BOROUGH OF NAUGATUCK
HAZARD MITIGATION PLAN UPDATE, 2015

Original Plan Adopted February 2009
Updated 2015

MMI #2097-11

Prepared for:

Borough of Naugatuck
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ACKNOWLEDGEMENTS AND CONTACT INFORMATION

This plan update was prepared under the direction of the Borough of Naugatuck. The following individual should be contacted with questions or comments regarding the plan:

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This Hazard Mitigation Plan Update could not have been completed without the time and dedication of the additional following individuals at the local level:

Ms. Ken Hanks, Fire and Emergency Management
Ms. Sandra Lucas-Ribeiro, Public Works Department
Mr. Wayne Zirolli, Engineering Department
Mr. Bill Hereman, Building Department
Mr. Keith Rosenfield, Land Use/Planning Department

The consulting firm of Milone & MacBroom, Inc. (MMI) prepared the subject plan update, building upon the initial work completed in 2009. The following individuals at MMI may be contacted with questions or comments regarding the plan update using the contact information on the title page or the electronic mail addresses below:

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APPENDICES

LIST OF ACRONYMS

AEL	Annualized Earthquake Losses
ARC	American Red Cross
ASFPM	Association of State Floodplain Managers
BCA	Benefit Cost Analysis
BCR	Benefit-Cost Ratio
BFE	Base Flood Elevation
BOCA	Building Officials and Code Administrators
CLEAR	Center for Land Use Education and Research (University of Connecticut)
CM	Centimeter
CRS	Community Rating System
DEEP	Department of Energy & Environmental Protection
DEMHS	Department of Emergency Management and Homeland Security
DFA	Dam Failure Analysis
DMA	Disaster Mitigation Act
DOT	Department of Transportation
DPW	Department of Public Works
EAP	Emergency Action Plan
ECC	Emergency Communications Center
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
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
HURDAT	Hurricane Database (NOAA's)
HURISK	Hurricane Center Risk Analysis Program
ICC	International Code Council
IPCC	Intergovernmental Panel on Climate Change
KM	Kilometer
KT	Knot
LID	Low Impact Development
LOMC	Letter of Map Change
MM	Millimeter
MMI	Milone & MacBroom, Inc.
MPH	Miles per Hour
NAI	No Adverse Impact
NCDC	National Climatic Data Center
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NFIRA	National Flood Insurance Reform Act
NOAA	The National Oceanic and Atmospheric Administration
OPM	Office of Policy and Management
POCD	Plan of Conservation and Development

PDM	Pre-Disaster Mitigation
RFC	Repetitive Flood Claims
RLP	Repetitive Loss Property
RSI	Regional Snowfall Impact
SCCOG	Southeastern Connecticut Council of Governments
SFHA	Special Flood Hazard Area
SLOSH	Sea, Lake and Overland Surges from Hurricanes
SRL	Severe Repetitive Loss
SSURGO	Soil Survey Geographic
STAPLEE	Social, Technical, Administrative, Political, Legal, Economic, and Environmental
TNC	The Nature Conservancy
USD	United States Dollars
USDA	United States Department of Agriculture
USGS	United States Geological Survey

EXECUTIVE SUMMARY

When the initial Hazard Mitigation Plan for the Borough of Naugatuck was developed and adopted and approved in 2009, the borough had not been struck by a major disaster in many years. Intense short-duration and localized flooding had caused damage to streets and utilities throughout Naugatuck. Severe thunderstorms in June 2002 and July 2007 produced torrential rain that downed trees and power lines. The 2007 storm caused significant flooding which closed Old Firehouse Road in Naugatuck.

In the years since the first Hazard Mitigation Plan was adopted and approved, a number of severe storms have occurred, resulting in presidential disaster declarations in Connecticut. These include flooding of March 2010, winter storms of January 2011, Tropical Storm Irene of August 2011, Winter Storm Alfred of October 2011, "Superstorm" Sandy of August 2012, and Winter Storm Nemo of February 2013.

All of these storms have tested the resilience of Naugatuck, demonstrating that the borough has considerable capacity to recover from storms. However, the borough remains at risk from flooding which is largely related to poor or nonexistent drainage systems. The borough also remains at risk to localized or widespread power outages caused by wind and snow events that damage utility lines, as well as nonresidential and residential structural damage from heavy snow loads.

Development pressures in Naugatuck fell considerably in the years after adoption of the first Hazard Mitigation Plan, coinciding with the economic downturn of 2008-2010. Many of the housing units proposed at that time were not constructed. Borough development has still not fully recovered from the economic downturn.

In light of the recent disasters, the primary goal of this hazard mitigation plan is the same as it was in 2009: to reduce the loss of or damage to life, property, infrastructure, and natural, cultural and economic resources from natural disasters. This includes the reduction of public and private costs. Going forward, the Borough intends to focus on a number of strategies carried forward from the first Hazard Mitigation Plan including addressing a variety of drainage problems.

Wind and snow hazards from hurricanes, tropical storms, thunderstorms, nor'easters, and other storms will continue to be addressed by preventive methods (such as tree limb trimming) that have been improved over the last few years based on experience with storms Irene and Alfred as well as other events.

A table of hazard mitigation strategies and actions is provided in Appendix A. The record of municipal adoption for this plan is provided in Appendix B. Appendix C contains a worksheet to be used by the Borough for annually documenting the status of potential mitigation actions. The remaining appendices include documentation of the planning process and other resources.

When this plan is next updated in 2018-2019, the Borough of Naugatuck intends to revisit issues related to land development if growth pressures materialize over the next few years. The next plan will also report on the status of any mitigation grants obtained by the Borough.

1.0 INTRODUCTION

1.1 Background and Purpose

The goal of emergency management activities is to prevent loss of life and property. The four phases of emergency management include Mitigation, Preparedness, Response and Recovery. Mitigation differs from the remaining three phases in that hazard mitigation is performed with the goal to eliminate or reduce the need to respond. The term *hazard* refers to an extreme natural event that poses a risk to people, infrastructure, or resources. In the context of disasters, pre-disaster hazard mitigation is commonly defined as any sustained action that reduces or eliminates long-term risk to people, property, and resources from hazards and their effects.

The primary purpose of a hazard mitigation plan (HMP) is to 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. Public safety and property loss reduction are the driving forces behind this plan. However, careful consideration also must be given to the preservation of history, culture and the natural environment of the region.

This HMP update was prepared specifically to identify hazards and potential mitigation measures in Naugatuck, Connecticut. The Borough's previous HMP was adopted by the Mayor and approved by the Federal Emergency Management Agency (FEMA) in April 2009 and is on file at the FEMA Region I office. The HMP expired in April 2014. The HMP is relevant not only in emergency management situations but also should be used within the Borough's land use, environmental, and capital improvement frameworks. While an update of the previous HMP, this HMP has been reformatted to be consistent with current FEMA planning requirements.

The Disaster Mitigation Act of 2000 (DMA), commonly known as the 2000 Stafford Act amendments, was approved by Congress and signed into law in October 2000, creating Public Law 106-390. The purposes of the DMA are to establish a national program for pre-disaster mitigation and streamline administration of disaster relief. The DMA requires local communities to have a FEMA-approved mitigation plan in order to be eligible to apply for and receive Hazard Mitigation Assistance (HMA) grants.

The HMA "umbrella" contains several competitive grant programs deigned to mitigate the impacts of natural hazards. This HMP update was developed to be consistent with the general requirements of the HMA program as well as the specific requirements of the Hazard Mitigation Grant Program (HMGP) for post-disaster mitigation activities, as well as the Pre-Disaster Mitigation (PDM) and Flood Management Assistance (FMA) programs. These programs are briefly described below.

Hazard Mitigation Grant Program (HMGP)

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 following 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 (Section 1.5) to prove cost effectiveness.

Pre-Disaster Mitigation (PDM) Program

The Pre-Disaster Mitigation Program was authorized by Part 203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 U.S.C. 5133. The PDM program provides funds to states, territories, tribal governments, communities, and universities for hazard mitigation planning and implementation of mitigation projects prior to disasters, providing an opportunity to reduce the nation's disaster losses through pre-disaster mitigation planning and the implementation of feasible, effective, and cost-efficient mitigation measures. Funding of HMPs and projects is meant to reduce overall risks to populations and facilities. PDM funds should be used primarily to support mitigation activities that address natural hazards. In addition to providing a vehicle for funding, the PDM program provides an opportunity to raise risk awareness within communities. The initial plan was funded through the PDM Program and this update was funded through the HMGP program.

Flood Mitigation Assistance (FMA) Program

The FMA program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP). 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 Biggert-Waters Flood Insurance Reform Act of 2012 eliminated the Repetitive Flood Claims (RFC) and Severe Repetitive Loss (SRL) programs and made the following significant changes to the FMA program:

- The definitions of repetitive loss and severe repetitive loss properties have been modified;
- Cost-share requirements have changed to allow more Federal funds for properties with repetitive flood claims and severe repetitive loss properties; and
- There is no longer a limit on in-kind contributions for the non-Federal cost share

Effective August 15 2013, acquisitions and elevations will be considered cost-effective if the project costs are less than $276,000 and $175,000, respectively. Structures must be located in Special Flood Hazard Areas (the area of the 1% annual chance flood). The benefit-cost analysis (BCA) will not be required.

The NFIP provides the funding for the FMA program. The PDM and FMA programs are subject to the availability of appropriation funding, as well as any program-specific directive or restriction made with respect to such funds.

One potentially important change to the PDM, HMGP, and FMA programs is that "green open space and riparian area benefits can now be included in the project benefit cost ratio (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.

Table 1-1 presents potential mitigation project and planning activities allowed under each FEMA grant program described above as outlined in the most recent HMA Unified Guidance document.

TABLE 1-1
Eligible Mitigation Project Activities by Program

Eligible Activities	HMGP	PDM	FMA
Property Acquisition and Structure Demolition or Relocation	X	X	X
Structure Elevation	X	X	X
Mitigation Reconstruction			X
Dry Floodproofing of Historic Residential Structures	X	X	X
Dry Floodproofing of Non-residential Structures	X	X	X
Minor Localized Flood Reduction Projects	X	X	X
Structural Retrofitting of Existing Buildings	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		
Generators	X	X	
5% Initiative Projects	X		
Advance Assistance	X		

Source: Table 3 – HMA Unified Guidance document

Many of the strategies and actions developed in this plan fall within the above list of eligible activities.

1.2 Hazard Mitigation Goals

The primary goal of this hazard mitigation plan is to ***reduce the loss of or damage to life, property, infrastructure, and natural, cultural and economic resources from natural disasters.*** This includes the reduction of public and private damage costs. Limiting losses of and damage to life and property will also reduce the social, emotional, and economic disruption associated with a natural disaster.

Developing, adopting, and implementing this hazard mitigation plan is expected to:

- ***Increase access to and awareness of funding sources for hazard mitigation projects.*** Certain funding sources, such as the Pre-Disaster Mitigation Competitive Grant Program and the Hazard Mitigation Grant Program, will be available if the hazard mitigation plan is in place and approved.

- ***Identify mitigation initiatives to be implemented if and when funding becomes available.*** This HMP will identify a number of mitigation recommendations, which can then be prioritized and acted upon as funding allows.

- ***Connect hazard mitigation planning to other community planning efforts.*** This HMP can be used to guide Naugatuck's development through inter-departmental and inter-municipal coordination.

- ***Improve the mechanisms for pre- and post-disaster decision making efforts.*** This plan emphasizes actions that can be taken now to reduce or prevent future disaster damages. If the actions identified in this plan are implemented, damage from future hazard events can be minimized, thereby easing recovery and reducing the cost of repairs and reconstruction.

- ***Improve the ability to implement post-disaster recovery projects*** through development of a list of mitigation alternatives ready to be implemented.

- ***Enhance and preserve natural resource systems.*** Natural resources, such as wetlands and floodplains, provide protection against disasters such as floods and hurricanes. Proper planning and protection of natural resources can provide hazard mitigation at substantially reduced costs.

- ***Educate residents and policy makers about natural hazard risk and vulnerability.*** Education is an important tool to ensure that people make informed decisions that complement the Borough's ability to implement and maintain mitigation strategies.

- ***Complement future Community Rating System efforts.*** Implementation of certain mitigation measures may increase a community's rating, and thus the benefits that it derives from FEMA. The Borough of Naugatuck has never participated in the Community Rating System.

These priorities have not changed since the initial Hazard Mitigation Plan was adopted in 2009. In particular, the Borough of Naugatuck has been making progress with many of the mitigation strategies listed in the initial plan.

1.3 Identification of Hazards and Document Overview

As stated in Section 1.1, the term *hazard* refers to an extreme natural event that poses a risk to people, infrastructure, or resources. Based on a review of the 2014 Connecticut Natural Hazard Mitigation Plan and correspondence with local officials, the following have been identified as natural hazards that can potentially affect the Borough of Naugatuck:

- ❑ Flooding
- ❑ Hurricanes and Tropical Storms
- ❑ Summer Storms (including lightning, hail, and heavy winds) and Tornadoes
- ❑ Winter Storms
- ❑ Earthquakes
- ❑ Dam Failure
- ❑ Wildfires

These are the same hazards that were addressed in the initial Naugatuck Hazard Mitigation Plan. They were reviewed during the development of the 2014 Connecticut Hazard Mitigation Plan Update (adopted January 2014) and Naugatuck's plan contributed to the Hazard Identification and Risk Assessment (HIRA) presented in the Connecticut Hazard Mitigation Plan Update. Thus, the plans are consistent. The only hazard given attention in the Connecticut Hazard Mitigation Plan Update but not addressed in the Naugatuck Hazard Mitigation Plan Update is drought; however, this is the lowest-ranked hazard of those discussed in the state's plan, with a medium-low composite risk score for New Haven County. In addition, the statewide and countywide annual estimated loss (AEL) in the state plan for this hazard is $0. As such, its inclusion was considered not necessary in the Naugatuck Hazard Mitigation Plan Update.

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 1-2 and 1-3 provide summaries of the hazard events and hazard effects that impact the Borough of Naugatuck, 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.

Despite the causes, the effects of several hazards are persistent and demand high expenditures from the Borough. In order to better identify current vulnerabilities and potential mitigation strategies associated with other hazards, each hazard has been individually discussed in a separate chapter.

This document begins with a general discussion of Naugatuck's community profile, including the physical setting, demographics, development trends, governmental structure, and sheltering capacity. Next, each chapter of this Plan is broken down into six or seven different parts. These are *Setting*; *Hazard Assessment*; *Historic Record*; *Existing capabilities*; *Vulnerabilities and Risk Assessment*; *and Potential Mitigation Strategies and Actions*, and if necessary, *a Status of Strategies and Actions.* These are described below.

- ❑ ***Setting*** addresses the general areas that are at risk from the hazard. General land uses are identified.

- ***Hazard Assessment*** describes the specifics of a given hazard, including general characteristics, and associated effects. Also defined are associated return intervals, probability and risk, and relative magnitude.

- ***Historic Record*** is a discussion of past occurrences of the hazard, and associated damages when available.

TABLE 1-2
Hazard Event Ranking

Natural Hazards	Location	Frequency of Occurrence	Magnitude/ Severity	Rank
	1 = small 2 = medium 3 = large	0 = unlikely 1 = possible 2 = likely 3 = highly likely	1 = limited 2 = significant 3 = critical 4 = catastrophic	
Winter Storms	3	3	2	8
Hurricanes	3	1	3	7
Summer Storms and Tornadoes	2	3	2	7
Earthquakes	3	1	2	6
Wildfires	1	2	1	4

- Each hazard may have multiple effects; for example, a hurricane causes high winds and inland flooding.
- Some hazards may have similar effects; for example, hurricanes and earthquakes may cause dam failure.

<u>Location</u>
1 = small: isolated to specific area during one event
2 = medium: multiple areas during one event
3 = large: significant portion of the Borough during one event

<u>Frequency of Occurrence</u>
0 = unlikely: less than 1% probability in the next 100 years
1 = possible: between 1 and 10% probability in the next year; or at least one chance in next 100 years
2 = likely: between 10 and 100% probability in the next year; or at least one chance in next 10 years
3 = highly likely: near 100% probability in the next year

<u>Magnitude/Severity</u>
1 = limited: injuries and/or illnesses are treatable with first aid; minor "quality of life" loss; shutdown of critical facilities and services for 24 hours or less; property severely damaged < 10%
2 = significant: injuries and/or illnesses do not result in permanent disability; shutdown of several critical facilities for more than one week; property severely damaged <25% and >10%
3 = critical: injuries and/or illnesses result in permanent disability; complete shutdown of critical facilities for at least two weeks; property severely damaged <50% and >25%
4 = catastrophic: multiple deaths; complete shutdown of facilities for 30 days or more; property severely damaged >50%

TABLE 1-3
Hazard Effect Ranking

Natural Hazard Effects	Location	Frequency of Occurrence	Magnitude/ Severity	Rank
	1 = small 2 = medium 3 = large	0 = unlikely 1 = possible 2 = likely 3 = highly likely	1 = limited 2 = significant 3 = critical 4 = catastrophic	
Nor'Easter Winds	3	3	2	8
Snow	3	3	2	8
Blizzard	3	3	2	8
Hurricane Winds	3	1	3	7
Falling Trees/Branches	2	3	2	7
Ice	3	2	2	7
Flooding from Poor Drainage	1	3	2	6
Thunderstorm and Tornado Winds	2	2	2	6
Riverine Flooding	2	3	1	6
Flooding from Dam Failure	1	1	4	6
Shaking	3	1	2	6
Lightning	1	3	1	5
Hail	1	2	1	4
Fire/Heat	1	2	1	4
Smoke	1	2	1	4

- ❑ Some effects may have a common cause; for example, a hurricane causes high winds and inland flooding.
- ❑ Some effects may have similar causes; for example, hurricanes and nor'easters both cause heavy winds.

<u>Location</u>
1 = small: isolated to specific area during one event
2 = medium: multiple areas during one event
3 = large: significant portion of the Borough during one event

<u>Frequency of Occurrence</u>
0 = unlikely: less than 1% probability in the next 100 years
1 = possible: between 1 and 10% probability in the next year; or at least one chance in next 100 years
2 = likely: between 10 and 100% probability in the next year; or at least one chance in next 10 years
3 = highly likely: near 100% probability in the next year

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1 = limited: injuries and/or illnesses are treatable with first aid; minor "quality of life" loss; shutdown of critical facilities and services for 24 hours or less; property severely damaged < 10%
2 = significant: injuries and/or illnesses do not result in permanent disability; shutdown of several critical facilities for more than one week; property severely damaged <25% and >10%
3 = critical: injuries and/or illnesses result in permanent disability; complete shutdown of critical facilities for at least two weeks; property severely damaged <50% and >25%
4 = catastrophic: multiple deaths; complete shutdown of facilities for 30 days or more; property severely damaged >50%

- ***Existing Capabilities*** gives an overview of the measures that the Borough of Naugatuck is currently undertaking to mitigate the given hazard. These may take the form of ordinances and codes, structural measures such as dams, or public outreach initiatives.

- ***Vulnerabilities and Risk Assessment*** focuses on the specific areas at risk to the hazard. Specific land uses in the given areas are identified. Critical buildings and infrastructure that would be affected by the hazard are identified.

- ***Potential Mitigation Strategies and Actions*** identifies mitigation alternatives, including those that may be the least cost effective or inappropriate for Naugatuck.

- ***Status of Strategies and Actions*** provides a summary of the recommended courses of action for Naugatuck that is included in the STAPLEE analysis described below.

This document concludes with a strategy for implementation of the Hazard Mitigation Plan, including a schedule, a program for monitoring and updating the plan, and a discussion of technical and financial resources.

