USGS since 2002.

According to the USGS, 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

Modified Mercalli Intensity

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.
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.
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.

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 Moment Magnitude for earthquakes with a magnitude of less than 3.5. Localized Richter Scales or other scales are used to calculate magnitudes for smaller earthquakes such as those that typically occur in Connecticut.

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

The effect of an earthquake on the earth's surface is called the intensity. The intensity scale currently in use, 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 3-37, while a description of each intensity level is presented above.

Table 3-37:
Comparison of Earthquake Magnitude and Intensity

Richter Magnitude	Typical Maximum Modified Mercalli Intensity
1.0 to 2.9	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 to XII

Source: USGS

Previous Occurrences

According to the Northeastern States at Boston College, there have been 150 recorded earthquakes in Connecticut between 1678 and 2014. All of the recorded quakes had a Richter Scale magnitude of less than 5.0, and the vast majority of the earthquakes had a magnitude of less than 3.0. The Northeast States Emergency Consortium reports that only 115 earthquakes were strong enough to be detected by people, and only the 1791 earthquake caused significant damage. Additional instances of seismic activity occurring in and around the NVCOG region is noted below based on information in USGS documents, from the Weston Observatory, the 2019 CT NHMP, other municipal hazard mitigation plans, and newspaper articles.

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

- Strong earthquakes in Massachusetts in November 1727 and November 1755 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.

- October 26, 1845: An Intensity V earthquake occurred in Bridgeport and approximated 3.9 to 4.3 on the Richter scale. This event damaged stone fences in Weston and rang a church bell in Westport.

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

- October 19, 1985: A small earthquake awakened many in lower Fairfield County. The earthquake measured 4.0 on the Richter Scale and its epicenter was located in Westchester County. The quake caused only minor damage such as cracks in windows.

- October 28, 1991: A 3.0-magnitude earthquake was recorded in Greenwich near where the Mianus River meets the Stamford boundary. No damage was reported.

- November 30, 2010: A magnitude 3.9 earthquake occurred 117 miles southeast of Bridgeport, Connecticut. The quake did not cause damage in Connecticut but was felt by residents along Long Island Sound.

- 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.

- A magnitude 2.1 quake occurred near Stamford on September 8, 2012. Dozens of residents reported feeling the ground move. No injuries were reported.

- The 2015 January and February earthquake swarm in the Plainfield, Connecticut area were the most significant geologic events to occur in the state in some time according to the Connecticut State Geologist. The swarm included earthquakes ranging in magnitude from 2.0 to 3.3. No damage was reported in the NVCOG region.

- September 9, 2020: According to Patch.com, a magnitude 3.1 quake centered in New Jersey was felt by residents in southwestern Connecticut as recorded by the USGS.

Probability of Future Events

According to the 2019 CT NHMP, 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 and not in the NVCOG region. Data available from the Weston

Observatory suggests that zero earthquakes have been centered in the NVCOG region since 1990. The most recent earthquake to occur in the region was a 2.3 magnitude quake that occurred approximately 10 kilometers west of Waterbury on February 21, 1989.

According to the USGS, Connecticut is in an area of moderate to low risk for earthquakes. The USGS prepared Modified Mercalli Intensity hazard maps for the U.S. in 2018 depicting estimates of certain intensities (and types of damage) being exceeded over the next 50 years. The NVCOG region has a 50% chance to experience an earthquake with an intensity of III or less in the next 50 years, a 10% change to experience an intensity of IV, and a 2% chance to experience an intensity of VI.

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.

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. When liquefaction occurs, the strength of the soil decreases, and 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.

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.

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 2019 CT NHMP identifies the area from Greenwich to New Haven as one of the most vulnerable in the state to potential earthquakes. The built environment in Connecticut includes old non-reinforced masonry that is not seismically designed. Those who live or work in non-reinforced 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.

Affected Population

Damaging earthquakes tend to be regional events and the entire region is likely to be affected by such an event. Poorly constructed buildings are most likely to be damaged during such an event, potentially displacing residents and businesses. During more severe events, indirect impacts will be felt by the entire community due to power outages and roadway damage.

Loss Estimates

According to the FEMA HAZUS-MH Estimated Annualized Earthquake Losses for the United States (2008) document, FEMA used probabilistic curves developed by the USGS for the National Earthquakes Hazards Reduction Program to calculate Annualized Earthquake Losses for the United States. Based on the results of this study, FEMA calculated the annualized earthquake loss for Connecticut to be $11,622,000. This figure placed Connecticut 30th out of the 50 states in terms of annualized earthquake loss. The magnitude of this figure stems from the fact that Connecticut has a large building inventory that would be damaged in a severe earthquake.

The 2019 CT NHMP 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 data from these scenarios were extracted from the HAZUS-MH output for the 2019 CT NHMP to generate potential damages in the NVCOG 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

While a significant earthquake has never been centered in the NVCOG region, the modeling suggests that a significant event in or near the region would have a serious impact. Copies of these HAZUS-MH Earthquake Event Reports are included in Appendix D. 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.

While these scenarios are unlikely, each would result in significant damage in the region with the East Haddam scenario causing the greatest damage. As Table 3-38 shows, more than 16% of all buildings in the NVCOG region would be at least moderately damaged including nearly 1,200 completely destroyed.

Table 3-38: Number of Buildings Damaged in Region by Earthquake Scenario

Damage Level	East Haddam	Haddam	Portland	Stamford
None	97,642	128,426	114,628	140,465
Slight	32,225	18,822	25,458	10,853
Moderate	19,608	6,734	12,319	3,154
Extensive	4,111	719	1,975	285
Complete	1,196	82	403	25
% with Moderate or Greater Damage	**16%**	**5%**	**9%**	**2%**

Source: HAZUS-MH

Furthermore, many essential facilities would lose functionality during the first day as shown in Table 3-39. For example, the HAZUS-MH model simulates that EOCs in the region would be operating at only 61% functionality on the day following the East Haddam scenario earthquake. The information suggests that earthquake response would be impacted in the region due to the damage sustained to these facilities.

Table 3-39: Average Percent Functionality of Essential Facilities on Day 1 Following Earthquake

Facility	East Haddam	Haddam	Portland	Stamford
EOC	61%	76%	71%	79%
Fire Dept.	62%	77%	73%	78%
Hospitals	60%	75%	68%	82%
Police Dept.	60%	74%	68%	81%
Schools	58%	73%	66%	82%

Source: HAZUS-MH

As expected for an event that causes widespread structure damage, sheltering requirements are also expected to be substantial during the East Haddam scenario. Potential shelter requirements are presented in Table 3-40. Significant outside resources may be needed in the region to cope with the aftermath of the East Haddam scenario.

Table 3-40: Shelter Requirements by Earthquake Scenario

Need	East Haddam	Haddam	Portland	Stamford
Displaced Households	1,609	470	913	213
People Needing Short-term Shelter	995	294	557	128

Source: HAZUS-MH

The economic impact from the East Haddam scenario would be devastating costing the region over $1.9 billion in damage from building-related and business-related losses. Table 3-41 summarizes the direct economic losses to homes and businesses in the region (not including potential lifeline-related losses to utilities and transportation systems).

Table 3-41: Economic Loss in Region by Earthquake Scenario (Millions)

Municipality	East Haddam	Haddam	Portland	Stamford
Ansonia	$55	$17	$19	$19
Beacon Falls	$26	$8	$12	$5
Bethlehem	$7	$2	$3	$2

Municipality	East Haddam	Haddam	Portland	Stamford
Bristol	$349	$106	$281	$17
Cheshire	$337	$102	$214	$12
Derby	$36	$11	$12	$16
Middlebury	$31	$9	$15	$7
Naugatuck	$97	$31	$51	$15
Oxford	$30	$9	$13	$13
Plymouth	$42	$13	$27	$3
Prospect	$44	$15	$22	$4
Seymour	$53	$16	$20	$17
Shelton	$94	$27	$30	$75
Southbury	$41	$12	$17	$27
Thomaston	$25	$7	$16	$3
Waterbury	$497	$153	$272	$49
Watertown	$62	$19	$36	$10
Wolcott	$77	$25	$52	$5
Woodbury	$21	$6	$10	$8
NVCOG	**$1,925**	**$589**	**$1,124**	**$306**

Source: HAZUS-MH

HAZUS-MH was also used in the 2019 CT NHMP to simulate a probabilistic earthquake scenario calculating an annualized loss estimate for each municipality. These data were extracted for the NVCOG municipalities. Property losses include building and contents losses, and other losses include inventory, relocation, rental, and wage losses. Results are presented in Table 3-42.

Table 3-42: Annualized Economic Loss in Region Due to Earthquake (Thousands)

Municipality	Property Loss	Income Loss	Other Losses	Total Annualized Losses
Ansonia	$45.6	$1.9	$9.2	$56.7
Beacon Falls	$16.4	$0.6	$3.3	$20.4
Bethlehem	$8.6	$0.3	$1.6	$10.6
Bristol	$135.0	$6.4	$29.6	$171.0
Cheshire	$82.9	$3.8	$17.4	$104.2
Derby	$31.6	$1.8	$7.4	$40.9
Middlebury	$21.3	$4.1	$6.7	$32.1
Naugatuck	$61.3	$2.2	$12.2	$75.7
Oxford	$29.0	$1.9	$5.3	$36.1
Plymouth	$25.5	$0.7	$4.5	$30.7
Prospect	$19.5	$0.7	$3.6	$23.8
Seymour	$42.8	$1.6	$7.2	$51.7
Shelton	$109.2	$4.9	$21.1	$135.1
Southbury	$55.3	$2.3	$10.9	$68.5
Thomaston	$20.2	$1.1	$4.3	$25.5
Waterbury	$259.2	$14.3	$66.1	$339.6
Watertown	$54.0	$2.2	$10.6	$66.8
Wolcott	$32.9	$2.5	$7.0	$42.3
Woodbury	$25.0	$1.3	$5.4	$31.7
NVCOG	**$1,075.5**	**$54.7**	**$233.4**	**$1,363.5**

Source: HAZUS-MH

3.3.10 Dam Failure

Dam failure is generally caused by other natural hazards: floods arising from thunderstorms, spring thaw, and hurricanes; wind damage from hurricanes and tornadoes; damage from ice jams, and forces from earthquakes. 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. A Fact Sheet regarding dam hazards is presented on the next page.

Location

Dam failure can only occur at and along the watercourses downstream of dams. Although the effects of dam failure can impact any of the NVCOG municipalities, 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.

Extent

The Connecticut DEEP administers the statewide Dam Safety Program and designates a classification to each state-inventoried dam based on its potential hazard. The hazard classifications are described in Table 3-43.

According to the Association of State Dam Safety Officials, dam failures are most likely to occur due to one of five reasons:

REGIONAL CHALLENGES

DAM HAZARDS

Shepaug Dam
Photo Wikipedia

Upper Shepaug Dam
*Photo **Warrenhistoricalsociety.org***

FOR MORE INFORMATION

Dam Safety Regulatory Program
(860) 424-3706
DEEP.DamSafety@ct.gov

WHAT IS THE CHALLENGE?

With precipitation patterns changing, and rainstorms becoming more intense due to climate change, dams may become increasingly stressed as water volumes increase during these heavy storms. Dam failure, especially higher hazard dams, can have serious impacts including loss of life, economic loss, and environmental damage.

Unlike other major infrastructure which is owned and regulated by the government, it is estimated that 56% of U.S. dams are privately owned (FEMA). These privately owned dams are often not maintained and are found to be in poor condition. The ownership status of these dams presents challenges when working to address necessary improvements.

The Connecticut Dam Safety Regulatory Program works to ensure that state dams are operated and maintained both safely and effectively. The program also requires owners of Class C (high hazard) and Class B (significant hazard) dams to update and file an Emergency Action Plan (EAP) every two years.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

There are over 180 dams in the NVCOG region, with 5 of these being classified as Class C, “High Hazard.” Failure of a significant (Class B) or high hazard dam can have serious impacts including loss of life, economic loss, and environmental damage.

An EAP can provide critical information for NVCOG municipalities when planning for dam failure and mitigation strategies. Helpful information includes:

- Inundation maps identifying potential inundation areas
- Lists of streets, roadways, addresses and highways that are subject to flooding.
- Identification of emergency evacuation routes.
- Identifying dam operation personnel responsible for monitoring and emergency response.

Any municipality within the NVCOG region with a Class B or C dam should ensure that EAPs have been filed with municipal offices so this critical information is readily available for both planning and emergency response purposes.

Table 3-43:
Connecticut DEEP Dam Classifications

Hazard Class	Hazard Potential
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.
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.
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.
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.
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.

Source: Connecticut DEEP

- **Overtopping** caused by water spilling over the top of the dam due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest. These account for approximately 34% of all U.S. dam failures.

- **Foundation defects** including settlement and slope instability cause about 30% of all U.S. dam failures.

- **Cracking** caused by movements such as the natural settling of a dam.

- **Inadequate maintenance and upkeep.**

- **Piping** when seepage through a dam is not properly filtered and soil particles continue to progress and form sinkholes in the dam. This accounts for approximately 20% of all U.S. dam failures. Seepage often occurs around hydraulic structures such as pipes and spillways, through animal burrows, around roots of woody vegetation, and through cracks in dams, dam appurtenances, and dam foundations.

Previous Occurrences

There have been a few dam failures in the NVCOG region in recorded history, as noted by the National Performance of Dams Program (NPDP) at Stamford University and other sources. Known dam failures in the NVCOG region include:

- September 18, 1890: Severe storms caused five dams to fail including Broad Brook Reservoir in Cheshire. The resultant flooding damaged two railroad trestles and six highway bridges, causing approximately $50,000 in damages (1890 dollars).

- When the Lake Housatonic Dam was constructed in Shelton and Derby in 1869, a freshet scoured out a cavity 20 feet deep in the riverbed. The cavity was filled with loose rock and a timber apron and capped with concrete. In 1891, the dam was damaged by the undermining of the loose rock under the concrete. In 1902, dam repairs were necessary due to muskrats burrowing under the foundation.

- Echo Lake Dam in Watertown failed on October 1, 1958 when dam repair work was incorrectly performed by a contractor. Piping appeared during refilling and four days later the dam washed out, requiring additional repairs in 1959.

- The Bronson Company Dam in Beacon Falls and the Hunts Brook Dam in Watertown were two of many dams across Connecticut that failed on June 4, 1982 as a result of heavy rainfall. Repairs were approximately $10,000 (1982 dollars) for each dam.

- The Long Meadow Pond Dam in Bethlehem overtopped during the April 2007 storms and sustained some damage but did not fail.

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 14 complete or partial dam failures across northern Connecticut and damage to another 30 dams across the state.

Probability of Future Events

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 because most spillways are designed to pass a greater discharge (such as some fraction of the probable maximum flood event). However, smaller privately owned dams are typically less inspected and maintained than dams owned by municipalities, utilities, and state government. Therefore, the probability of a major (Class C or Class B) dam failure occurring in the region is believed to be less than 1% in the next 100 years, while the chance of a minor dam failure is believed to be more likely at a 1% annual chance per year.

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. All dams are subject to inspection on a regular schedule mandated by Connecticut DEEP based on hazard classification. High hazard (Class C) and significant hazard (Class B) 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.

Of the 588 registered dams in the NVCOG region, only 51 are Class C. Another 48 are Class B, 90 are Class BB, and the remaining 399 are dams whose failure would have relatively little potential impact on life or property. The 51 class C dams are distributed throughout the region (Table 3-44). All but three municipalities in the region have at least one Class C dam (Beacon Falls, Middlebury, and Woodbury do not). Figure 3-8 shows the location and class of each dam in the NVCOG region.

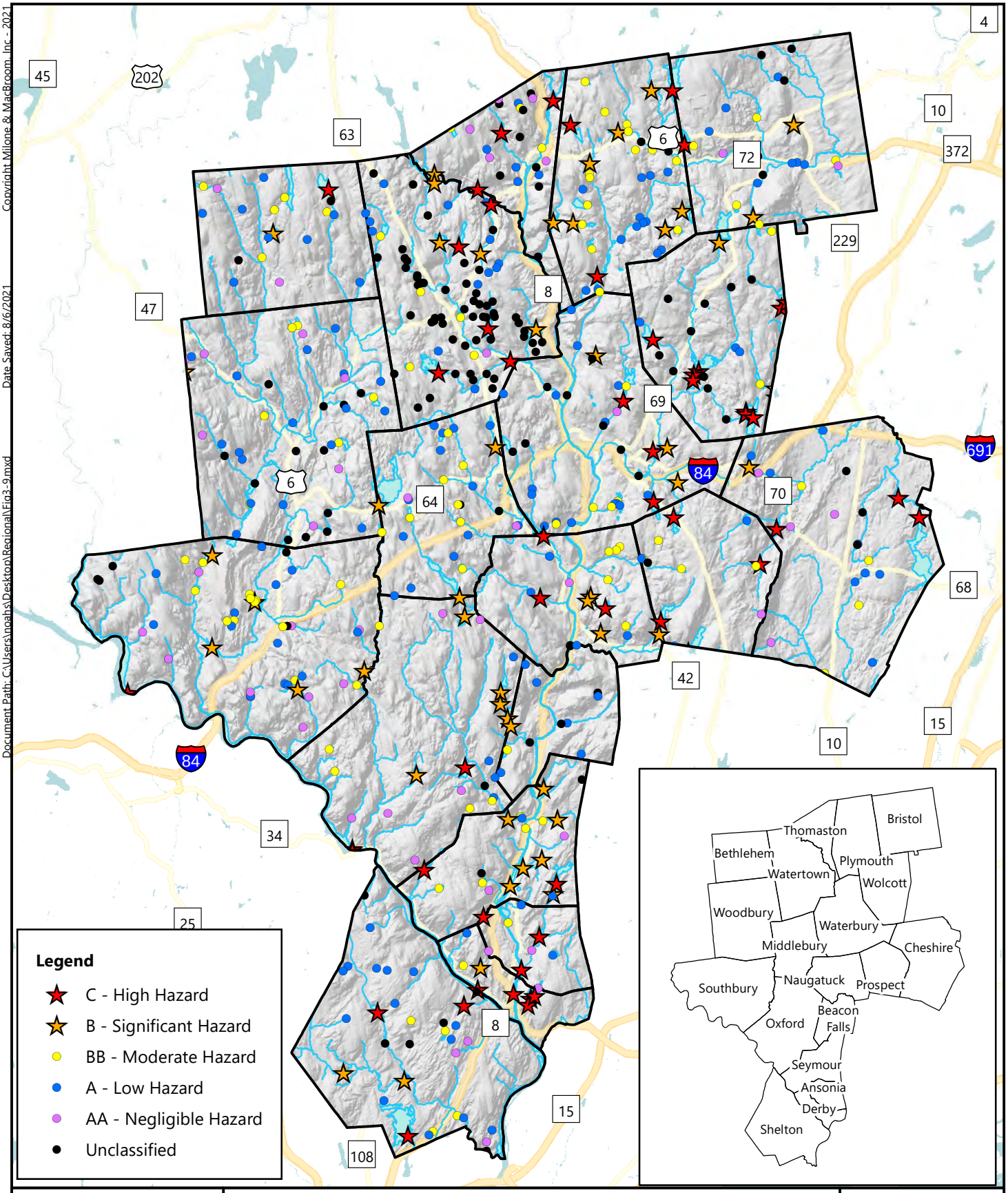
Table 3-44: Significant and High Hazard Dams

Municipality	Class B	Class C	Total
Ansonia	0	3	3
Beacon Falls	1	0	1
Bethlehem	1	1	2
Bristol	2	3	5
Cheshire	1	3	4
Derby	1	5	6
Middlebury	3	0	3
Naugatuck	4	3	7
Oxford	5	2	7
Plymouth	7	3	10
Prospect	0	3	3
Seymour	7	2	9
Shelton	2	3	5
Southbury	5	1	6
Thomaston	1	3	4
Waterbury	3	3	6
Watertown	4	5	9
Wolcott	1	8	9
Woodbury	0	0	0
NVCOG	**48**	**51**	**99**

Source: Connecticut DEEP

Many of the Class C dams in the region are used for water supply, hydropower, or for flood control purposes. Failure of these dams would likely cause significant flooding damage in the region as noted by the examples below:

- Failure of the Bristol Reservoir #1 Dam would cause significant flooding and damage downstream along the Pequabuck River in Bristol, particularly near Rockwell Park and the Route 72 area near North Main Street.
- Failure of the Black Rock Dam in Thomaston would cause significant flooding damage in Thomaston, Waterbury, and Naugatuck.
- Failure of the Thomaston Dam would cause significant flooding along the Naugatuck River in Thomaston, Waterbury, Naugatuck, Beacon Falls, Seymour, Ansonia, and Derby.
- Failure of the Stevenson Dam in Oxford, the Shepaug Dam in Southbury, or the Candlewood Lake Dam in New Milford would cause significant flooding along the Housatonic River, with serious damage occurring in Oxford, Shelton, Seymour, and Derby.



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DAM HAZARD CLASS

HAZARD MITIGATION PLAN UPDATE
NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS
49 LEAVENWORTH STREET, 3RD FLOOR
WATERBURY, CT 06702

N

0 10,000 20,000
Feet

SCALE 1 " = 20,000 '
DATE 8/6/2021
3211-29
PROJ. NO.

FIG. 3-8

Affected Population

Once a dam collapses, the damage it does is largely dependent upon the sorts of land uses downstream. Not only can buildings downstream be inundated by resulting flooding, but 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 ice or debris carried therein. Refer to Section 3.3.2 for more information. Furthermore, failure of a reservoir dam could result in a water supply emergency for the affected utility.

Loss Estimates

Due to the relatively minimal historic record of dam failure events that estimated or reported damages specific to dam failure, annualized loss estimates could not be generated from the historic record for Litchfield County municipalities using the NPDP and other sources (as was done for the remaining municipalities). Although it is well known that dam failures occurred in Litchfield County during the 1955 floods, the damage specific to dam failure does not appear to have ever been estimated separate from the other flooding impacts. Loss estimates due to dam failure in the Litchfield County municipalities were therefore based on statewide impacts estimated in Table 4-4 of the 2019 CT NHMP. In both cases, the annualized loss was reduced by the percentage of the municipal population to that of the greater area. The annualized loss estimates due to dam failure in each NVCOG municipality based on this method is presented in Table 3-45.

Table 3-45: Annualized Dam Failure Loss Estimates

Municipality	Annualized Loss
Ansonia	$818
Beacon Falls	$268
Bethlehem	$11
Bristol	$371
Cheshire	$1,268
Derby	$543
Middlebury	$337
Naugatuck	$1,363
Oxford	$569
Plymouth	$124
Prospect	$422
Seymour	$718
Shelton	$4,750
Southbury	$856
Thomaston	$52
Waterbury	$4,710
Watertown	$428
Wolcott	$723
Woodbury	$83
NVCOG	**$18,414**

Source: CT NHMP, NPDP

3.3.11 Landslides

The word "landslide" is a general term for most types of landforms and processes involving the downslope movement of soil and rock materials. Landslides have many causes, but most involve earth materials with low shear strength, high ground-water saturation, an interruption of the slope by natural causes or human activities, or a combination of the above.

Location

There are several areas of the NVCOG region at risk for landslides, as described below. As the word "Valley" in NVCOG implies, the region has many areas where the topography is extremely steep. In particular, significant landslides have historically occurred in Ansonia, Derby, Seymour, Shelton, and Waterbury. Although steep slope mapping is not available, Figure 3-9 presents the location of erosion susceptible sites in the NVCOG region which likely include many areas prone to landslides. Landslides occasionally occur in these areas due to human activities or groundwater saturation. Debris from landslides can flow or move beyond the bottom of the slope, or may impact utilities, resulting in the effects of the landslide being felt in a wider area.

Extent

According to the USDA, landslides occur in all 50 States, causing $1 to 2 billion in damage and more than 25 fatalities on average each year. Landslides pose serious threats to highways and structures that support fisheries, tourism, timber harvesting, mining, and energy production. Landslides commonly accompany other major natural disasters, such as earthquakes and floods, exacerbating relief and reconstruction efforts. Expanded development onto less desirable slopes and soils has increased the incidence of landslide disasters.

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Legend

Areas Considered Most Susceptable to Erosion

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EROSION SUSCEPTIBILITY

HAZARD MITIGATION PLAN UPDATE
NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS
49 LEAVENWORTH STREET, 3RD FLOOR
WATERBURY, CT 06702

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0 10,000 20,000
Feet

SCALE 1 " = 20,000 '
DATE 8/6/2021
3211-29
PROJ. NO.

FIG. 3-9

According to the USDA, there are two primary causes for slope failure or landslides. One involves an uneven distribution of weight on a slope. Adding weight to the top of a slope (fill, a structure, tall trees, soil saturation, etc.) or removing weight at the toe of a slope (excavation, erosion, drainage, landslide, etc.) causes the weight on the slope to be uneven and thus often results in slope failure. The second cause of slope failure is typically the wetting of a weak layer that is inclined at the same angle as the ground surface. Water can reduce the strength and lubricate the layer, allowing the upper block of wet soil to slide down the slope. A variation of this cause is the accumulation of water on a soil or rock layer with a low permeability rate. The water can saturate the layers above the water restriction, adding weight to the upper layers. The water on top of the restrictive layer can also reduce the shear strength of the soil and lubricate any failure planes, causing a slope failure.

Landslides are common throughout the Appalachian region and New England. The greatest hazard in these areas is from sliding of clay-rich soils. Landslides are hazardous to life and property both in the landslide itself and in the areas where the landslide material is deposited. While some landslides are stable and unlikely to move again; others can be reactivated by basal undercutting, such as that caused by stream erosion or by excavation. Excavation for road construction can be particularly hazardous. Movement can also recur because of increased ground-water pressure, such as that induced by the removal of forest cover or the diversion of drainage water.

According to the USDA, the following locations are generally prone to landslides:

- Existing old landslides
- Steep slopes or the base of slopes
- Areas in or at the base of minor drainage hollows
- The base or top of an old fill slope or steep cut slope
- Areas where part of the natural slope is interrupted
- Developed hillsides where leach field septic systems are used

Numerous areas of the NVCOG region are built on steeply sloping terrain. Such areas have the potential for a landslide to develop, especially when the terrain is characterized by poorly draining soils or served by an inadequate drainage system. Most landslides in the region develop due to heavy rainfall saturating the upper parts of the soil with groundwater, although there are some that develop due to poor excavation practices.

Finally, landslides and slumps do not always occur near watercourses. In areas where the drainage network is comprised only of sheet flow, roadways can act as watercourses and break apart, exposing the road subbase which can be prone to significant erosion.

Previous Occurrences

Although steep slopes exist throughout the NVCOG region, the topography is generally stable. Nevertheless, minor and major landslides have occurred as a result of extreme rainfall or human activities, and these have occurred on both short- and long-term timescales. Recent landslide events in the region include:

- A wall along South Main Street in Ansonia composed of granite blocks is slowly coming apart just to the north of Columbia Street. Over time, large trees have grown on top of and have rooted themselves into the wall. The wall is in danger of collapsing which may result in a future landslide.

- In Derby, landslides have occurred at several condominium complexes requiring repairs by property owners. City officials also have concerns regarding the steep slope at the base of Gilbert Street.

- Construction activities in Waterbury in the 1990s occurring at the toe of the slope of Waterville Street compromised the natural grade of the 50 to 75-foot hill, resulting in a collapse. Part of Waterville Street later collapsed as well, and that portion of the road is currently a one-way street. This area continues to be considered by the City as a potential landslide area.

- A landslide occurred in Seymour in the vicinity of Cedar and Rose Streets around the turn of the century.

- The extreme rain event on June 2, 2006 caused many slopes to fail in Waterbury including on Charles Street, East Mountain Road, Roasario and Tedesco Drive, the corner of Southview Street and Madison Street to South Main Street, Highland Avenue at Highview

Street, and Willow Street. Figure 3-10 presents an aerial photo of the repaired slide area between Southview Street and South Main Street.

- A severe mudslide occurred on North Oak Avenue in Shelton in December 2009 that undermined a vacant home and required its removal. The mudslide was caused by burst water pipes saturating the hillside.

- The section of Shelton Avenue at the Riverdale Apartments in Shelton suffered a substantial landslide during a heavy rainfall event in 2010. A residence needed to be relocated.

- A landslide occurred along the face of a steep slope on Platt Street in Ansonia in 2011.

Figure 3-10: Repaired Landslide Site at Southview Street and South Main Street, Waterbury
Source: 2014 City of Waterbury HMP

Probability of Future Events

Historically, there have been approximately 16 significant landslide events over the past 25 years in the NVCOG region. This suggests that, on average, approximately 0.6 significant landslide events will occur each year. However, given the historic record it is likely that multiple landslides will occur in response to a single rain event. As the rainfall intensity is expected to increase in the future, it is believed reasonable to expect approximately 1 significant landslide event to occur each year (either a landslide, slump, or slope failure).

Impacts to Community Assets

Although direct landslide damage generally impacts only a small area on and at the base of the slope that has failed, public water, sewer, gas, and electric utilities damaged by a landslide can have more of a widespread impact. Therefore, it is important for NVCOG municipalities to identify areas that are prone to slope failure and restrict development, clearing and excavation activities in order to mitigate damages at those locations.

In particular, the City of Waterbury has identified major municipal water mains that travel through areas of steep slopes. In some cases, the shifting or failing of a steep slope has been identified as the cause of a water main break. As the municipal water mains provide public water supply and fire protection to several tens of thousands of people, this risk is of concern for the City.

Affected Population

The most likely affected population by landslides include those living on the top of an affected slope who may lose or need to relocate their structure, those located at the bottom of an affected slope who may experience damage to structures or vehicles, and people reliant on affected utilities in the area. While injuries or fatalities have not occurred during any of the recent landslides in the NVCOG region, the possibility exists particularly for sudden unexpected slides.

Loss Estimates

In general, loss estimates for landslides are relatively minor. The larger events in Waterbury have required several hundreds of thousands of dollars to repair, while other events are in the tens of thousands or less to repair, relocate or demolish affected homes, etc.

As detailed records of landslide costs are not immediately available, estimated damages were developed based on the historic record and applied to the five municipalities at most risk for landslides. Assuming that the damages were approximately $1 million over the past 25 years, the annualized loss for these five municipalities is approximately $40,000. These costs were applied to the give communities based on the fraction of events occurring in that community over the past 25 years. Results are presented in Table 3-46.

Table 3-46: Annualized Landslide Loss Estimates

Municipality	Annualized Loss
Ansonia	$7,500
Derby	$7,500
Seymour	$2,500
Shelton	$5,000
Waterbury	$17,500
NVCOG	**$40,000**

3.4 Overall Hazard Risk

This document has been prepared with the understanding that a single hazard effect may be caused by multiple hazard events. For example, flooding may occur as a result of frequent heavy rains, a hurricane, or a winter storm. Thus, Tables 3-47 and 3-48 provide summaries of the hazard events and hazard effects that impact the NVCOG region and include criteria for characterizing the locations impacted by the hazard, the frequency of occurrence of the hazards, and the magnitude or severity of the hazards. The information collected and evaluated in Section 3.1, Section 3.2, and in Section 3.3 were used to quantify the summaries.

Furthermore, it is understood that each natural hazard may have multiple effects; for example, a hurricane causes high wind and flooding. Some hazards can also have similar effects; for example, hurricanes and earthquakes both can potentially cause dam failure. Based on the rankings in Tables 3-47 and 3-48, information regarding structures and populations at risk, hazard information in the historic record, and the available loss estimates, each hazard is provided an overall qualitative summary rank of risk. This is provided by community in Table 3-49 as some communities may feel lesser effects from certain hazards than others. The breakdown of the summary rankings is as follows:

Table 3-47: Hazard Event Ranking

Hazard Event	Location[1]	Freq. of Occur.[2]	Magnitude or Severity[3]	Rank
Winter Storms	3	3	2	8
Hurricanes	3	1	3	7
Terrorism	1	2	4	7
Drought	3	2	1	6
Earthquakes	3	2	1	6
Nor'easter	3	2	1	6
Thunderstorms	2	3	1	6

Table 3-47: Hazard Event Ranking

Hazard Event	Location[1]	Freq. of Occur.[2]	Magnitude or Severity[3]	Rank
Tornadoes	1	2	3	6
Tropical Storms	3	1	2	6
Dam Failure	1	0	4	5
Landslides	1	2	1	4
Wildfires	1	1	1	3

1. Small (1) affects an isolated to specific area during one event. Medium (2) affects a slightly larger are or multiple areas during one event. Large (3) affects most or all of the community during one event.
2. Unlikely (0) has a less than 1% probability in the next 100 years. Possible (1) has between a 1% and 10% probability, or at least one chance in the next 100 years. Likely (2) has a greater than 10% probability, or at least one chance in the next 10 years. Highly Likely (3) is expected at least once per year.
3. Limited (1) means injuries and/or illnesses are treatable with first aid; minor quality of life loss; shutdown of critical facilities for 24 hours or less; less than 10% of property severely damaged. Significant (2) means injuries and/or illnesses do not result in permanent disability; shutdown of critical facilities for less than 2 weeks; 10% to 25% of property severely damaged. Critical (3) means injuries and/or illnesses result in permanent disability; critical facilities shutdown for more than 2 weeks; 25% to 50% of property severely damaged. Catastrophic (4) means multiple deaths, shutdown of critical facilities for more than 1 month; more than 50% of property severely damaged.

Table 3-48: Hazard Effect Ranking

Hazard Effect	Location[1]	Freq. of Occur.[2]	Magnitude or Severity[3]	Rank
Severe Winds	3	3	2	8
Snow	3	3	2	8
Blizzard	3	2	2	7
Coastal Flooding	2	3	2	7
Falling Trees / Branches	2	3	2	7
Hurricane Wind	3	1	3	7
Disruption	1	3	2	6
Ice	3	2	1	6
Major Dam Failure	2	0	4	6
Riverine Flooding	2	3	1	6
Shaking	3	1	2	6
Crop Loss	2	2	1	5
Hail	2	2	1	5
Lightning	1	3	1	5
Nuisance Flooding	1	3	1	5
Post-Event Trauma	2	1	2	5
Tornado Wind	1	1	3	5

Hazard Effect	Location[1]	Freq. of Occur.[2]	Magnitude or Severity[3]	Rank
Extreme Cold	3	1	1	4
Extreme Heat	3	1	1	4
Fire / Heat / Smoke	1	2	1	4
Tsunami	2	1	1	4
Landslide	1	2	1	4
Minor Dam Failure	1	1	1	3

Note: 1, 2, and 3 are the same as the table above.

Table 3-49: Qualitative Summary of Hazard Risk

Municipality	Flooding	Winter Storms	Hurricanes	Tornadoes	Thunderstorms	Wildfires	Drought	Earthquakes	Landslides	Dam Failure
Ansonia	L	M	H	H	L	L	L	M	L	L
Beacon Falls	L	M	H	M	L	M	L	M	L	L
Bethlehem	L	L	M	M	L	M	L	M	L	L
Bristol	H	H	H	H	M	L	H	H	L	L
Cheshire	L	M	H	H	L	M	L	H	L	L
Derby	L	M	H	H	L	L	L	M	L	L
Middlebury	L	M	H	M	L	M	L	M	L	L
Naugatuck	L	M	H	H	L	L	L	M	L	L
Oxford	M	M	H	H	L	M	L	M	L	L
Plymouth	L	M	H	H	L	L	M	M	L	L
Prospect	L	M	H	M	L	M	L	M	L	L
Seymour	L	M	H	H	L	L	L	M	L	L
Shelton	M	M	H	L	M	L	M	H	L	L
Southbury	M	M	H	H	L	M	L	M	L	L
Thomaston	L	M	H	M	L	L	L	M	L	L
Waterbury	M	H	H	H	M	L	L	H	M	L
Watertown	M	M	H	H	M	L	M	M	L	L
Wolcott	L	M	H	H	L	M	L	M	L	L
Woodbury	L	M	H	M	L	M	L	M	L	L
NVCOG	**M**	**M**	**H**	**H**	**L**	**M**	**L**	**M**	**L**	**L**

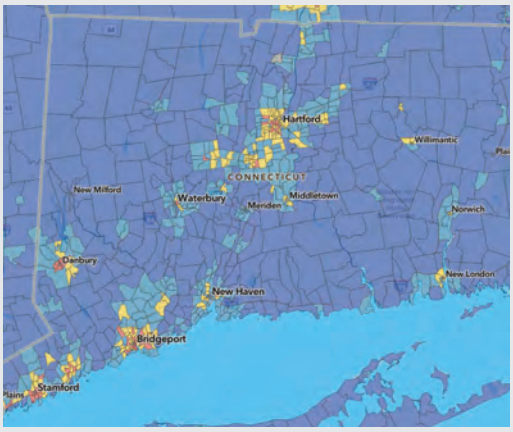
Note: L = Low, M = Moderate, H = High

- **High** risk hazards typically affect the entire community and/or have repeated impacts year to year or are less frequent but highly damaging events.
- **Moderate** risk hazards typically affect all or portions of the community and have repeated impacts from year to year that are not particularly damaging.
- **Low** risk hazards typically affect only a limited area of a community or are generally infrequent.

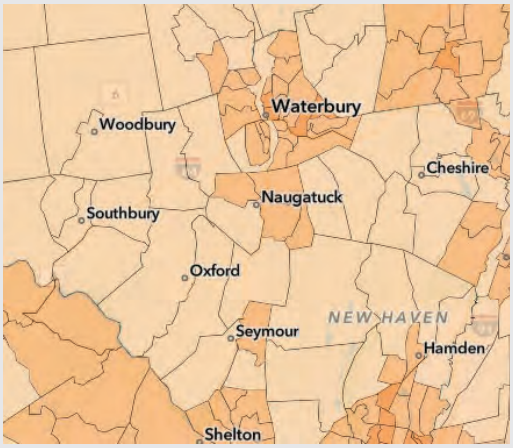
Based on discussions with municipal staff and input from the public during workshops and through the online survey, it was determined that NVCOG municipal officials and residents believe that high wind events such as tropical cyclones, hurricanes, and tornadoes present the highest risk to the NVCOG region. Flooding, winter storms, wildfires, and earthquakes present an overall moderate risk. The remaining hazards and effects evaluated in this Plan present a relatively low risk to the region. The number of strategies and actions identified by each community in the annexes tend to be greater for the higher risk hazards than for the lower risk hazards as expected from the level of risk.

NEW INITIATIVES

NATIONAL RISK INDEX



National Risk Index mapped in CT



Expected Annual Loss mapped in the NVCOG region through the NRI tool

FOR MORE INFORMATION

The National Risk Index
https://www.fema.gov/flood-maps/products-tools/national-risk-index
FEMA-NRI@fema.dhs.gov

WHAT IS THE INITIATIVE?

The National Risk Index (NRI) is a new, online mapping tool from FEMA that identifies the level of risk communities nationwide face from 18 natural hazards.

This mapping tool visualizes natural hazard risk metrics and includes data about expected annual losses, social vulnerabilities and community resilience.

The NRI incorporates physical and social vulnerability data to identify communities more at-risk to the adverse impacts of natural hazards. Data is presented at the county and census-tract level.

NRI allows decision-makers to take a holistic view of community risk to natural hazards via online maps and data. It helps communities before and during the planning process by illustrating which natural hazards pose a risk, and the community's current level of resilience. It can also inform community outreach during the mitigation and community planning process.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

The NRI presents a user-friendly tool for exploring the relative exposure levels of different areas and populations to natural hazards. Many of the loss estimates used to calculate the index, and presented through the NRI mapping product, are similar to those used in the risk analysis performed for the NVCOG Hazard Mitigation Plan update.

The NRI can assist NVCOG communities in:

- Updating emergency operations plans
- Enhancing hazard mitigation plans
- Prioritizing and allocating resources
- Identifying the need for more refined risk assessments
- Community-level risk communication and engagement
- Educating homeowners and renters
- Supporting adoption of enhanced codes and standards
- Informing long-term community recovery

4.0 Existing Capabilities

Hazard mitigation is accomplished at the federal, state, regional, and local levels. While most activities to mitigate hazard risk take place at the local level, other entities also have an important role to play in reducing vulnerability to natural hazards as well as floodplain management. For example, projects listed in this Plan update are eligible for certain federal grant programs. The following sections highlight existing capabilities that promote hazard mitigation in the NVCOG region.

4.1 Federal

There are numerous federal strategies in place to mitigate the effects of natural hazards. In addition to the HMA grant programs identified in Section 7.1, grant funding and technical resources are available through the U.S. Fire Administration, the U.S. Fish and Wildlife Service, USACE, and other federal agencies as discussed in Section 7.2 and Section 7.3. Specific federal programs that contribute to mitigation on a daily basis are discussed below.

Of note is that FEMA has prepared the document Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards. This document is available for download from FEMA[2] and provides a resource that communities may use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters. In addition, FEMA[3] has prepared a Risk Management Series brochure outlining various publications related to natural disasters and terrorism.

4.1.1 Flood Mitigation

Mitigation for flooding is provided by programs through FEMA and its NFIP, the NWS, the USACE, and the NRCS.

National Flood Insurance Program

One of the best methods of property protection for existing homes is for the homeowner to purchase flood insurance through the NFIP. While insurance does not prevent flooding, insurance payouts assist homeowners in restoring their properties more quickly than could be performed with savings alone. The NFIP was created by the U.S. Congress in 1968 to help provide a means for property owners to financially protect themselves from the impacts of flooding.

For more information about the NFIP, visit https://www.floodsmart.gov/

The NFIP offers flood insurance to homeowners, renters, and business owners if their community participates in the NFIP. Participating communities agree to adopt and enforce ordinances that meet or exceed the minimum federal requirements to reduce the risk of flooding. Each of the NVCOG municipalities has continually participated in the NFIP since the dates the initial Flood Hazard Boundary Maps were developed for their communities as detailed in Table 4-1, and each municipality plans to continue its participation in the NFIP for the foreseeable future using the Flood Insurance Rate Maps (FIRMs) developed by FEMA.

Table 4-1: NFIP Status

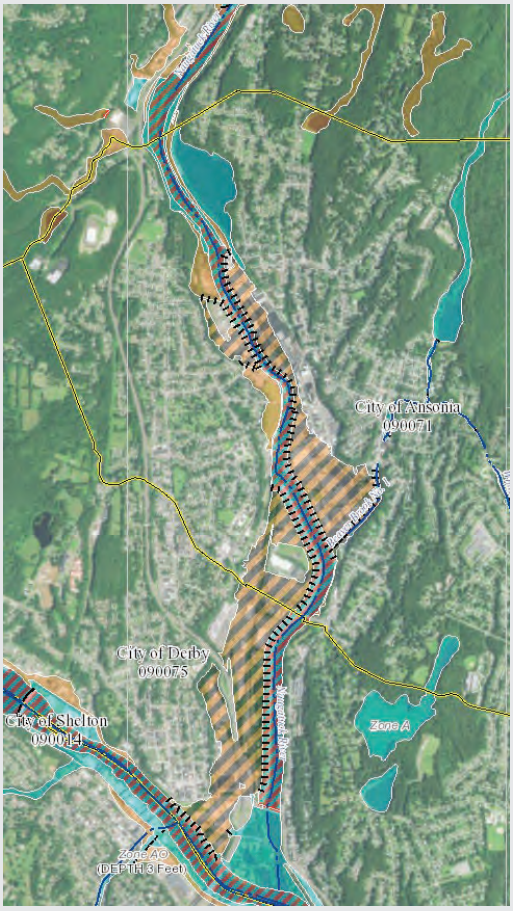
Municipality	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date
Ansonia	5/3/1974	9/2/1981	5/16/2017
Beacon Falls	5/3/1974	3/1/1979	10/16/2013
Bethlehem	2/21/1975	6/4/1990	6/4/1990
Bristol	5/17/1974	11/18/1981	5/16/2017
Cheshire	4/5/1974	7/16/1981	5/16/2017
Derby	6/28/1974	9/15/1977	5/16/2017
Middlebury	9/6/1974	10/16/1979	7/8/2013
Naugatuck	6/28/1974	8/15/1979	7/8/2013
Oxford	6/28/1974	12/4/1979	7/8/2013
Plymouth	8/16/1974	10/15/1982	11/6/1998
Prospect	6/21/1974	2/4/1977	5/16/2017
Seymour	7/26/1974	7/3/1978	10/16/2013
Shelton	5/24/1974	9/29/1978	6/18/2010
Southbury	2/8/1974	3/28/1980	7/8/2013
Thomaston	5/31/1974	7/5/1982	7/5/1982
Waterbury	3/22/1974	11/1/1979	7/8/2013
Watertown	5/31/1974	11/5/1980	11/5/1980
Wolcott	5/3/1974	7/5/1982	7/8/2013
Woodbury	4/12/1974	1/5/1978	10/20/1978

Source: FEMA Community Status Book

[2] https://www.fema.gov/media-library-data/20130726-1904-25045-0186/fema_mitigation_ideas_final508.pdf
[3] https://www.fema.gov/sites/default/files/2020-07/rms_pubs_brochure_3_07_0.pdf.

REGIONAL INITIATIVES

REGIONAL FEMA MAP UPDATES



DFIRM along the Naugatuck River
Image: FEMA

FOR MORE INFORMATION

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WHAT IS IT?

FEMA continuously works to update its Flood Insurance Rate Maps (FIRMs) across the country. In the past, updates have been performed for individual communities, and later they were completed at the county scale; FEMA now performs map updates by watershed. FEMA is currently in the process of updating FIRMS for the Saugatuck (Southwest Coast), Farmington River, and Housatonic River Watersheds.

Currently adopted FIRMs in NVCOG are dated from 2008, 2010, and 2017 (with updates to levee mapping in Ansonia and Derby in 2013).

The new updates will impact NVCOG communities as follows:

Saugatuck	Farmington	Housatonic		
Shelton	Bristol	Ansonia	Naugatuck	Thomaston
	Plymouth	Beacon Falls	Oxford	Waterbury
	Wolcott	Bethlehem	Plymouth	Watertown
		Bristol	Prospect	Wolcott
		Cheshire	Seymour	Woodbury
		Derby	Shelton	
		Middlebury	Southbury	

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

FEMA map updates are performed in order to make sure that FIRMs accurately reflect current flood risk conditions. Updated maps may show higher flood risks than previously shown in some areas, and lower flood risks in others; these changes may reflect physical changes in flood conditions, or improved modeling results since adoption of the previous map.

Local communities can participate in the map updates in the following ways:

1. Pay attention to correspondence from FEMA/mapping contractors and important dates/milestones.
2. Provide feedback when asked, this is your chance to make changes to the map and get FEMA to pay for it.
3. When final maps go effective, town is required to update local floodplain zoning regulations or ordinance or be suspended from the NFIP (hinders home sales)

Homes and buildings in high-risk flood areas, defined by FEMA as areas with a 1% annual chance of flooding and known as SFHAs, are required to have flood insurance if the building is financed with a mortgage from federally regulated or insured lender. Homes and businesses in moderate (0.2% annual chance of flooding) to low-risk areas that have such mortgages are typically not required to have flood insurance, although it may be required at the discretion of the lender. Property owners and renters in these areas may always voluntarily choose to purchase flood insurance. According to the NFIP, over 20% of all NFIP insurance claims and one-third of all federal disaster assistance payouts for flooding come from properties outside of SFHAs.

The NFIP works closely with more than 80 private insurance companies to offer flood insurance because flooding is not covered under standard homeowner's insurance policies. Rates are set nationally and do not differ from company to company or agent to agent, and unlike many types of insurance rates do not increase when claims are made. Property owners should be encouraged to submit claims under the NFIP whenever flooding damage occurs in order to increase the eligibility of the property for projects under the various mitigation grant programs.

A variety of structural-related mitigation strategies, including the use of freeboard, can be applied to new development and substantial redevelopment although these are beyond the minimum requirements of the NFIP. The first-floor elevation is one of the primary components to determining the flood risk of a structure within a SFHA. The minimum national standard under the NFIP for the elevation of the first floor of new and substantially improved structures is to place the floor at or above the base flood elevation. Freeboard requirements (such as those mandated by the State of Connecticut) provide an additional level of protection to areas at risk of flooding by requiring new development or substantial improvement to be elevated to the base flood elevation plus an additional amount.

The hydrology and hydraulics used to define SFHAs is detailed in a FIS which must be concurrently reviewed to properly interpret FIRMs. FEMA encourages local communities to use more accurate topographic maps to expand upon the FIRMs published by FEMA. This is because many FIRMs were originally created using quadrangle maps prepared by the United States Geological Survey with 10-foot contour intervals, but many municipalities today have contour maps of one- or two-foot intervals that show more recently constructed roads, bridges, and other anthropologic features. An alternate approach is to record high water marks and establish those areas inundated by a recent severe flood to be the new regulatory floodplain. While these maps cannot replace the FIRM for insurance purposes, they may be used to regulate development provided that the mapped area is the same size or larger than that mapped on the FIRM.