1.4 Documentation of the Planning Process

The Borough of Naugatuck is a member of the Council of Governments of the Central Naugatuck Valley (COGCNV), the regional planning agency for Naugatuck and twelve other member municipalities: Beacon Falls, Bethlehem, Cheshire, Middlebury, Oxford, Prospect, Southbury, Thomaston, Waterbury, Watertown, Wolcott, and Woodbury. All of these communities maintain single-jurisdiction hazard mitigation plans.

The following individuals from the Borough of Naugatuck provided information, data, studies, reports, and observations; and were involved in the development of the initial Plan and this update:

TABLE 1-4
Local Plan Development Participants

Name	Department or Commission	Initial Plan?	First Update?
Mr. James R. Stewart, P.E., Director	Public Works Department	Yes	Yes
Ms. Sandra Lucas-Ribeiro	Public Works Department	--	Yes
Mr. Ken Hanks	Emergency Management	Yes	Yes
Mr. Wayne Zirobbs, P.E.	Public Works Department	--	Yes
Mr. Bill Hereman	Building Official	--	Yes
Mr. Keith Rosenfeld	Planning and Zoning Department	Yes	Yes
Mr. Mike Bronko Former Naugatuck Mayor	Mayor's Office	Yes	--
Mr. Al Pistarelli Former Naugatuck Mayoral Aide	Mayor's Office	Yes	--

Name	Department or Commission	Initial Plan?	First Update?
Mr. Fran Dambowsky	Naugatuck Emergency Management and Homeland Security	Yes	--
Mr. James Ricci, Jr.	Naugatuck Fire Department	Yes	--
Mr. Hank Witkowski	Superintendent of Public Works/Streets	Yes	--

A data collection, evaluation, and outreach program was undertaken to compile information about existing hazards and mitigation in the Borough, as well as to identify areas that should be prioritized for hazard mitigation. The following is a list of meetings, field reconnaissance and additional details used in the development of the initial Hazard Mitigation Plan and this 2014 update:

<u>Initial Plan</u>

- ***A project meeting with Borough officials was held January 23, 2008.*** Necessary documentation was collected, and problem areas within the Borough were discussed.
- ***Field inspections were performed on February 13, 2008.*** Observations were made of flooding and hazard prone areas within the Borough after a period of heavy rain falling on frozen ground.
- ***A public information meeting was held March 3, 2008 at 6:00 P.M.*** Preliminary findings were presented and public comments solicited.

While residents were invited to the public information meeting via newspaper, no residents attended that were not Borough personnel. Ten municipal agencies and civic organizations were invited via a mailed copy of the press release that announced the public information meeting. These included the following:

- Naugatuck River Watershed Association;
- Naugatuck Valley Health District;
- Naugatuck Chamber of Commerce;
- United Way of Greater Waterbury;
- American Red Cross – Waterbury Area;
- Naugatuck Inland Wetlands Commission;
- Naugatuck Planning Commission;
- Naugatuck Zoning Commission;
- Naugatuck Economic Development Corporation; and
- Naugatuck Economic Development Commission.

No representatives of these organizations attended the meeting. Residents were also encouraged via newspaper articles to contact the COG with comments.

It is important to note that COGCNV manages the Central Naugatuck Valley Emergency Planning Committee. This committee was coordinating emergency services in the region during the development of the initial plan. Fire, Police, EMS, Red Cross, emergency management directors, and other departments participated in these efforts. In June 2004, over 120 responders participated in the region's first tabletop exercise on biological terrorism. Area health directors, hospitals, and other health care professionals also meet monthly with the Health and Medical Subcommittee to share information, protocols, and training. Thus, local knowledge and experience gained through the Emergency Planning Committee activities was transferred by the COGCNV to the hazard mitigation planning process.

Additional opportunities for the public to review the initial Plan were implemented in advance of the public hearing to adopt the plan. The draft that was sent for FEMA review was posted on the Borough website and the COGCNV website to provide opportunities for public review and comment. During the public hearing to adopt the plan, any remaining comments from the public were addressed.

Updated Plan

- ***A project meeting with Borough officials was held September 23, 2013.*** The update process was described, necessary documentation was collected, and hazard-prone areas within the Borough were discussed.

Public Survey

In lieu of holding a public information meeting for the plan update, the Borough of Naugatuck elected to host a public survey via www.surveymonkey.com. The survey was open from October 15, 2013 to November 25, 2013, with the last participants taking the survey on October 22, 2013. Notification of the survey was posted on the Patch.com on October 15, 2013. In addition, the Emergency Management Director sent an email blast to the residents of Naugatuck requesting their assistance in completing the survey.

A total of fifty five people participated in the survey. The respondent's addresses signified a good spatial representation in the borough. Twenty one participants indicated that they were aware that the borough maintained a HMP.

Participants were asked which recent events, if any, have generated awareness of natural hazards. Table 1-5 summarizes the responses.

TABLE 1-5
Contributors of Awareness of Natural Hazards

Events	Number of Participants Selecting
Winter Storm Nemo in February 2013	37
"Superstorm" Sandy in October 2012	30
Local rain and flooding event On August 1, 2012	25
"Winter Storm" Alfred in October 2011	28
Hurricane/Tropical Storm Irene in August 2011	23
The Virginia earthquake in August 2011	2
The Springfield, Massachusetts tornado of June 2011	7
The snowstorms of January 2011 that caused buildings to collapse	23
Write-in Responses	
Other: Flooding along Long Meadow Brook after rainstorms	1
Other: Flash Flooding in Naugatuck and hail storm	1

The next question asked responders to rate hazards on a scale of 1 (low threat) to 3 (high threat) in Naugatuck. Responses are presented in Table 1-6.

TABLE 1-6
Potential Hazard Threat Based on Survey Response

Hazard	Number of Participants Selecting		
	Low Threat	Moderate Threat	High Threat
Flooding	8	12	9
Hurricanes and Tropical Storms	8	33	13
Tornadoes	24	17	11
Severe Thunderstorms (including hail or downbursts)	8	21	25
Winter Storms (including snow or ice) and Blizzards	12	3	38
Earthquakes	43	7	4
Wildfires and Brush Fires	32	17	4
Landslides	42	8	3
Dam Failure (could be caused by other hazards)	39	9	5
Additional comments: FEMA states flood risk is high but this is not the case; new floodplain study needs to take place.			

The follow-up question asks which hazards have impacted the participant's business. Table 1-7 summarizes these results.

TABLE 1-7
Impact to Responder's Home or Business

Hazard	Number of Participants Selecting
Flooding	16
Hurricanes and Tropical Storms	25
Tornadoes	2
Severe Thunderstorms (including hail or downbursts)	17
Winter Storms (including snow or ice) and Blizzards	49
Earthquakes	0
Wildfires and Brush Fires	0
Landslides	0
Dam Failure (could be caused by other hazards)	0

When asked if any specific areas of Naugatuck were vulnerable to any of the above hazards, participants entered the following responses:

- ❑ Maple Street and May Street
- ❑ Water Street near the railroad station is closed after most rain events
- ❑ Church Street
- ❑ All Mountain Roads due to snow
- ❑ Rubber Avenue, along Long Brook Meadow
- ❑ Anderson Street at Spring Street

- May Street and Bird Road
- Meadow and Lower Hillside Avenue
- Salem and New Street
- Cherry Street Extension
- Spring Street at Bridge Street
- Intersections of Gorman/Pleasant and Spencer Streets
- Scott Road and Andrew Avenue
- Trowbridge Place

The next question asked if responders had noticed an increase in maintenance in Naugatuck due to increased pressure on utility companies to harden utility lines and manage vegetation following the wind and snow events of 2011. A total of twenty three of the responders answered yes and thirty one answered no.

Due to potential increases in flood insurance premiums nationwide, responders were asked what their thoughts on flood insurance were. The results are presented in Table 1-8.

TABLE 1-8
Concerns with Flood Insurance Rates

Actions	**Number of Participants Selecting**
I do not have flood insurance and have no opinions about it	28
I currently have flood insurance and am not concerned about changes in the premium	1
I currently have flood insurance and will be looking for ways to reduce my premium, such as elevating my home	0
I would be supportive of looking for ways to reduce flood insurance policies for all policy holders	25
Additional comments: • We are not allowed to have it because we live on top of a hill. • Perhaps there should be more restrictions on building near watercourses. • We are on top of Horton Hill and the area does not flood. • Don't build in areas known to flood or raise the ground level for any new buildings going in that area.	4

When asked "What are the most important things that your municipal government and leaders can do to help residents and businesses be prepared for a disaster and become more resilient over time," Responses are presented in Table 1-9

TABLE 1-9
Most Important Community Mitigation Measures Based on Survey Results

	Number of Participants Selecting
Provide outreach and education to residents, businesses and organizations to help them better understand risks and be prepared	27
Provide technical assistance to residents, businesses and organizations to help them reduce losses from hazards and disasters	27
Conduct projects in the community, such as drainage and flood control projects, to mitigate for hazards and minimize impacts from disasters.	29
Make it easier for residents, businesses and organizations to take their own actions to mitigate for hazards and become more resilient to disasters.	23
Improve warning and response systems to improve disaster management	22
Enact and enforce regulations, codes and ordinances such as zoning regulations and building codes	21
Additional Comments: • Have checks in place for elderly and handicapped people, either through neighborhood watch or other system. • All of the above • Do not overuse the reverse 911 calls • Be diligent in preparation rather than apologetic during or after an event. • New developers need to follow wetland and floodplain regulations. • Automated phone/email/text warning system has been outstanding during the past few storms. • Naugatuck has done a wonderful job preparing residents. • Better routine maintenance of catch basins. • Additional funding for the Public Works Department to restore personnel and equipment. • Naugatuck's warning and response systems are very helpful.	8

Responders were asked if they have taken any steps to reduce risks to their family homes or businesses. The results are summarized in Table 1-10

TABLE 1-10
Personal Mitigation Measures Taken Based on Survey Response

	Number of Participants Selecting
Elevated my home or business to reduce food damage	2
Floodproofed my business to reduce flood damage	3
Installed storm shutters or structural/roof braces to reduce wind damage	1
Taken measures to reduce snow build-up on roofs.	14
Cut back or removed vegetation from my overhead utility lines or roof	9
Replaced my overhead utility lines with underground lines	0
Managed vegetation to reduce risk of wildfire reaching my home or business	7
Developed a disaster plan for my family, home or business	13
Maintain a disaster supply kit for my family, home or business	23

	Number of Participants Selecting
Participated in public meetings to discuss the Plan of Conservation and Development or open space plans	3
Participated in public meetings to discuss or approve changes to zoning or subdivision regulations	0
I have not taken any of these actions	15
Additional Comments: • Condo living prevents such actions (except personal family planning) • Two residents indicated they had purchased a generator • Installed trench and sump pump but additional work is needed	4

Participants were what one action that could be taken in Naugatuck to reduce risks to hazards and disasters. Responses included:

- ❑ Develop a plan to include Condominium Associations.
- ❑ Purchase larger plows and ensure snow plows work properly
- ❑ Enforce trimming of overhanging trees no matter who owns the property.
- ❑ Ensure residents do not put snow and/or leaves back in the roadways.
- ❑ Ensure residents are aware of emergency plans (possibly through mailers).
- ❑ Replace overhead utilities with underground lines.
- ❑ Address flood prone areas.
- ❑ Increase awareness and community outreach.
- ❑ Financial assistance for all residents to flood proof homes.
- ❑ Evacuation centers must be designated and have emergency generators.
- ❑ Check on elderly at senior complexes first.

When asked to provide any additional comments or questions to be addressed as the borough updates its hazard mitigation plan, responses included:

- ❑ Better enforcement of Borough regulations
- ❑ Better shoveling of snow for emergency personnel, storm drain maintenance is essential.
- ❑ Chief Hanks has been very thoughtful regarding resident safety.
- ❑ Increase resident awareness and provide education for them to protect their homes and family from disasters.
- ❑ Do not scramble reception of police scanners during storms.
- ❑ Facebook utilization has been helpful.

A total of fifteen participants provided additional contact information for follow-up.

Overall, the survey revealed that Naugatuck residents see winter storms, tropical storms and hurricanes as having the highest threat and impacting their own homes the most. Residents are primarily concerned with risks to power lines and overhead utilities during winter and wind storms, and desire more maintenance and removal of trees. Secondary to the concerns about trees and power outages, a few residents have concerns about flooding. Several respondents commented on the need to address storm drain maintenance throughout the borough.

Newspaper Articles

In addition to the public outreach described above, the Voices published a regional newspaper story about the plan update process and the need to remain eligible for potential hazard mitigation grants. The newspaper maintains readership in Bethlehem, Middlebury, Naugatuck, Southbury, Woodbury, and Oxford. The story, "Mitigation Updates Underway," was printed in the August 28, 2013 edition of the Voices. The article noted that all of the municipalities were in various stages of the planning process, and explained why the process was important. The article ended with a statement that residents and business owners can send ideas and comments for the plans to the COGCNV at comments@cogcnv.org.

The thirteen COGCNV municipalities also participated in a regional newspaper story about the plan update process and the need to remain eligible for potential hazard mitigation grants. The story, "Ready for Nature's Nastiness," was printed in the September 28, 2013 edition of the Waterbury Republican American, which maintains readership in all 13 COGCNV communities. A copy is included in Appendix D. The article noted that all of the municipalities were in various stages of the planning process. Potential mitigation projects in several of the towns were described. The article ended with a statement that residents and business owners can send ideas and comments for the plans to the COGCNV at comments@cogcnv.org.

Appendix D contains copies of the minutes for both meetings referenced above as well as the referenced newspaper articles and other records that document the development of the Hazard Mitigation Plan.

1.5 Coordination with Neighboring Communities

Naugatuck has coordinated with neighboring municipalities in the past relative to hazard mitigation and emergency preparedness and will continue to do so. The following is a list of the communities that are adjacent to Naugatuck.

TABLE 1-11
Municipalities Adjacent to Naugatuck

City / Town	Hazard Mitigation Plan Status
Town of Oxford	Single Jurisdiction Plan
Town of Wolcott	Single Jurisdiction Plan
Town of Prospect	Single Jurisdiction Plan
Town of Middlebury	Single Jurisdiction Plan
City of Waterbury	Single Jurisdiction Plan
Town of Beacon Falls	Single Jurisdiction Plan
Town of Bethany	Single Jurisdiction Plan

Input from neighboring communities was sought during the development of the initial HMP through outreach to the chief elected officials of those communities by way of the COGCNV involvement and the activity of the Central Naugatuck Valley Emergency Planning Committee described above.

In addition, letters were mailed to all adjacent communities to invite them to participate in the planning process for this hazard mitigation plan update. A copy of this letter is included in Appendix D.

2.0 COMMUNITY PROFILE

2.1 Physical Setting

The Borough of Naugatuck is located in New Haven County. It is bordered by the Town of Beacon Falls to the south, the Town of Oxford to the west, the Town of Middlebury and the City of Waterbury to the north, and the Towns of Prospect and Bethany to the east and southeast. Refer to Figure 2-1 for a location schematic and Figure 2-2 for a location map.

Naugatuck is located within the western part of the crystalline uplands, or Western Highlands, of western Connecticut. This geologic feature consists of three belts of metamorphic rocks bounded to the west by the sediments and metamorphic rocks of the Hudson River valley and on the east by the Triassic sediments of the Connecticut River valley.

The topography of the Borough is generally moderate sloping along the Naugatuck River in the central portion of the Borough in the developed area. Steeper sections of land occur in the southwestern portion of the Borough near the Naugatuck State Forest, although both the west and east sides of the community are quite hilly. Elevations range from approximately 200 feet above sea level along the Naugatuck River in the northern part of the Borough to over 870 feet above sea level near Andrews Hill in the southwestern part of the Borough, based on the National Geodetic Vertical Datum of 1929. The hilly, elevated terrain of Naugatuck makes it particularly vulnerable to an array of natural hazards. In fact, approximately 23% of land area has slopes greater than 15%.

2.2 Existing Land Use

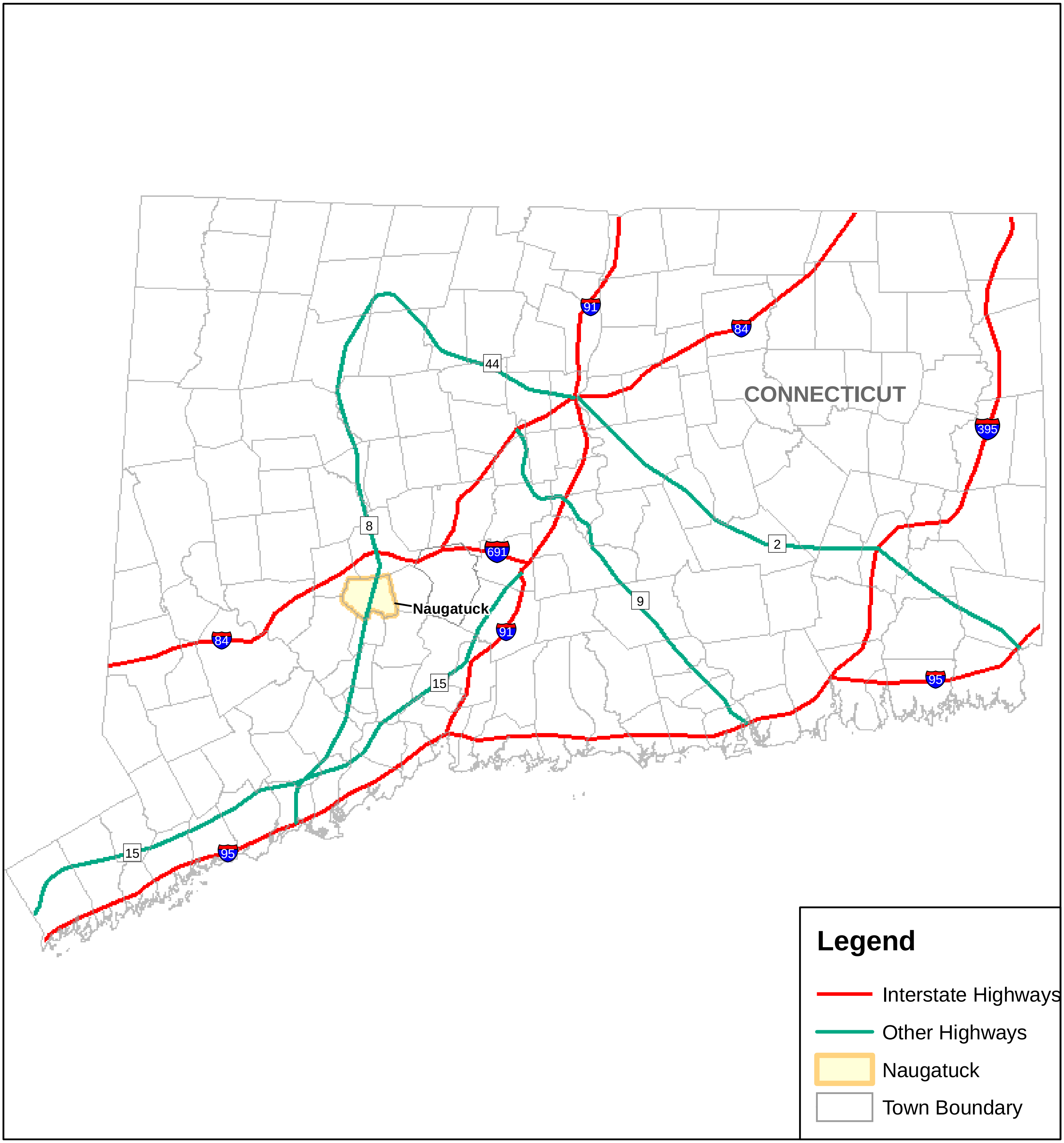
The Borough of Naugatuck encompasses 16.4 square miles. Table 2-1 provides a summary of land use in Naugatuck by area. In addition, refer to Figure 2-3 for a map of generalized land use provided by the COGCNV.