Adoption of a different floodplain map is allowed under NFIP regulations as long as the new map covers a larger floodplain than the FIRM. It should be noted that the community's map will not affect the current FIRM or alter the SFHA used for setting insurance rates or making map determinations; it can only be used by the community to regulate floodplain areas. The FEMA Region I office has more information on this topic. Contact information can be found in Section 7.2.

Reductions in floodplain area or revisions of a mapped floodplain can only be accomplished through revised FEMA-sponsored engineering studies or Letters of Map Change. To date, several Letters of Map Amendment and Letters of Map Revision have been submitted for the NVCOG municipalities as expected given the relatively developed nature of the local floodplains.

In order to encourage more flood resilient development and assist local communities in implementing the NFIP regulations, FEMA has developed a variety of training modules and publications as presented below:

- A compilation of flood resistant provisions in the 2018 International Building Code[4]
- A publication to protect building utility systems from flood damage[5]

[4] https://www.fema.gov/sites/default/files/2020-08/fema_2018-i-codes-flood-provisions.pdf
[5] https://www.fema.gov/sites/default/files/2020-07/fema_p-348_protecting_building_utility_systems_from_flood_damage_2017.pdf

- A publication to floodproof non-residential buildings[6]
- A publication and flyer[7] for protecting manufactured homes from floods and other hazards

Community Rating System

FEMA's Community Rating System (CRS) is a voluntary program that offers discounts of flood insurance premiums to communities that undertake activities beyond minimum flood insurance standards. Activities include public outreach and information regarding flood protection, open space protection, stormwater management, and floodplain mitigation. No NVCOG communities presently participate in the CRS program, although Cheshire previously participated in the program from 1993 to 2003.

Multi-jurisdictional HMPs that are prepared in accordance with the CRS Floodplain Management Planning process qualify for floodplain management planning credit in the CRS Program. Each CRS community is awarded approximately 200 points for adopting this HMP. CRS Program requirements for this HMP post-adoption include:

- An annual evaluation report on progress towards Plan implementation must be prepared and submitted with the community's annual CRS recertification. This report must be submitted to the governing body, released to the media, and made available to the public.

- If a community is receiving credit as a result of participation in a multi-jurisdictional HMP, the annual evaluation report must discuss the individual strategies and actions for that community. This can be performed by participating in a multi-jurisdictional annual plan review committee or through separate submittals by each community. A community will not receive credit if it was not present at the regional meeting. Therefore, the submittal needs to record attendance and show who participated in preparation of the report.

- The community must update the HMP every five years.

As public information activities are an important and required component of the CRS, the public participation requirements and recommendations of this HMP regarding public education and awareness can be implemented through the CRS program.

The CRS program requires that communities with 10 or more RLPs (Category C communities) prepare a floodplain management plan that covers the RLP areas. Category C communities in the NVCOG region include Bristol, Oxford, Shelton, and Southbury. In order to enhance future CRS participation, these municipalities should prepare a Repetitive Loss Area Analysis should funding be available.

National Weather Service

The NWS issues a Flood Advisory, Flood Watch, Flood Warning, or Flash Flood Warning to advise citizens when hazardous flooding conditions may occur. State and local governments typically rely on NWS forecasts to prepare for and respond to flooding events.

- A **Flood Advisory** is issued when a specific weather event that is forecasted to occur may become a nuisance, but when flooding is not expected to be bad enough to issue a warning.

- A **flood watch** or a **flash flood watch** is issued for an area when conditions in or near the area are favorable for a flood or flash flood, respectively. A flash flood watch or flood watch does not necessarily mean that flooding will occur, but that people should be prepared for a warning to be issued.

- A **flood warning** or a **flash flood warning** is issued for an area when parts of the area are either currently flooding, highly likely to flood, or when flooding is imminent. People in areas at risk of flooding should move immediately to high ground.

United States Army Corps of Engineers

USACE has designed, constructed, and operates flood protection projects in a variety of communities across Connecticut. According to the FIS for New Haven County, within the NVCOG region the USACE:

[6] https://www.fema.gov/sites/default/files/2020-07/fema_p-936_floodproofing_non-residential_buiildings_110618pdf.pdf
[7] https://www.fema.gov/sites/default/files/2020-07/fema85_flyer_052219.pdf

- Constructed a local flood protection project along Beaver Brook in Ansonia as part of a greater dike and floodwall project along the lower section of Beaver Brook and the Naugatuck River in order to confine design storm peak discharges to the conveyance channel.

- Constructed a local flood protection project along the east bank of the Naugatuck River in Waterbury from the Chase Brass Dam to the railroad crossing upstream. The flood protection project consists of channel improvements, a floodwall, and a protective dike that confines the 0.2% annual chance flood to the river channel and protects a major industrial area.

- Constructed a large flood control dam on the main stem of the Naugatuck River (Thomaston Dam) in 1970 and six additional flood control dams on tributaries: Hall Meadow Brook Dam on the West Branch Naugatuck River, East Branch Dam on the East Branch Naugatuck River, Northfield Brook Dam (1966), Black Rock Dam on Branch Brook (1970), Hancock Brook Dam (1966), and Hop Brook Dam. Combined, these dams provide a total flood capacity of 77,000 acre-feet. The net result of these flood control reservoirs is to store all runoff up to a 100-year storm and provide for its release at a controlled rate. This will reduce the flood stage height of a flood similar to the August 1955 flood by 18.6 feet at the confluence of Branch Brook and the Naugatuck River.

The USACE also oversees levee certification for all levees in the region. All four levees are accredited per the New Haven County FIS. Leveed areas include:

- A levee extends along the right bank of the lower section of Beaver Brook in Ansonia and connects to a levee on the left bank of the Naugatuck River.

- A levee extends along the left bank of the Housatonic River and connects to a levee on the right back of the Naugatuck River in Derby. The dikes protect against a flood with a stage of 28 feet at O'Sullivan's Island.

The USACE also has provided dam evaluation services, with a significant number of Phase I and Phase II dam assessments completed in the late 1970s throughout Connecticut. Furthermore, the USACE reviews and accredits levee systems such as those in Ansonia and Derby as described above.

Natural Resource Conservation Service

The NRCS designs and funds flood mitigation projects through its Emergency Watershed Protection (EWP) program. According to the FIS for Watertown, the NRCS performed channel work along Steele Brook in the 1970s which were effective at preventing flood losses during floods in March 1977.

More recently, the NRCS EWP program focuses on funding projects to address debris-clogged stream channels, undermined and unstable streambanks, jeopardized water control structures and public infrastructure, wind-borne debris removal, and damaged upland sites stripped of protective vegetation by fire or drought. Landowners must have a project sponsor (typically a local government) support any EWP grant application. Four projects occurred in Bristol following Tropical Storm Irene in 2011 including three bank stabilization projects and one debris removal project to restore channel conveyance. NRCS also performed a riverbank project in Woodbury when excessive velocities scoured out the riverbank and nearly undermined a house.

4.1.2 Winter Storms

FEMA's Building Sciences division regularly prepares guidance materials for construction in areas impacted by winter storms. For example, FEMA[8] has produced a Snow Load Safety Guidance Document.

4.1.3 Tropical Cyclones and Hurricanes

NOAA issues an annual hurricane outlook to provide a general guide to each upcoming hurricane season based on various climatic factors. However, it is impossible to predict exactly when and where a hurricane will occur. NOAA believes that "hurricane landfalls are largely determined by the weather patterns in places the

[8] https://www.fema.gov/sites/default/files/2020-07/fema_snow_load_2014.pdf

hurricane approaches, which are only predictable within several days of the storm making landfall." Tracking of hurricanes has advanced to the point where areas often have one week of warning time or more prior to a hurricane strike.

Connecticut is located in FEMA Zone II regarding maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 mph. This wind speed could occur as a result of either a hurricane or a tornado. The American Society of Civil Engineers recommends that new buildings be designed to withstand this peak three-second gust.

FEMA has also prepared multiple publications regarding mitigating potential wind damage, including the following presented below:

- A wind retrofit guide and flyer[9] for residential buildings
- Detailed guidelines for conducting wind vulnerability assessments of existing critical facilities[10]
- A compilation of the wind resistant provisions of the 2018 International Building Code[11]

4.1.4 Tornadoes and Thunderstorms

Warning is the primary method of existing mitigation for tornadoes and thunderstorm-related hazards. The NOAA NWS issues watches and warnings when severe weather is likely to develop or has developed, respectively. Table 4-2 lists the NOAA Watches and Warnings, respectively, as pertaining to actions to be taken by emergency management personnel in connection with thunderstorms and tornadoes.

Both the FEMA and the NOAA websites contain valuable information regarding preparing for and protecting oneself during a tornado as well as information on a number of other natural hazards. Available information from FEMA includes:

Table 4-2: NOAA Watches and Warnings

Weather Condition	Meaning	Action
Flash Flood Watch	It is possible that rains will cause flash flooding in your area.	Notify personnel to watch for street or river flooding.
Flash Flood Warning	Flash flooding is occurring or imminent in your area.	Watch local rivers and streams. Be prepared to evacuate low-lying areas. Take appropriate actions listed in emergency plans.
Severe Thunder-storm Watch	Severe thunderstorms are possible in your area, with winds greater than 58 mph, or hail 0.75-inches in diameter, or a tornado likely to develop	Notify personnel and watch for severe weather.
Severe Thunder-storm Warning	Severe thunderstorms are occurring or are imminent in your area based on spotters or as indicated by weather radar.	Notify personnel and watch for severe conditions or damage (i.e., downed power lines and trees). Take appropriate actions listed in municipal emergency plans.
Tornado Watch	Tornadoes are possible in your area.	Notify personnel and be prepared to move quickly if a warning is issued.
Tornado Warning	Tornadoes are occurring or are imminent in your area.	Notify personnel, watch for severe weather, and ensure personnel are protected. Take appropriate actions listed in emergency plans.

Source: NOAA

- Design and construction guidance for creating and identifying community shelters
- Recommendations to better protect your business, community, and home from tornado damage, including construction and design guidelines for structures
- Ways to better protect property from wind damage

[9] https://www.fema.gov/sites/default/files/2020-07/p-804_wind-retrofit-guide-residential.pdf
[10] https://www.fema.gov/sites/default/files/2020-07/guidelines-wind-vulnerability.pdf
[11] https://www.fema.gov/sites/default/files/2020-07/2018-ibc-compliation-wind-resistant-provisions.pdf

- Ways to protect property from flooding damage
- Construction of safe rooms within homes

More information is available from:

FEMA: http://www.fema.gov/library/

NOAA: https://www.nssl.noaa.gov/education/svrwx101/

NOAA information includes a discussion of family preparedness procedures and the best physical locations during a storm event. NOAA encourages all residents to purchase a NOAA weather radio containing an alarm feature.

4.1.5 Wildfires

The NWS issues a Red Flag warning when winds will be sustained or there will be frequent gusts above a certain threshold (usually 25 mph), the relative humidity is below 30%, and precipitation for the previous five days has been less than one-quarter inch. Such conditions can cause wildfires to quickly spread from their source area.

FEMA has produced a "Defensible Space" Technical Fact Sheet for Construction in Wildfire Zones[12].

4.1.6 Drought

The National Integrated Drought Information System (https://www.drought.gov/drought/) is a multi-federal agency effort that tracks drought conditions throughout the United States. A variety of resources are available related to planning and preparedness, education, and recovery from droughts. This site incorporates current data developed by the United States Drought Monitor (https://droughtmonitor.unl.edu/).

4.1.7 Earthquakes

FEMA has produced a fact sheet[13] that addresses seismic building code provisions for improving earthquake resilience in new buildings.

4.1.8 Dam Failure

FEMA has prepared a fact sheet[14] to increase awareness of potential dam risk.

The Association of State Dam Safety Officials provides a variety of resources related to dam management primarily aimed at state dam safety officials but also useful for dam owners, stakeholders, and the public. This information can be accessed from https://www.damsafety.org/.

4.2 State

There are numerous state capabilities in place to mitigate the effects of natural hazards in Connecticut. The Connecticut Department of Emergency Services and Public Protection (DESPP), Connecticut DEMHS, the Connecticut DEEP, the CTDOT, and other agencies provide funding and technical assistance related to mitigation as discussed in Section 7.3. Specific state programs that contribute to mitigation on a daily basis are discussed below.

4.2.1 Multiple Hazards

Hazard Mitigation Planning

The State HMP (2019 CT NHMP) is updated every five years by Connecticut DEMHS as required by FEMA. The document examines statewide impacts of natural hazards, compares impacts between counties, examines state capabilities, and outlines new initiatives for hazard mitigation planning at the state level that is to be enacted at the local level over the next five years.

The Connecticut State Colleges and Universities has also prepared a HMP for its campuses. In the NVCOG region, the 2014 Multi-Campus Hazard Mitigation Plan covers Naugatuck Valley Community College in Waterbury as shown on the Fact Sheet below.

[12] https://www.ready.gov/sites/default/files/2020-03/home-builder-guide-construction-defensible-space.pdf
[13] https://www.fema.gov/sites/default/files/2020-10/fema_seismic-building-code-provisions-new-buildings-create-safer-communities_fact-sheet.pdf
[14] https://www.fema.gov/media-library-data/1485871092404-7a14db27056f2f5bb7bb75cfcbe017d1/damsafety_factsheet_2016.pdf

Codes and Design Standards

The Connecticut Department of Administrative Services, Division of Construction Services includes the Office of the State Building Inspector. This office maintains the current (2018) state building code. Each NVCOG municipality has adopted the Connecticut Building Code as its building code, and literature is generally available regarding design standards in each local Building Department office. The code includes design standards for wind, snow load, earthquakes, and other hazards.

The new code is significant relative to flood mitigation. Adherence to the State Building Code requires that the foundation of structures will withstand flood forces and that all portions of the building subject to damage are above or otherwise protected from flooding. It requires 1 foot of freeboard in all A and AE zones, flood openings are required in breakaway walls; and essential facilities must be elevated 2 feet above the BFE or to the 0.2% annual chance flood elevation. Refer to the Fact Sheet below for more details.

Monitoring and Alert Systems

DESPP maintains the statewide "CT Alert" Emergency Notification System. This system uses the State's Enhanced 9-1-1 database for location-based notifications to the public for life-threatening emergencies. Emergency notification systems are extremely useful for natural hazard mitigation, as a community warning system that relies on radios and television is less effective at warning residents during the night when the majority of the community is asleep. Each of the NVCOG municipalities receives regular weather updates through DEMHS Region 2, Region 3, or Region 5 email alerts as well as watches and warnings issued by the NWS.

DEMHS is a division of DESPP. DEMHS administers the FEMA HMA grant programs in Connecticut, and also oversees the statewide hazard mitigation planning process. This includes both the State HMP and the development of local and regional plans including this Plan update.

CTDOT has implemented the Statewide Roadway Weather Information System (RWIS). Each of the 13 RWIS sites communicate real-time and historical weather information to CTDOT staff and weather services. This information is used to monitor impacts of heavy rainfall and to inform a variety of winter maintenance activities. An additional 23 additional priority sites have been identified to expand the system from the existing 13 sites.

State-Sponsored Grant Programs

The Connecticut Office of Policy and Management manages the Small-Town Economic Assistance Program (STEAP) which provides grant funding through the State Bond Commission for capital projects such as constructing, reconstructing, or repairing roads access ways, and other site improvements. STEAP-eligible communities in the NVCOG region include all municipalities except Ansonia, Bristol, and Waterbury. Funded projects since 2005 related to hazard mitigation include construction and renovation of facilities to be used as shelters, bridge and culvert repair/replacements, road reconstructions, water main replacements, critical facility upgrades (including generators), solar power arrays, and drainage improvements.

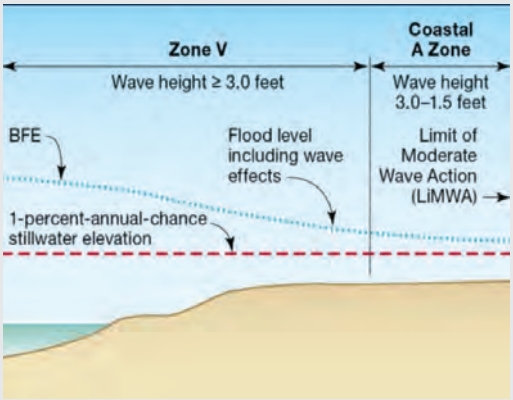
The Local Transportation Capital Improvement Program administered by CTDOT provides state funds to municipal governments in urbanized areas in lieu of Federal funds otherwise available through Federal transportation legislation. This program has fewer constraints and requirements than currently exist when using certain types of federal funds. NVCOG solicits project proposals from member municipalities, reviews applications with communities to ensure the project's purpose and need meet the goals of the LOTCIP, and reviews projects through the town-led design process to ensure projects meet design standards and have realistic cost estimates. NVCOG maintains a financial plan to ensure program is fiscally constrained.

The Connecticut Farm Services Agency provides a variety of programs to assist the state's agricultural producers. The Supplemental Revenue Assistance or "SURE" program provides crop disaster assistance to eligible producers on farms that have incurred crop protection or crop quality losses due to natural disasters. The Emergency Assistance for Livestock, Honey Bees & Farm-Raised Fish or "ELAP" program covers losses from disaster not adequately covered by other disaster programs. The Livestock Indemnity Program or "LIP" provides 75% market value in benefits to livestock producers for livestock deaths in excess of normal mortality caused by adverse weather. The Noninsured Crop Disaster Assistance Program (NAP)

NEW INITIATIVES

STATE BUILDING CODE AND FLOOD REGULATIONS

V Zone versus Coastal A Zone
FEMA



V Zone versus Coastal A Zone
FEMA

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WHAT IS THE INITIATIVE?

The State of Connecticut adopted an updated State Building Code effective October 1, 2018. The 2018 Connecticut State Building Code incorporates a suite of national and international model codes, including the 2015 International Building Code (IBC), and 2015 International Residential Code (IRC), both of which include provisions for flood mitigation.

The 2015 IBC includes flood-resistant construction standards for non-residential structures (Appendix G), while the 2015 IRC includes such standards for residential structures (Chapter 3, Section R322).

Key flood-resistance provisions in the 2018 Connecticut State Building Code include:

- Structures in all flood hazard areas (including A Zones) must have the lowest floor elevated to the BFE plus 1 foot.
- Structures in Coastal High Hazard Areas (V Zones and Coastal A Zones - A zones subject to wave heights between 1.5 ft and 3 ft) must have the bottom of the lowest horizontal structural member elevated to the BFE plus 1 foot
- Critical facilities in hazard zones must be meet the above requirements to BFE plus 2 feet.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

The Connecticut State Building Code is enforced statewide; however, updating local zoning regulations can support municipal efforts to bring the local building-stock up to code.

Model Floodplain Regulations have been developed by the Department of Energy and Environmental Protection (DEEP) for both inland and coastal communities. These model regulations outline the changes municipalities need to make to incorporate the new State Building Code language.

Simply implementing the State Building Code locally without updating the flood damage prevention regulations may be insufficient, as the permitting and building approvals are not always parallel. Updating local regulations to incorporate State Building Code requirements will avoid confusion, aid enforcement, and make inspections more effective.

A specific hazard mitigation action related to the State Building Code update was suggested for municipalities in this plan: All municipalities should incorporate the model state flood regulations provided by DEEP, including provisions for freeboard and for elevating building mechanical and electrical systems.

provides financial assistance to producers of noninsurable crops when low yields, inventory loss, or prevented planting occurs due to natural disasters. Emergency Farm Loan funds are also available for counties receiving a presidential disaster or emergency declaration.

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. The 2017 CEQ annual report indicates that Connecticut is not on track for meeting its open space preservation goal. Full counts of open space assets are not presently available in Connecticut but should be made available in an upcoming statewide Open Space Plan.

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 Connecticut DEEP Open Space and Watershed Land Acquisition Grant Program is usually available every 2 years. According to the 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. NVCOG assists municipalities and land trusts in their efforts to secure grants by writing letters of support on their behalf to the Connecticut 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. These resources are used to provide the local match for the state grant or are used to acquire lands without state assistance.

Sustainable CT

Sustainable CT is a voluntary certification program created by the Connecticut Conference of Municipalities to recognize thriving and resilient Connecticut communities. Sustainable CT is an independently funded, grass-roots, municipal effort designed to support all municipalities, regardless of size, geography, or resources. Sustainable CT empowers municipalities to create high collective impact for current and future residents.

Sustainable CT provides a wide-ranging menu of best practices for building sustainable municipalities. Municipalities choose Sustainable CT actions from this "Master Action List," implement them, and earn points toward certification. Many actions are consistent with the goals of hazard mitigation and, if accomplished, may demonstrate progress with hazard mitigation. One such action is to conduct a Climate Vulnerability Assessment, identifying how climate change will impact the community. Each municipality in the region has incorporated projected climate change impacts within its respective annex of the Hazard Mitigation Plan.

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 initiative specifically encourages consideration of low-income residents and their vulnerability to extreme weather.

Resilient Connecticut

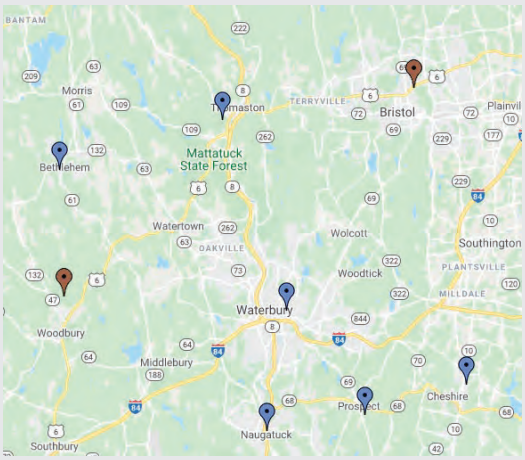
CIRCA began the Resilient Connecticut initiative in 2018. The initiative aims to establish resilient coastal communities through the Resilience Framework, which includes:

- Supporting healthy buffering ecosystems
- Fostering critical infrastructure that is adapted to withstand occasional flooding
- Establishing resilient and strong connections between critical services, infrastructure, and transport hubs
- Increasing investment in identified "Resilience Zones" that will increase economic resilience by strongly

NEW INITIATIVES

"SUSTAINABLE CT"

Sustainable CT
Local Actions.
Statewide Impact.



Images courtesy of Sustainable CT

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https://sustainablect.org/about/contact-us/

WHAT IS THE INITIATIVE?

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 Sustainable CT 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:

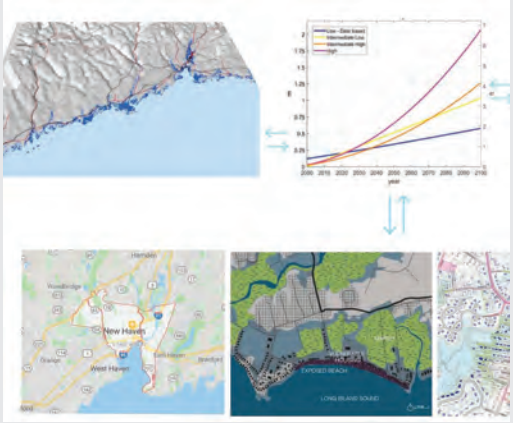
- Identify, or create and disseminate, a toolkit for pre-disaster business preparedness and for post-disaster conditions.
- Review and revise regulations to encourage and promote LID.
- Review the POCD and adopt a revised POCD that includes the Hazard Mitigation Plan goals and at least three other sustainability 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.

All towns in the NVCOG region have a Climate Vulnerability Assessment in their respective annex of the Hazard Mitigation Plan. In addition, the annexes of communities not registered with Sustainable CT have an action to register; those of communities already registered have an action to pursue one of the other actions listed above.