TABLE 2-1
Land Use by Area

Land Use	Area (acres)	Pct.
Vacant	3,990	38%
Residential - Low Density	2,088	20%
Residential - Medium Density	1,563	15%
Recreational	1,090	10%
Industrial	486	5%
Agricultural	260	2%
Commercial	233	2%
Residential - High Density	215	2%
Utilities/Transportation	187	2%
Institutional	179	2%
Mining	122	1%
Water	107	1%
Total	***10,520***	***100%***

Source: Council of Governments Central Naugatuck Valley, 2000

Figure 2-1: Naugatuck Location Map



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", DEP
For general planning purposes only. Delineations may not be exact.
September 2008

0 10 20 Miles

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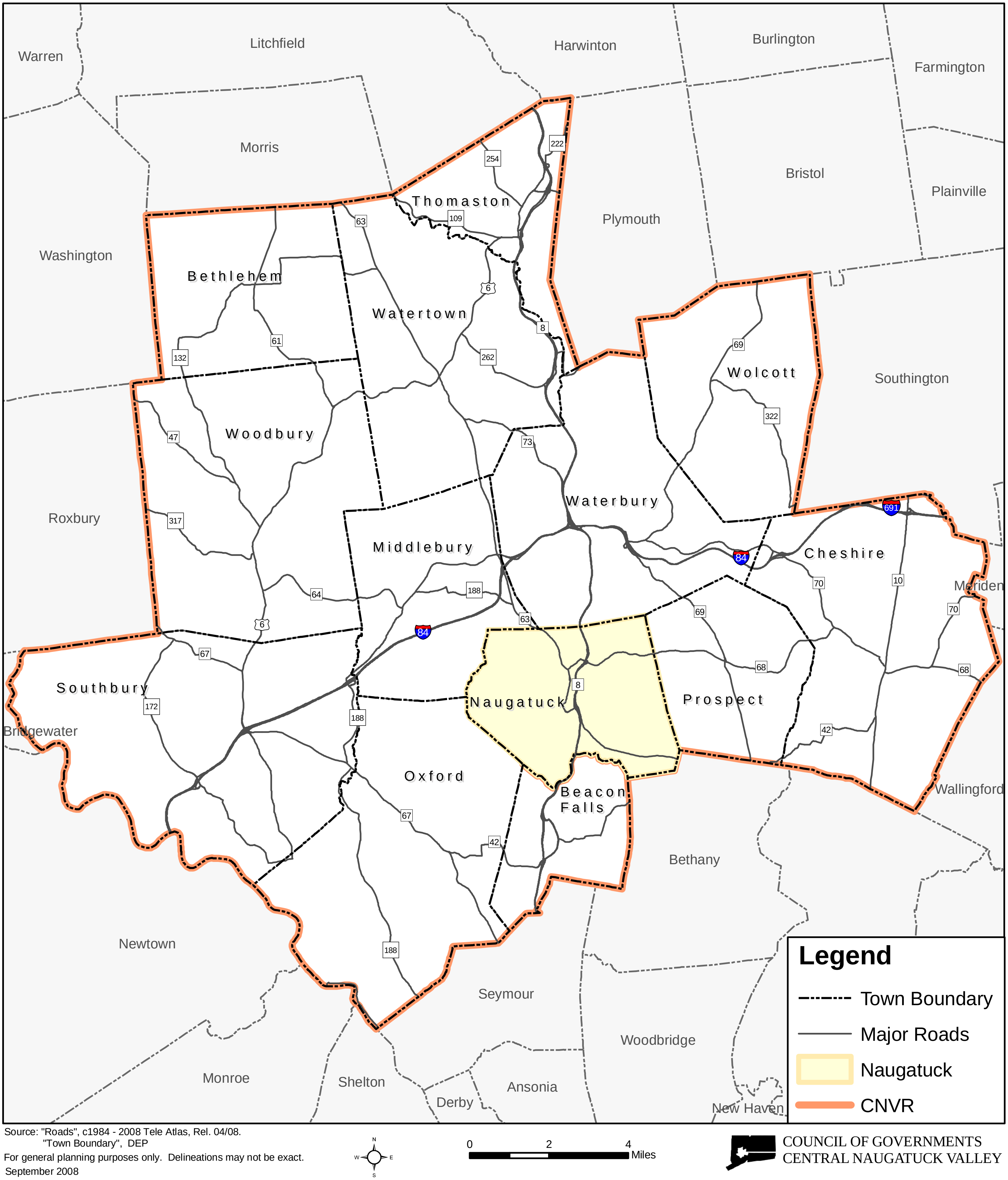
Figure 2-2: Naugatuck in the CNVR



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", DEP
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Naugatuck is characterized by its hills and steep slopes, which limit development in much of the Borough. Naugatuck features a linear commercial & institutional district along Route 63, the Naugatuck River and Route 8, extending from Route 68 in the north to Cherry Street in the south. To the east and west of this district are medium density residential neighborhoods. Further to the east and west, low density residential areas are interspersed with agricultural areas. Some isolated high density residential areas are dispersed throughout the Borough.

A large industrial park is located in the northeast corner of Naugatuck to the north of Route 68. A large area at the southern border of the Borough is protected open space. Nearly 30% of land in Naugatuck is classified as open space, with roughly half of this area permanently protected, including State Forest, and the other half consisting of water company land and others types of open space. There is a general lack of open space along watercourses such as Fulling Mill Brook, Cold Spring Brook, Beacon Hill Brook, and Long Meadow Pond Brook. However, steep slopes along the watercourses tend to limit some development.

2.3 Geology

Geology is important to the occurrence and relative effects of natural hazards such as earthquakes. Thus, it is important to understand the geologic setting and variation of bedrock and surficial formations in Naugatuck. The following discussion highlights Naugatuck's geology at several regional scales. Geologic information discussed in the following section was acquired from GIS available from the Connecticut DEEP.

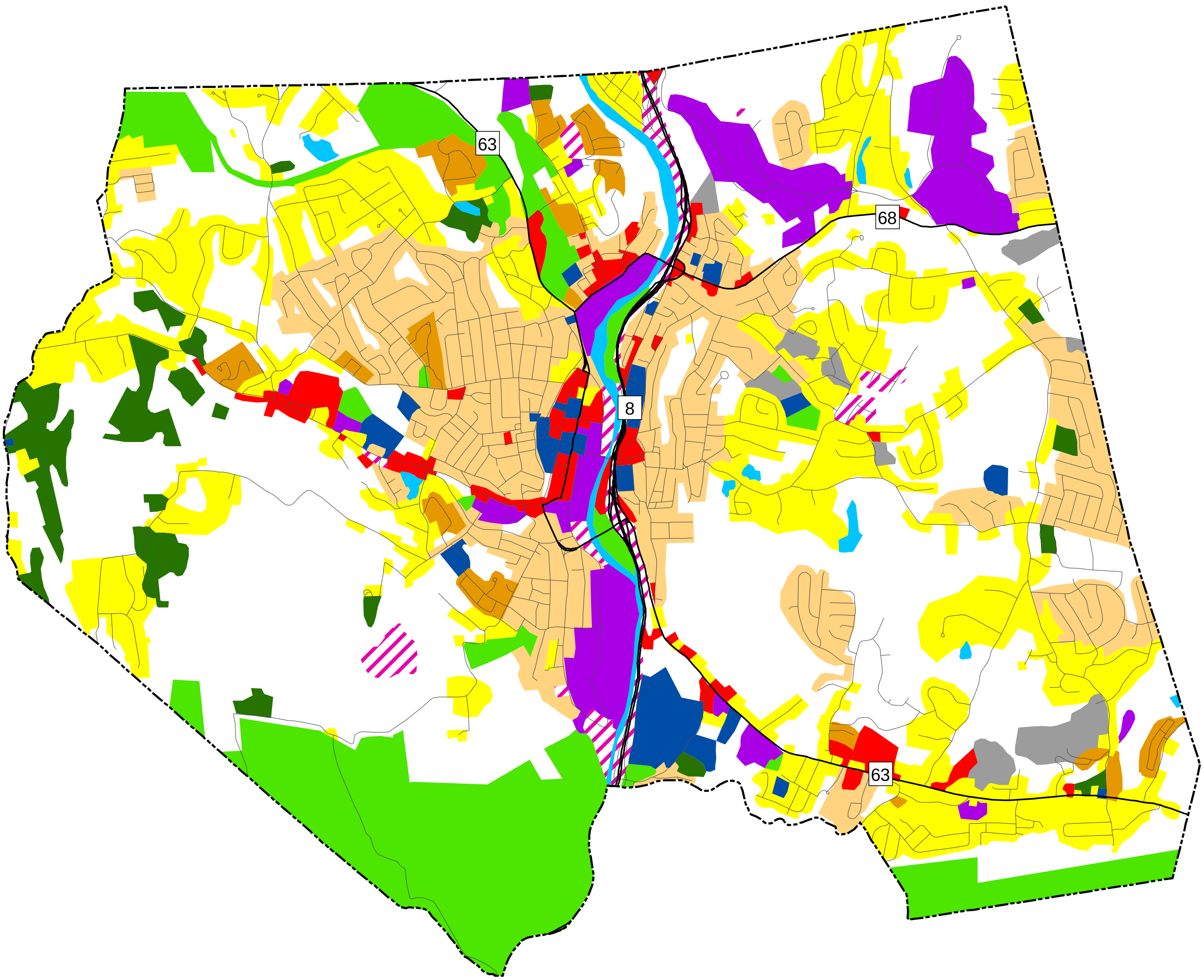
In terms of North American bedrock geology, the Borough of Naugatuck is located in the northeastern part of the Appalachian Orogenic Belt, also known as the Appalachian Highlands. The Appalachian Highlands extend from Maine south into Mississippi and Alabama and were formed during the orogeny that occurred when the super-continent Pangea assembled during the late Paleozoic era. The region is generally characterized by deformed sedimentary rocks cut through by numerous thrust faults.

> ***Bedrock Geology***
> Connecticut bedrock geology is comprised of several "terranes." Terranes are geologic regions that reflect the role of plate tectonics in Connecticut's natural history.

Regionally, in terms of New England bedrock geology the Borough of Naugatuck lies primarily within the Eugeosyncline Sequence. Bedrock belonging to the Eugeosyncline Sequence are typically deformed, metamorphosed, and intruded by small to large igneous plutons.

The bedrock beneath the Borough of Naugatuck is almost entirely part of the Iapetos Terrane, comprised of remnants of the Iapetos Ocean that existed before Pangaea was formed. This terrane formed when Pangaea was consolidated and its boundaries are generally coincident with the Eugeosyncline Sequence geologic province described above. The remaining bedrock in the Borough is related to the Iapetos Terrane. It is associated with the Proto-North American (Continental) Terrane / Taconic Allochthons and is known as "Displaced Iapetos Terrane."

Figure 2-3: Naugatuck Generalized Land Use



Legend

- Town Boundary
- Major Roads
- Local Roads
- AG *Agriculture*
- CF *Institutional*
- CM *Commercial*
- IN *Industrial*
- RL *Residential - Low Density less than 2 dewlling units per acre*
- RM *Residential - Medium Density 2-8 dwelling units per acre*
- RH *Residential - High Density 8 or more dwelling units per acre*
- RX *Resource Extraction*
- TU *Transportation & Utilities*
- UL *Undeveloped Land*
- W *Water*
- RC *Recreational*

Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", DEP
"Land Use", COGCNV 2000
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The Borough of Naugatuck's bedrock consists primarily of metasedimentary and metaigneous schists and secondarily of metamorphic amphibolite and granofels, and metasedimentary and metaigneous gneisses within the Iapetos Terrane. The bedrock alignment trends generally southeast to northwest in the Borough, although regionally the bedrock formations appear to ring about Naugatuck while fault lines trend southwest to northeast. Refer to Figure 2-4 for a depiction of the bedrock geology in the Borough of Naugatuck.

The three primary bedrock formations in the Borough (from north to south) are Waterbury Gneiss, Taine Mountain and Collinsville Formation (undivided), and The Straits Schist. In addition, there is a small area of Ultramafic Rock in the northern part of the Borough. Bedrock outcrops are prevalent in Naugatuck, and are often be found at higher elevations and on hilltops. The primary bedrock formations are described in more detail below:

- ❑ Waterbury Gneiss consists of gray to dark-gray fine to medium-grained schist and gneiss.
- ❑ The Taine Mountain and Collinsville Formation (undivided) consists of gray, medium grained, well-laminated granofels with gray and silvery, medium- to coarse-grained schist and dark, fine- to medium-grained amphibolite and hornblende gneiss.
- ❑ The Straits Schist is a silver to gray coarse-grained schist.

One unnamed fault is located in Naugatuck in the far southeast corner of the Borough. The fault divides an area of the Straits Schist and forms a portion of the boundary between the Straits Schist and the Taine Mountain and Collinsville Formation in this area of the Borough. This small fault runs southwest to northeast, eventually joining the Western Border Fault in Southington. The Western Border Fault is a large fault extending along the western edge of the Mesozoic Basin and stretches from Milford northwards into Massachusetts. None of these faults are active.

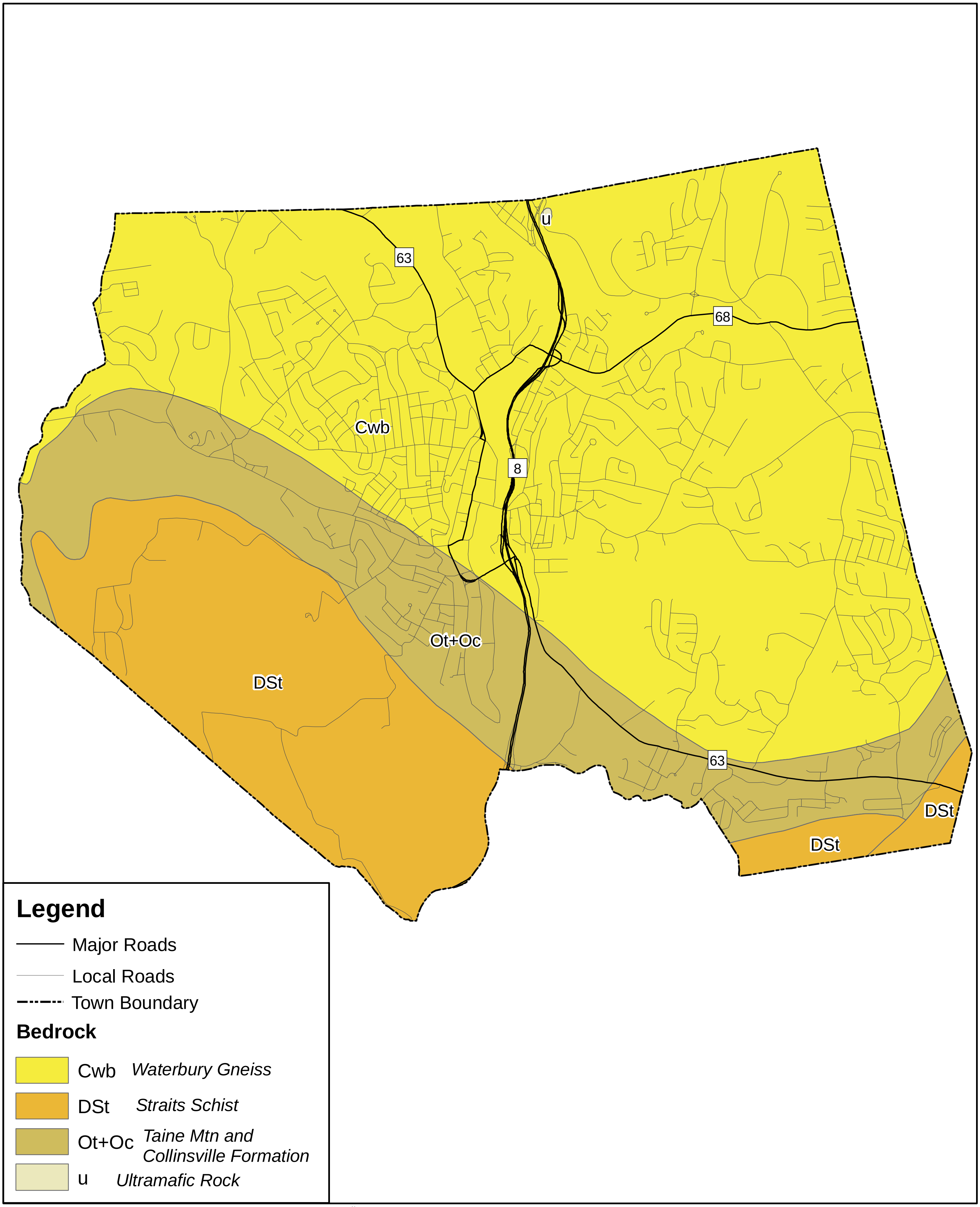
At least twice in the late Pleistocene, continental ice sheets moved across Connecticut. As a result, surficial geology of the Borough is characteristic of the depositional environments that occurred during glacial and postglacial periods. Refer to Figure 2-5 for a depiction of surficial geology.

Much of the Borough is covered by glacial till. Tills contain an unsorted mixture of clay, silt, sand, gravel, and boulders deposited by glaciers as a ground moraine. This area includes nearly all of Naugatuck with the exception of the river valleys associated with the Naugatuck River and its tributary streams. Stratified sand and gravel ("stratified drift") areas are associated with the Naugatuck River, Long Meadow Pond Brook, Hop Brook, Fulling Mill Brook, and Beacon Hill Brook and their tributaries. These deposits accumulated by glacial meltwater streams during the outwash period following the latest glacial recession.

The amount of stratified drift present in the Borough is important for several reasons:

- ❑ First, thicker sequences of the stratified drift are currently used by the Connecticut Water Company to provide drinking water and fire protection water via wells.
- ❑ Second, with regard to flooding, areas of stratified materials are generally coincident with inland floodplains. This is because these materials were deposited at lower elevations by glacial streams, and these valleys later were inherited by the larger of our present-day streams and rivers. However, smaller glacial till watercourses can also cause flooding, though flooding on such watercourses is rare in Naugatuck.

Figure 2-4: Naugatuck Bedrock Geology



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", "Bedrock", DEP
For general planning purposes only. Delineations may not be exact.
September 2008

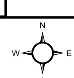


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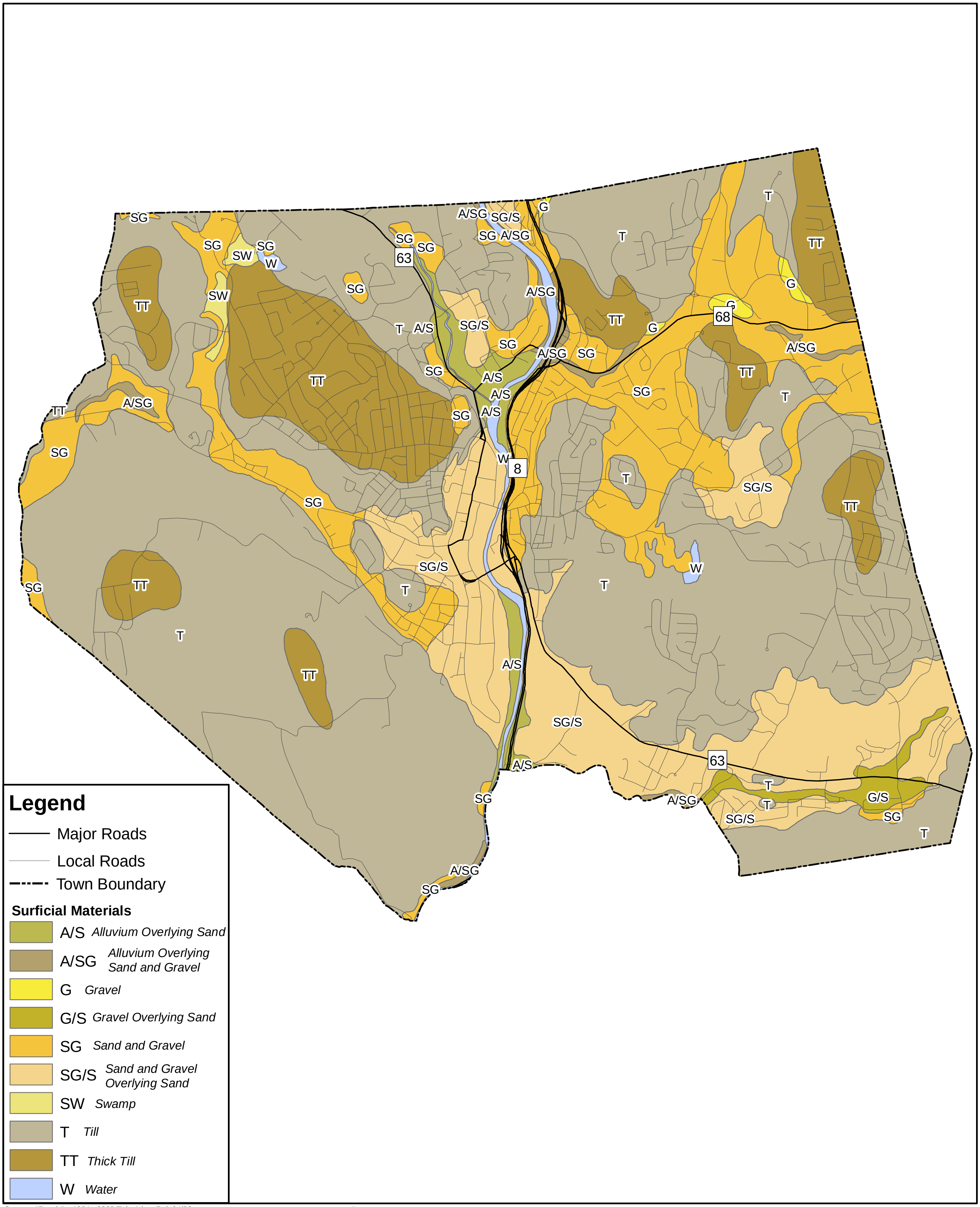
Figure 2-5: Naugatuck Surficial Geology



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", "Surficial Materials", DEP
For general planning purposes only. Delineations may not be exact.

September 2008

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- Finally, the amount of stratified drift also has bearing on the relative intensity of earthquakes and the likelihood of soil subsidence in areas of fill. These topics will be discussed in later sections.

2.4 Current Climate Conditions and Climate Change

Naugatuck has an agreeable climate, characterized by moderate but distinct seasons. The average mean temperature is approximately 48 degrees, with summer temperatures in the mid-80s and winter temperatures in the upper 20's to mid-30s, Fahrenheit. Extreme conditions raise summer temperatures to near 100 degrees and winter temperatures to below zero. Median snowfall is just over 30 inches per year as measured at the Mount Carmel weather station in Hamden (NCDC, 2007). Median annual precipitation is 44 inches, spread evenly over the course of a year.

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.

By comparison, average annual state-wide precipitation based on more than 100 years of record is nearly the same, at 45 inches. However, average annual precipitation in Connecticut has been increasing by 0.95 inches per decade since the end of the 19th century (Miller et. al., 2002; NCDC, 2005). Likewise, total annual precipitation in the Borough has increased over time.

Like many communities in the United States, Naugatuck experienced a population boom following World War II. This population increase led to concurrent increases in impervious surfaces and the amount of drainage infrastructure. Many post-war storm drainage systems and culverts were likely designed using rainfall data published in "Technical Paper No. 40" by the U.S. Weather Bureau (now the National Weather Service) (Hershfield, 1961). The rainfall data in this document dates from the years 1938 through 1958. These values are the standard used in the current Connecticut DOT Drainage Manual (2000) and have been the engineering standard in Connecticut for many years.

This engineering standard was based on the premise that extreme rainfall series do not change through time such that the older analyses reflect current conditions. Recent regional and state-specific analyses have shown that this is not the case as the frequency of two-inch rainfall events has increased and storms once considered a 1% annual chance event are now likely to occur twice as often. As such, the Northeast Regional Climate Center (NRCC) has partnered with the Natural Resources Conservation Service (NRCS) to provide a consistent, current regional analysis of rainfall extremes (http://precip.eas.cornell.edu/) for engineering design. The availability of updated data has numerous implications for natural hazard mitigation as will be discussed in Section 3.0.

2.5 Drainage Basins and Hydrology

The Borough of Naugatuck drains to six major watersheds corresponding to the Naugatuck River, Hop Brook, Long Meadow Pond Brook, Fulling Mill Brook, Beacon Hill Brook, and Little River. These are described below. Various ponds and streams are found within both the eastern and western sections of the Borough, which is divided by the southward-flowing Naugatuck River. All of the watersheds in Naugatuck are part of the regional Naugatuck River basin that ultimately discharges into the Housatonic River. The drainage basins are described below, and summarized in Table 2-2.

TABLE 2-2
Drainage Basins

Drainage Basin	Area (sq. mi)	Percent of Borough
Naugatuck River	5.96	36.2%
Long Meadow Pond Brook	3.26	19.9%
Fulling Mill Brook	2.96	18.0%
Beacon Hill Brook	2.65	16.1%
Hop Brook	1.60	9.7%
Little River	0.01	0.1%
Total	***16.44***	***100.0%***

Source: Drainage Basins, 2008 CT DEEP GIS Data for Connecticut

Naugatuck River

The Naugatuck River originates near the City of Torrington and flows south almost 40 miles to meet the Housatonic River in the City of Derby, giving it a total basin area of 311 square miles. It is the only major river in Connecticut whose headwaters are within the boundaries of the state. The Naugatuck River is well-known for its rich industrial history and the many defunct dams associated with these industries.

All of the land in Naugatuck eventually drains into the Naugatuck River, but only 5.96 square miles (sq. mi) or 36.2% of the land area drains directly into the river. This area is comprised of a north-south corridor that passes through the center of the Borough. The Naugatuck River also makes up a portion of the Borough's southern boundary.

The river is joined by a number of tributaries as it flows through the Borough, including Long Meadow Pond Brook, Hop Brook, Fulling Mill Brook, Cold Spring Brook, and several unnamed streams. Egypt Brook and Little River drain through portions of the Borough before their confluence with the Naugatuck River downstream of Naugatuck, and Spruce Brook and Beacon Hill Brook join the Naugatuck River at the boundary between Naugatuck and Beacon Falls.

Much of the land surrounding the Naugatuck River is urbanized, however there are large areas in the watershed that are undeveloped, such as the area near Spruce Brook which flows through the Naugatuck State Forest in the southwest section of the watershed.

Long Meadow Pond Brook

Long Meadow Pond Brook drains 3.26 sq. mi. of land in the eastern section of the Borough (19.9% of Naugatuck's total land area). Its headwaters are located in Lake Elise in western Middlebury. From the lake, Long Meadow Pond Brook flows southward into Long Meadow Pond, a body of water with a surface area of approximately 100 acres.

Long Meadow Pond Brook continues to meander eastward through the Town of Oxford into Naugatuck, collecting a number of unnamed tributaries before passing underneath a downtown factory and falling into the Naugatuck River. Development in the watershed is concentrated in the lower reaches. Two dams lie along its reach in Naugatuck, impounding the Armory Pond and the Naugatuck Ice Company Pond.

Fulling Mill Brook

Fulling Mill Brook drains 2.96 square miles of land (18.0% of the Borough's land area) in the northeastern corner of Naugatuck. It has its headwaters in central Prospect near Brewster Pond. The Brook begins at the west edge of Brewster Pond at the Salem Road Pond Dam, and flows westward and northward across Prospect into Beer Pond. After passing through Beer Pond, the brook flows westward into Naugatuck.

Once entering Naugatuck, the brook joins an unnamed tributary that drains Schildgen Pond, and Cold Spring Brook in the vicinity of City Hill Road and North Main Street before flowing into the Naugatuck River. In total, the Fulling Mill Brook drainage basin covers 5.38 square miles in Naugatuck, Prospect, and Waterbury.

Beacon Hill Brook

Beacon Hill Brook forms the Borough's southeastern boundary with the Town of Beacon Falls. The brook drains a total of 2.65 square miles of land within Naugatuck (16.1% of the Borough's land area) in the southeastern section of the Borough.

Beacon Hill Brook has its headwaters near the Bethany-Prospect Town line along State Route 69. It drains southwest into Bethany, entering the Long Hill Reservoir. Beacon Hill Brook flows west out of the reservoir through southeastern Naugatuck towards Straitsville. It is joined by Marks Brook west of Horton Hill Road and by Straitsville Brook near Beacon Valley Road. The brook then begins to form the boundary between Beacon Falls and Naugatuck, eventually passing under Route 8 and reaching its confluence with the Naugatuck River. In total, Beacon Hill Brook drains 10.22 square miles of land across Naugatuck, Beacon Falls, Bethany and Prospect.

Hop Brook

Hop Brook drains 1.60 square miles of land in the northwestern section of Naugatuck (approximately 9.7% of the Borough's total land area). It originates in northwestern Middlebury and flows through parts of Watertown and Middlebury before joining the Naugatuck River in Naugatuck near the intersection of Church Street and Bridge Street. The largest body of water that Hop Brook passes through is Hop Brook Lake, a flood control reservoir located on the border between Waterbury and Middlebury, just to the north of Naugatuck.

In addition to a number of unnamed tributaries, there are several smaller named tributaries that flow into Hop Brook, including Goat Brook, Long Swamp Brook, and Welton Brook in Middlebury, and Pigeon Brook in Naugatuck. In total, Hop Brook drains 17.40 square miles of land located within the municipalities of Naugatuck, Waterbury, Middlebury, Watertown and Woodbury.

Little River

A small portion in the southwestern corner of Naugatuck (0.01 sq. mi. or 0.1% of the Borough's land area) drains to the southwest into the Little River watershed. The Little River originates in western Oxford and flows generally south-southeast towards Seymour. It is joined by several unnamed tributaries and larger tributaries including Jacks Brook and Towantic Brook before its confluence with the Naugatuck River near Route 67 in Seymour. In total, the Little River watershed drains 15.50 square miles of land in Seymour, Beacon Falls, Oxford, Middlebury and Naugatuck.

2.6 Population and Demographic Setting

Table 2-3 provides population data from the year 2000 and 2010 census counts. The total CNV Region population as indicated in the 2010 Census is 287,768 persons. The total land area is 309 square miles, yielding a regional population density of 931 persons per square mile. Waterbury has the highest population density with 3,866 individuals per square mile; Bethlehem has the lowest population density with 186 individuals per square mile.

TABLE 2-3
Population Density by Municipality, Region, and State, 2000 and 2010

Municipality	Land Area (sq. miles)	Population 2000	Population Density, 2000	Population, 2010	Population Density, 2010
Beacon Falls	9.77	5,246	537	6,049	619
Bethlehem	19.36	3,422	177	3,607	186
Cheshire	32.90	28,543	868	29,261	889
Middlebury	17.75	6,451	363	7,575	427
Naugatuck	16.39	30,989	1,891	31,862	1,944
Oxford	32.88	9,821	299	12,683	386
Prospect	14.32	8,707	608	9,405	657
Southbury	39.05	18,567	475	19,904	510
Thomaston	12.01	7,503	625	7,887	657
Waterbury	28.55	107,271	3,757	110,366	3,866
Watertown	29.15	21,661	743	22,514	772
Wolcott	20.43	15,215	745	16,680	816
Woodbury	36.46	9,198	252	9,975	274
CNV Region	309.02	272,594	882	287,768	931
Connecticut	4844.80	3,405,565	703	3,574,097	738

Source: United States Census Bureau, 2000 Census of Population and Housing, Summary File 1; Census 2010, Profile of General Population and Housing Characteristics

The population of Naugatuck increased by 18% between 1960 and 1970, by 15% between 1970 and 1980, and by 16% between 1980 and 1990. These three decades were representative of the last true development surge in recent history., as growth then dropped to 1% from 1990-2000. Growth from 2000 through 2010 was approximately 3%.

Based on analysis by the Council of Governments of the Central Naugatuck Valley in its 2008 Regional Plan, population in the region outside of Waterbury is estimated to grow about 10%

from 2005 to 2025, while the state of Connecticut is expected to grow about 5% during this same timeframe. According the Connecticut Economic Resource Center, the median sales price of owner-occupied housing in the Borough of Naugatuck in 2010 was $190,500, which is slightly lower than the statewide median sales price of $246,000.

Naugatuck has populations of people who are elderly, linguistically isolated, and/or disabled. These are depicted by the five census blocks in Naugatuck on Figures 2-6, 2-7, and 2-8. The populations with these characteristics have numerous implications for hazard mitigation, as they may require special assistance or different means of notification before disasters occur. These will be addressed as needed in subsequent sections.

2.7 Governmental Structure

The Borough of Naugatuck is governed by a Mayor-Council form of government in which legislative responsibilities are the responsibility of the Council members (known as Burgesses) and the Mayor serves as the chief executive. In addition to the Burgesses, there are boards, commissions and committees providing input and direction to Borough administrators. Also, Borough departments provide municipal services and day-to-day administration. Many of these commissions and departments play a role in hazard mitigation, including the Planning Commission, the Zoning Commission, the Conservation Commission, the Inland Wetland Commission, the Emergency Management Department, the Building Inspector, the Fire Department, the Police Department, and the Public Works/Streets Department.

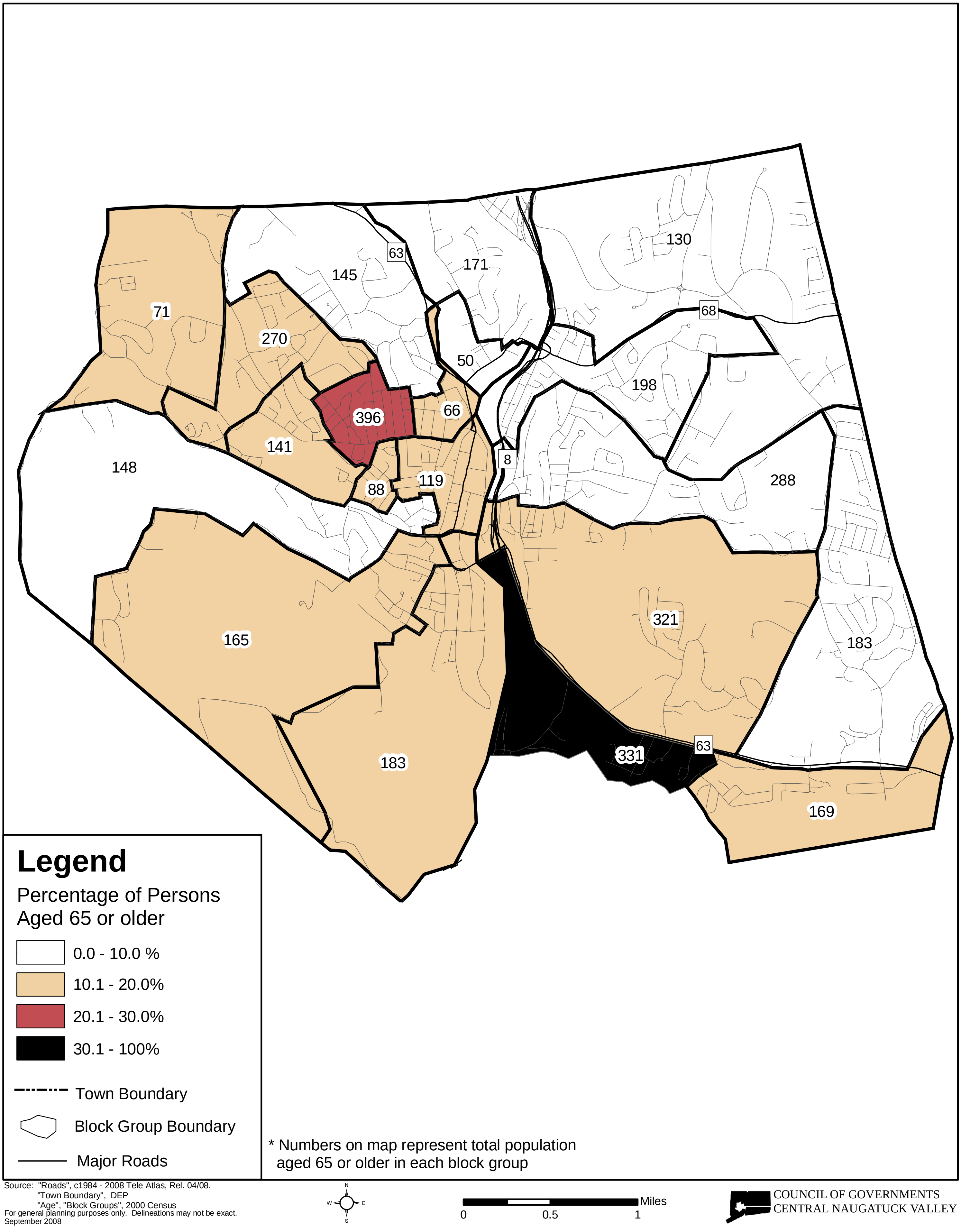
The Department of Public Works is the principal municipal department that responds to problems caused by natural hazards. Complaints related to Borough maintenance issues are routed to the Department of Public Works. These complaints are usually received via phone, fax, mail, or email and are recorded in a database. The complaints are investigated as necessary until remediation surrounding the individual complaint is concluded.

2.8 Development Trends

Naugatuck was settled in 1701 but the Borough was not incorporated until 1844. The settlement was agrarian in its origins, but as time passed industry developed using the Naugatuck River as a power source. Initial industries included woolen mills and metal factories.

Several landmarks in Naugatuck are representative of its prominent historic industry. Naugatuck was the site of the invention of vulcanized rubber by Charles Goodyear in the mid-1800s. As a result, Naugatuck led in the manufacturing of rubber-soled shoes, tires and other rubber-based products. The United States Rubber Company, later known as Uniroyal, was founded in 1892; the headquarters was relocated in the 1980s. The organization manufactured Keds shoes and the artificial leather known as Naugahyde. Another landmark, the Peter Paul Company, manufactured candy bars at a large factory on Route 63 starting in 1922 until the facility was closed in 2007. In recent years, several of the buildings associated with the candy factory have been torn down and Parcel "C" has been remediated. The Borough purchased Parcel B and has completed environmental studies on the property.