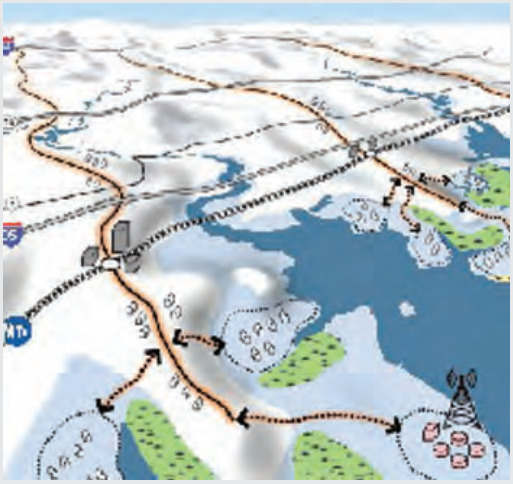
Bristol, Cheshire, Waterbury, and Woodbury are bronze certified communities. Communities that are registered and preparing for advancement include Bethlehem, Naugatuck, Prospect, Southbury, Seymour, Oxford, Thomaston, Derby, and Ansonia.

NEW INITIATIVES

RESILIENT CONNECTICUT



Resilient Connecticut



Resilient Connecticut

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WHAT IS THE INITIATIVE?

The Connecticut Institute for Resilience and Climate Adaptation (CIRCA) began the Resilient Connecticut (Resilient CT) initiative in 2018. Resilient CT aims to establish resilient coastal communities through the Resilience Framework, which includes:

- Supporting healthy buffering ecosystems
- Creating critical infrastructure that's adapted to withstand occasional flooding
- Establish resilient and strong connections between critical services, infrastructure, and transport hubs
- Increasing investment in identified "Resilience Zones" that will increase economic resilience by strongly tying-back to regional transportation networks and economic opportunities.

The initiative is currently in Phase II, which consists of regional and municipal resilience planning and engagement efforts built around the Resilience Framework.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Resilient Connecticut is working to make the planning components of Phase II well-aligned with municipal hazard mitigation strategies.

Resilient Connecticut specifically focuses on communities with major highways and passenger rail lines, and communities with transit-oriented development (TOD) potential. In NVCOG, these communities are Waterbury, Naugatuck, Beacon Falls, Seymour, Ansonia, and Derby. Each of these municipal annexes in this HMP includes an action to “Collaborate with CIRCA on the ‘Resilient Connecticut’ project.”

Communities in NVCOG can accomplish this by:

- Partnering with CIRCA to develop climate adaptation and resilience projects that address flooding and heat;
- Participating in Resilient CT engagement efforts; and
- Visiting https://resilientconnecticut.uconn.edu/ to learn more.

tying-back to regional transportation networks and economic opportunities

The initiative is currently in Phase II, which consists of regional and municipal resilience planning and engagement efforts built around the Resilience Framework. Resilient Connecticut is working to make the planning components of Phase II well-aligned with municipal hazard mitigation strategies.

Resilient Connecticut specifically focuses on communities with major highways and passenger rail lines, and communities with transit-oriented development (TOD) potential. In the region, these communities are Ansonia, Beacon Falls, Derby, Naugatuck, Seymour, Shelton, and Waterbury. The municipal annex of each community noted above includes an action to collaborate with CIRCA on the Resilient Connecticut project. This action may be accomplished by:

- Participating in Resilient Connecticut engagement efforts
- Recognizing "zones of shared risk" that may not follow political boundaries
- Looking for options to link "zones of shared risk
- Visiting the https://resilientconnecticut.uconn.edu website to learn more

Historic and Cultural Resources

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 six southern 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:

- 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

A best practice guide for planning techniques to make historic resources more resilient was distributed in 2018. This guide can be used by all jurisdictions in Connecticut 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. Guide available at <portal.ct.gov/DECD/Content/Historic-Preservation/01_Programs_Services/Hurricane-Sandy-Program/Resiliency-Planning>.

4.2.2 Flooding

Flood Control Structures

The State of Connecticut developed and partially implemented a master plan for flood control improvements in Bristol following the August 1955 flood. In conjunction with the City, improvements were constructed at the Middle Street Dam, to the open channel between the dam and Downs Street, and the open channel from the Pequabuck River culvert upstream to Jacobs Street. In addition, reinforcement of the concrete culverts along the Pequabuck River and North Creek were performed. These improvements increased the overall flood carrying capacity.

MITIGATION SUCCESS STORY

ANSONIA AND DERBY LOCAL FLOOD PROTECTION PROJECTS

Section of Local Protection Project. Photo: USACE

Section of Local Flood Protection Project. Photo: NVCOG

FOR MORE INFORMATION

US Army Corps of Engineers
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WHAT IS IT?

Since the 1955 flood, extensive structural flood mitigation projects have been completed along streams in the NVCOG region. This includes:

- -The Ansonia Local Protection Project, located along the Naugatuck River and Beaver Brook in southwestern Ansonia and along the Naugatuck River in northwestern Derby.
- The Derby Local Protection Project, located in Derby at the confluence of the Housatonic and Naugatuck Rivers.

These major structural projects were completed in the early 1970s, and consist of earthen dikes and concrete floodwalls, pumping stations, and closeable flood gates. The systems currently protect over 500 acres of highly-developed land.

While effective at mitigating flooding, the environmental and social impacts of these types of major structural interventions can be significant. Many communities in the region have explored ways to improve community access to rivers, and to restore some natural features of the river, such as through multi-use greenways constructed partially on top of flood control systems.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

The types of intensive structural mitigation approaches represented by the major flood control dams in the Naugatuck River watershed, as well as the flood control levees and floodwalls through Ansonia, Derby, and Waterbury/ Watertown, are generally believed to be costly, intrusive, and less prudent than other flood mitigation options under current regulatory, permitting, and funding environments. Modest flood control and flood protection system projects are generally allowed by the federal government, but federal involvement from the Army Corps of Engineers is typically sought when these structures are desired.

Communities must maintain existing structural flood mitigation systems to ensure they continue to function as designed; furthermore, climate-change induced shifts in precipitation patterns must be considered with regard to the long-term functionality of such systems.

Ultimately, a combination of hard engineered structures and natural approaches can maintain ecosystem and social benefits while reducing flood risks.

MITIGATION SUCCESS STORY

FLOOD CONTROL PROJECTS

Thomaston Dam.
Photo: USACE

Hop Brook Dam and Lake.
Photo: USACE

FOR MORE INFORMATION

US Army Corps of Engineers
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https://www.nae.usace.army.mil

WHAT IS IT?

Since the 1955 flood, extensive structural flood control projects have been completed along streams in the NVCOG region to reduce flooding. These include:

- Black Rock Lake in Thomaston and Watertown
- East Branch Dam in Torrington (operated and maintained by the state of Connecticut)
- Hall Meadow Brook Dam in Torrington (operated and maintained by the state of Connecticut)
- Hancock Brook Lake in Plymouth
- Hop Brook Lake in Naugatuck, Middlebury and Waterbury
- Northfield Brook Lake in Thomaston and Litchfield
- Thomaston Dam in Thomaston

These seven flood control systems are meant to work together to reduce flood risk along the Naugatuck River. They also reduce flood risk along tributaries such as Hop Brook and Hancock Brook.

The Army Corps of Engineers also completed local flood protection system projects such as the Ansonia and Derby levee system (described on another sheet) and the Waterbury/ Watertown Local Protection Project located along the east bank of the Naugatuck River in the Waterville section of Waterbury and Watertown.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

The types of intensive structural mitigation approaches represented by the major flood control dams in the Naugatuck River watershed, as well as the flood control levees and floodwalls through Ansonia, Derby, and Waterbury/ Watertown, are generally believed to be costly, intrusive, and less prudent than other flood mitigation options under current regulatory, permitting, and funding environments. Modest flood control and flood protection system projects are generally allowed by the federal government, but federal involvement from the Army Corps of Engineers is typically sought when these structures are desired.

Communities must maintain existing structural flood mitigation systems to ensure they continue to function as designed; furthermore, climate-change induced shifts in precipitation patterns must be considered with regard to the long-term functionality of such systems.

Ultimately, a combination of hard engineered structures and natural approaches can maintain ecosystem and social benefits while reducing flood risks.

In 1978, the State appropriated $170,000 for flood control improvements in the central business district of Terryville (Plymouth). These included reconstruction of the upper portion of the Main Street bridge, demolition of a dwelling immediately upstream of the bridge, and channel modifications. The Main Street bridge was reconstructed in 1996.

According to the New Haven County FIS, 5 four reservoirs in Wolcott (Chestnut Hill Reservoir, two Scovill Reservoirs, and Hitchcock Lake) store floodwaters and modify the severity of floods along the Mad River by delaying the timing of peak discharge on each watershed and providing flood storage.

Ice Jam Monitoring

The Connecticut DEEP monitors the occurrence of ice jams throughout the state. According to the 2019 CT NHMP, ice jams are relatively infrequent in the state. Ice jam flooding last occurred in Connecticut since 2018, with ice jams historically occurring in the region along the Housatonic River in Southbury.

Codes and Design Standards

The CTDOT has standards for the design of culverts and bridges on State roads, and these standards are often used by local communities. CTDOT uses the NOAA-published Volume 10, Version 3.0 of the "NOAA Atlas 14, Precipitation-Frequency Atlas of the United States" for the northeastern states for its runoff calculations.

Connecticut Public Act 18-182 updated the flood design standards for state-funded critical facilities. This Public Act requires use of the most updated sea level rise scenarios (such as those developed by CIRCA or others) to be considered under local and regional planning in the state. Example facilities covered by the act include schools, elderly housing facilities, residences, and hazardous waste facilities. The base flood elevation for such facilities is the 0.2% annual chance flood elevation.

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 Connecticut 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.

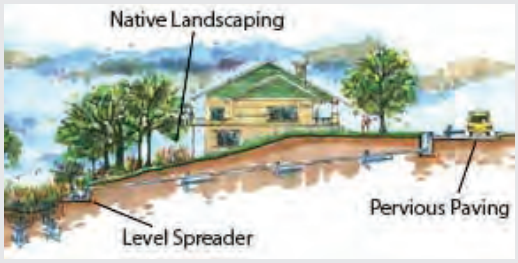
In 2012, the Connecticut DEEP updated the manual and guidelines to incorporate appendices on Low Impact Development (LID). LID manages stormwater by design-ing with nature in mind. LID techniques seek to retain stormwater close to where it falls thus keeping runoff out of pipes that drain to waterways. NVCOG 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. 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 Fact Sheet following this page describes rural resiliency.

The *Low Impact Sustainable Development Design Manual* developed for the Town of Morris by Trinkaus Engineering, LLC with funding from CIRCA 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.

NEW INITIATIVES

LOW IMPACT DEVELOPMENT FOR RURAL RESILIENCY



Images: nrcs.usda.gov

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WHAT IS THE INITIATIVE?

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 of communities 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 for rural communities focuses on strategies achievable by rural municipalities, which tend to have different challenges as compared to urban communities.

Rural municipalities in the NVCOG Region such as Prospect and Bethlehem can benefit from mitigation actions related to increasing resiliency through LID.

The manual focuses on strategies achievable by rural municipalities, which tend to have different challenges as compared to urban communities. Rural municipalities across the region can benefit from using the manual to guide implementation of stormwater runoff mitigation actions.

Helping Small Businesses Mitigate Impacts

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. Natural disasters can result in property damage, loss of inventory, and business interruption; another important risk that many small businesses face is that of environmental contamination and legal liabilities resulting from toxic chemical releases into the environment during or following a disaster.

In an effort to assist small business with natural hazard mitigation, Connecticut DEEP has proposed strategies for towns to implement education and awareness programs with recommendations for best management practices (BMPs) to help business owners and municipalities prevent commercial pollutants from entering the environment. Such education and awareness programs may help small businesses and the municipalities in which they are located avoid expensive cleanups, reduce legal liability challenges, mitigate potential risks to public health, and accelerate business recovery and reopening – reducing negative impacts to the municipality's economic base.

The municipalities of the region can benefit from mitigation actions related to mitigating flood impacts to small businesses that use toxic chemicals. A selection from the following actions has been included in each of the municipal annexes, depending on the needs of each community:

- Provide information on the municipal website about CT DEEP training and information around small business chemical management for hazard resilience.
- Use the CT Toxics Users and Climate Resilience Map to identify toxic users located in hazard zones within your community. Contact those users to inform them about the CT DEEP small business chemical management initiative.
- Host a CT DEEP presentation for municipal staff and local businesses about business chemical management for hazard resilience.

CT DEEP has recommended that each municipality be listed as the lead agency for each of these actions, with assistance from CT DEEP noted (CT DEEP will develop information for dissemination). The suggested action priority is "medium", with a completion time frame of one year.

4.2.3 Winter Storms

The CTDOT is responsible for maintenance and plowing along state roadways, and local communities coordinate with the CTDOT when problems need to be addressed.

The amended Connecticut Building Code specifies that a pressure of 30 to 40 psf be used as the base "ground snow load" for computing snow loading for different types of roofs. The psf is set by municipality, with southern municipalities in the NVCOG region being assigned 30 psf and northern municipalities assigned 35 psf. The International Building Code specifies the same pressure for habitable attics and sleeping areas and specifies a minimum pressure of 35 psf for all other areas.

4.2.4 Tropical Cyclones and Hurricanes

The Connecticut Public Utility Regulatory Authority (PURA) piloted a "micro-grid" program following storms Irene, Alfred, and Sandy designed to provide backup power supplies to small areas critical to public supply distribution such as supermarkets, gas stations, and pharmacies. These infrastructure improvements will allow for small areas of the power grid to be isolated and operated independently through emergency generators. Presently underway at PURA in 2020 is consideration of three policy tracks considering reliability and system resilience metrics and targets, non-wire alternatives, and the state's clean and renewable energy program as part of its review of grid modernization efforts.

Wind loading requirements are addressed through the state building code. The 2018 Connecticut State Building Code specifies the design wind speed for construction in all the Connecticut municipalities, with the addition of

split zones for some towns. The ultimate design wind speed is assigned by municipality, and within the NVCOG region varies from 110 mph to 135 mph depending on the risk category of the structure.

4.2.5 Tornadoes and Thunderstorms

According to the 2019 CT NHMP, the occurrence of tornadoes in Connecticut is not considered frequent enough to justify the construction of tornado shelters at this time. Instead, the state has provided NOAA weather radios to all public schools as well as many municipalities for use in local government buildings. These radios provide immediate notification of a weather watch or warning such that the community can advise students or residents to take appropriate precautions. In addition, the Connecticut State Building Code includes guidelines for the proper grounding of buildings and electrical boxes.

4.2.6 Wildfires

Connecticut enacted its first statewide forest fire control system in 1905, when the state was largely rural with very little secondary growth forest. By 1927, the state had most of the statutory foundations for today's forest fire control programs and policies in place such as the State Forest Fire Warden system, a network of fire lookout towers and patrols, and regulations regarding open burning. The severe fire weather in the 1940s prompted the state legislature to join the Northeastern Interstate Forest Fire Protection Compact with its neighbors in 1949.

There are procedures in place for requesting assistance or other resources to aid in responding to all hazards including forest and wildland fires. 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 (Connecticut General Statute Sec. 28-22a) outlines the process for requesting assistance. If regional resources are depleted, Connecticut 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.

The Forestry Division at the Connecticut DEEP keeps close watch over areas with below normal precipitation and utilizes precipitation and soil moisture data to compile and broadcast daily forest fire probability forecasts. Forest fire danger levels are classified as low, moderate, high, very high, or extreme.

The Connecticut DEEP has an Open Burning Program for municipalities. The program requires individuals to be nominated by the Chief Executive Officer in each municipality that allows open burning. Nominees must take an online training course and exam to become certified by the Connecticut DEEP as a local "Open Burning Official." Permit template forms were also revised that provides permit requirements so that the applicant / permittee is made aware of the requirements prior to, during and after the burning activity. The regulated activity is then overseen by the certified local official.

4.2.7 Drought

The State of Connecticut maintains a website at https://portal.ct.gov/Water/Drought/Drought-Home that is the drought information center maintained by the Interagency Drought Work Group. Links are provided to various information sources such as the U.S. Drought Monitor; groundwater, streamflow, and reservoir levels; and the Palmer Drought Severity Index. As such, State officials are well-positioned to track the occurrence of droughts in Connecticut and assist local communities.

As a planning mitigation effort developed after the 2002 drought that affected the state, the National Drought Mitigation Center through the Interagency Drought Work Group prepared a "Connecticut Drought Preparedness and Response Plan". The purpose of this plan is to help assess and reduce the impact a drought has over an area by conserving essential water use during water shortages. These two mitigation practices may make the difference in the severity of a period of drought across the region. The Connecticut Drought Preparedness and Response

Plan was last updated in 2018 using the lessons learned during the 2015-2016 drought.

The Connecticut Department of Public Health completed the Water Utility Coordinating Committee process in 2018 and prepared a Statewide Coordinated Water System Plan. This process identified future public water supply needs in Connecticut and the utilities best suited to meet those needs. The impacts of drought on the availability of water supply (and to a lesser extent, control of wildfires through evaluation of fire protection) is listed as one of the top ten considerations for the State's public water suppliers.

The Forestry Division at the Connecticut DEEP keeps watch over areas exhibiting below normal precipitation, because of their increased risk of fires in times of drought. As a planning mitigation effort developed after the 2002 drought that affected the state, the National Drought Mitigation Center through the Interagency Drought Work Group prepared a "Connecticut Drought Preparedness and Response Plan". The purpose of this plan is to help assess and reduce the impact a drought has over an area by conserving essential water use during water shortages. These two mitigation practices may make the difference in the severity of a period of drought across the region. The Connecticut Drought Preparedness and Response Plan was last updated in 2018 using the lessons learned during the 2015-2016 drought.

The Connecticut Farm Services Agency manages the Livestock Forage Disaster Program or "LFP" which provides compensation to eligible livestock producers that have suffered grazing losses for covered livestock on land that is native or improved pastureland with permanent vegetative cover or is planted specifically for grazing. The grazing losses must be due to a qualifying drought condition as measured by the U.S. Drought Monitor during the normal grazing period for the county.

4.2.8 Earthquakes

CTDOT has indicated that one of its long-term goals is to design and retrofit earthquake resistant roads and bridges. In addition, the 2018 Connecticut State Building Code includes seismic design criteria for buildings. New construction in each of the NVCOG municipalities is required to meet the requirements of Seismic Design Category B or C depending on site soil class.

4.2.9 Dam Failure

The Dam Safety Section of the Connecticut DEEP Inland Water Resources Division is charged with the responsibility for administration and enforcement of Connecticut's dam safety laws. The existing statutes require that permits be obtained to construct, repair, or alter dams and that existing dams be inventoried and periodically inspected to assure that their continued operation does not constitute a hazard to life, health, or property.

The dam safety requirements are codified in Sections 22a-401 through 22a-411 inclusive of the Connecticut General Statutes. Sections 22a-409-1 and 22a-409-2 of the Regulations of Connecticut State Agencies have been enacted and set requirements for the registration, classification, and inspection of dams. Connecticut Public Act 83-38 (incorporated into Connecticut General Statute 22a-401 through 22a-411) required that the owner of a dam or similar structure provide information to the Commissioner of Connecticut DEEP by registering their dam by July 1, 1984.

Dams permitted by CT DEEP must be designed to pass the 1% annual chance rainfall event with one foot of freeboard, a factor of safety against overtopping.

Significant and high hazard dams are required to meet a design standard greater than the 1% annual chance rainfall event.

Important dam safety program changes have occurred in Connecticut over the past decade. Act No. 13-197, An Act Concerning the Dam Safety Program and Mosquito Control, passed in June 2013 and implemented new requirements for dams related to registration, maintenance, and EAPs. This act required owners of certain unregistered dams or similar structures to register them by October 1, 2015. The Act generally shifts regularly scheduled formal inspection and reporting requirements from the Connecticut DEEP to the owners of dams (Table 4-3). The act also makes owners generally responsible for supervising and inspecting construction work and

REGIONAL CHALLENGES

KINNEYTOWN DAM FISH PASSAGE

Kinneytown Dam and Fish Ladder
K. Zak

Cracks and exposed rebar on the dam
J. Waldman

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WHAT IS THE CHALLENGE?

Kinneytown Dam is a hydroelectric dam located in Seymour, CT on the Naugatuck River. It was designed to produce electricity by driving turbines in two powerhouses. The dam includes a fish ladder designed to allow for fish passage between the downstream and upstream sides of the dam; however, the Kinneytown Dam fish ladder has been found to be preventing safe, timely, and effective fish passage, with migratory fish largely cut off from upstream habitats.

Investigation into fish passage at Kinneytown Dam has also raised concerns about the general condition of the facility. The dam has large cracks throughout, exposing rebar, with water freely flowing through leaks in the downstream face of the dam.

Recent development along the river downstream, including recreational development of O'Sullivan's Island and the Naugatuck River Greenway Trail presents additional risk to life and property should the dam fail.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

NVCOG is communicating with the Federal Energy Regulatory Commission, which licenses operation of the Kinneytown Dam, and is working with the Naugatuck River Restoration Coalition (NRRC) and a coalition of partners to require Kinneytown Hydro Co. Inc. (KHC, the dam operator) to make needed improvements.

Comprehensive improvements to the dam will include restoration of fish passage as well as completion of essential dam safety improvements. It is possible that complete removal of the dam would be pursued as an alternative to permanently achieve both of those goals.

Improved dam safety at this site will provide a regional benefit, as multiple downstream communities and important regional assets (including recent developments, O'Sullivan's Island recreational area, and the Naugatuck River Greenway Trail) would be impacted by a failure. Mitigation will be a regional effort, involving coordination between municipalities, the dam operator, and State and Federal institutions.

establishes new reporting requirements for owners when the work is completed.

Table 4-3: Dam Inspection Schedule

Hazard Classification	Inspection Frequency
AA – Negligible Hazard	At least once
A – Low Hazard	Every 10 years
BB - Moderate	Every 7 years
B – Significant Hazard	Every 5 years
C – High Hazard	Every 2 years

Source: Connecticut DEEP Dam Safety Division

Dams found to be unsafe under the inspection program must be repaired by the owner. Depending on the severity of the identified deficiency, an owner is allowed reasonable time to make the required repairs or remove the dam. If a dam owner fails to make necessary repairs to the subject structure, the Connecticut DEEP may issue an administrative order requiring the owner to restore the structure to a safe condition and may refer noncompliance with such an order to the Attorney General's Office for enforcement. As a means of last resort, the Connecticut DEEP Commissioner is empowered by statute to remove or correct, at the expense of the owner, any unsafe structures that present a clear and present danger to public safety.

EAPs are used in case of a breach to reduce damage and loss of life by having a set plan of response for the event. Effective October 1, 2013, the owner of any high or significant hazard dam (Class B and Class C) must develop and implement an EAP. The EAP shall be updated every two years, and copies shall be filed with Connecticut DEEP and the chief executive officer of any municipality that would potentially be affected in the event of an emergency. Regulations adopted by the Connecticut DEEP established the requirements for such EAPs, including but not limited to (1) criteria and standards for inundation studies and inundation zone mapping; (2) procedures for monitoring the dam or structure during periods of heavy rainfall and runoff, including personnel assignments and features of the dam to be inspected at given intervals during such periods; and (3) a formal notification system to alert appropriate local officials responsible for the warning and evacuation of residents in the inundation zone in the event of an emergency.

To date, dam failure analyses have been prepared for many of the high hazard dams, and these are included in the EAPs. The inundation limits portrayed in the dam failure analysis maps represent a highly unlikely, worst-case scenario flood event and should be used for emergency action planning only. As such, they are appropriate to identify properties for which contact information should be included in the local emergency notification database. These analyses should not be interpreted to imply that the dams evaluated are not stable, that the routine operation of the dams presents a safety concern to the public, or that any particular structure downstream of the dam is at imminent risk of being affected by a dam failure.

Connecticut DEEP also administers the Flood and Erosion Control Board program, which can provide non-competitive state funding for repair of municipality-owned dams. Funding is limited by the State Bond Commission. CGS Section 25-84 allows municipalities to form Flood and Erosion Control Boards, but municipalities must take action to create the board within the context of the local government such as by revising the municipal charter. In many cases (particularly in small towns), a Town's Flood and Erosion Control Board is the Board of Selectmen.

4.3 Regional

While most activities to mitigate natural hazard risk occur at the local level, NVCOG and other regional entities have an important role to play in reducing vulnerability to natural hazards, as well as in floodplain management. Regional projects and plans are presented below.

4.3.1 Regional Hazard Mitigation Planning

NVCOG and its precursor agencies have long promoted hazard mitigation planning in the region. It is generally expected that NVCOG will help to facilitate HMP maintenance and also coordinate the next regional HMP update prior to the expiration of this Plan.