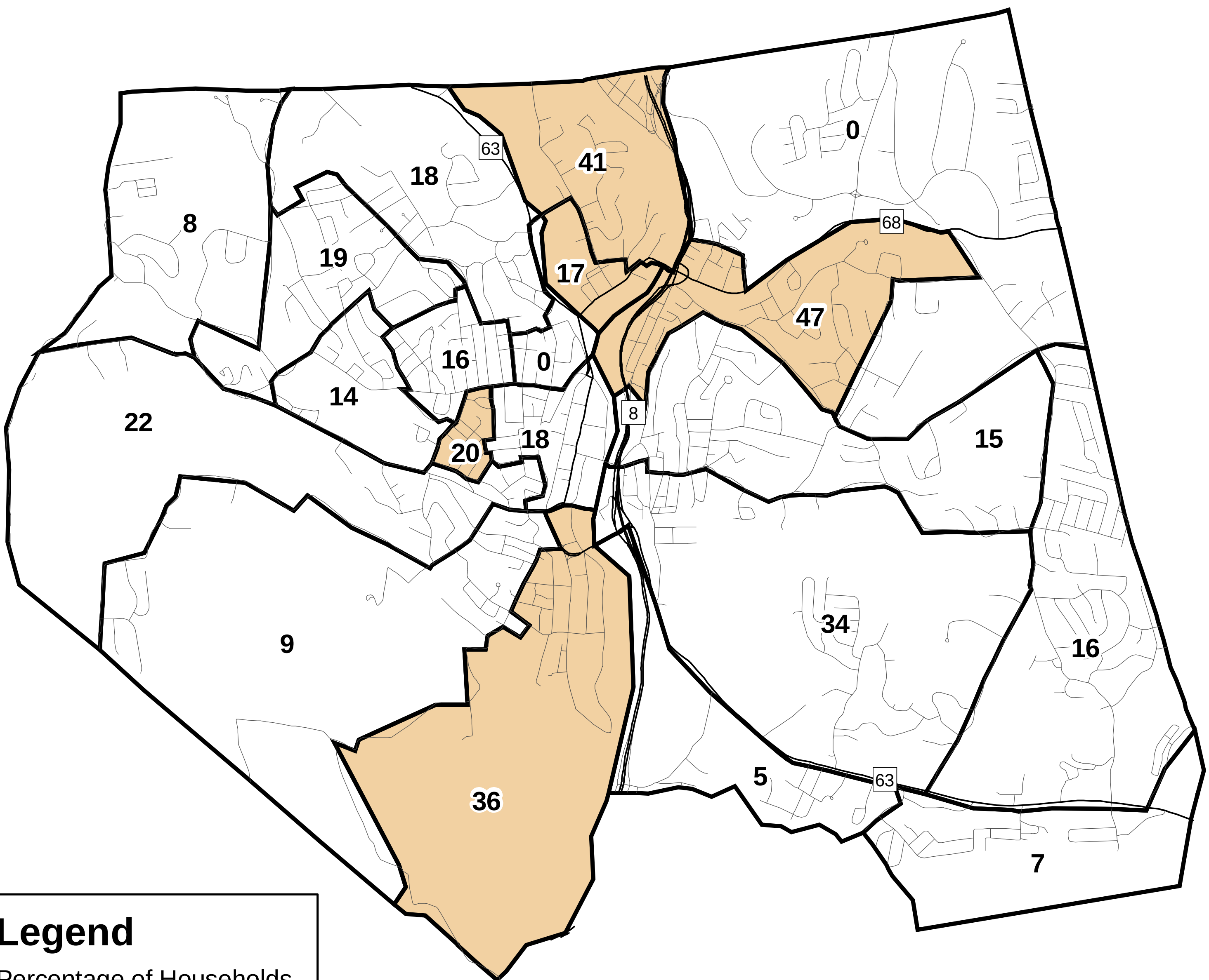
Figure 2-6: Naugatuck Elderly Population



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", DEP
"Age", "Block Groups", 2000 Census
For general planning purposes only. Delineations may not be exact.
September 2008

COUNCIL OF GOVERNMENTS
CENTRAL NAUGATUCK VALLEY

Figure 2-7: Naugatuck Linguistically Isolated Households



Legend

Percentage of Households Linguistically Isolated

- 0.0 - 4.9 %
- 5.0 - 9.9 %
- 10.0 - 14.9 %
- greater than 15%
- Town Boundary
- Block Group Boundary
- Major Roads

Data based on block group geography.
A linguistically isolated household is one in which no member 14 years old and over (1) speaks only English or (2) speaks a non-English language and speaks English "very well." In other words, all members 14 years old and over have at least some difficulty with English.

* Numbers on map represent total households that are linguistically isolated in each block group

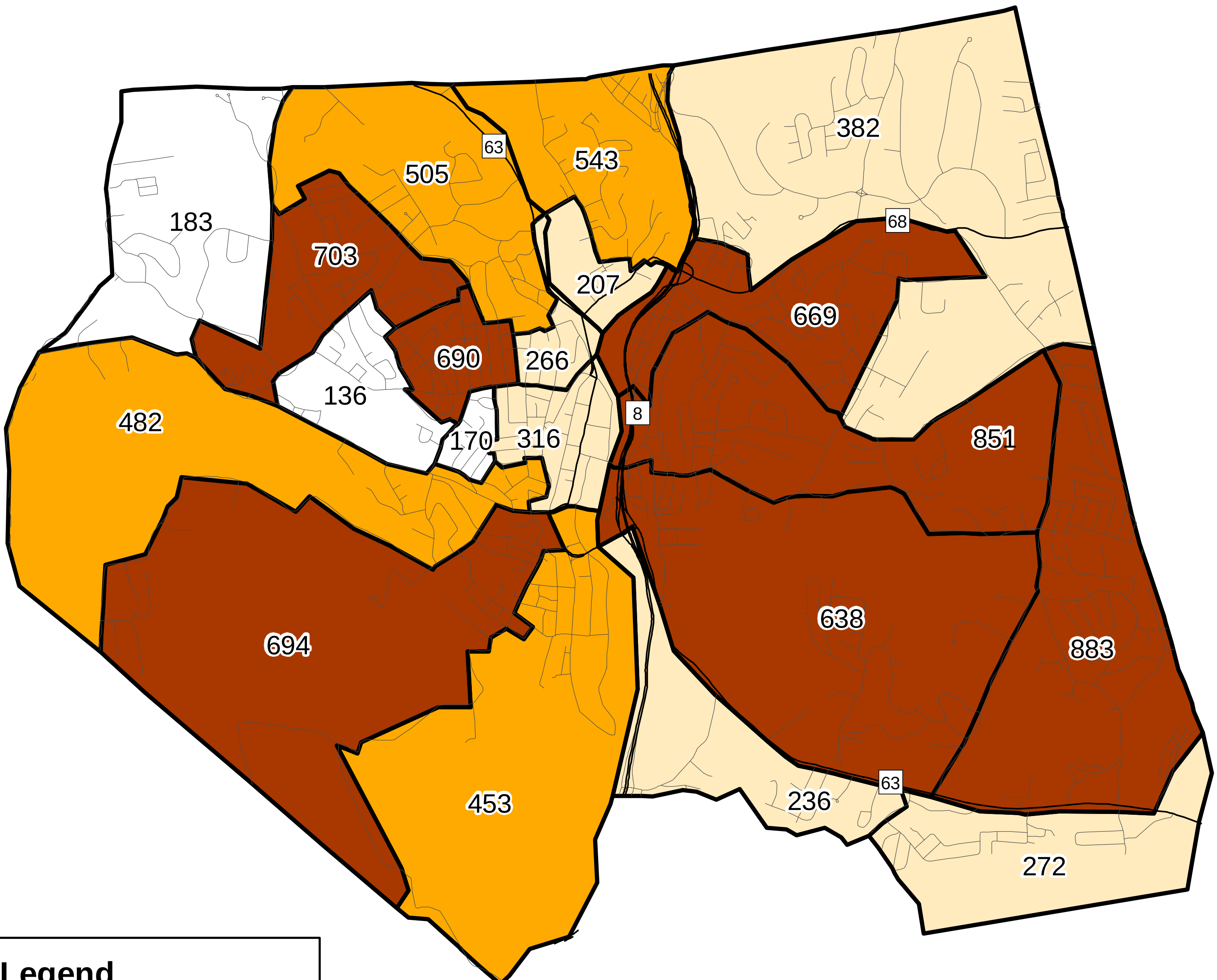
Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", DEP
"Linguistically Isolated", "Block Groups", 2000 Census
For general planning purposes only. Delineations may not be exact.
September 2008

N W E S

0 0.5 1 Miles

COUNCIL OF GOVERNMENTS
CENTRAL NAUGATUCK VALLEY

Figure 2-8: Naugatuck Disabilities Map



Legend

Total Disabilities Tallied
of People Aged 5 and Older

- 0 - 200
- 201 - 400
- 401 - 600
- > 600

Town Boundary

Block Group Boundary

Major Roads

Disabilities are categorized as sensory, physical, mental, self-care, go-outside-home, and employment

* Numbers on map represent total disabilities tallied for people aged 5 or older in each block group

Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", DEP
"Disability", "Block Groups", 2000 Census
For general planning purposes only. Delineations may not be exact.
September 2008

N W E S

0 0.5 1 Miles

COUNCIL OF GOVERNMENTS
CENTRAL NAUGATUCK VALLEY

The Borough has developed zoning and subdivision regulations that have general implications regarding hazard mitigation. For example, cul-de-sacs in new developments are discouraged and connectivity of roads is encouraged. Specifically, the Borough requires a 50-foot right of way for local residential streets with a turnaround located at the end of dead end streets. Cul-de-sacs can have no more than 20 homes or can be no longer than 1,000 feet, whichever constraint is more stringent. Subdivisions featuring cul-de-sacs offer a single access point for emergency services, lengthening emergency response times and rendering those residential areas vulnerable if access is cut off by flooding or downed tree limbs.

The Borough of Naugatuck retained a consultant to review Zoning and Subdivision Regulations in 2008. The review was completed in November 2008. Most of the recommendations are related to incorporating elements of low impact development into the regulations, especially with regard to stormwater management. In some cases, this may result in modifications to roadway and cul-de-sac widths and dimensions. However, the recommendations provide for emergency service officials to continue reviewing development plans in order to ensure that any reductions in paved surface areas will not impair the ability to respond to emergencies.

The Naugatuck Subdivision Regulations require that utilities serving new developments must be installed underground wherever possible. Exceptions due to shallow bedrock are granted on a case-by-case basis. Public water supply is available throughout the majority of Naugatuck and connectivity is recommended for new developments. Where public water supply is unavailable, 25,000-gallon cisterns are required for fire protection.

In the five years since the adoption of the first HMP, residential and commercial development within the Borough has slowed substantially. Many lots have been approved and are on record but construction has not started because the demand has not materialized.

Future development is also expected to occur at the sprawling Uniroyal industrial property and at the former Peter Paul Company commercial property. These properties are not located within SFHA's. However, the Uniroyal Industrial property is located adjacent to the Naugatuck River Floodway and future development should take this into consideration during the design phase. The Borough of Naugatuck has and will continue to ensure that new development is sited and approved with minimal risk from natural hazards.

2.9 Critical Facilities and Sheltering Capacity

The Borough considers its police, fire, governmental, service and major transportation facilities to be its most important critical facilities, for these are needed to ensure that emergencies are addressed while day-to-day management of Naugatuck continues. Educational institutions are included in critical facilities as well, as these can be used as shelters. In addition, Borough personnel consider public and private water, sewer, electric, and communication utilities to be critical facilities.

The Department of Public Works utilizes a light tower generator for limited standby power, allowing them to assist critical facilities and conduct operational activities during emergencies.

A list of critical facilities is provided in Table 2-4. Shelters, transportation, communications, and utilities are described in more detail below, along with a summary of the potential for these facilities to be impacted by natural hazards.

TABLE 2-4
Critical Facilities in Naugatuck

Type	Name	Address	Located in SFHA?
Municipal Offices	Borough of Naugatuck Offices	229 Church Street	500-year
Police Station	Borough of Naugatuck Police Department	211 Spring Street	No
Fire Department	Naugatuck Fire Headquarters	41 Maple Street	500-year
Fire Department	Eastside Fire Station	Intersection of May Street & Osborn Road	No
EMT - Ambulance	Borough of Naugatuck Ambulance Services	246 Rubber Avenue	No
Public Works	Borough of Naugatuck Public Works Department	246 Rubber Avenue	No
Utility - Sewer	Wastewater Treatment Plant	500 Cherry Street	500-year
Utility - Water	Connecticut Water Company	(Infrastructure)	Some
Utility – Phone	Southern New England Telephone	(Infrastructure)	Some
Utility – Electric	Connecticut Light & Power South Naugatuck Substation	Cherry Street	500-year
Utility – Gas	Algonquin Gas Pipeline	Northern Naugatuck	Some
Senior Center	Naugatuck Senior Center	300 Meadow Street	No
Food Bank	Ecumenical Food Bank	75 Spring Street	500-year
School	Borough of Naugatuck High School	543 Rubber Avenue	No
School	City Hill Middle School	441 City Hill Street	No
School	Hillside Middle School	51 Hillside Avenue	No
School	Cross Street Intermediate School	120 Cross Street	No
School	Hop Brook Intermediate School	75 Crown Street	500-year
School	Andrew Avenue Elementary School	140 Andrew Avenue	No
School	Central Avenue Elementary School	28 Central Avenue	No
School	Maple Hill Elementary School	641 Maple Hill Road	No
School	Prospect Elementary School	100 Prospect Street	No
School	Salem Elementary School	124 Meadow Street	No
School	Western Elementary School	100 Pine Street	No

Source: Council of Governments Central Naugatuck Valley; Borough of Naugatuck

Shelters

Emergency shelters are considered to be an important subset of critical facilities, as they are needed in most emergency situations. The Borough of Naugatuck has designated the local schools as shelters, but none of the structures have emergency generators. Hop Brook Intermediate School is the only designated shelter located in the 500-year floodplain, and therefore could not be used in the event of an extreme flood. City Hill School and Naugatuck High School are currently designated as emergency supply distribution points. Currently, the Borough is completing 81 million dollars worth of renovations to Naugatuck High School, which includes a new backup generator. Upon completion the high school will become the primary shelter.

The specific location(s) used as shelters during an event depends on the nature and extent of the incident. The Borough currently does not have the capacity to shelter 10% of its population due to lack of trained staff to operate shelters. The Borough currently recommends that people shelter in place unless relocation is necessary due to an imminent threat, such as severe flooding.

If there is a single shelter open for a local event, the Borough would rely on volunteers from the American Red Cross to staff the shelter. Some of the local emergency volunteers have received shelter training. If the event requires several shelters, especially if the affected area extends beyond Naugatuck, the Borough would not have enough staff on hand to maintain the shelters. Regionally-located mass care facilities operated and paid for by the American Red Cross may be available during recovery operations when additional sheltering services are necessary. The Naugatuck Emergency Management Advisory Council plans on addressing sheltering issues in 2009.

In case of a power outage, it is anticipated that 10-20% of the population would relocate, although not all of those relocating would necessarily utilize the shelter facilities. While the Borough has no elderly housing facilities, The Borough Emergency Operations Plan includes a list of addresses of special needs persons that would require special assistance during an emergency. In addition, the Borough realizes that the influx of active adult housing in Borough is increasing the amount of population that requires more assistance during emergencies, and plans to account for these populations in its emergency plan updates.

Transportation

The Borough of Naugatuck does not have any hospitals. Instead, residents use the nearby facilities in Waterbury. As a means of accessing these facilities, Naugatuck has convenient access on Route 8 that functions as the major transportation artery. Naugatuck's full-time ambulance corps staffs the ambulance service to these hospitals. If paramedics are needed, they are called in from Waterbury.

Evacuation routes are regionally defined by the Regional Evacuation Plan. Route 8, which runs north-south through central Naugatuck, provides access to Waterbury and Interstate 84 to the north and Bridgeport and Route 15 and Interstate 95 to the south. State Route 68 also runs from Prospect in the east and merges with State Route 63 in the center of the Borough. South Main Street (Route 63) is also an evacuation route into the Town of Bethany.

Communications

The primary answering point for emergency calls is the Police Department on Spring Street. The Borough also uses enhanced 9-1-1 service through the Northwest Connecticut Public Safety Communication Center, Inc. to facilitate ambulance dispatch. Borough personnel supplement 9-1-1 service with radios. The Borough uses phone lines to enhance their radio communications. If phone service is cut off, Borough personnel rely on low-band radios and cellular communications. The Borough has also contracted with Emergency Communications Network, Inc. to provide "CodeRED" high-speed telephone emergency notification services. The CodeRED system is capable of telephoning warnings into areas likely to be impacted by a disaster, or into the entire Borough, at a rate of 60,000 calls per minute.

The Borough of Naugatuck is in the southeast portion of Region 5 of the Connecticut Emergency Medical Service regions. The Borough dispatch center has a high band radio compatible with Region 5, which contains most of the COGCNV municipalities. Thus, it is important that Naugatuck maintain emergency notification systems compatible with those of Region 5, which contains most of the COGCNV municipalities. The Borough's enhanced 9-1-1 service is already compatible with much of Region 5, and Region 2 to the south. As development continues in the eastern portion of Borough, it is also important for Naugatuck 's system to be compatible with Prospect's (also Region 2) to the east. The town of Prospect also uses CodeRED. The Borough has mutual aid agreements with all neighboring communities.

Utilities

Water service is a critical component of hazard mitigation, especially in regards to fighting wildfires. It is also necessary for everyday residential, commercial, and industrial use. The Connecticut Water Company provides potable and fire fighting water to the majority of the Borough. The Fire Department uses alternative water supplies to fight fires in the less developed areas of Naugatuck, including fire ponds and underground water tanks, and brings as much water in its tankers as possible to these fires. This is discussed further in Section 9.0.

Sewer service is an often overlooked critical facility. The Naugatuck Wastewater Treatment Plant is located at the south end of Cherry Street and serves most of the developed area of Naugatuck. Other utilities important enough to be considered critical facilities include the electric substation on Cherry Street, the Algonquin Gas Pipeline that traverses northern Naugatuck, and the electric and telephone lines in the Borough. Gas and electricity are important for both day-to-day living and emergency usage, and the telephone is used to complement emergency communications in the Borough.

Potential Impacts from Natural Hazards

Critical facilities are not regularly impacted by flooding in the Borough of Naugatuck, despite several critical facilities being located in the 500-year floodplain. Major transportation arteries, such as State roads, are largely unaffected by flooding, and the emphasis on creating through streets has provided multiple modes of egress to the majority of neighborhoods in Naugatuck.

No critical facilities are particularly susceptible to wind, summer storms, winter storms, or earthquakes more than the rest of the Borough. However, the Public Works Department, Ambulance Services, Fire Department, Borough Offices, South Naugatuck CL&P Substation, and Hop Brook School are all located within a mapped dam failure inundation area, and Maple Hill School is located on the edge of a wildfire risk area. Subsequent sections will discuss each natural hazard in detail and include a description of populations at-risk.

3.0 FLOODING

3.1 Setting

According to FEMA, most municipalities in the United States have at least one clearly recognizable flood-prone area around a river, stream, or large body of water. These areas are outlined as Special Flood Hazard Areas (SFHA) and delineated as part of the National Flood Insurance Program (NFIP). Flood-prone areas are addressed through a combination of floodplain management criteria, ordinances, and community assistance programs sponsored by the NFIP and individual municipalities.

Many communities also have localized flooding areas outside of SFHAs. These floods tend to be shallower and chronically reoccur in the same area due to a combination of factors. Such factors include ponding, poor drainage, inadequate storm sewers, clogged culverts or catch basins, sheet flow, obstructed drainageways, sewer backup, or overbank flooding from small streams.

In general, flooding affects small areas within Naugatuck with moderate to frequent regularity. Areas impacted by overflow of the Naugatuck River and major watercourses are generally limited to river corridors and floodplains. Indirect flooding that occurs in the floodplains adjacent to the rivers and localized nuisance flooding along tributaries is a more common problem in the Borough. This type of flooding occurs particularly along roadways as a result of inadequate drainage and other factors. The frequency of flooding in Naugatuck is considered highly likely for any given year, but flooding damage only has a limited geographic effect (refer to Tables 1-2 and 1-3). Localized flooding along roadways resulting from inadequate drainage and other factors is also a flooding issue that the Borough regularly faces.