4.3.2 Regional Emergency Planning Team and Emergency Support Functions

NVCOG communities are part of Connecticut DEMHS Region 2, Region 3, and Region 5 which include Regional Emergency Planning Teams that facilitate emergency management and hazard mitigation efforts in those areas.

The DEMHS regions utilize area representatives with a diverse variety of experience to comprise Emergency Support Functions that support overall DEMHS goals while providing in-depth insight and guidance for certain emergency areas. For example, ESF-6 deals with all emergency operations as it relates to regional mass care. The chairs of ESF-6 are responsible for providing and ensuring adequate amounts of regional assets are available in the event of an emergency, for providing annual training and exercises for volunteer staff and municipalities and ensuring emergency preparedness at the regional level.

4.3.3 Housatonic River Management Plan

The Northwestern Connecticut Council of Governments and Dodson Associates prepared the Housatonic River Management Plan in 2006. This document outlines the existing conditions along the Housatonic River and a variety of recreational management and water quality recommendations to maintain this resource. Many of the recommendations are consistent with flood mitigation techniques.

4.3.4 Unified Planning Work Program

This program includes several studies related to hazard mitigation, particularly resilience efforts to analyze, assess, and improve the transportation system's vulnerability to natural hazards such as flooding and storm surge. The most recent documents for the NVCOG region were released in August 2019.

4.3.5 Regional Viewer

NVCOG maintains a Regional Viewer consisting of property data, land use, zoning, wetland data, FEMA floodplains, and aerial imagery along with a number of other statewide data layers. Future improvements will be aimed at including regional zoning layers, FEMA flood zones, wetland data, and stormwater features. All of this information is useful evaluating the potential effects of hazards.

4.3.6 Regional Stormwater Management Planning

One requirement for municipalities under the MS4 program is to map all stormwater infrastructure, which is a challenge for many NVCOG communities due to infrastructure age, lost records, submerged infrastructure, and staff and funding availability. NVCOG has assisted its municipalities by identifying priority areas for mapping and providing mapping assistance as noted on the following Fact Sheet. NVCOG has also partnered with the Pomperaug River Watershed Coalition (PRWC) to provide public outreach materials necessary for municipal compliance with the MS4 General Permit.

4.3.7 Regional Plan of Conservation and Development

NVCOG is presently utilizing the Regional POCDs developed by its predecessor agencies. NVCOG plans to prepare a Regional POCD for the NVCOG region in the near future. The Regional POCD will likely encourage infrastructure and climate resiliency, development patterns that avoid exacerbating runoff and flooding, and include a discussion on climate change (including sea level rise and the potential effects on stormwater management, surface water quality, erosion and sedimentation, and other issues.

The Regional POCD will likely identify that common priorities exist in the region's previous hazard mitigation plans that must be built upon to ensure a consistent regional approach to hazard mitigation. As with the previous regional POCDs, numerous goals and policies in the upcoming Regional POCD are expected to be related to hazard mitigation, although some policies are more practical and/or achievable in the 5-year timeframe of this HMP than others. Potential recommendations that should be considered by NVCOG during the Regional POCD update include:

- Developing sample zoning language for adoption by NVCOG municipalities to address impervious surfaces, building coverage, model streambelts, tower siting, and Green Area cover standards
- Requesting FEMA update FIRMs in the region with updated hydrological data.

NEW INITIATIVES

REVISED MUNICIPAL SEPARATE STORMWATER SYSTEM (MS4) GENERAL PERMIT

http://nemo.uconn.edu/ms4/index.htm

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WHAT IS THE INITIATIVE?

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 May 2018 (effective July 1, 2019) 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. Every NVCOG municipality aside from Bethlehem is 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.

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 therefore 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.

4.3.8 Road-Stream Crossing Survey Program

The Housatonic Valley Association (HVA) has been surveying and monitoring culverts throughout the Housatonic Valley in order to identify perched, undersized, and shallow culverts which both impede fish passage and are issues for flood conveyance. Work is ongoing, but thus far 15% of the surveyed culverts are expected to overtop during a 25-year flood event. HVA's program prioritizes the crossings at most risk and helps municipalities to find funding to upgrade such crossings. HVA is also creating Road-Stream Crossing Management Plans specific to municipalities to assist communities with identifying replacements, and also, in coordination with its project partners such as Trout Unlimited, can provide design assistance to reduce project costs.

4.4 Municipal

Local mitigation capabilities generally fall within the categories of Prevention, Property Protection, Emergency Services, Public Education and Awareness, Natural Resource Protection, and Structural Projects. An individual action could fall within one or more of these categories. Typical general local mitigation strategies are discussed below.

4.4.1 Prevention

In general, preventative strategies are those that will keep a problem from getting worse. These often include adoption of regulations or conducting planning studies to better understand a vulnerability and potential solutions.

Prevention capabilities include zoning regulations and subdivision regulations that restrict development in areas at risk of flooding or at other unsafe areas such as near steep slopes, provide design criteria for development in certain zones, and require open space to be set aside. In Connecticut, the local ordinance designed to meet the minimum standards of the NFIP is often contained directly within the zoning regulations. However, recall from Section 4.2.1 that the State Building Code is more restrictive than the minimum NFIP standard. Local enforcement of the State Building Code is also a preventative measure typically overseen by the local Building Official. The Connecticut State Building Code is enforced statewide.

However, simply implementing the 2018 State Building Code locally without updating the flood damage prevention regulations may be insufficient, as the permitting and building approvals are not always parallel. Updating local regulations to incorporate State Building Code requirements will avoid confusion, aid enforcement, and make inspections more effective. Furthermore, updating local zoning regulations can support municipal efforts to bring the local building-stock up to code.

Local inland wetlands and watercourses regulations also provide an additional layer of local oversight over activities that may encroach upon wetlands and watercourses. Local regulations are typically enforced by a Zoning Enforcement Officer or a Land Use Inspector, a municipal employee who provides a liaison to the applicable commissions. Prevention capabilities also include regular inspections of dams by the property owner.

Connecticut DEEP has designed a model ordinance that incorporates the higher regulatory standards required by the State Building Code. The model ordinance includes provisions for both inland and coastal communities as discussed in Section 4.2.1. These model regulations outline the changes municipalities need to make to incorporate the current State Building Code language. NHCOG communities would not need to utilize the coastal provisions of the model ordinance.

Each NVCOG municipality has a local POCD. Several goals of these plans are pertinent to hazard mitigation, including conservation goals such as protecting natural resources, addressing drainage problems, preserving open space and greenways, and infrastructure goals such as addressing community facility and utility needs. POCDs typically identify watercourses, steep slopes greater than 25%, wetlands, and the SFHA as resources to preserve and avoid to the extent possible. A typical goal identified in local POCDs is to encourage future development away from sensitive natural resources and to minimize potential impacts. A variety of goals and objectives related to hazard mitigation have been identified in the local POCDs and are discussed in the annexes for each community.

NEW INITIATIVES

HOUSATONIC VALLEY ASSOCIATION ROAD-STREAM CROSSING MANAGEMENT

Before and After photos of an upgraded culvert using HVA best practices.
Photos: HVA

FOR MORE INFORMATION

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WHAT IS THE INITIATIVE?

The Housatonic Valley Association (HVA) has been working to develop road-stream crossing management plans (RSCMPs) for communities throughout the Housatonic watershed; as of 2021, there were 21 completed plans. Each RSCMP includes a prioritized inventory of road-stream crossing structures, conceptual designs of priority replacement projects, and a project narrative that can be used in grant applications for implementation.

HVA, NVCOG, and Save the Sound have proposed expanding road-stream crossing assessments, replacement prioritization, and design to the Naugatuck River watershed. It is likely that RSCMPs will soon be developed for Thomaston, Cheshire, and Prospect.

Climate change impacts (more frequent extreme precipitation, rising temperatures) will increase the risk of culvert failures, as well as increase stressors to native fish and wildlife. Replacing problem culverts with structures that conserve natural stream processes can increase the climate resiliency of both the built and natural environments.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

A road-stream crossing inventory can help a community understand its risks, while a road-stream crossing management plan can help mitigate that risk. NVCOG communities can leverage the work completed by the HVA to inform local hazard mitigation planning. They can also use the tools and techniques developed through the HVA inventory and planning process to conduct additional work at a local level.

Road-Stream Crossing Management Plans are complete or in process for the following NVCOG communities:

Seymour Oxford	Naugatuck Beacon Falls	Watertown

A town-specific Road-Stream Crossing Inventory is available for Oxford at hvatoday.org/road-stream-crossing-inventories.

Visit hvatoday.org/reconnect-rivers-streams to learn more about the project.

4.4.2 Property Protection

Property protection strategies typically address the vulnerability of individual buildings. This can include methods to make one building or a series of nearby buildings more resilient.

Many property protection measures, such as elevation to reduce the impact of flooding, are costly and may require acquisition of grant funding to successfully complete. NVCOG municipalities have experience in preparing grant applications such that this effort can be performed when applicable. Other resources are available to assist with grant applications, including NVCOG staff and private consultants.

Each NVCOG municipality has a tree warden who encourages residents to cut trees that may be dangerous to power lines, and who identifies trees on municipal property and along rights-of-way that require trimming. While local public works staff can perform ground-level trimming, most elevated trimming is contracted out in the region.

The SHPO historic resource resiliency planning initiative is described in more detail in Section 4.2.1. Most municipal annexes in this HMP include at least one action related to this initiative.

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 HMP suggests that several NVCOG municipalities conduct a survey of potential historic resources that focuses on areas within natural hazard risk zones. Some municipalities should also seek to inform owners of historic property regarding retrofitting methods that are hazard resilient but do not conflict with historic preservation goals.

4.4.3 Emergency Services

Emergency services strategies are typically aimed at strengthening or protecting emergency services before, during, or immediately after an occurrence. Mitigation measures related to emergency services typically involve increasing lead times prior to the occurrence of an event and ensuring that adequate facilities and supplies are available to property respond to an event including backup supplies such as generators. For example, local emergency management directors are typically responsible for monitoring local weather warnings and advising local personnel, and work with the owners of large dams to ensure there is lead time to enact the EAP if a failure was imminent. Mitigation strategies that protect reservoirs and wellfields which are used to provide fire protection water also fall under emergency services.

Each NVCOG municipality maintains a community-wide Emergency Operations Plan (EOP) that is currently updated annually. Under Public Act 15-20, beginning on January 1, 2017 local EOPs must be updated and filed with DEMHS every other year. This plan may include evacuation procedures for certain parts of a community, such as mobile parks, campgrounds, or areas subject to flooding. It may also identify areas that may be difficult to access with emergency vehicles, such as narrow roads or steep roads that may be difficult to pass during winter storms. In addition, each municipality is party to other emergency planning documents, such as EAPs for significant and high hazard dams. These EOPs and EAPs provide a framework for responding to emergencies. Note that local emergency management directors are also typically responsible for maintaining mutual aid agreements with surrounding communities.

All municipalities currently utilize the state supported WebEOC, an interactive web application, for their incident management functions. The software enables the state, region, and its municipalities to track and monitor data as well as resources. WebEOC capabilities include event reporting, data repositories, and situational awareness. The latter creates the ability to communicate resource requests to mobile or field devices so long as an internet connection is provided. The software requires diligence from the user end with a need for continuous updating and sending of information.

One measure taken each winter is plowing. Local public works departments typically perform local plowing with assistance from local park departments and outside contractors. Pre-storm treatment is applied in most communities to mitigate the impacts to driving, and parking bans can be declared in each NVCOG municipality

to ensure that access can be maintained for plows. Most communities have standardized plowing routes that prioritize access to critical facilities but also use radios to redirect plows to assist with emergency response.

The NVCOG municipalities rely primarily on radio, television, area newspapers, the internet, local emergency notification systems such as CodeRED, and the state CT Alert emergency notification system to notify residents of oncoming storm danger and to announce the availability of shelters. Some communities are small enough that the creation of informational displays in local municipal buildings and high traffic businesses (such as supermarkets) can be performed. Other local capabilities are described in each annex. Prior to severe storm events, NVCOG municipalities ensure that warning and notification systems and communication equipment are working properly and prepare for the possible evacuation of impacted areas.

Several NVCOG communities have Local Emergency Planning Committees that focus on preparedness. Committee roles may include identification and cataloguing of potential hazards, identifying available resources, mitigating hazards when feasible, and preparation of emergency plans. These committees are structured to anticipate and plan the initial emergency response for foreseeable disasters but not to participate in the response.

In addition, some communities have Community Emergency Response Teams or "CERTs" composed of local citizens who are trained to aid emergency responders. Local emergency staff typically review new development projects for emergency response access concerns and encourage the creation of through streets to ensure multiple modes of egress and encourage private property owners to widen access for emergency equipment. Finally, the purchase of any new emergency response equipment (such as all-terrain vehicles to access remote wildfires) would fall under this category.

4.4.4 Public Education and Awareness

Public education strategies seek to inform State officials, local officials, or the general public about ways to protect oneself from the effects of natural hazards, ways to increase resiliency to natural hazards, or to increase coordination between groups to achieve a common goal. For example, the NVCOG municipalities each make available a variety of pamphlets related to hazard mitigation and/or have website sections dedicated to discussing emergency preparedness. Local building departments also have information available regarding design standards.

Several of the communities also work together to resolve flooding concerns. For example, the municipalities of Plymouth and Bristol worked with Plainville in 2014 to perform the Pequabuck River Study. The study evaluated flood levels along the Pequabuck River and provided recommendations for reducing flood risk.

A variety of federal agencies (FEMA, NOAA, etc.) have information available on family preparedness procedures and the best physical locations to be during each type of storm event. This information is made available by each NVCOG municipality when pamphlets are available.

Each municipal annex of this HMP includes at least one action related to the Sustainable CT initiative. Annexes of communities that are not already registered with Sustainable CT have an action to register. Annexes of communities already registered have an action calling for the community to pursue one of the following Sustainable CT strategies relevant to hazard mitigation:

- Identify, or create and disseminate, a toolkit for pre-disaster business preparedness and for post-disaster conditions.
- Review and revise regulations to encourage and promote LID.
- Review the POCD and adopt a revised POCD that includes the HMP goals and at least three other sustainability concepts.

4.4.5 Natural Resource Protection

Natural resource protection strategies focus on protection of natural resources, often through the acquisition of open space to prevent future development. Preservation or enhancement of open space could, for example, allow floodplain functions to be able to be performed unimpeded by development. A common natural resource protection strategy is the acquisition of property at risk of flooding and converting that property to open space, but

undeveloped land could also be purchased and so assigned. Subdivision regulations typically require open space set-asides to provide a measure of natural resource protection, and local POCDs typically either have or reference and Open Space Plan that prioritizes future open space acquisition, development of trails and greenways, and funding sources for open space. Of particular interest to many communities is that recreational uses on open space are encouraged within SFHAs. Communities often work directly with local land trusts to accomplish common conservation and floodplain management goals related to land acquisition.

Communities that control large areas of forests and brush land occasionally conduct controlled burns to minimize the amount of low-lying combustible materials that could lead to dangerous wildfires during dry conditions. Such burns are often conducted under the guidance of the Connecticut DEEP.

The availability of the *Low Impact Sustainable Development Design Manual* presents an opportunity to guide local flood hazard mitigation actions. Strategies such as reducing impervious services, installing infiltration systems, and zone-specific standards can 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 can increase the resilience of communities to the impacts of climate change on the natural, built, and human environments. 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.

Mitigation actions that promote the use of LID techniques were incorporated into many of the municipal annexes of this HMP. Primarily, this was done through the action related to Sustainable CT, which includes a sub-action to "Revise regulations to promote LID".

4.4.6 Structural

Structural project strategies typically include construction of a capital improvement that reduces vulnerability to natural hazard damage, such as dams, floodwalls, or access roads into outlying areas. Drainage systems and public water systems are the most typical structural projects being constructed in most NVCOG communities, although the significant dam projects completed by the USACE along the Naugatuck River Valley are also structural projects.

Structural projects related to flood mitigation are typically aimed at drainage system installation and maintenance and increasing conveyance at culverts and bridges. Local public works departments are typically responsible for maintenance of municipal drainage systems while the CTDOT maintains those for state roads. This maintenance includes programs to clean out blockages caused by growth and debris.

Other structural project strategies can include the installation of new water mains to provide fire protection to outlying areas, or installation of dry hydrants for the same purpose. Storage tanks can also be installed in new developments in outlying areas to provide a source of firefighting water. Such structural projects are also typically emergency services projects.

5.0 Mitigation Strategies

5.1 Types of Mitigation Strategies

Potential mitigation strategies are numerous and varied. Not all mitigation strategies are appropriate for every community, and some communities have greater capacity to institute mitigation strategies than others. The general mitigation strategies presented herein should be considered by each NVCOG municipality whenever conditions are appropriate. These are in addition to the specific strategies and actions outlined in each municipal annex.

5.1.1 Prevention

Example mitigation strategies for natural hazards can include:

- Strengthen flood mitigation provisions in local land use regulations to be, at a minimum, consistent with those in the 2018 State Building Code
  - Structures in all inland SFHAs (including A zones) must have the lowest floor elevated to the BFE plus 1 foot
  - Critical facilities must meet the above requirement to the BFE plus 2 feet
- Strengthen flood mitigation provisions in local land use regulations by adopting "No Adverse Impact" policies, and/or lengthening the timeframe utilized for substantial improvement calculations to two or more years
- Develop and/or strengthen stormwater management regulations and programs, such as by reducing stormwater runoff from new development sites and adoption of impervious surface limitations
- Prepare watershed management plans
- Require the use of FEMA Elevation Certificates to ensure compliance with flood regulations (as required for the CRS program)
- Join FEMA's CRS program
- Conduct hydrologic and hydraulic studies to evaluate risks and potential flood mitigation strategies.
- Develop stream buffer ordinances
- Prohibit reconstruction and redevelopment in areas susceptible to chronic flooding
- Utilize a tracking program to track natural events and responses in order to help prioritize potential future projects.

5.1.2 Property Protection

A variety of property protection strategies can be implemented at the local level to prevent damage to individual properties. These can include:

- Elevating and floodproofing for homes and businesses, particularly RLPs
- Creation of flood walls to protect one or more buildings
- Inspection of trees and tree-trimming along power lines (by Eversource) and near vulnerable structures
- Locating utilities underground
- Insulating pipes to protect against freezing and bursting
- Removing snow from flat roofs or using heating coils to melt snow
- Temporarily hardening homes and businesses in advance of heavy wind events (boarding windows, closing shutters, moving small items inside)
- Performing wind damage retrofit projects (installing shutters, wind-resistant windows, code plus projects (those that exceed the local building code), roof projects, and load path projects)
- Strengthening and retrofitting non-reinforced masonry buildings and non-ductile concrete facilities that are particularly vulnerable to ground shaking
- Encouraging property owners to remove deadfall in wooded areas of their properties, and to trim back overgrowth encroaching on structures
- Hardening of critical facilities and infrastructure
- Installing surge protection on critical electronics

5.1.3 Emergency Services

Example mitigation actions related to emergency services may include:

- Flood proofing critical facilities, such as wastewater treatment plants, police and fire stations, EOCs, and emergency shelters
- Relocating critical facilities to locations outside of flood prone areas

MITIGATION SUCCESS STORY

PEQUABUCK RIVER FLOOD STUDY IN BRISTOL AND PLYMOUTH

Courtesy of City of Bristol

AECOM — MITIGATION PROJECTS PHOTOGRAPHIC LOG

Client Name:	Site Location: BRI3 – Raise Channel Walls	Project No.
City of Bristol, CT.	Bristol, CT	36939882

Photo No.	Date:
3	08/28/11

Direction Photo Taken:
Looking westerly from Riverview Apartments parking lot.

Description:
View of Pequabuck River on 8-28-11 at Pequabuck River Culvert inlet adjacent to River View Apartments near School St. downstream of West St. Photo taken by Jose Luis Torres.

Courtesy of AECOM

FOR MORE INFORMATION

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WHAT IS IT?

The City of Bristol hired a consultant to evaluate flooding conditions in the Pequabuck River watershed from Plymouth through Bristol. Residents have experienced significant flooding within this watershed. The flood study included evaluations of hydraulic conditions and recommendations for mitigation where possible.

The flood study consisted of hydrologic evaluations of the watershed, hydraulic analysis of river and stream channels, evaluation of mitigation measures, and development of a master plan for long-term improvements.

The final reports included summaries of flooding concerns and locations, detailed flood maps and hydraulic information, and site-specific flood mitigation recommendations.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Since completion of the flood study, the City of Bristol has been able to implement some of the mitigation activities recommended in the study report.

NVCOG municipalities can perform detailed flood studies that cover the entire communities, or that focus on specific watersheds that have known flood challenges.

Performing studies that evaluate flooding on the watershed scale allows for a more comprehensive understanding of that area's hydrology and hydraulic setting, which will enable implementation of more successful and sustainable solutions. As climate change alters precipitation patterns, these kinds of flood studies may become even more important.

MITIGATION SUCCESS STORY

HOME ELEVATIONS: MAPLES NEIGHBORHOOD, SHELTON

Homes in the Maples areas
Photo by SLR

FOR MORE INFORMATION

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WHAT IS IT?

Home elevation generally refers to the retrofit of a residential property so that livable spaces are raised above flood levels. This is completed by converting the lower levels of a structure into an enclosure that is flood resistant or completely floodable, in compliance with FEMA guidelines. While there are several techniques for home elevation, typically an existing structure is lifted off of its existing foundation and placed onto a new, higher foundation. New construction built above flood elevations is also referred to as being elevated.

Home elevation projects must adhere to local zoning regulations and ordinances. These include requirements to be elevated above the local Base Flood Elevation (BFE) and freeboard (additional elevation requirements above the BFE, typically instituted as a safety precaution), and compliance with local height restrictions (some communities offer flexible height restrictions in the case of home elevations performed to meet floodplain zoning regulations.

Home elevation is the only flood mitigation activity permissible by FEMA for private residential properties in flood zones.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Flood damages and repairs can be extremely costly depending on the event and severity of impairment. Therefore, homeowners are urged to seek mitigation strategies to help ease the financial burden of flood recovery.

Property owners throughout the region with homes vulnerable to flooding, in either coastal or riverine flood zones, can consider elevation as a mitigation strategy. While it can be costly, grant funds can be utilized for elevation projects.

In the City of Shelton, numerous property owners have taken advantage of opportunities to elevate homes in the Maples neighborhood along the Housatonic River. Many elevations were privately-funded, while others were assisted through ICC and/or grants.

Other NVCOG municipalities have successfully elevated homes over the past few decades. Elevations will continue to be an effective method of flood mitigation in the region.

MITIGATION SUCCESS STORY

PROPERTY ACQUISITONS: POMPERAUG RIVER, SOUTHBURY

Flood of 2007
Photo courtesy of Town of Southbury

River Trail Open Space
Photo courtesy of SLR

FOR MORE INFORMATION

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WHAT IS IT?

Property acquisitions have proven to be an effective means of reducing flood losses in the United States. After acquisition, properties are cleared of structures and returned to open space that can be flooded without damage and losses.

The River Trail and Flood Bridge Road neighborhoods in Southbury have suffered repeated flood damage from the Pomperaug River over the last few decades. Many property owners have taken steps to reduce losses by elevating homes. However, the Town has worked with several property owners to facilitate acquisitions of properties, followed by removal of structures and return to open space. A small park along River Trail is pictured to the left.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Property owners that experience flooding regularly may be interested in relocating or may struggle to sell their property as values drop. Municipalities may want to avoid the costs of ongoing maintenance, mitigation, and emergency response activities.

In such situations, municipalities can support owners by acquiring their at-risk properties and enabling them to relocate. Flooding can be further mitigated by removing structures on such properties and preserving them as open space.

State and federal grants are often available for property acquisition and open space creation, bringing money into the community and supporting the local economy.

- Requiring new municipal critical facilities to comply with the State of Connecticut design standards for critical facilities regardless of funding source
- Upgrade or install generators to ensure adequate backup power is available to critical facilities
- Improve coordination with local utilities, particularly "Make Safe" crews for clearing of tree debris near powerlines
- Improve emergency access to critical facilities
- Encourage or perform public water supply infrastructure upgrades for areas with substandard fire protection, and extensions into areas with without adequate fire protection
- Install dry hydrants or cisterns in areas where public water supply is not available
- Purchase equipment to fight forest fires in remote areas

5.1.4 Public Education and Awareness

Example mitigation actions related to public education and awareness may include:

- Perform outreach regarding flood risk, sea level rise, and safety, particularly to flood prone neighborhoods and owners of RLPs.
- Encourage property owners and renters in flood prone areas to purchase flood insurance
- Hold workshops to facilitate dissemination of information on technical assistance programs
- Add pages to municipal websites dedicated to natural hazard event preparation and safety during power outages
- Add seasonal pages to municipal websites to address preparation for typical natural hazard events such as winter storms, hurricanes, and thunderstorms
- Disseminate informational pamphlets and brochures to public locations such as municipal buildings and libraries
- Distribute wildfire risk information to properties along the wildland-urban interface.

5.1.5 Natural Resource Protection

Example projects related to natural resource protection may include:

- Acquisition of flood prone property (particularly RLPs) and conservation to permanent open space
- Protection and restoration of natural flood mitigation features such as wetlands, riverbanks, and dunes
- Establish riparian or vegetative buffers to prevent erosion, slow drainage, and improve water quality
- Establish a green infrastructure program

5.1.6 Structural Projects

Structural projects include bracing and hardening for critical equipment such as generators or retrofitting a dam to pass a larger flood event without causing damage to the dam. Other example projects may include:

- Increase capacity of stormwater drainage systems
- Separate combined storm sewer and sanitary sewer systems
- Increase capacity of detention and retention ponds and basins
- Elevate roads, bridges, and other infrastructure above the base flood elevation
- Construct berms and dikes of erosion-resistant material to protect vulnerable buildings and areas
- Install bioengineered bank stabilization techniques
- Establish debris management and clearing capabilities

Power-outages caused by the effects of winter storms, hurricanes, lightning, and other natural hazards is one of the most 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.

Municipalities can mitigate damages and disruption caused by outages by working to increase the resiliency of the power grid, improving outage response, installing emergency generators in critical facilities, developing local power generation and microgrids, and helping residents and businesses prepare for outages.

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

MITIGATION SUCCESS STORY

BRIDGE REPLACEMENTS & UPGRADES: CHESHIRE

The new Blacks Road Bridge
Photo CheshireCT.org

Bridge washout in Middlebury
Photo Patch

FOR MORE INFORMATION

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WHAT IS THE CHALLENGE?

Infrastructure throughout the Naugatuck Valley region, such as bridges and culverts, have over time become increasingly inadequate and undersized. Many times these insufficiencies lead to damages or washouts during a flood event.

With many communities throughout the Region and the state dealing with multiple undersized components at once, it has become challenging for communities to address these concerns on a large scale and securing funding for the necessary upgrades.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

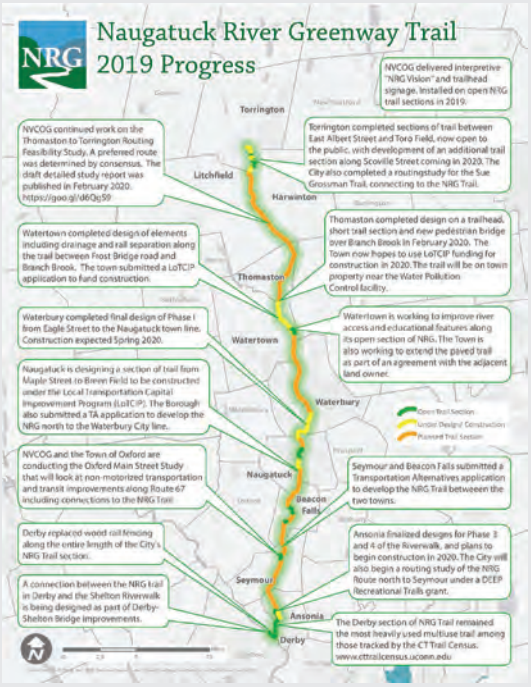
The Town of Cheshire has worked to replace three bridges in recent years, including the Blacks Road Bridge over Honeypot Brook which needed conveyance capacity increase. In addition, the Creamery Road Bridge over Honeypot Brook and the East Johnson Avenue Bridge over the Quinnipiac River were replaced.

While not all bridge and culvert replacements and repairs are necessarily directly related to increasing conveyance, many actions taken are also necessary for withstanding flood velocities, erosion, or debris build up. Infrastructure maintenance and upgrades are an important hazard mitigation action to assist in flood control, property and roadway protection, ensuring clear evacuation routes, and to aide in easing recovery efforts.

MITIGATION SUCCESS STORY

NAUGATUCK RIVER GREENWAY TRAIL

The NRG Trail in Derby
Photo NRG Trail Thomaston to Torrington Routing Feasibility Study



NRG Trail 2019 Progress
Photo NVCOG

FOR MORE INFORMATION

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WHAT IS IT?

The Naugatuck River Greenway (NRG) Trail is a multi-use trail that travels through 11 municipalities along 44 miles of the Naugatuck River. This trial connected green spaces and provides pedestrian river access. The trail is currently in different phases of completion with some sections open for use, others under construction, and others are still in early planning phases.

The trail is developed and designed by each town and city it travels through, and is funded by both state and federal grants, and other local sources.

Aside from providing river access, the trail is a useful tool to ensure open space is preserved along the river. By maintaining open space along the river, the flood hazard is reduced with the absence of private properties and structures.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Communities along the NRG Trail can utilize this opportunity to acquire properties along the Naugatuck River that may be at risk of flooding. Property acquisition is one of the most effective mitigation strategies as the structure is being completely removed from the hazard and open space remains in its place.

Also, municipalities can work to design remaining stretches to be floodable, or aid in flood control. If there are stretches along the NRG Trail that may be flood prone, certain LID applications may be appropriate and can be incorporated into designs.

There are various opportunities for towns and cities to mitigate flooding along the NRG Trail. When designing, municipalities should evaluate high hazard areas, and identity potential strategies that may be applicable.

power to connected users – typically critical facilities and nearby commercial nodes such as gas stations, pharmacies, and grocery stores.

Every municipal annex in this HMP includes some mitigation actions related to increasing the resiliency of the electric grid. Mitigation actions include the following:

- Coordinate with the local energy utility on efforts to improve grid resiliency and outage response.
- Perform public outreach and education about power outage safety and mitigation.
- Maintain public "comfort stations" for residents without power to keep warm or cool, and recharge electronic devices.
- Create a communications plan that considers power loss, and the possible loss of internet and phone capabilities that may result.
- Maintain a list of residents who rely on powered medical devices to facilitate check-ins and response during power outages.
- Install backup power at critical facilities
- Explore development of local power generation (such as solar panels) and microgrids

5.2 Mitigation 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 NVCOG 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 mitigate natural hazards more effectively.

5.2.1 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 a 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, NVCOG's ability to implement mitigation activities is also tied to financial limitations. 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 NVCOG can be impacted.

Finally, as discussed throughout Sections 4.1, 4.2, and 4.3, there are numerous ongoing federal, state, and regional programs ongoing that compete for the attention of local staff, boards, and commissions. As noted in those sections (and also in Section 5.1), there are numerous potential actions for NHCOG municipalities derived from these initiatives that are relevant to the goals of this HMP. Specific actions related to these programs have been incorporated as noted above into each municipal annex. Furthermore, Section 5.3 recommends that NVCOG actively facilitate completion of several objectives related to these programs over the next 5 years.

5.2.2 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

MITIGATION SUCCESS STORY

WATER UTILITY RESILIENCE

General vicinity of water system interconnection, Middlebury

Logo courtesy of PRWC

FOR MORE INFORMATION

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WHAT IS IT?

Heritage Village Water Company withdraws groundwater from a series of wells located near the Pomperaug River. The water utility serves portions of three towns (Southbury, Middlebury, and Oxford) and has grown over the years in response to development pressures in the communities served.

The Pomperaug River Watershed Coalition (PRWC) has conducted and commissioned numerous studies of the river including an instream flow study that characterized impacts of low river flows on fish habitats. Low instream flows have long been a concern for PRWC and the Town of Southbury, and they are keenly interested in ensuring that the water company withdrawals are limited during times of drought or extended dry periods.

Two key efforts were completed in the 2010s to address concerns about instream flow. First, Heritage Village Water Company interconnected with Connecticut Water Company through a water main extension and pumping station located in central and western Middlebury. Second, Heritage Village Water Company worked with PRWC and the Town of Southbury to complete the instream flow study and develop a low-flow response management plan. These two key efforts have provided a long-term, sustainable framework for helping to reduce groundwater withdrawals during dry periods and droughts.

REGIONAL SIGNIFICANCE AND LINK TO HAZARD MITIGATION

Drought preparation and response is an emerging concern in Connecticut as extended dry periods and flashy droughts become more common. Although the State has taken steps to update the Connecticut Drought Preparedness and Response Plan and incorporate drought concerns into the State Water Plan and State Coordinated Water System Plan, few recent examples of innovative responses are available. The interconnection between Heritage Village Water Company and Connecticut Water Company followed by the development of the management plan for the Pomperaug River serves as an excellent example for how other water utilities, communities, and watershed organizations can work together to foster drought resilience.

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, Connecticut DEEP, and DEMHS.

Most NVCOG municipalities are active in regional organizations such as NVCOG, the Connecticut Conference of Municipalities, and the Connecticut Council of Small Towns, 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.

5.2.3 State Infrastructure

Many NVCOG municipalities have previously identified stormwater management as a high priority natural hazard mitigation concern and 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 municipalities 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 and a changing climate will have on combined sewer overflows and dam safety.

5.2.4 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. Coordination issues occurred in many communities during Tropical Storm Isaias in August 2020 suggesting that coordination improvements have yet to be fully established.

5.3 Ranking of Mitigation Strategies

To prioritize recommended mitigation actions, it is necessary to determine how effective each measure will be in reducing or preventing damage. 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.

Criteria were divided into potential benefits (pros) and potential costs (cons) for each mitigation strategy. The questions in Table 5-1 were asked about the proposed mitigation strategies.

Benefit-cost review was emphasized in the prioritization process by double-ranking technical feasibility and economic considerations. Another consideration is the potential social costs of a project. FEMA encourages communities to consider issues of environmental justice when considering mitigation projects. This is because

certain types of mitigation projects may disproportionally affect lower income areas or higher income areas as opposed to helping all members of a community.

Table 5-1: STAPLEE Benefit-Cost Overview

Social
✓ Is the proposed strategy socially acceptable to the community? ✓ 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
✓ Will the proposed strategy work? ✓ Will it reduce losses in the long term with minimal secondary impacts? ✓ Is the action technically feasible? ✓ Will it create more problems than it will solve? ✓ Does it solve the problem or only a symptom?
Administrative
✓ Does the project make it easier for the community to administrate future mitigation or emergency response actions? ✓ 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
✓ 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.)? ✓ 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
✓ 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? ✓ 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
✓ 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? ✓ 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
✓ Will this action beneficially affect the environment (land, water, endangered species)? ✓ 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; a score of "0.5" was assigned if there would be a slightly beneficial effect; 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; a score of "-0.5" was assigned if there would be a slightly unfavorable impact; 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 as noted above.

- 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 appended to each municipal annex. The highest scoring is determined to be of more importance economically, socially, environmentally, and politically and, hence, is prioritized over those with lower scoring. Scoring is translated into rankings of "High", "Medium", or "Low" relative to range of scores for that community. The mitigation strategy is divided into objectives and tasks at the end of each community section with the priority of each task clearly identified.

An implementation strategy and schedule are included for each strategy and action, detailing the responsible department and anticipated time frame for the specific recommendations listed throughout each annex. Funding sources for proposed strategies and actions are also listed. More information about potential funding sources is provided in Section 7.0.

The cost of each strategy and action has been estimated into ranges. Exact costs estimates were not developed for this planning document. A cost estimate of "Minimal" implies that the total cost should be less than $1,000; an estimate of "Low" implies a total cost of less than $10,000; an estimate of "Moderate" implies a total cost of less than $100,000; and an estimate of "High" implies a total cost that is greater than $100,000.

5.4 Regional Mitigation Strategies

As presented in Section 1.2, NVCOG's goal for this HMP is to reduce loss of life, damage to property and infrastructure, costs to residents and businesses, and municipal service costs due to the effects of natural hazards and disasters. Education of residents and policymakers and the connection of hazard mitigation planning to other community planning efforts are key to achieving this goal, as is the enhancement and preservation of natural resource systems in each member community.

In order to meet this goal, NVCOG has developed the following objectives and strategies that it will attempt to implement over the next five years. These objectives are primarily aimed at implementation of state planning goals and assistance to NVCOG municipalities related to implementation of their strategies and actions. Note that these strategies (in Table 5-2) are not ranked per the STAPLEE process described above but rather in order of importance to NVCOG.

Finally, NVCOG has identified that there are shared strategies for many of its municipalities where there may be an opportunity to visualize regional solutions. A summary table of common themes is presented as Table 5-3.

NVCOG's goal for this HMP is to reduce loss of life, damage to property and infrastructure, costs to residents and businesses, and municipal service costs due to the effects of natural hazards and disasters. Education of residents and policymakers and the connection of hazard mitigation planning to other community planning efforts are key to achieving this goal, as is the enhancement and preservation of natural resource systems in each member community.

Table 5-2: NVCOG Mitigation Strategies for 2021-2026

Objective 1: Assist with HMP implementation and maintenance

Strategies and Actions:

1.1	Notify municipalities of the availability of funding sources and provide guidance for grant applications.	
	Action Description:	Notify member communities of the annual opportunity to apply for HMA grand funding, and the opportunity to apply for HMGP funding whenever applicable. Provide letters of support when appropriate. Provide a seminar (with assistance from Connecticut DEMHS) or other guidance to assist communities with preparing grant applications.
	Lead:	NVCOG
	Priority:	Moderate
	Estimated Cost:	Low
	Potential Funding Source(s):	NVCOG operating budget
	Timeframe:	Annually or more frequently as grant opportunities are available
1.2	Host an annual meeting to encourage HMP maintenance	
	Action Description:	NVCOG will host an annual meeting of local coordinators to discuss the status of regional initiatives, collect feedback on implementation of local strategies and actions, provide a forum to discuss implementation challenges, and to share ideas. NVCOG will request that local coordinators hold an internal meeting to track progress on local mitigation actions, and add new actions if appropriate, prior to attending the regional meeting.
	Lead:	NVCOG
	Priority:	Moderate
	Estimated Cost:	Low
	Potential Funding Source(s):	NVCOG operating budget
	Timeframe:	Annually
1.3	Secure funding for regional projects	
	Action Description:	NVCOG will help local communities secure funding for regional projects that may benefit more than one community. Example projects may include encouraging FEMA to update the hydrology used to generate FIRMs for riverine flooding in the region, advocating for adoption of streambelt regulations, and working with communities to reduce the impact of impervious surfaces.
	Lead:	NVCOG
	Priority:	Low
	Estimated Cost:	Varies
	Potential Funding Source(s):	NVCOG operating budget, grants
	Timeframe:	As needed

1.4 Encourage local communities to participate in the CRS program by hosing an informational workshop	
Action Description:	NVCOG will organize an informational workshop to present the CRS program to its member municipalities. Speakers from FEMA and ISO will be requested to attend to present on the topic. Existing CRS communities in the region will be asked to provide lessons learned.
Lead:	NVCOG
Priority:	Low
Estimated Cost:	Low
Potential Funding Source(s):	NVCOG operating budget
Timeframe:	2022

1.5 Secure funding for HMP update	
Action Description:	NVCOG will secure funding in a timely manner in order to ensure that the next HMP update is completed and adopted before expiration of this HMP.
Lead:	NVCOG
Priority:	High
Estimated Cost:	Low
Potential Funding Source(s):	NVCOG operating budget
Timeframe:	2024-2025

Objective 2: Assist NVCOG municipalities in implementing State of Connecticut planning goals

Strategies and Actions:

2.1 Assist local communities regarding identification of historic and cultural resources and potential mitigation actions	
Action Description:	As NVCOG communities move to implement the SHPO recommendations related to historic and cultural resources, NVOG will assist with identification of historic resources, review of floodplain and historic preservation regulations and ordinances, regional and state coordination, incorporation of historic preservation into planning documents, recovery planning, adaptation measures, and education. This will particularly be important for the five Litchfield County communities and Bristol where SHPO has not performed a detailed study.
Lead:	NVCOG
Priority:	Low
Estimated Cost:	Low
Potential Funding Source(s):	NVCOG operating budget
Timeframe:	As requested

2.2 Encourage participation in the Sustainable CT program	
Action Description:	The Sustainable CT program is a potential way for NVCOG communities to help track sustainability goals and actions and there are many parallels for hazard mitigation. NVCOG will encourage enrollment in the program and provide technical assistance and guidance to assist communities with enrollment.
Lead:	NVCOG
Priority:	Low
Estimated Cost:	Low
Potential Funding Source(s):	NVCOG operating budget
Timeframe:	As requested

2.3 Assist small businesses in the region to better prepare for natural hazards	
Action Description:	NVCOG will coordinate with member municipalities and local chambers of commerce to prepare a presentation aimed at assisting small businesses in the region mitigate the impact of natural hazards. This includes recommendations for improved chemical safety practices to protect the environment and public health following natural hazard events. A seminar will be provided with requested speakers from Connecticut DEEP and other agencies focused on business needs.
Lead:	NVCOG
Priority:	Low
Estimated Cost:	Low
Potential Funding Source(s):	NVCOG operating budget
Timeframe:	2023

2.4 Provide technical assistance regarding the MS4 program	
Action Description:	Municipal separate storm sewer permit registrations and compliance remains an important consideration for many NVCOG municipalities. As compliance may achieve parallel hazard mitigation actions, NVCOG will provide technical assistance to its communities related to compliance as requested.
Lead:	NVCOG
Priority:	Low
Estimated Cost:	Low
Potential Funding Source(s):	NVCOG operating budget
Timeframe:	As requested

Table 5-3: Common Themes and Number of Related Municipal Strategies and Actions for NVCOG Region

Strategy or Action Theme	Number of Municipalities with Theme	Ansonia	Beacon Falls	Bethlehem	Bristol	Cheshire	Derby	Middlebury	Naugatuck	Oxford	Plymouth	Prospect	Seymour	Shelton	Southbury	Thomaston	Waterbury	Watertown	Wolcott	Woodbury
Flood Regulations	18	2	2	2	2	2	2	2	2	2	2	2	3	2	2	3	2	2	2	2
Historic & Cultural Resources	18	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
RLP	13	0	0	0	2	2	2	3	0	2	2	0	3	2	2	1	2	2	2	1
Drainage	12	7	2	0	0	0	0	0	2	2	1	1	3	1	0	1	4	1	1	0
Dam Safety	10	0	0	0	1	3	1	3	0	0	3	0	2	0	0	2	2	1	1	0
Flood Map Updates	17	1	1	1	1	0	1	1	1	1	2	1	1	1	1	1	1	2	2	1
Critical Facility Protection	11	2	1	0	0	1	4	2	0	0	1	0	5	1	1	1	0	1	0	0
Resilient CT	13	2	2	0	0	1	2	1	2	1	0	1	2	2	1	0	2	0	1	0
Small Business Chemicals	18	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Backup Power	10	3	0	1	3	0	2	0	0	0	1	0	0	2	1	2	1	0	2	0
Culvert & Bridge Upgrades	10	0	3	1	0	1	0	3	0	1	1	0	1	4	0	0	0	2	3	0

Strategy or Action Theme	Number of Municipalities with Theme	Ansonia	Beacon Falls	Bethlehem	Bristol	Cheshire	Derby	Middlebury	Naugatuck	Oxford	Plymouth	Prospect	Seymour	Shelton	Southbury	Thomaston	Waterbury	Watertown	Wolcott	Woodbury
Low Impact Development	12	0	1	1	2	0	0	1	0	1	2	1	1	0	1	1	0	1	1	1
Sustainable CT	18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Evacuation & Access	9	6	1	1	0	0	1	0	0	0	1	0	2	1	1	0	0	1	0	2
Administration, Enforcement, & Maintenance	8	0	1	0	0	0	1	0	0	1	1	1	1	0	0	0	2	2	0	1
Study	8	2	0	0	1	0	0	0	0	1	1	0	1	0	0	0	3	1	1	0
Wildfire Risk Reduction	7	0	0	0	1	0	0	3	0	0	1	0	0	1	0	2	1	0	1	0
Acquisition & Open Space	6	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0	3	1	0	0
Landslide Mitigation	4	3	0	0	0	0	2	0	0	0	0	0	2	0	0	0	2	0	0	0
Public Education & Engagement	8	0	0	0	0	0	2	0	1	1	1	0	1	1	0	1	1	0	0	0
Emergency Response, Alerts, & Communication	6	1	0	0	2	0	0	0	0	1	0	0	1	0	0	1	2	0	0	0
Sheltering Capabilities	4	1	0	1	0	0	5	0	1	0	0	0	0	0	0	0	0	0	0	0
Tree and Debris Management	6	2	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	1	0	0
Flood Mitigation	6	0	0	0	2	0	0	0	0	1	0	0	0	0	1	1	2	1	0	0
Conservation & Restoration	3	0	0	0	0	0	0	1	0	0	1	0	0	2	0	0	0	0	0	0
Utility Resilience	3	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1
CRS	3	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Relocate/Retreat	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
HMP in Planning Docs	2	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

Note: The second column summarizes the number of NVCOG municipalities implementing at least one action under the theme listed in that row. The numbers in each municipality's column indicates the number of actions that fall within each theme that the given community is implementing. Cells are highlighted for convenience, with blue cells indicating the five of more related strategies and actions proposed by that municipality.

6.0 Plan Implementation

6.1 Plan Adoption

Upon receipt of FEMA's conditional approval on October 12, 2021, each municipality's governing body as well as NVCOG's council formally adopted the Plan Update (with an initial adoption date of January 20, 2022). Copies of each municipal adoption resolution is included in Appendix E.

6.2 Plan Implementation

Implementation of the strategies contained within this plan will depend largely on the availability of resources. Each municipality and NVCOG 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 groundwork 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.

Following adoption, copies of this Plan update will be made available to all community departments by the chief elected official and the local coordinator of each municipality as a planning tool to be used in conjunction with existing plans, regulations, budgets, capital improvement programs, day-to-day operations, and other processes and projects. It is expected that revisions to other community plans and regulations will reference this Plan update and its updates. Specific community plans that could be updated to include references to this Plan update are discussed within each community annex, but could include the following existing programs and activities:

- Regional POCD – Each municipality is included in the development and update of a regional plan which is intended to guide future development throughout each community in the planning region. Municipalities should take steps to ensure consistency between the regional POCD and this Plan update.
- Local EOPs – These Plans are part of an overall emergency management program and provide specific details on how a community will respond to emergencies. These plans are updated annually. Information contained within this Plan update will help to inform specific strategies and actions within local Emergency Operations Plans.
- Regional Transportation Plan – Each municipality is included in the development and update of the regional plan, which is intended to help meet the needs of the region's residents for safety, mobility, and a healthy economy effectively and efficiently, while preserving the region's quality of life and its historical, man-made, and natural/environmental resources. Municipalities should take steps to ensure consistency between roads and bridges in need of repair in the regional transportation plan and this Plan.
- Local Bridge Program – This program provides for financial assistance from the state to municipalities for the removal, replacement, reconstruction, or rehabilitation of local bridges. Municipalities should take steps to ensure consistency between bridges in need of repair listed in the local bridge program and in this Plan.
- Capital Improvement Program – Each municipality should consider including projects identified in this HMP in its municipal CIP.
- Local POCD – Each municipality has a POCD that guides development in the community. Information contained within this Plan should be utilized to encourage growth and development in areas that are less susceptible to natural hazards and to encourage safe development practices. Information in this Plan update will be incorporated or referenced in the next POCD update in each community as well as other planning documents.
- Water Conservation Plans and Emergency Contingency Plans – Water systems that serve more than 1,000 people are required by State law to develop these plans. They provide current information regarding long-term supply and demand

management as well as short-term emergency planning for the utility, including instructions on how to proceed when water supplies are curtailed by drought. The information in this Plan update may help inform these plans by identifying vulnerable areas.

- Water System Vulnerability Assessments – Water systems that serve more than 3,300 people are required by Federal law to develop these plans. They are used by water systems to plan, prepare, and respond to damage from natural hazards, accidents, and terrorist attacks. The information in this Plan update may help inform such plans by identifying vulnerable areas and linkages between local and utility response planning.

- FEMA CRS– Many mitigation strategies can contribute positively toward a community's score in this program, which can lower flood insurance rates for properties in the community.