3.2 Hazard Assessment

Flooding is the most common and costly natural hazard in Connecticut. The state typically experiences floods in the early spring due to snowmelt and in the late summer/early autumn due to frontal systems and tropical storms, although localized flooding caused by thunderstorm activity can be significant. Flooding can occur as a result of other natural hazards, including hurricanes, summer storms, and winter storms. Flooding can also occur as a result of ice jams or dam failure (Section 8.0), and may also cause landslides and slumps in affected areas. According to FEMA, there are several different types of inland flooding:

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

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

- **Shallow Flooding:** Occurs in flat areas where a lack of a water channel results in water being unable to drain away easily. The three types of shallow flooding include:
  - **Sheet Flow:** Water spreads over a large area at uniform depth;
  - **Ponding:** Runoff collects in depressions with no drainage ability; and

- **Urban Flooding:** Occurs when man-made drainage systems are overloaded by a larger amount of water than the system was designed to accommodate.

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

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

***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 100-year floodplain that are outside the floodway and are subject to inundation but do not convey the floodwaters at a high velocity.*

In order to provide a national standard without regional discrimination, the 1% annual chance flood (previously known as the "100-year" flood) has been adopted by FEMA as the base flood for purposes of floodplain management and to determine the need for insurance. The risk of having a flood of this magnitude or greater increases when periods longer than one year are considered. For example, FEMA notes that a structure located within the 1% annual chance floodplain has a 26% chance of suffering flood damage during the term of a 30-year mortgage. The 0.2% annual chance floodplain (previously known as the "500-year" floodplain) indicates areas of moderate flood hazard.

Naugatuck has consistently participated in the NFIP since 1979. SFHAs in Naugatuck are delineated on a Flood Insurance Rate Map (FIRM) and supported by a Flood Insurance Study (FIS). These maps demonstrate areas within Naugatuck that are vulnerable to flooding. The initial FIRMs were published on August 15, 1979 and were updated on July 8, 2013.

FEMA commenced the Flood Map Modernization program for New Haven County, Connecticut in August 2007 when the initial HMP was under development. The "Map Mod" program enabled a more accurate representation of SFHAs in Naugatuck. The current New Haven County FIS and FIRM panels were effective December 17, 2010. This HMP update is the first to be developed subsequent to the effective date of the current FIS and FIRM panels.

Refer to Figure 3-1 for the areas of Naugatuck susceptible to flooding based on FEMA flood zones. Table 3-1 describes the various zones depicted on the FIRM panels for Naugatuck.

TABLE 3-1
FIRM Zone Descriptions

Zone	Description
A	An area inundated by 100-year flooding, for which no base flood elevations (BFEs) have been determined.
AE	An area inundated by 100-year flooding, for which BFEs have been determined.
Area Not Included	An area that is located within a community or county that is not mapped on any published FIRM.
X	An area that is determined to be outside the 100- and 500-year floodplains.
X500	An area inundated by 500-year flooding; an area inundated by 100-year flooding with average depths of less than 1 foot or with drainage areas less than 1 square mile; or an area protected by levees from 100-year flooding.

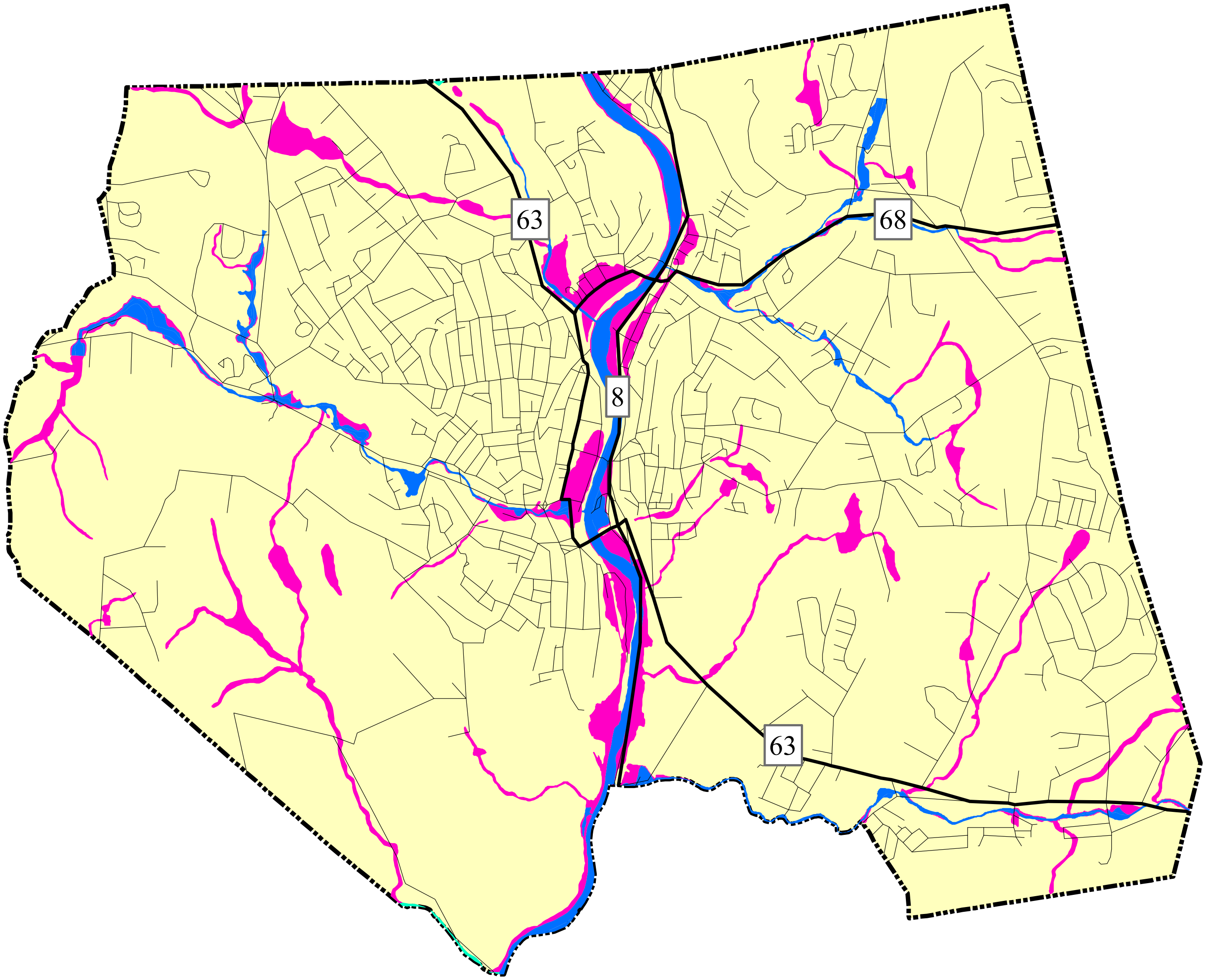
In some areas of Naugatuck, flooding occurs with a much higher frequency than those mapped by FEMA. This nuisance flooding occurs from heavy rains with a much higher frequency than those used to calculate the 100-year and 500-year flood events, and often in different areas than those depicted on the FIRM panels. These frequent flooding events occur in areas with insufficient drainage; where conditions may cause flashy, localized flooding; and where poor maintenance may exacerbate drainage problems. These areas are discussed in Sections 3.3 and 3.5.

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 500-year flood event on a tributary may only contribute to a 50-year flood event downstream. This is due to the distribution of rainfall 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. Such dams are located on the Naugatuck River upstream of the Borough of Naugatuck, in Thomaston and Torrington.

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 250-year event while flood frequencies were slightly greater than a 10-year event on the Naugatuck River in the adjacent Town of Beacon Falls, immediately downstream of Naugatuck. Flood events can also be mitigated or exacerbated by in-channel and soil conditions, such as low or high flows, the presence of frozen ground, or a deep or shallow water table, as can be seen in the following historic record.

3.3 Historic Record

In every season of the year throughout its recorded history, the Borough of Naugatuck has experienced various degrees of flooding. Melting snow combined with early spring rains have caused frequent spring flooding. Numerous flood events have occurred in late summer to early autumn resulting from storms of tropical origin moving northeast along the Atlantic coast. Winter floods result from the occasional thaw, particularly during years of heavy snow, or periods of rainfall on frozen ground. Other flood events have been caused by excessive rainfalls upon saturated soils, yielding greater than normal runoff.



Legend

Naugatuck Boundary

State Routes

Local Roads

Flood Zones

1% Annual Chance of Flooding w/o Elevations

1% Annual Chance of Flooding with Elevations

0.2% Annual Chance of Flooding

SOURCE(S):
"Town Boundary", "State Routes", "Streets" CT DEEP, FEMA Flood Zones DFIRM 2010

Figure 3-1: FEMA Flood Zones in Naugatuck

LOCATION:
Naugatuck, CT

N

Nauagatuck Natural Hazard Mitigation Plan Update

MXD: P:\2097-11\Design\GIS\Maps\Naugatuck\2013_Figure3-1FEMAFlood.mxd

Map By: JDW
MMI#: 2097-11
Original: 07/03/2013
Revision: 7/25/2013
Scale: 1 inch = 0.75 mile

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Notable historic floods have occurred along the Naugatuck River in Naugatuck in November 1927, March 1936, September 1938, January 1949, and August and October 1955. All of these floods were the result of high intensity rainfall falling on saturated or frozen ground.

In terms of damage to the Borough of Naugatuck, the most severe of these was due to Hurricane Diane in August 1955. Peak daily flows along the Naugatuck River were gauged by the USGS to be 53,400 cubic feet per second (cfs) in Thomaston and 106,000 cfs in Beacon Falls, equivalent of a greater than 500-year flood event on the Naugatuck River. This hurricane is the storm of record for both stations. The August 1955 flood resulted in the loss of 36 lives and caused over $193 million dollars in physical damages in areas downstream of the Thomaston Dam.

Flood heights related to the August 1955 storm were estimated to have a return period of 250 years in Naugatuck. The October 1955 flood had a recurrence interval of just over 100 years, and the 1936, 1938, and 1948 floods had recurrence intervals greater than 50, greater than 50, and approximately 100 years, respectively as measured in Beacon Falls.

According to the National Climatic Data Center (NCDC) Storm Events Database, there have been approximately 28 flooding events and 20 flash flood events in New Haven County since 1993. The following are descriptions of more recent examples of floods in and around the Borough of Naugatuck as described in the NCDC Storm Events Database, and based on correspondence with municipal officials.

- April 16, 1996: A low pressure system produced heavy rainfall in New Haven and Middlesex Counties, with 12-hour rainfall amounts in New Haven County ranging from 2.8 to 6.1 inches. The storm caused three dams in Middletown and one dam in Wallingford to breach and resulted in un-insured flood damages of approximately $1.5 million.
- March 9, 1998: Two low pressure systems formed over the southeastern United States that brought thunderstorms and heavy rainfall to New Haven County, resulting in widespread urban and small stream flooding. Water inundated several basements in Naugatuck. The storm produced wind gusts up to 55 miles per hour (mph) that contributed to scattered power outages. Rainfall amounts ranged from two and a half to four inches.
- January 15, 1999: A combination of heavy rain falling on frozen ground, snow and ice melting, and partially clogged storm drains caused widespread flash flooding of low-lying and poor drainage areas across Fairfield and New Haven Counties. Waterbury experienced significant widespread street and basement flooding.
- September 16, 1999: Torrential record rainfall preceding the remnants of Tropical Storm Floyd caused widespread urban, small stream, and river flooding. A total of 6.18 inches of rain was recorded in the nearby Town of Ansonia, and wind gusts peaked at up to 60 mph. Fairfield County was declared a disaster area, along with Litchfield and Hartford Counties. Initial cost estimates for damages to the public sector was $1.5 million for those three counties. These estimates do not account for damages to the private sector and are based on information provided by the Connecticut Office of Emergency Management. Serious wide-spread flooding of low-lying and poor drainage areas resulted in the closure of many roads and basement flooding across Fairfield, New Haven, and Middlesex Counties.
- April 21, 2000: A series of intense thunderstorms accompanied by two to four inches of rainfall produced lightning strikes and widespread flooding of small streams, brooks, rivers, and low-lying and poor drainage areas. Hockanum Brook in the adjacent Town of Beacon Falls was about two feet over its banks as a result of this storm.

- October 2005: Although the consistent rainfall of October 7-15, 2005 caused flooding and dam failures in most of Connecticut (most severely in northern Connecticut), the precipitation intensity and duration was such that only minor flooding occurred in Naugatuck. The Naugatuck River at Beacon Falls and Waterbury experienced significant rises within its banks.
- April 22-23, 2006: A sustained heavy rainfall caused streams to overtop their banks and drainage systems to fail throughout New Haven County. Rainfall amounts ranged from three to six inches across the region, including 4.34 inches in Naugatuck.
- June 2, 2006: An isolated severe thunderstorm produced up to eight inches of heavy rainfall that caused widespread damage in Waterbury, Wolcott, and Prospect. The storm caused slumps and drainage failures throughout the adjacent City of Waterbury, and several streets were flooded and damaged in all three municipalities.
- April 15-16, 2007: A spring nor'easter dropped over six inches of rain in the Greater Waterbury area, causing widespread flooding.
- July 19, 2007: Route 8 in the adjacent Town of Beacon Falls was closed due to flash flooding.
- August 29, 2011: Tropical Storm Irene produced heavy rainfall between five and 10 inches within a 12-hour period. The rainfall resulted in widespread flash flooding and river flooding across the northwest part of New Haven County, and a major disaster declaration was declared (FEMA-4023-DR).

On August 1, 2012, a localized heavy rainfall dropped 6" of rain in the Greater Naugatuck area in one hour. This storm caused drainage failures, flooding of streets and homes and the collapse of several retaining walls throughout the Borough. All of the Long Meadow Pond Brook culverts flooded. A detailed description of the storm and damage can be found on the borough's web site at http://www.naugatuck-ct.gov/content/77/1528/3889.aspx. A copy of this web page can be found in Appendix D.

3.4 Existing Capabilities

Regulations and Other Methods of Prevention

The Borough of Naugatuck has in place a number of measures to prevent flood damage. These include regulations and plans that control encroachment and development in and near floodplains and floodways. Regulations, codes, and ordinances that apply to flood hazard mitigation in conjunction with and in addition to NFIP regulations include:

- ***Floodplains:*** Section 29 of the December 2013 Zoning Regulations is essentially the local version of the NFIP regulations. This section recognizes areas of special flood hazards within the Borough as a zoning overlay and establishes minimum standards and review procedures over the use of the land in order to reduce flooding hazard to human life and health, reduce flood damages to public and private property, minimize disruptions of commerce and governmental services, protect values, maintain the natural drainage system's capacity to safely store and transport flood water and minimize damaging flood erosion and any increases in downstream flood potential. It establishes the FIRMs and the FIS as the official maps for delineating areas of special flood hazard.

  - Section 29.5.1 requires new construction and substantial improvements to be anchored and resistant to flood damage.

- ⇨ Section 29.5.3.1 requires that no new construction be permitted in A zones with established flood elevations if the base flood elevation would be increased by more than one foot.
- ⇨ Section 29.6.1 requires that new construction and substantial improvements of any residential structure shall have the lowest floor, including the basement, elevated at least two feet above the base flood.
- ⇨ Section 29.6.2 requires that new construction and substantial improvements of any nonresidential structure shall have the lowest floor, including the basement, elevated at least two feet above the base flood, or flood proofed.
- ⇨ Section 29.6.3 provides additional requirements for mobile home parks.
- ⇨ Sections 29.6.4 and 29.7 control encroachment into floodways.
- ⇨ Section 29.6.8 requires floodplain compensation for development that reduces the holding capacity of floodplains.

An application for approval of a development in a flood plain must be submitted to the Zoning Enforcement Officer and be approved before construction can begin.

- ❑ ***Open Space Subdivision Plans*** (Section 35 of the December 2013 Zoning Regulations). This sections allows for the proposal and permitting of an "open space subdivision" to preserve land as unsubdivided and undeveloped; for parks; for conserving natural resources; and to protect streams, rivers and ponds to avoid "flooding" and "erosion."

- ❑ ***The 2011 Naugatuck Subdivision Regulations*** contain numerous provisions relative to flood hazard mitigation:

  - ⇨ Section 3.2.4 requires that an Engineering Report be submitted with all applications, and that it shall address impacts on floodplains, aquifers, watersheds, greenways and natural features. This report shall also include summaries of stormwater drainage designs.
  - ⇨ Sections 4.3.2 and 4.4.2 require that existing and proposed watercourses, wetlands, ponds, swamps, shorelines, floodplain or flood boundaries be shown on site plans.
  - ⇨ Section 4.7.7 requires delineation of floodplain or flood boundaries and base flood elevation data within the subdivision.
  - ⇨ Section 5.2 requires that any lot which is "found to be unsuitable for occupancy and buildings by reason of water or flooding conditions, unsuitable soil, topography, ledge, rock or other conditions shall be combined with another contiguous lot that is suitable.…"
  - ⇨ Section 5.8 guides stormwater management and drainage system design to ensure peak flow attenuation or other mitigation.
  - ⇨ Section 5.9 guides stormwater conveyance and stipulates the storm frequencies that must be conveyed by bridges, culverts, catch basins, etc.

- ❑ ***Flood Hazard Standards*** (Section 5.12 of the 2011 Subdivision Regulations) requires that:

  - ⇨ 5.12.1 – Proposed subdivisions shall be consistent with the need to minimize flood damage
  - ⇨ 5.12.2 – Public utilities, including adequate storm drainage, shall be designed, located and constructed to minimize flood damage.
  - ⇨ 5.12.3 – Adequate storm drainage shall be provided to reduce exposure to flood damage.

- ⇨ 5.12.4 – Base flood elevation data shall be provided for all land proposed to be subdivided, whether or not it is available from FEMA.

- ❑ ***Soil Erosion and Sediment Control Plan*** (Section 4.6 of the 2011 Subdivision Regulations and Section 36 of the Naugatuck Zoning Regulations). These sections require the submittal of a Soil Erosion and Sediment Control Plan with any application in which the disturbed area of such development is cumulatively more than one-half acre.

- ❑ ***Inland Wetlands and Watercourses Regulations***. These 2009 regulations define in detail the Borough of Naugatuck's requirements regarding development near wetlands, watercourses, and water bodies. Section 2 defines "Regulated Activities" covered by the Regulations. Section 4 states that no person may conduct or maintain a regulated activity without obtaining a permit. Section 7 outlines the application requirements, and requires the delineation of the boundaries of all wetlands and watercourses on the plans for Inland Wetlands and Watercourses Commission submittals. In particular:

  - ⇨ Section 7.5.9 requires delineation of "floodplain limits and elevations,… drainage systems and channels…."
  - ⇨ Section 7.6.7 requires additional information regarding measures that "prevent flooding… erosion and sedimentation and obstruction of drainage…."
  - ⇨ Section 8.6 requires providing a hydrologic analysis of runoff and peak flow.
  - ⇨ Section 10.2.1 states that the Commission must consider the environmental impact of the proposed action, including the effects on the watercourse's natural capacity to support fish and wildlife, to prevent flooding, to supply and protect surface and ground waters, to control sediment, to facilitate drainage, to control pollution, to support recreational activities, and to promote public health safety and welfare.
  - ⇨ Section 10.2.7 requires evaluation of the impact of the activity on upstream and downstream wetlands and watercourses as well as impacts on the overall watershed.
  - ⇨ Section 10.2.9 requires evaluation of stormwater management.
  - ⇨ Section 10.2.10 requires consideration of, among other things, management of open spaces and detention basins.

- ❑ ***Aquifer Protection Regulations.*** These regulations replaced Section 28 of the Zoning Regulations subsequent to the State's adoption of the model aquifer protection ordinance. The regulations apply to the two aquifer protection zones in the Borough, located around the Indian Field groundwater supply in nearby Prospect (with the zone extending into Naugatuck) and the Marks Brook groundwater supply in southeastern Naugatuck. Although the regulations primarily address land uses that involve use, storage, or transfer of hazardous materials or chemicals within the aquifer protection zones, they provide an additional level of protection in the floodplains within each zone. Although the Indian Field wells are located in a floodplain in Prospect, the Marks Brook aquifer protection zone includes portions of the Marks Brook and Beacon Hill Brook floodplains in Naugatuck.

- ❑ ***Plan of Conservation & Development.*** According to the 2013 Plan of Conservation and Development, thirty percent of the land area in Naugatuck is currently set aside as open space exceeding the state goal of 21 percent. The Plan also notes that trends have been positive as the Borough has acquired open space and required developers to provide open space. Examples of this include the acquisition of the Gunntown Nature Preserve, Fawn Meadow Field and the anticipated grant for acquisition of a 145 acre parcel on Andrew Mountain.

Overall, the intent of these regulations is to promote the public health, safety, and general welfare and to minimize public and private losses due to flood conditions in specific areas of the Borough of Naugatuck by the establishment of standards designed to:

- Protect human life and public health;
- Minimize expenditure of money for costly flood control projects;
- Minimize the need for rescue and relief efforts associated with flooding;
- Ensure that purchasers of property are notified of special flood hazards;
- Ensure that all land approved for subdivision shall have proper provisions for water, drainage, and sewerage and in areas contiguous to brooks, rivers, or other bodies of water subject to flooding, and that proper provisions be made for protective flood control measures;
- Ensure that property owners are responsible for their actions;
- Ensure the continued eligibility of owners of property in Naugatuck for participation in the National Flood Insurance Program.

The Borough of Naugatuck retained a consultant to review Zoning and Subdivision Regulations in 2008. The review was completed in November 2008. Most of the recommendations are related to incorporating elements of low impact development into the regulations, especially with regard to stormwater management. In no case did a recommendation reduce any requirements related to flood hazard mitigation, and in fact, the recommendations provided for enhanced peak flow management in new developments, if implemented.

The Borough of Naugatuck Zoning Enforcement Officer serves as the NFIP administrator and oversees the enforcement NFIP regulations under the authority of the Zoning Commission. The Borough currently has no plans to enroll in the Community Rating System program.

The Borough of Naugatuck uses the 100-year flood lines from the FIRM and FIS delineated by FEMA as the official maps and report for determining special flood hazard areas. FEMA completed its "Map Mod" program, which created single FIRM for New Haven County. Many municipalities with revised FIRMs from the Map Mod program have found that more properties are in floodplains than originally believed.

Zoning and subdivision regulations require that all structures in flood hazard areas have their lowest floor (including basement) be two feet above established base flood elevations. Standards require that all proposals be consistent with the need to minimize flood damage, that public facilities and utilities be located and constructed to minimize flood damage, and that adequate drainage is provided. Wet floodproofing is required for buildings that include a fully enclosed space below the base flood elevation formed by foundation or other exterior walls. No encroachment on floodways is allowed that will raise the level of base flood elevation. The Naugatuck Inland Wetlands Commission also reviews new developments and existing land uses on and near wetlands and watercourses.

<u>Flood Control Projects</u>

Subsequent to the devastating floods of 1955, extensive flood control modifications have been made to the Naugatuck River basin, including the construction of five flood control dams by the ACOE. Three of these dams are located upstream of Naugatuck in the Town of Thomaston, and two others are located further upstream in Torrington. These dams are further described in

Section 8.3. According to the FEMA FIS for Thomaston, these five dams can store all runoff up to a 100-year storm and provide a controlled release to the channel downstream.

Drainage Systems

The Naugatuck Department of Public Works is in charge of the maintenance of the Borough's drainage systems, and performs clearing of bridges and culverts and other maintenance as needed. Drainage complaints are routed to the department and recorded. The Borough uses these documents to identify potential problems and plan for maintenance and upgrades. The Borough can also access NOAA's Automated Flood Warning System to monitor precipitation totals.

Borough officials indicated that drainage improvements along Nettleton Avenue were completed in 2012. In addition, an HMGP application for Cherry Street drainage improvements was submitted in 2012. Although this did not get funded, the fact that they submitted an application demonstrates that they have the capability to do so.

Emergency Services

The National Weather Service issues a flood watch or a flash flood watch 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. The National Weather Service issues a flood warning or a flash flood warning for an area when parts of the area are either currently flooding, highly likely to flood, or when flooding is imminent.

> The Borough of Naugatuck can access the ***National Weather Service*** website at http://weather.noaa.gov/ to obtain the latest flood watches and warnings before and during precipitation events.

In summary, many of Naugatuck's capabilities to mitigate for flood damage have improved since the initial hazard mitigation plan was adopted, particularly with regard to knowledge of hazard areas. Specifically, the floodplain regulations require two feet of freeboard which far exceeds the minimum criteria set by NFIP. Overall, the increased knowledge of vulnerable areas, combined with other local planning efforts, has assisted community officials and commissions to provide a variety of flood mitigation recommendations for new development.

3.5 Vulnerabilities and Risk Assessment

This section discusses specific areas at risk to flooding within the Borough. Major land use classes and critical facilities within these areas are identified. According to the FEMA FIRMs, approximately 219 acres of land in Naugatuck are located within the 100-year flood boundary and 575 acres of land are located within the 500-year flood boundary. In addition, indirect and nuisance flooding occurs near streams and rivers throughout Naugatuck due to inadequate drainage and other factors.

The primary waterway in the Borough is the Naugatuck River, which flows north to south through the Borough. The remaining waterways in Naugatuck are mostly tributary streams and brooks significant for water supply and conservation purposes, with only Hop Brook noted as recreational resource. Recall from Figure 3-1 that SFHAs with defined elevations are delineated for the Naugatuck River, Hop Brook, Long Meadow Pond Brook, Fulling Mill Brook, Cold Spring Brook, and Beacon Hill Brook. These watercourses, along with several additional smaller streams, have 500-year floodplains delineated by approximate methods. All of these delineated floodplains are generally limited to the areas adjacent to the streams.

Due to the large amount of buffer capacity provided by the ACOE flood control dams upstream, there is little wide-scale flooding in Naugatuck. Specific areas susceptible to flooding were identified by Borough personnel and observed by Milone & MacBroom, Inc. staff during field inspections as described in Section 1.5. Most flooding occurs due to large amounts of rainfall, sometimes falling in conjunction with snowmelt, and it often occurs due to undersized road culverts and drainage problems.

3.5.1 Vulnerability Analysis of Repetitive Loss Properties and Critical Facilities

No repetitive loss or severe repetitive loss properties are located in Naugatuck. None of Naugatuck's critical facilities are located in SFHAs.

3.5.2 Vulnerability Analysis of Areas Along Watercourses

- Spencer Street Corridor/Cherry Street/Pleasant Avenue – This area was cited as a significant flood-prone area during the data collection meeting for the initial plan, although severe damage does not occur and nuisance flooding appears to be the problem. A review of historical topographic maps reveals that an unnamed stream was formerly located in this area in 1947, flowing from west to east, but it has been located in a culvert underground since at least 1954. Refer to Figure 3-2 on the next page for a depiction of the watercourse in 1947, Figure 3-3 for a depiction of the area in 1954, and Figure 3-4 for a depiction at the present time.

  Currently, there is a detention pond near this area with an adjacent swale from a hillside; and a stream daylights to the west of Lewis Street. Streets and homes can flood within the development during periods of heavy rainfall. Stormwater systems tied to this watercourse are also affected. It has been reported that water levels can rise so rapidly that a "geyser" forms in the storm drainage system when water gets backed up following periods of high rainfall. In fact, the historic Grant House on Cherry Street Extension was damaged due to pressures within the stormwater system.

- Long Meadow Pond Brook – The corridor of this stream and its tributary (depicted on Figure 3-5) were noted by Borough personnel as experiencing flooding during heavy rainfall. The specific area of concern is located adjacent to the Long Meadow Pond Brook and its tributary near Rubber Avenue and Harlow Court, near Mountview Plaza and north of the Baummer Dam. The flooding at this site is partly associated with water entering from the vicinity of Webb Road. There have been approximately four residential or commercial sites that have been flooded in this location, though repetitive loss properties are not located in this area. Flooding in this area was also discussed in Section 3.3 and noted that all of the Long Meadow Pond Brook culverts flooded during the August 1, 2012, localized heavy rainfall which dropped 6" of rain in the Greater Naugatuck area in one hour.

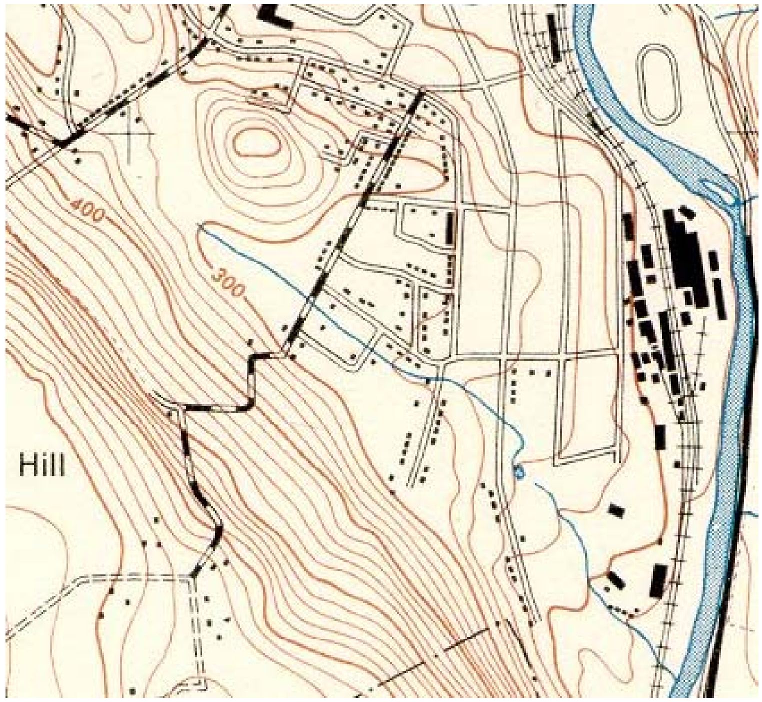


Figure 3-2 – View of 1947 Topographic Map, Spencer Street Corridor

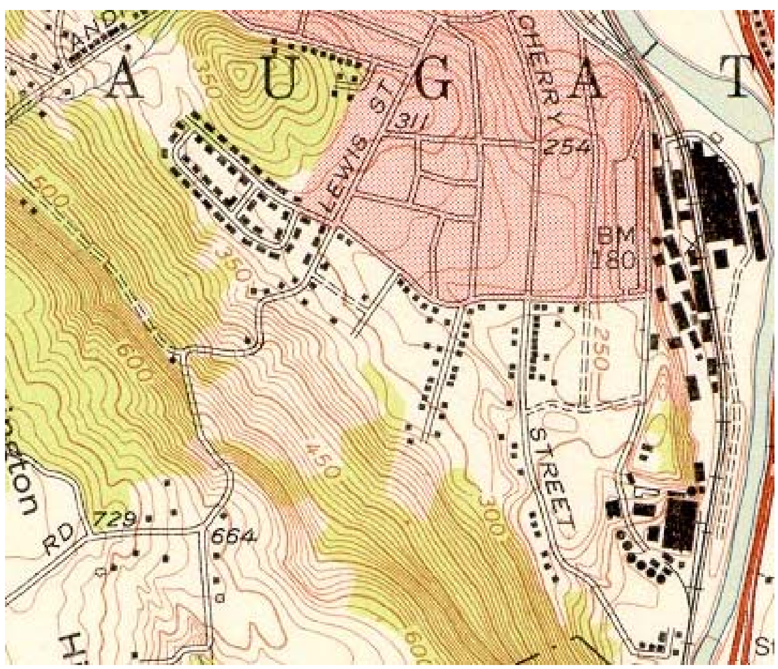
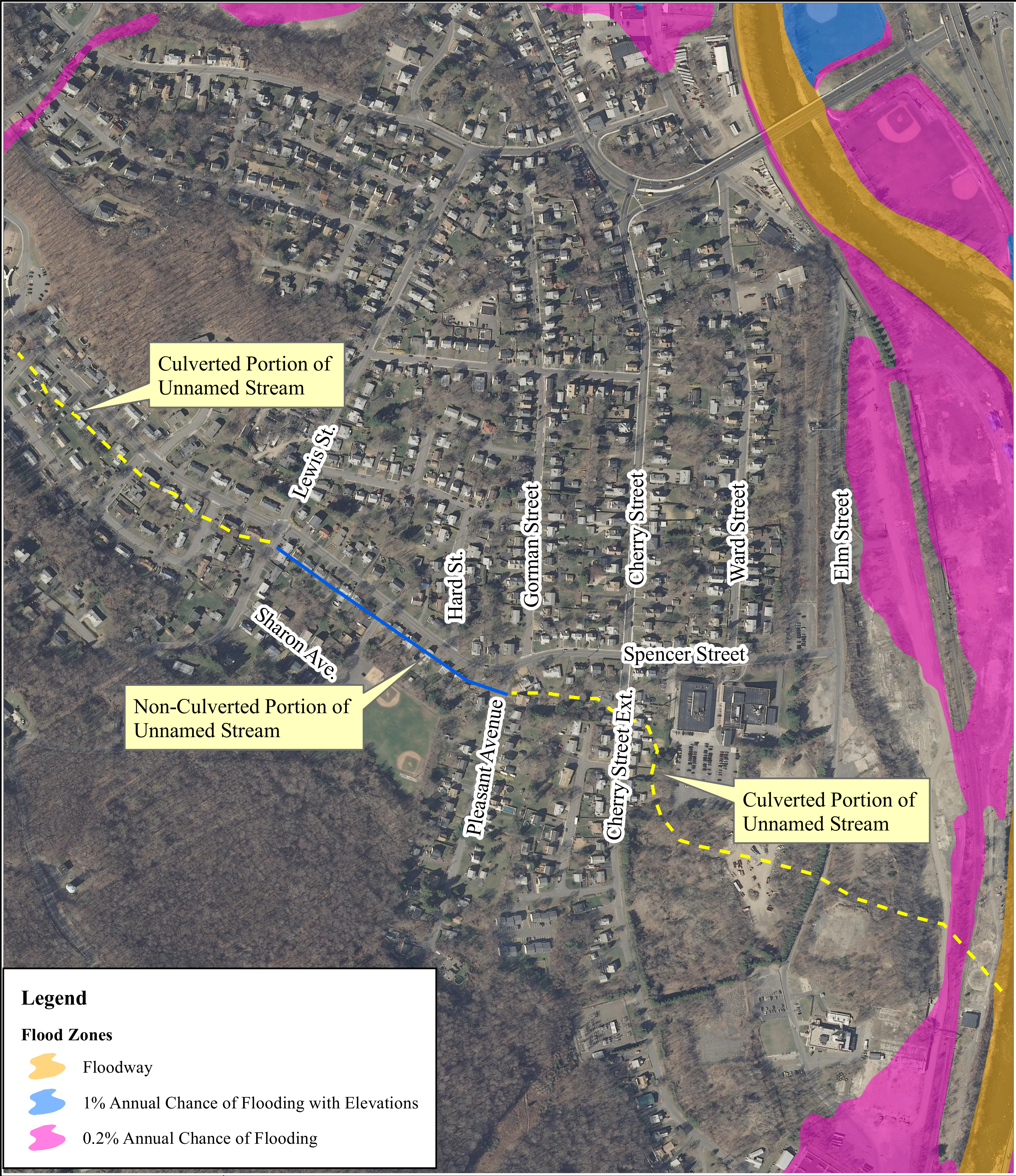


Figure 3-3 – View of 1954 Topographic Map, Spencer Street Corridor



SOURCE(S):		LOCATION:
FEMA Flood Zones DFRIM 2010, CT Ortho 2012	**Figure 3-4: Spencer/Cherry Street/ Pleasant Avenue Study Area**	**Naugatuck, CT**

N

NaugatuckNatural Hazard Mitigation Plan Update

MXD: P:\2097-11\Design\GIS\Maps\Naugatuck\2013_Figure3-4Spencer.mxd

Map By: JDW
MMI#: 2097-11
Original: 01/2009
Revision: 07/03/2013
Scale: 1 inch = 500 feet

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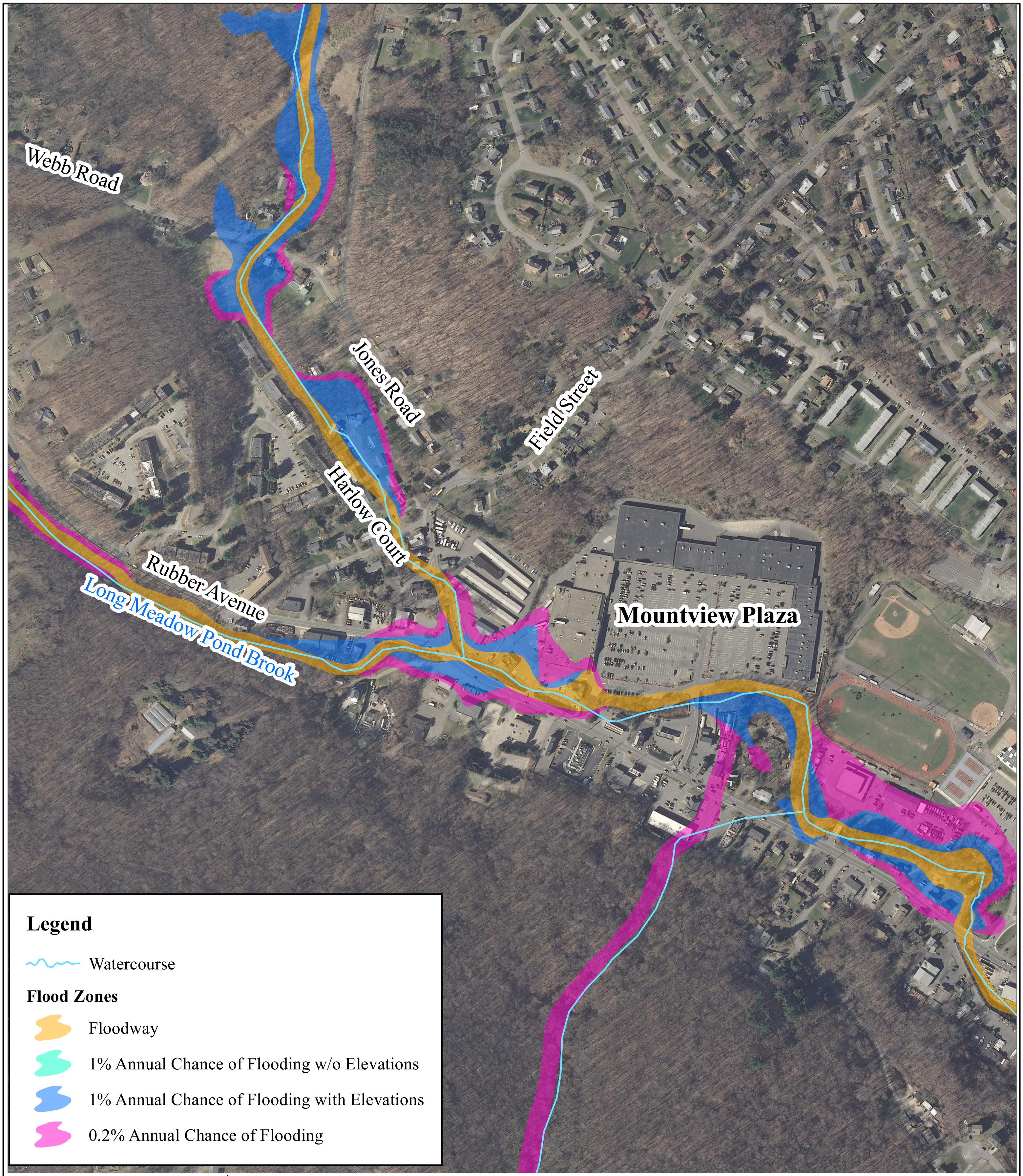

SOURCE(S):
FEMA Flood Zones DFRIM 2010,
CT Ortho 2012

Figure 3-5: Long Meadow Pond Brook Study Area

LOCATION:
Naugatuck, CT

N

Naugatuck Natural Hazard Mitigation Plan Update

MXD: P:\2097-11\Design\GIS\Maps\Naugatuck\2013_Figure3-5Long.mxd

Map By: JDW
MMI#: 2097-11
Original: 01/2009
Revision: 07/03/2013
Scale: 1 inch = 500 feet

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- Arch Street – The lower portion of Arch Street at Long Meadow Pond Brook receives three feet of standing water during large rainfall events. A storm drain near a vacant building is sometimes clogged, causing storm water to back up and build in the street during these storms. On one account, the standing water caused a dumpster to float.