NVCOG will be responsible for encouraging that local plan updates incorporate pertinent information from this HMP. In some cases, the specific incorporation of the information in previous HMPs to other community plans has occurred as listed in each municipal annex. In all cases, the most recent HMP was utilized as an additional reference to provide guidance to community staff.

6.3 Plan Monitoring

The plan maintenance process includes monitoring, evaluating, and updating the Plan update. This process is detailed below.

6.3.1 Plan Maintenance Oversight

Future monitoring, evaluating, and updating of the overall Plan update will be coordinated by NVCOG. Each municipality has assigned a Local Coordinator who will be responsible for monitoring the successful implementation of this Plan update at the local level. As individual strategies and actions of this Plan update are implemented, they must be implemented by the municipal departments that oversee these activities. The Local Coordinator (and staff) will provide the linkage between the multiple municipal departments involved in hazard mitigation at the local level. As this Plan update will be adopted by the local government, coordination is expected to occur without significant barriers. The Local Coordinator for each community in this Plan update is identified as the Municipal Contact at the bottom of page ii and is responsible for Plan maintenance as discussed in the remainder of Section 6.3.

6.3.2 Site Reconnaissance for Specific Suggested Actions

The Local Coordinator, with the assistance of appropriate department staff, will annually perform reconnaissance-level inspections of sites that are associated with specific actions (such as culvert and bridge replacements, home elevations, vegetation clearing areas, etc.). This will ensure that the suggested actions remain viable and appropriate. The worksheet in Appendix F will be filled out for specific project-related actions as appropriate. This worksheet is taken from the *Local Mitigation Planning Handbook*.

The Local Coordinator will be responsible for obtaining a current list of RLPs in the community each year. This list is available from the State NFIP Coordinator with Connecticut DEEP. The RLPs shall be subject to a windshield survey at least once every two years to ensure that the list is reasonably accurate relative to addresses, mitigation status, and other basic information. Some of the reconnaissance-level inspections could occur coincidentally during events such as flooding when survey or response is underway.

6.3.3 Annual Reporting and Meeting

The Local Coordinator is responsible for holding a local annual meeting to review the Plan update. Matters to be reviewed on an annual basis include the goals and objectives of the Plan update, hazards or disasters that occurred during the preceding year, mitigation activities that have been accomplished to date, a discussion of reasons that implementation may be behind schedule, and suggested actions for new projects and revised activities. Results of site reconnaissance efforts will be reviewed. A meeting should be conducted at least two months before the annual application cycle for grants under the HMA program. This will enable a list of possible projects to be circulated to applicable local departments to review and provide sufficient time to develop a grant application. The Local Coordinator shall prepare and

maintain documentation and minutes of this annual review meeting. This meeting will also prepare Local Coordinators for attendance at the annual regional Local Coordinator meeting to be held by NVCOG as noted in Section 5.4.

6.3.4 Post-Disaster Reporting and Meeting

Subsequent to federally declared disasters in Connecticut that includes the county of the participating community (Fairfield, Hartford, Litchfield, or New Haven), a meeting shall be conducted by the Local Coordinator with representatives of appropriate departments to develop a list of possible projects for developing an HMGP application. The Local Coordinator shall prepare a report of the recent events and ongoing or recent mitigation activities for discussion and review at the pre-HMGP application meeting. This report may be consistent with any post-event reports required by FEMA. Public outreach may be solicited for HMGP applications at a *separate* public meeting that could be combined with a community meeting to discuss the Plan update.

6.3.5 Continued Public Involvement

Continued public involvement will be sought regarding the monitoring, evaluating, and updating of this Plan. First, the public is invited to send written comments about the Plan for consideration for future Plan updates. Written comments should be addressed to the Local Coordinator in each community. Second, each community will seek public involvement regarding Plan maintenance through a combination of community meetings, presentations on local cable access channels, and/or input to web-based information gathering tools. Each Local Coordinator will be responsible for publicizing the request for public comment including notifications posted on the municipal web site. Finally, each community will be responsible for making public comments available for consideration during the Plan review process.

6.4 Plan Updates

As noted in Section 5.4, NVCOG intends to secure the funding required to update the multi-jurisdictional HMP in a timely manner such that the current Plan will not expire while the Plan update is in development.

To update the Plan, the Local Coordinator will coordinate the appropriate group of local officials consisting of representatives of many of the same departments solicited for input to this plan update. In addition, local business leaders, community and neighborhood group leaders, relevant private and non-profit interest groups, and the neighboring municipalities will be solicited for representation.

The project action worksheets prepared by the local coordinator and annual reports described above will be reviewed. In addition, the following questions will be asked:

- Do the mitigation goals and objectives still reflect the concerns of local residents, business owners, and officials?
- Have local 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 locally since the last edition of the HMP was developed? Were these anticipated and evaluated in the HMP or should these hazards be added to the plan?
- Are current personnel and financial resources at the local level sufficient for implementing mitigation actions?
- For each mitigation action that has not been started or 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 actions 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?

Future HMP updates may include deleting suggested actions as projects are completed, adding suggested actions as new hazard effects arise, or modifying hazard vulnerabilities as land use changes. For instance, several prior actions were removed while preparing this Plan update because (1) they had become institutionalized capabilities, (2) they were successfully completed, (3) they were no longer necessary, or (4) they were subsumed by more specific local or State actions.

7.0 Resources and References

Technical and financial resources to assist with implementation of this plan can be found herein. In particular, local adoption of this Plan enables each participating community to access the HMA grant programs described in Section 7.1.

7.1 HMA Grant Programs

7.1.1 Hazard Mitigation Grant Program

The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The HMGP provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. A key purpose of the HMGP is to ensure that any opportunities to take critical mitigation measures to protect life and property from future disasters are not "lost" during the recovery and reconstruction process after a disaster. The "5% Initiative" is a subprogram that provides the opportunity to fund mitigation actions that are consistent with the goals and objectives of the state and local mitigation plans and meet all HMGP requirements, but for which it may be difficult to conduct a standard benefit cost analysis (BCA) to prove cost effectiveness.

7.1.2 Flood Mitigation Assistance (FMA) Program

The FMA program was created as part of the National Flood Insurance Reform Act or "NFIRA" of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the NFIP. The NFIP provides the funding for the FMA program. FEMA provides FMA funds to assist states and communities with implementing measures that reduce or eliminate the long-term risk of flood damage to buildings, homes, and other structures insurable under the NFIP. The long-term goal of FMA is to reduce or eliminate claims under the NFIP through mitigation activities. The FMA program is subject to the availability of appropriation funding, as well as any program-specific directive or restriction made with respect to such funds.

7.1.3 Building Resilient Infrastructure and Communities

The Building Resilient Infrastructure and Communities (BRIC) program aims to categorically shift the federal focus away from reactive disaster spending and toward research-supported, proactive investment in community resilience. The BRIC program replaced the previous Pre-Disaster Mitigation funding program in 2020. FEMA anticipates BRIC funding projects that demonstrate innovative approaches to partnerships, such as shared funding mechanisms, and/or project design. For example, an innovative project may bring multiple funding sources or in-kind resources from a range of private and public sector stakeholders or offer multiple benefits to a community in addition to the benefit of risk reduction.

7.1.4 Eligible Activities

The HMA grant programs may provide between 75% to 100% funding for eligible projects depending on the project type. Note that 100% funding is only typically available for severe repetitive loss properties and most grants receive a 75% federal share. HMGP and FMA grants have traditionally had a maximum federal share of $3 million, while the BRIC grants may have a maximum federal share of $50 million in 2020.

Table 7-1 presents potential mitigation project and planning activities allowed under each HMA grant program described above as outlined in the most recent

HMA Unified Guidance document. Many of the strategies and actions developed in this plan fall within this list of eligible activities.

Table 7-1: HMA Eligible Activities

Eligible Activities	HMGP	FMA	BRIC
Property Acquisition and Structure Demolition or Relocation	X	X	X
Structure Elevation	X	X	X
Mitigation Reconstruction	X	X	X
Dry Floodproofing of Historic Residential Structures	X	X	X
Dry Floodproofing of Non-residential Structures	X	X	X
Generators	X	X	
Localized Flood Reduction Projects	X	X	X
Non-Localized Flood Reduction Projects	X	X	
Structural Retrofitting of Existing Buildings	X	X	X
Non-structural Retrofitting of Existing Buildings and Facilities	X	X	X
Safe Room Construction	X	X	
Wind Retrofit for One- and Two-Family Residences	X	X	
Infrastructure Retrofit	X	X	X
Soil Stabilization	X	X	X
Wildfire Mitigation	X	X	
Post-Disaster Code Enforcement	X		
Advance Assistance	X		
5% Initiative Projects	X		
Miscellaneous / Other	X	X	X
Hazard Mitigation Planning	X	X	X
Planning Related Activities	X		
Technical Assistance			X
Management Cost	X	X	X

Source: 2015 HMA Guidance, BRIC Website

7.1.5 Benefit-Cost Analysis

According to FEMA, BCA is a method that determines the future risk reduction benefits of a hazard mitigation project and compares those benefits to its cost. The result is a benefit-cost ratio (BCR). A project is considered cost-effective when the BCR is 1.0 or greater. HMA grant applicants (states) and sub-applicants (municipalities) must use FEMA-approved methodologies and tools – such as the BCA Toolkit - to demonstrate the cost-effectiveness of their projects.

The current BCA Toolkit[15] is an Add-On for Microsoft Excel. FEMA provides both online study courses and classroom courses to train users on the BCA Toolkit, and encourages local officials to contact the State Hazard Mitigation Officer for assistance reviewing and performing a BCA. Consultants are also available to assist communities in the preparation of BCAs. For example, Level 2 HAZUS-MH Analysis can be used to generate project benefits for more complicated projects with effects spanning entire neighborhoods or larger areas.

In addition, effective August 15, 2013 acquisition and elevation projects are automatically considered cost-effective if the project costs are less than $276,000 and $175,000, respectively. Structures must be located in the SFHA (the 1% annual chance floodplain) to qualify. For these structures, the BCA will not be required.

One potentially important recent change to the HMA grant programs is that "green open space and riparian area benefits can now be included in the project BCR once the project BCR reaches 0.75 or greater." The inclusion of environmental benefits in the project BCR is limited to acquisition-related activities. These additional benefits can often raise a BCR above 1.0 for eligibility purposes.

7.2 Technical and Financial Resources

This section is comprised of a list of resources that may potentially provide technical and financial assistance for completion of the actions as described in this HMP. This list is not inclusive of all resources and should be updated periodically. In most cases, any grant funding provided by these agencies will have cost-sharing requirements requiring funding through local capital improvement or operating budgets.

[15] https://www.fema.gov/grants/guidance-tools/benefit-cost-analysis

7.2.1 Federal Resources

Environmental Protection Agency – Region I
1 Congress Street, Suite 100
Boston, MA 02114-2023
(888) 372-7341

EPA offers grants for restoration and repair and for educational activities, including:

- **Capitalization Grants for State Revolving Funds** that can be used for low interest loans to governments to repair, replace, or relocate wastewater treatment plants damaged in floods. The grants do not apply to drinking water or other utilities.

- **Clean Water Act Section 213 Grants** to state agencies that can be used for funding watershed resource restoration activities including wetlands and other aquatic habitats (riparian zones). Only activities that control non-point source pollution are eligible. The cost-share grants are administered through Connecticut DEEP.

Federal Emergency Management Agency (Region I)
99 High Street, 6th Floor, Boston, MA 02110
(617) 956-7506) http://www.fema.gov

FEMA provides funding for mitigation activities through several programs including the HMA programs described above. Each NVCOG municipality is eligible to apply for funding through the State of Connecticut as a subgrantee. The State of Connecticut (as well as online resources) can provide application development and project eligibility assistance.

Federal Insurance and Mitigation Administration
The Federal Insurance and Mitigation Administration is comprised of three divisions that administer FEMA's hazard mitigation programs.

- The **Risk Analysis Division** applies engineering and planning practices in conjunction with advanced technology tools to identify hazards, assess vulnerabilities, and develop strategies to manage the risks associated with natural hazards. FEMA programs administered by the Risk Analysis Division include:
  - Flood Map Modernization Program: Maintains and updates NFIP mapping.
  - National Dam Safety Program: Provides state assistance funds, research, and training in dam safety procedures.
  - National Hurricane Program: Conducts and supports projects and activities that help protect communities from hurricane hazards.
  - Multi-Hazard Mitigation Planning Program: A process for states and communities to identify policies, activities, and tolls that can reduce or eliminate long-term risk to life and property from a hazard event.

- The **Risk Reduction Division** works to reduce risk to life and property through the use of land use controls, building practices, and other tools. These activities address risk in both the existing built environment and in future development, and they occur in both pre- and post-disaster environments. FEMA programs administered by the Risk Reduction Division include:

  - HMA Grant Programs: Provides grants to states and local governments to implement long-term hazard mitigation measures as described in Section 7.1.
  - CRS Program: A voluntary incentive program under the NFIP that recognizes and encourages community floodplain management activities.
  - National Earthquake Hazards Reduction Program: Works in conjunction with state and regional organizations to support state and local programs designed to protect citizens from earthquake hazards.
  - Rehabilitation of High Hazard Potential Dam Grant Program: Provides technical, planning design, and construction assistance in the form of grants for rehabilitation of eligible high hazard potential (Class C) dams. Each eligible state may submit one grant application per year. To be eligible, the dam must have an approved EAP and fail to meet the minimum state dam safety standards and therefore pose an unacceptable risk to the public as determined by the State Dam Safety Program.

- The **Risk Insurance Division** helps reduce flood losses by providing affordable flood insurance for property owners and by encouraging communities to adopt and enforce floodplain management regulations that mitigate the effects of flooding on new and improved structures. FEMA programs administered by the Risk Analysis Division include:

  - NFIP: Enables property owners in participating communities to purchase flood insurance, assists communities in complying with the requirements of the program, and publishes FIRMs and FISs to determine areas of risk.
  - Office of Response & Recovery: As part of the National Disaster Recovery Framework, the Office of Response & Recovery provides information on dollar amounts of past disaster assistance including Public Assistance, Individual Assistance, and Temporary Housing. Information on retrofitting and acquisition/relocation initiatives is maintained by the division. The Office also provides mobile emergency response support to disaster areas, supports the National Disaster Medical System, and provides urban search and rescue teams for disaster victims in confined spaces. Federal disaster assistance programs are coordinated by this Office, including:
    - *Public Assistance Grant Program*: Provides 75% grants for mitigation projects to protect eligible damaged public and private nonprofit facilities from future damage.
    - *Individuals and Family Grant Program*: Provides "minimization" grants at 100% costs.
    - The *HMGP* and *Fire Management Assistance Grant Program*. The Assistance to Firefighters Grant helps local fire departments non-affiliated emergency medical service organizations meet emergency response needs.
  - Emergency Management Performance Grants Program: Provides resources to assist state, local, tribal, and territorial governments in preparing for all hazards. Allowable costs support efforts to build and sustain core capabilities across the prevention, protection, mitigation, response, and recovery mission areas.

Small Business Administration (Region I)
10 Causeway Street, Suite 812
Boston, MA 02222-1093
(617) 565-8416 http://www.sba.gov

The Small Business Administration has the authority to "declare" disaster areas following disasters that affect a significant number of homes and businesses but that would not need additional assistance through FEMA (Administration assistance is triggered by a FEMA declaration, however). The Administration can provide additional low-interest funds (up to 20% above what an eligible applicant would "normally" qualify for) to install mitigation measures. They can also loan the cost of bringing a damaged property up to state or local code requirements. These loans can be used in combination with the new "mitigation insurance" under the NFIP or in lieu of that coverage.

U.S. Army Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751
(978) 318-8520

USACE provides 100% funding to states and local governments for floodplain management planning and technical assistance under several flood control acts and the Floodplain Management Services Program. The Flood Risk Management Program provides 50% funding for eligible floodproofing and flood preparedness projects. The Levee Program provides information on levee safety, risk assessment, and risk reduction.

U.S. Department of Agriculture
Natural Resources Conservation Service
Connecticut State Office
344 Merrow Road, Suite A
Tolland, CT 06084-3917
(860) 871-4011

The NRCS works cooperatively with landowners, conservation districts, federal, state, and local governments, and citizens from urban and rural communities to restore and enhance the landscape. NRCS soil conservationists, soil scientists, agronomists, ecologists, engineers, planners, and other specialists promote land stewardship by providing technical

assistance through teams to address surface and groundwater quality; wetlands, riparian areas, and biodiversity; aquatic and terrestrial habitat; and impacts of land use changes. The Emergency Watershed Protection and Watershed and Flood Prevention Operations Programs provide technical and financial assistance to reduce or prevent flood damage, reduce soil erosion, and improve water quality.

U.S. Department of Commerce
National Weather Service
Northeast River Forecast Center
445 Myles Standish Boulevard
Taunton, MA 02780
(508) 824-5116 http://www.nws.noaa.gov

The NWS provides weather, water, and climate data, forecasts and warnings for the protection of life and property and the enhancement of the national economy.

U.S. Economic Development Administration
Philadelphia Regional Office
900 Market Street, Room 602
Philadelphia, PA 19107
(215) 597-8723 https://www.eda.gov/

The Administration assists local governments affected by disasters by providing technical assistance and grant funding.

U.S. Department of Housing and Urban Development
20 Church Street, 19th Floor
Hartford, CT 06103-3220
(860) 240-4800 http://www.hud.gov

The U.S. Department of Housing and Urban Development offers Community Development Block Grants to communities with populations greater than 50,000, who may contact the agency directly regarding such grants. One program objective is to improve housing conditions for low- and moderate-income families. Projects can include acquiring flood prone homes or protecting them from flood damage. Funding is a 100% grant and can be used as a source of local matching funds for other funding programs such as FEMA's HMA Grants. Funds can also be applied toward "blighted" conditions, which is often the post-flood condition. A separate set of funds exists for conditions that create an "imminent threat." The funds have been used in the past to replace (and redesign) bridges where flood damage eliminates police and fire access to the other side of the waterway. Funds are also available for smaller municipalities through the state administered block grant program participated in by the State of Connecticut.

U.S. Department of the Interior
National Park Service
Rivers, Trails, & Conservation Assistance
15 State Street
Boston, MA 02109
(617) 223-5123 http://www.nps.gov/rtca

The National Park Service provides communities with technical assistance to conserve rivers, preserve open space, and develop trails and greenways and assists with the identification of nonstructural options for floodplain development.

U.S. Fish & Wildlife Service
New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087
(603) 223-2541 http://www.fws.gov

The U.S. Fish and Wildlife Service provides technical and financial assistance to restore wetlands and riparian habitats through the North American Wetland Conservation and Partners for Fish and Wildlife programs.

7.2.2 State Resources

Connecticut Department of Administrative Services
Division of Construction Services
Office of the State Building Inspector
450 Columbus Boulevard, Suite 1303
Hartford, CT 06103
(860) 713-5900
https://portal.ct.gov/DAS/Office-of-State-Building-Inspector/Office-of-State-Building-Inspector

The Office of the State Building Inspector is housed under the Division of Construction Services. The Office is responsible for administering and enforcing the Connecticut State Building Code and is also responsible for the municipal Building Inspector Training Program.

Connecticut Department of Economic and Community Development
505 Hudson Street
Hartford, CT 06106-7106
(860) 270-8000 https://portal.ct.gov/DECD

The Connecticut Department of Economic and Community Development administers HUD's State CDBG Program, awards smaller communities and rural areas grants for use in revitalizing neighborhoods, expands affordable housing and economic opportunities, and improves community facilities and services.

Connecticut Department of Emergency Services & Public Protection
25 Sigourney Street, 6th Floor
Hartford, CT 06106-5042
(860) 256-0800 https://portal.ct.gov/DEMHS

DESPP houses DEMHS which oversees statewide emergency preparedness, response and recovery, mitigation, and an extensive related training program. The State Hazard Mitigation Officer is responsible for hazard mitigation planning and policy, and oversight and administration of the HMA Grant programs, also has the responsibility for ensuring the CT NHMP is updated every five years.

Connecticut Department of Energy & Environmental Protection
79 Elm Street
Hartford, CT 06106-5127
(860) 424-3000 https://portal.ct.gov/DEEP

The Connecticut DEEP provides technical assistance to sub-applicants for planning efforts and hazard mitigation assistance projects. The department includes several divisions with various functions related to hazard mitigation:

- The **Bureau of Water Protection and Land Reuse, Inland Water Resources Division** is generally responsible for flood hazard mitigation in Connecticut, including administration of the NFIP.
- The **State NFIP Coordinator** provides floodplain management and flood insurance technical assistance, floodplain management ordinance review, substantial damage/improvement requirements, community assistance visits, and other general flood hazard mitigation planning including the delineation of floodways.
- The **Flood & Erosion Control Board Program** aids municipalities with active Flood and Erosion Control Boards to solve flooding, beach erosion, and dam repair problems. The program empowers local municipalities to construct and repair flood and erosion management systems. Certain nonstructural measures that mitigate flood damages are also eligible. Funding is provided to communities that apply for assistance through a Flood & Erosion Control Board, with allocations determined by priority when funds are available.
- The **Inland Wetlands and Watercourses Management Program** provides training, technical, and planning assistance to local Inland Wetlands Commissions and reviews and approves municipal regulations for localities. Also controls flood management and natural disaster mitigation.
- The **Dam Safety Program** is charged with the responsibility for administration and enforcement of Connecticut's dam safety laws. The program regulates the operation and maintenance of dams in the state. Permits the construction, repair, or alteration of dams, dikes, or similar structures and maintains a registration database of all known dams statewide. This program also operates a statewide inspection program.
- The **Clean Water Fund** provides funding and grants under the Clean Water Act involving sewage treatment plant construction and upgrades, combined sewer overflow remediation, nutrient removal and non-point source pollution control projects that protect Long Island Sound, collection system improvements, water pollution control, and river restoration.
- The **Bureau of Water Management Planning and Standards Division** administers the Section 319

nonpoint source pollution reduction grants and municipal facilities program, which deals with mitigating pollution from wastewater treatment plants.

- The **Office of Long Island Sound Programs** administers the Coastal Area Management Act program and Long Island Sound License Plate Program.

Connecticut Department of Transportation
2800 Berlin Turnpike
Newington, CT 06131-7546
(860) 594-2000 https://portal.ct.gov/DOT

CTDOT administers the federal surface transportation bill Fixing America's Surface Transportation Act or "FAST Act" that includes grants for projects that promote alternative or improved methods of transportation. Funding through grants can often be used for projects with mitigation benefits such as preservation of open space in the form of bicycling and walking trails. CTDOT is also involved in traffic improvements and bridge repairs that could be mitigation related. The Local Bridge Program provides 50% funding for bridges that are structurally deficient or have other issues eligible for funding under the program.

Connecticut Institute for Resilience & Climate Adaptation
UConn Avery Point Campus
1080 Shennecosett Road
Groton, CT 06340
(860) 405-9171 https://circa.uconn.edu/

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. CIRCA has awarded grants for projects through its Municipal Resilience Grants Program to municipalities and regional councils of governments. Additional 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 Connecticut DEEP, CTDOT, 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.

Connecticut Office of Policy & Management
450 Capitol Avenue
Hartford, CT 06106
(860) 418-6355
https://portal.ct.gov/OPM/Bud-Other-Projects/STEAP/STEAP_Home

This agency manages STEAP grants to small towns for economic development, community conservation, and quality-of-life capital projects for localities. Grants are administered by various state agencies depending upon the project type.

Connecticut State Historic Preservation Office
Certified Local Government & Grants Coordinator
(860) 500-2356
https://portal.ct.gov/DECD/Services/Historic-Preservation

SHPO provides technical assistances related to projects that may affect historic resources, and provides grants to support identification, preservation, protection, and restoration of historic buildings and sites.

7.2.3 Private and Other Resources

AmeriCorps
1-800-942-2677
https://www.nationalservice.gov/programs/americorps

AmeriCorps provides grants to national and local nonprofits, government agencies, faith-based and other

community organizations and other groups committed to strengthening their communities through volunteering. Service project teams may be available to assist with projects such as surveying, tree planting, restoration, construction, and environmental education.

Association of State Dam Safety Officials
450 Old Vine Street
Lexington, KY 40507
(859) 257-5140 http://www.damsafety.org

This is a nonprofit organization of state and federal dam safety regulators, dam owners and operators, dam designers, manufacturers and suppliers, academia, contractors, and others interested in dam safety. Their mission is to advance and improve the safety of dams by supporting the dam safety community and state dam safety programs, raising awareness, facilitating cooperation, providing a forum for the exchange of information, representing dam safety interests before governments, providing outreach programs, and creating a unified community of dam safety advocates.

Association of State Floodplain Managers
8301 Excelsior Drive
Madison, WI 53717
(608) 828-3000 http://www.floods.org

This is a professional association with a membership of over 7,000 that provides education to assist state and local governments with the NFIP, CRS, and flood mitigation. The Association has developed a series of technical and topical research papers and a series of proceedings from their annual conferences. Many "mitigation success stories" have been documented through these resources and provide a good starting point for planning.

Connecticut Association of Flood Managers
P.O. Box 270213
West Harford, CT 06127
ContactCAFM@gmail.com http://www.ctfloods.org

The Connecticut Association of Flood Managers is a professional association of local and state floodplain managers, consultants, academics, and experts in related fields that provides training and outreach regarding flood management and mitigation techniques. An educational annual conference is held in Connecticut each year. It is the local state chapter of Association of State Floodplain Managers.

Connecticut Land Conservation Council
27 Washington Street
Middletown, CT 06457
(860) 852-5512 http://www.ctconservation.org/

The Council serves Connecticut's land trusts by representing their interests to state government, connecting them to training and guidance resources on both statewide and local levels, and providing direct assistance to aid in achieving conservation goals. Land trusts may be interested in providing funding to preserve land as open space. Land Trusts operating in the NVCOG region include:

- Bethany Land Trust, Inc.
- Bethlehem Land Trust, Inc.
- Cheshire Land Trust, Inc.
- Environmental Learning Centers of CT, Inc.
- Flanders Nature Center & Land Trust, Inc.
- Heritage Land Preservation Trust
- Katherine Bakeless Wildflower & Nature Preserve, Inc.
- Middlebury Land Trust, Inc.
- Naugatuck Land Trust
- Northwest Connecticut Land Conservancy, Inc.
- Oxford Land Trust, Inc.
- Plymouth Land Trust, Inc.
- Prospect Land Trust, Inc.
- Roxbury Land Trust, Inc.
- Seymour Land Conservation Trust, Inc.
- Shelton Land Conservation Trust
- South Central Connecticut Regional Water Authority
- Southbury Land Trust
- Steep Rock Association, Inc.
- Waterbury Land Trust
- Watertown Land Trust, Inc.
- Wildlife in Crisis Land Trust
- Wolcott Land Conservation Trust, Inc.

Eversource Energy Center
University of Connecticut
Storrs, CT 06269-3037
860-486-6806 https://www.eversource.uconn.edu/

The Center researches and develops new technologies and science-based solutions for increasing the reliability of the electric grid from impacts of storms and climate change. Predictive models include outage predictions, vegetation mapping and mapping of tree risk, electric grid reinforcement modeling, and renewable energy research.

Insurance Institute for Business and Home Safety
4775 East Fowler Avenue
Tampa, FL 33617
(813) 286-3400 http://www.ibis.org

The institute conducts objective, scientific research to identify and promote effective actions that strengthen homes, businesses, and communities against natural disasters and other causes of loss. The institute advocates the development and implementation of building codes and standards nationwide and may be a good source of model code language.

Multidisciplinary Center for Earthquake Engineering and Research
University at Buffalo
State University of New York
Red Jacket Quadrangle
Buffalo, NY 14261
(716) 645-3391 http://mceer.buffalo.edu

Originally a source for earthquake statistics, research, engineering and planning advice, the Center's mission has expanded from earthquake engineering to the technical and socioeconomic impacts of a variety of hazards, both natural and man-made, on critical infrastructure, facilities, and society.

National Association of Flood & Stormwater Management Agencies
1301 K Street, Suite 800 East
Washington, DC 20005
(202) 218-4122 http://www.nafsma.org

The Association is an organization of public agencies whose function is the protection of lives, property and economic activity from the adverse impacts of storm and flood waters. The Association advocates public policy, encourages technologies, and conducts education programs which facilitate and enhance the achievement of the public service function of its members.

National Emergency Management Association
P.O. Box 11910
Lexington, KY 40578
(859) 244-8000 http://nemaweb.org

The National Emergency Management Association provides national leadership and expertise in comprehensive emergency management, serves as a vital emergency management information and assistance resource, and advances continuous improvement in emergency management through strategic partnerships, innovative programs, and collaborative policy positions.

Natural Hazards Center
University of Colorado at Boulder, 482 UCB
Boulder, CO 80309-0482
(303) 492-6818 http://www.colorado.edu/hazards

The Natural Hazards Center advances and communicates knowledge regarding hazard mitigation and disaster preparedness, response, and recovery. Using an all-hazards and interdisciplinary framework, the Center fosters information sharing and integration of activities among researchers, practitioners, and policy makers from around the world, supports and conducts research, and provides educational opportunities for the next generation of hazards scholars and professionals. The Floodplain Management Resource Center is a free library and referral service of the Association of State Floodplain Managers for floodplain management publications.

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Appendix A

Municipal Planning Process

Appendix Provided in
Digital Format

Appendix B

Regional Workshops

Appendix Provided in
Digital Format

Appendix C

Public Outreach

Appendix Provided in
Digital Format

Appendix D

HAZUS-MH Output

Appendix Provided in
Digital Format

Appendix E

Adoption Resolutions

CERTIFICATE OF ADOPTION
ANSONIA BOARD OF ALDERMEN

A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE, 2021-2026

WHEREAS, the City of Ansonia has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Ansonia Board of Aldermen approved the previous version of the Plan in 2012; and

WHEREAS, the City of Ansonia and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Ansonia; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Ansonia, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Ansonia eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Board of Aldermen:

1. The Plan is hereby adopted as an official plan of the City of Ansonia;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Board of Aldermen.

Adopted this 9th **day of** NOV., **2021 by the Board of Aldermen of Ansonia, Connecticut**

Mayor

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Ansonia this 10th day of NOV., 2021.

City Clerk

ant.

CERTIFICATE OF ADOPTION
BEACON FALLS BOARD OF SELECTMEN

A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE, 2021-2026

WHEREAS, the Town of Beacon Falls has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Beacon Falls Board of Selectmen approved the previous version of the Plan in 2015; and

WHEREAS, the Town of Beacon Falls and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Beacon Falls; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Beacon Falls, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Beacon Falls eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Board of Selectmen:

1. The Plan is hereby adopted as an official plan of the Town of Beacon Falls;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Board of Selectmen.

Adopted this 10 **day of** Jan **, 2021 by the Board of Selectmen of Beacon Falls, Connecticut**

First Selectman

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Beacon Falls this 12 day of Jan, 2021.

Denise E. Hendricks, Asst. Town Clerk

Town Clerk

CERTIFICATE OF ADOPTION
BETHLEHEM BOARD OF SELECTMEN

A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE, 2021-2026

WHEREAS, the Town of Bethlehem has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Bethlehem Board of Selectmen approved the previous version of the Plan in 2015; and

WHEREAS, the Town of Bethlehem and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Bethlehem; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Bethlehem, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Bethlehem eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Board of Selectmen:

1. The Plan is hereby adopted as an official plan of the Town of Bethlehem;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Board of Selectmen.

Adopted this 19th day of Oct., 2021 by the Board of Selectmen of Bethlehem, Connecticut

First Selectman

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Bethlehem this 19th day of Oct, 2021.

Town Clerk Asst.

City of Bristol
Office of Town and City Clerk
111 North Main Street
Bristol, Connecticut
(860)584-6200

December 16, 2021

Mr. Raymond Rogozinski
Director Public Works
City Hall
111 North Main Street
Bristol, Connecticut 06010

Dear Mr. Rogozinski:

At a meeting of the City Council on December 14, 2021 the following Resolution was adopted:

WHEREAS, the City of Bristol has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and
WHEREAS, the Bristol City Council approved the previous version of the Plan in 2016; and
WHEREAS, the City of Bristol and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and
WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and
WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Bristol; and
WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Bristol, with the effect of protecting people and property from loss associated with those hazards; and
WHEREAS, adoption of this Plan will make Bristol eligible for funding to alleviate the impacts of future hazards; now therefore be it
RESOLVED by the City Council:

1. The Plan is hereby adopted as an official plan of the City of Bristol;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;

3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the City Council.

To authorize the Mayor or Acting Mayor to sign any and all documents required for the Hazard Mitigation Plan Update, 2021-2026.

Very truly yours,

Therese Pac, MCTC, MMC
Town and City Clerk

Bristol
CONNECTICUT
All Heart ™

Department of Public Works | 860.584.6125

MEMORANDUM

DATE: December 6, 2021

TO: Mayor Jeffrey Caggiano
City Council

FROM: Raymond A. Rogozinski, P.E., Director of Public Works

RE: Regional Hazardous Mitigation Plan

The Board of Public Works received and reviewed the regional Hazard Mitigation Plan at its November 18, 2021 meeting prepared by SLR Engineering for the Naugatuck Valley Council of Governments. The plan includes a Municipal Annex that provides specific provision associated with the City of Bristol. A link to plan is provided below and includes both the Regional "Multi-Jurisdictional Document" and the "Municipal Annexes".

www.nvcogct.gov/hmp.

Based on a review and DPW staff recommendation of the referenced plan the Board of Public Works recommended the following City Council action:

> **Motion to approve the Regional Hazardous Mitigation Plan Update 2021-26 with Municipal Annex for Bristol prepared by NVCOG. Said approval shall authorize the Mayor to sign any and all documents required for approval. Resolution adopting said mitigation plan attached.**

In addition to serving as a planning document to prepare for disaster the Hazard Mitigation Plan is required to make the City eligible for grants administered by FEMA.

Please feel free to contact me with any question at 860-584-6113.

City of Bristol
Public Work Department
111 North Main Street
Bristol, CT 06010
www.bristolct.gov

Presented at Council Meeting
12/14/2021
Adopted
Ordered Filed
Referred to

RECEIVED
2021 DEC -7 AM 9:39
TOWN AND CITY CLERK
BRISTOL, CT

MOTION by Mr. Borowy; seconded by Mr. Slocum.

BE IT RESOLVED, that the Town Council approves Resolution #111621-2

RESOLUTION #111621-2

BE IT RESOLVED, that the Town Council adopts the Naugatuck Valley Council of Governments Hazard Mitigation Plan Update for 2021-2026 as presented.

VOTE The motion passed unanimously by those present.

B. Authorization to apply for the DEEP CT Recreational Trails Grant.

MOTION by Ms. Nichols; seconded by Mr. Walsh.

BE IT RESOLVED, that the Town Council approves Resolution #111621-3

RESOLUTION #111621-3

BE IT RESOLVED, that the Town Council authorizes application for the DEEP CT Recreational Trails Grant for the purpose of installing chicanes on the Farmington Canal Linear Trail at the West Main Street Crossing.

Discussion
Ms. Nichols commented on the ongoing problems with safer crossing of West Main Street since installation of the Hawk System. It is a busy crossing with a need to make it safer. She noted people are not using the system and there is crossing at high rates of speed (bikes/vehicles). The town instituted temporary measures to slow down, use of the Hawk system, and this fund will provide permanent offset gates to keep everyone safe. It is an 80% grant with 20% town matching funds. Total project cost is about $30,000. Ms. Nichols supports the resolution for the safety of the entire area of town.

It was stated by Mr. Oris that the Hawk Lighting System is a disaster waiting to happen, and he supports the replacement with permanent offset gates. The Hawk lighting is confusing, with the State dictating how it operates. In addition to the chicanes, he would like to reach out to the Legislators or someone at the State level to modify the system for public safety.

VOTE The motion passed unanimously by those present.

C. Authorization to apply for the 2022 Public, Educational and Governmental Programming and Educational Technology Investment Account (PEGPETIA) Grant Program.

CERTIFICATE OF ADOPTION
DERBY BOARD OF ALDERMEN/ALDERWOMEN

A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE, 2021-2026

WHEREAS, the City of Derby has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Derby Board of Aldermen/Alderwomen approved the previous version of the Plan in 2012; and

WHEREAS, the City of Derby and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Derby; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Derby, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Derby eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Board of Aldermen/Alderwomen:

1. The Plan is hereby adopted as an official plan of the City of Derby;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Board of Aldermen/Alderwomen.

Adopted this 18TH day of November, 2021 by the Board of Aldermen/Alderwomen of Derby, Connecticut

Mayor

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Derby this 11TH day of January 2022

Town Clerk

2022 JAN 11 PM12:44

TOWN OF MIDDLEBURY

Office of the Selectmen

CERTIFICATE OF ADOPTION
A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE, 2021-2026

WHEREAS, the Town of Middlebury has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Middlebury Board of Selectmen approved the previous version of the Plan in 2014; and

WHEREAS, the Town of Middlebury and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Middlebury; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Middlebury, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Middlebury eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Board of Selectmen:

1. The Plan is hereby adopted as an official plan of the Town of Middlebury;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Board of Selectmen.

Adopted this 6th day of December, 2021 by the Board of Selectmen of Middlebury, Connecticut

Edward B. [illegible]
First Selectman

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Middlebury this 8th day of Dec, 2021.

Judith M. Berson
Town Clerk

TOWN OF MIDDLEBURY SEAL CONNECTICUT

BOROUGH OF NAUGATUCK
Nancy K. DiMeo, Borough Clerk

229 CHURCH STREET
NAUGATUCK, CT 06770
PHONE: 203-720-7008
FAX: 203-720-7099
ndimeo@naugatuck-ct.gov

I, Nancy K. DiMeo, Borough Clerk of the Borough of Naugatuck, do hereby certify that the following is a true and correct copy of a resolution adopted by the Naugatuck Board of Mayor and Burgesses at its duly called and held meeting on November 3, 2021, at which a quorum was present and acting throughout, and that the resolution has not been modified, rescinded, or revoked and is at present in full force and effect:

WHEREAS, the Borough of Naugatuck has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Naugatuck Board of Mayor and Burgesses approved the previous version of the Plan in 2015; and

WHEREAS, the Borough of Naugatuck and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Naugatuck; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Naugatuck, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Naugatuck eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Board of Mayor and Burgesses:

1. The Plan is hereby adopted as an official plan of the Borough of Naugatuck.

2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them.

3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.

4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Board of Mayor and Burgesses.

ROLL CALL VOTE:

FOR		**OPPOSE**	**ABSTAIN**
Mayor N.W. Hess	J. Mizeski	None	None
R. Neth	G. Mudry		
M. Bronko	D. Neth-Kunin		
F. Dambowsky	M. Smith		
C. Marenghi	R. Vitale		

Motion carried 10-0-0

IN WITNESS WHEREOF: The undersigned has executed this certificate on this 9th day of November 2021.

Nancy K. DiMeo, Borough Clerk

Nancy K. DiMeo, Borough Clerk

CERTIFICATE OF ADOPTION
OXFORD BOARD OF SELECTMEN

A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE, 2021-2026

WHEREAS, the Town of Oxford has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires*), resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Oxford Board of Selectmen approved the previous version of the Plan in 2014; and

WHEREAS, the Town of Oxford and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Oxford; and WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Oxford, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Oxford eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Board of Selectmen:

1. The Plan is hereby adopted as an official plan of the Town of Oxford;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Board of Selectmen.

Adopted this 17th day of November, 2021 by the Board of Selectmen of Oxford, Connecticut

First Selectman

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Oxford this 29 day of November, 2021.

Rosemary Harner, Assistant Town Clerk

TOWN OF PLYMOUTH
Office of the Mayor
80 Main Street
Terryville, CT 06786
Phone: (860) 585-4001 Fax: (860) 585-4015

CERTIFICATE OF ADOPTION
PLYMOUTH TOWN COUNCIL

A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE, 2021-2026

WHEREAS, the Town of Plymouth has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Plymouth Town Council approved the previous version of the Plan in 2016; and

WHEREAS, the Town of Plymouth and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Plymouth; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Plymouth, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Plymouth eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Town Council:

1. The Plan is hereby adopted as an official plan of the Town of Plymouth;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Town Council.

Adopted this 4th day of January, 2022 by the Town Council of Plymouth, Connecticut

Joseph Kilduff /Joseph Kilduff
Mayor

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Plymouth this 11th day of January, 2022.

Erica Calviga
Town Clerk

CERTIFICATE OF ADOPTION
PROSPECT TOWN COUNCIL

A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE, 2021-2026

WHEREAS, the Town of Prospect has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g., *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Prospect Town Council approved the previous version of the Plan in 2015; and

WHEREAS, the Town of Prospect and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Prospect; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Prospect, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Prospect eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Town Council:

1. The Plan is hereby adopted as an official plan of the Town of Prospect;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Town Council.

Adopted this 4 day of JAN, 2022 by the Town Council of Prospect, Connecticut

Mayor, Robert J. Chatfield

Chairman Town Council, Jeffrey B. Slapikas

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Prospect this 6 day of Jan 2022.

Town Clerk, Michelle Lisowski

CERTIFICATE OF ADOPTION
SEYMOUR BOARD OF SELECTMEN

A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE, 2021-2026

WHEREAS, the Town of Seymour has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Seymour Board of Selectmen approved the previous version of the Plan in 2012; and

WHEREAS, the Town of Seymour and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Seymour; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Seymour, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Seymour eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Board of Selectmen:

1. The Plan is hereby adopted as an official plan of the Town of Seymour;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Board of Selectmen.

Adopted this 17 **day of** Nov, **2021 by the Board of Selectmen of Seymour, Connecticut**

First Selectman

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Seymour this 18th day of Nov., 2021.

Town Clerk

CERTIFICATE OF ADOPTION
SHELTON BOARD OF ALDERMEN

A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE, 2021-2026

WHEREAS, the City of Shelton has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Shelton Board of Aldermen approved the previous version of the Plan in 2012; and

WHEREAS, the City of Shelton and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Shelton; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Shelton, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Shelton eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Board of Aldermen:

1. The Plan is hereby adopted as an official plan of the City of Shelton;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Board of Aldermen.

Adopted this 10th day of November, 2021 by the Board of Aldermen of Shelton, Connecticut

Mark A. Lauretti, Mayor

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Shelton this 18 day of Nov., 2021.

Margaret R. Domorod, City / Town Clerk

CERTIFICATE OF ADOPTION
SOUTHBURY BOARD OF SELECTMEN

A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE, 2021-2026

WHEREAS, the Town of Southbury has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Southbury Board of Selectmen approved the previous version of the Plan in 2014; and

WHEREAS, the Town of Southbury and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Southbury; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Southbury, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Southbury eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Board of Selectmen:

1. The Plan is hereby adopted as an official plan of the Town of Southbury;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Board of Selectmen.

Adopted this 18th day of November, 2021 by the Board of Selectmen of Southbury, Connecticut

First Selectman

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Southbury this 19 day of NOV, 2021.

Town Clerk

CERTIFICATE OF ADOPTION
TOWN OF THOMASTON BOARD OF SELECTMEN

A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE 2021-2026

WHEREAS, the Town of Thomaston has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires), resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Thomaston Board of Selectmen approved the previous version of the Plan in 2015; and

WHEREAS, the Town of Thomaston and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Thomaston; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Thomaston, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Thomaston eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Board of Selectmen:

1. The Plan is hereby adopted as an official plan of the Town of Thomaston;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Board of Selectmen.

Adopted this 19th day of October, 2021 by the Board of Selectmen of Thomaston, Connecticut

First Selectman

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Thomaston this 19th day of October, 2021.

Town Clerk

CERTIFICATE OF ADOPTION
BOARD OF ALDERMEN
CITY OF WATERBURY

A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE, 2021-2026

WHEREAS, the City of Waterbury has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Board of Aldermen, City of Waterbury approved the previous version of the Plan in 2014; and

WHEREAS, the City of Waterbury and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Waterbury; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Waterbury, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Waterbury eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Board of Aldermen:

1. The Plan is hereby adopted as an official plan of the City of Waterbury;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Board of Aldermen.

Adopted this 10th day of January, 2022 by the Board of Aldermen, Waterbury, Connecticut

Mayor: Neil M. O'Leary

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Waterbury this 10 day of January, 2022.

City Clerk: Michael J. Dalton

AUTHORIZING RESOLUTION OF THE

Watertown Town Council

CERTIFICATION:

I, Lisa Dalton, the Town Clerk of Town of Watertown, do hereby certify that the following is a true and correct copy of a resolution adopted by Town Council at its duly called and held meeting on December 6, 2021 at which a quorum was present and acting throughout, and that the resolution has not been modified, rescinded, or revoked and is at present in full force and effect:

Watertown Town Council

WHEREAS, the Town of Watertown has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires), resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Watertown Town Council approved the previous version of the Plan in 2014; and

WHEREAS, the Town of Watertown and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Watertown; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Watertown, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Watertown eligible for funding to alleviate the impacts of future hazards;

NOW THEREFORE BE IT RESOLVED BY THE WATERTOWN TOWN COUNCIL:

1. The Plan is hereby adopted as an official plan of the Town of Watertown;

2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;

3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.

4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Watertown Town Council.

IN WITNESS WHEREOF: The undersigned has executed this certificate this 8th day of December 2021

Lisa Dalton, Town Clerk

PLACE SEAL HERE (or "L.S." if no seal

#469

CERTIFICATE OF ADOPTION
WOLCOTT TOWN COUNCIL

A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE, 2021-2026

WHEREAS, the Town of Wolcott has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Wolcott Town Council approved the previous version of the Plan in 2014; and

WHEREAS, the Town of Wolcott and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Wolcott; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Wolcott, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Wolcott eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Town Council:

1. The Plan is hereby adopted as an official plan of the Town of Wolcott;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Town Council.

Adopted this 21st day of December, 2021 by the Town Council of Wolcott, Connecticut

Rachel Wisler

Rachel Wisler, Chairman

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Wolcott this **22nd day of December, 2021.**

Karen Mowad

Karen Mowad, Town Clerk

CERTIFICATE OF ADOPTION
WOODBURY BOARD OF SELECTMAN

A RESOLUTION ADOPTING THE NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS HAZARD MITIGATION PLAN UPDATE, 2021-2026

WHEREAS, the Town of Woodbury has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, droughts, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Woodbury Board of Selectman approved the previous version of the Plan in 2014; and

WHEREAS, the Town of Woodbury and the Naugatuck Valley Council of Governments developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for the Hazard Mitigation Plan Update, 2021-2026 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held and public input was sought in 2020 and 2021 regarding the development and review of the Hazard Mitigation Plan Update, 2021-2026; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for Woodbury; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact Woodbury, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make Woodbury eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Board of Selectmen:

1. The Plan is hereby adopted as an official plan of the Town of Woodbury;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Board of Selectman.

Adopted this 10 **day of** November **2021 by the Board of Selectman of Woodbury, Connecticut**

Barbara K. Rubenstein
First Selectman

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of Woodbury this 15th day of NOV, 2021.

Mia M. Mancini
Town Clerk – ASST

NAUGATUCK VALLEY
COUNCIL of GOVERNMENTS
49 Leavenworth Street, 3rd Floor, Waterbury, CT 06702 · 203-757-0535 · 203-735-8688 · nvcogct.gov

RESOLUTION 2022-07

NAUGATUCK VALLEY COUNCIL OF GOVERNMENTS
HAZARD MITIGATION PLAN 2021-2026 ENDORSEMENT

I certify that the following is a true copy of the vote of the Naugatuck Valley Council of Governments at its meeting on December 10, 2021 in Waterbury, Connecticut, at which a quorum was present.

WHEREAS, the Naugatuck Valley Council of Governments received federal funding from FEMA to develop a multijurisdictional Hazard Mitigation Plan for all 19 NVCOG municipalities.

WHEREAS, NVCOG staff and their consultant SLR worked with municipal officials, stakeholders and the public to review previous plans and identify natural hazards and risks, existing capabilities, and activities that can be undertaken by a community to prevent loss of life and reduce property damages associated with the identified hazards.

WHEREAS, SLR prepared a Multijurisdictional Hazard Mitigation Plan and 19 individual Municipal Annexes consistent with FEMA requirements.

WHEREAS, FEMA approved the Multijurisdictional Hazard Mitigation Plan and 19 Municipal Annexes pending local adoption.

BE IT RESOLVED, that the NVCOG endorses the Naugatuck Valley Council of Governments Hazard Mitigation Plan, 2021-2026

Dated at Waterbury, Connecticut, on December 10, 2021
Agency: Naugatuck Valley Council of Governments

Signed _____
Neil O'Leary, Chairman

Appendix F

Mitigation Strategy Worksheet

Appendix Provided in
Digital Format