- Beacon Valley Road – Flooding has been reported along Beacon Valley Road near Beacon Falls. This neighborhood becomes inundated with water from Beacon Hill Brook after heavy rains. See Figure 3-6 for a vicinity map.

Other Areas of Concern

- Cold Spring Brook – Although not mentioned at the data collection kick-off meeting, this corridor was investigated. The brook is very close to Brook Street and flooding could affect homes and access to Cold Spring Circle.

- Crown Spring Bridge – This bridge over Hop Brook on Bridge Street has recurring problems with flooding after periods of heavy rainfall.

- East Waterbury Road – The portion of East Waterbury Road below the Union Ice Company Dam now becomes flooded after heavy rains. As a result of the pond losing storage due to sedimentation, this problem may be worsening. During substantial rain events, the dam overtops and water spills onto East Waterbury Road. The water runs down the road and eventually re-enters the tributary to Fulling Mill Brook. Under certain conditions, water can enter homes.

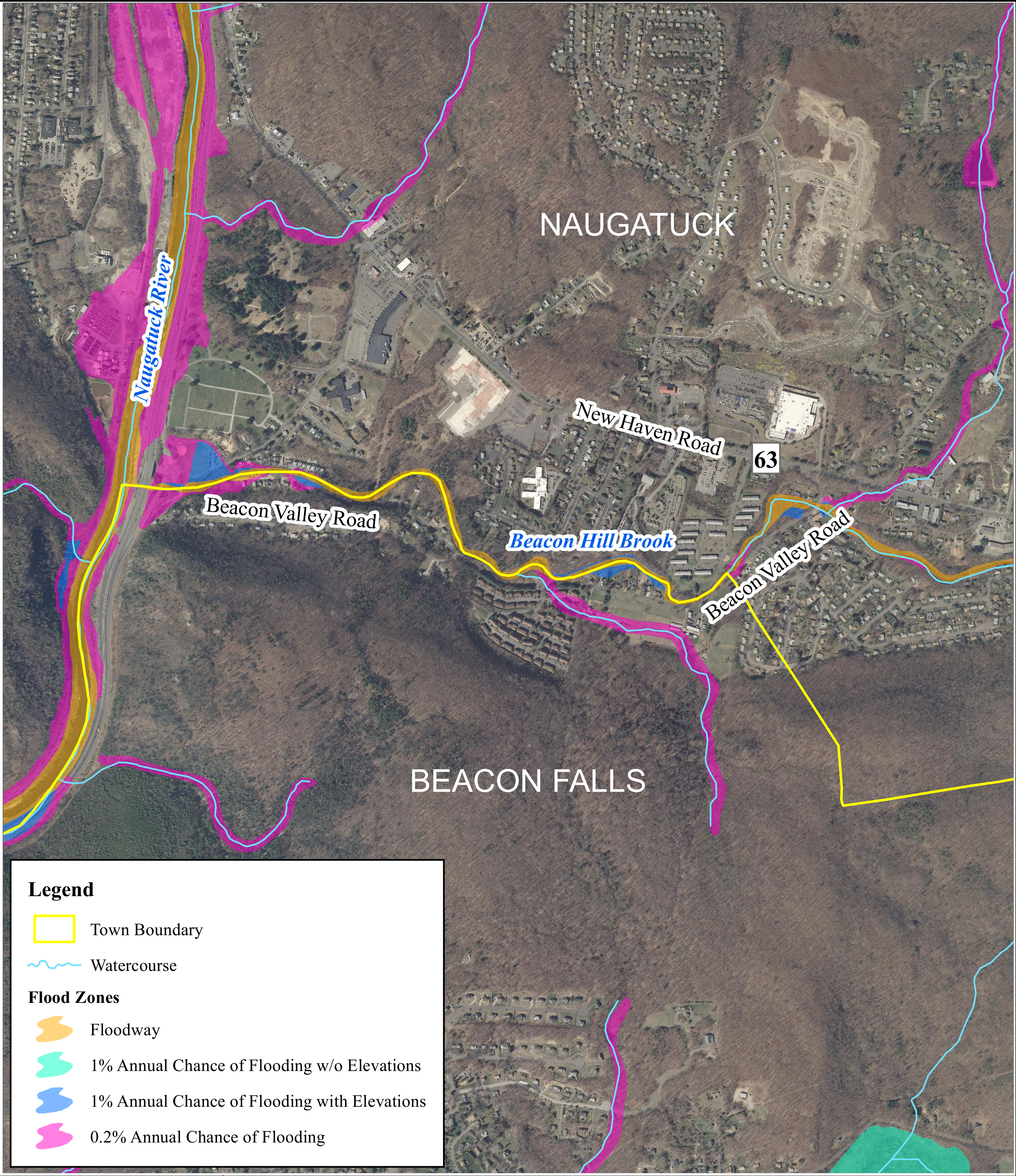
- Fulling Mill Brook along Route 68 – Flooding of Route 68 has been known to occur during periods of heavy rain. The channel is near street level in some areas, and when water is overbank, it causes minor flooding.

- Highland Street near Galpin Street – This area was reported to have flooding issues after substantial rain events. The area was inspected but the alleged drainage problems were not apparent. Problems may occur under more significant events.

- May Street – The nearby unnamed stream may have the tendency to jump the culvert at the intersection with Bird Road and cause washouts in a resident's yard.

- Nichols Garage (Irving Gas Station) – This site marks the point at which Pigeon Brook flows underground before entering Hop Brook. There is a pond adjacent to the garage at this site that may have mitigated flooding problems in the past, but it has become filled with silt.

- Maple Street – A sinkhole approximately 100 feet long formed in July 2008 near the Naugatuck Fire Headquarters. The sinkhole was the result of the failure of an old storm drain.



SOURCE(S):
FEMA Flood Zones DFIRM 2010, CT Ortho 2012

Figure 3-6: Beacon Valley Road Study Area

LOCATION:
Naugatuck, CT

Naugatuck Natural Hazard Mitigation Plan Update

MXD: P:\2097-11\Design\GIS\Maps\Naugatuck\2013_Figure3-6Beacon.mxd

Map By: JDW
MMI#: 2097-11
Original: 01/2009
Revision: 07/03/2013
Scale: 1 inch = 1,250 feet

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It should be noted that in response to chronic downtown and neighborhood flooding problems, the Mayor's Office in association with the Department of Public Works, the Fire Department and the Engineering Department met with State officials to determine the appropriate course of action. Steps were taken to determine the areas of critical need and subsequently an HMGP application was submitted to secure funding for drainage improvements on Nettleton Avenue and within the vicinity of Cherry Street. At this time, it does not appear that this project was selected for funding.

3.5.3 HAZUS-MH Vulnerability Analysis

HAZUS-MH is FEMA's loss estimation methodology software for flood, wind, and earthquake hazards. The current version of the software utilizes year 2000 U.S. Census data and a variety of engineering information to calculate potential damages (valued in year 2006 dollars) to a user-defined region. The software was utilized to perform a basic analysis to generate potential damages to major streams in Naugatuck from a 1% annual chance riverine flood event. Hydrology and hydraulics for the streams and rivers were generated utilizing digital elevation models available from the DEEP that were prepared using the 2000 LiDAR study. HAZUS-MH output is included in Appendix C. The following paragraphs discuss the results of the HAZUS-MH analysis.

Major streams in Naugatuck were defined by HAZUS as the following.

- Beacon Hill Brook;
- Cold Spring;
- Fulling Mill Brook;
- Hop Brook;
- Long Meadow Brook;
- Naugatuck River;
- Schlidgen Pond Brook and;
- Webb Brook.

Unnamed tributaries and named tributaries not modeled as a separate stream are included in the calculations for the nearest downstream tributary.

A summary of the default building counts and values is shown in Table 3-2. Approximately $2.9 billion dollars of building value were estimated to exist within Naugatuck.

TABLE 3-2
HAZUS-MH Flood Scenario – Basic Information

Occupancy	Dollar Exposure
Residential	$1,785,053,000
Commercial	$327,455,000
Other	$174,060,000
Total	**$2,886,568,000**

The HAZUS-MH simulation estimates that during a 1% annual chance flood event, 2 buildings will be at least moderately damaged and four will be substantially damaged from flooding. Table 3-3 presents the expected damages based on building type.

TABLE 3-3
HAZUS-MH Flood Scenario – Building Stock Damages

Stream	1-10% Damaged	11-20% Damaged	21-30% Damaged	31-40% Damaged	41-50% Damaged	Substantially Damaged
Beacon Hill Brook	None	None	None	None	None	None
Cold Spring	None	None	None	None	None	None
Fulling Mill Brook	None	None	None	None	None	None
Hop Brook	None	None	None	None	None	None
Long Meadow Brook	None	None	None	None	None	None
Naugatuck River	None	None	None	None	1	2
Schlidgen Pond Brook	None	None	None	None	1	2
Webb Brook	None	None	None	None	None	None

HAZUS-MH utilizes a subset of critical facilities known as "essential facilities" that are important following natural hazard events. These include fire stations, hospitals, police stations, and schools. The software simulated that under the 1% annual chance flood event, none of Naugatuck's essential facilities will be damaged.

The HAZUS-MH simulation estimated the following tons of debris would be generated by flood damage for the 1% annual chance flood scenario along each stream. The simulation also estimates the number of truckloads (at approximately 25 tons per truck) that will be required to remove the debris. The breakdown of debris generation is as follows:

TABLE 3-4
HAZUS-MH Flood Scenario – Debris Generation (Tons)

Stream	Finishes	Structural	Foundations	Total	Truckloads
Beacon Hill Brook	15	None	None	15	1
Cold Spring	11	None	None	11	1
Fulling Mill Brook	33	None	None	33	2
Hop Brook	1	None	None	1	1
Long Meadow Brook	33	1	None	34	2
Naugatuck River	144	152	116	412	16
Schlidgen Pond Brook	61	68	45	174	7
Webb Brook	5	1	None	6	1

HAZUS-MH calculated the potential sheltering requirement for the 1% annual chance flood event along each stream. Displacement includes households evacuated from within or very near to the inundated areas. Of these households, some people will seek temporary shelter in public shelters, while others are predicted to stay with friends, family, or in hotels or motels.

TABLE 3-5
HAZUS-MH Flood Scenario – Sheltering Requirements

Stream	Displaced Households	Population Using Public Shelters
Beacon Hill Brook	10	5
Cold Spring	6	1
Fulling Mill Brook	12	12
Hop Brook	2	None
Long Meadow Brook	16	11
Naugatuck River	22	30
Schlidgen Pond Brook	13	17
Webb Brook	12	17

HAZUS-MH also calculated the predicted economic losses due to the 1% annual chance flood event along each stream. Economic losses are categorized between building-related losses and business interruption losses. Building-related losses (damages to building, content, and inventory) are the estimated costs to repair or replace the damage caused to the building and its contents. This information is presented in Table 3-6. Business interruption losses are those associated with the inability to operate a business because of the damage sustained during the flood, and include lost income, relocation expenses, lost rental income, lost wages, and temporary living expenses for displaced people. This information is presented in Table 3-7.

TABLE 3-6
HAZUS-MH Flood Scenario – Building Loss Estimates

Stream	Residential	Commercial	Industrial	Others	Total
Beacon Hill Brook	$160,000	$200,000	$20,000	$10,000	$380,000
Cold Spring	$120,000	$10,000	$20,000	$10,000	$170,000
Fulling Mill Brook	$380,000	$150,000	$50,000	$40,000	$630,000
Hop Brook	None	$70,000	$10,000	None	$80,000
Long Meadow Brook	$210,000	$1,530,000	$100,000	$10,000	$1,850,000
Naugatuck River	$2,320,000	$6,910,000	$230,000	$200,000	$9,660,000
Schlidgen Pond Brook	$1,330,000	$80,000	$60,000	None	$1,460,000
Webb Brook	$30,000	$30,000	$10,000	$10,000	$80,000

TABLE 3-7
HAZUS-MH Flood Scenario – Business Interruption Estimates

Stream	Residential	Commercial	Industrial	Others	Total
Beacon Hill Brook	None	None	None	None	None
Cold Spring	None	None	None	None	None
Fulling Mill Brook	None	None	None	None	None
Hop Brook	None	None	None	None	None
Long Meadow Brook	None	$10,000	None	None	$10,000
Naugatuck River	None	$40,000	None	$20,000	$60,000
Schlidgen Pond Brook	None	None	None	None	None
Webb Brook	None	None	None	None	None

The HAZUS-MH results are generally consistent with observed conditions in Naugatuck. Aside from the drainage-related flooding problems that are not addressed by HAZUS, the most damaging floods occur along the Long Meadow Brook and the Naugatuck River.

3.6 Potential Mitigation Strategies and Actions

A number of measures can be taken to reduce the impact of a local or nuisance flood event. These include measures that prevent increases in flood losses by managing new development, measures that reduce the exposure of existing development to flood risk, and measures to preserve and restore natural resources. These are listed below under the categories of *prevention*, *property protection*, *structural projects*, *public education and awareness*, *natural resource protection*, and *emergency services*.

3.6.1 Prevention

It is important to promote coordination among the various departments that are responsible for different aspects of flood mitigation. Coordination and cooperation among departments should be reviewed every few years as specific responsibilities and staff change.

Prevention of damage from flood losses often takes the form of floodplain regulations and redevelopment policies that restrict the building of new structures within defined areas. These are usually administered by building, zoning, planning, and/or code enforcement offices through capital improvement programs and through zoning, subdivision, floodplain, and wetland ordinances. It also occurs when land is prevented from being developed through the use of conservation easements or conversion of land into open space.

Planning and Zoning: Zoning and Subdivision ordinances regulate development in flood hazard areas. Flood hazard areas should reflect a balance of development and natural areas, although ideally they will be free from development. Site plan and new subdivision regulations typically include the following:

- Requirements that every lot have a buildable area above the flood level;
- Construction and location standards for the infrastructure built by the developer, including roads, sidewalks, utility lines, storm sewers, and drainage-ways; and
- A requirement that developers dedicate open space and flood flow, drainage, and maintenance easements.
- Policies requiring the design and location of utilities to areas outside of flood hazard areas when applicable and the placement of utilities underground when possible.
- 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.
- 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.

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 11.

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.

Reductions in floodplain area can only be accomplished through revised FEMA-sponsored engineering studies or Letters of Map Change (LOMC).

<u>Stormwater Management Policies</u>: Development and redevelopment policies to address the prevention of flood damage must include effective stormwater management policies. Developers are typically required to build detention and retention facilities where appropriate. Additional techniques include enhancing infiltration to reduce runoff volume through the use of swales, infiltration trenches, vegetative filter strips, and permeable paving blocks. The goal is that post-development stormwater does not leave a site at a rate higher than under predevelopment conditions.

Standard engineering practice is to avoid the use of detention measures if the project site is located in the lower one-third of the overall watershed. The effects of detention are least effective and even detrimental if used at such locations because of the delaying effect of the peak discharge from the site that typically results when detention measures are used. By detaining stormwater in close proximity of the stream in the lower reaches of the overall watershed, the peak discharge from the site will occur later in the storm event, which will more closely coincide with the peak discharge of the stream, thus adding more flow during the peak discharge during any given storm event. Due to its geography, Naugatuck contains a range of upper to lower portions of watersheds. Developers should be required to demonstrate whether detention or retention will be the best management practice for stormwater at specific sites in regards to the position of each project site in the surrounding watershed.

Due to its topography, Naugatuck is situated in the upper and lower parts of several watersheds. Developers should be required to demonstrate whether detention or retention will be the best management practice for stormwater at specific sites in regards to the position of each project site in the surrounding watershed.

<u>Drainage System Maintenance</u>: An effective drainage system must be continually maintained to ensure efficiency and functionality. Maintenance should include programs to clean out blockages caused by overgrowth and debris. Culverts should be monitored, and repaired and improved when necessary. The use of Geographic Information System (GIS) technology would greatly aid the identification and location of problem areas.

Education and Awareness: Other prevention techniques include the promotion of awareness of natural hazards among citizens, property owners, developers, and local officials. Technical assistance for local officials, including workshops, can be helpful in preparation for dealing with the massive upheaval that can accompany a severe flooding event. Research efforts to improve knowledge, develop standards, and identify and map hazard areas will better prepare a community to identify relevant hazard mitigation efforts.

3.6.2 Property Protection

A variety of steps can be taken to protect existing public and private properties from flood damage. Performing such measures for repetitive loss properties would provide the greatest benefit to residents and the NFIP. Potential measures for property protection include:

- ***Relocation of structures at risk for flooding to a higher location on the same lot or to a different lot outside of the floodplain***. Moving an at-risk structure to a higher elevation can reduce or eliminate flooding damages to that property.

- ***Elevation of the structure***. Building elevation involves the removal of the building structure from the basement and elevating it on piers to a height such that the first floor is located above the 100-year flood level. The basement area is abandoned and filled to be no higher than the existing grade. All utilities and appliances located within the basement must be relocated to the first floor level. The area below the first floor may only be used for building access and parking.

- ***Construction of localized property improvements such as barriers, floodwalls, and earthen berms***. Such structural projects can be used to prevent shallow flooding and are described in Section 3.3.6.

- ***Performing structural improvements to mitigate flooding damage***. Such improvements can include:

  - ***Dry floodproofing of the structure to keep floodwaters from entering***. Walls may be coated with compound or plastic sheathing. Openings such as windows and vents would be either permanently closed or covered with removable shields. Flood protection should extend only two to three feet above the top of the concrete foundation because building walls and floors cannot withstand the pressure of deeper water.

  > **Dry floodproofing refers to the act of making areas below the flood level watertight.**
  >
  > **Wet floodproofing refers to intentionally letting floodwater into a building to equalize interior and exterior water pressures.**

  - ***Wet floodproofing of the structure to allow floodwaters to pass through the lower area of the structure unimpeded***. Wet floodproofing should only be used as a last resort above the first floor level. If considered, furniture and electrical appliances should be elevated above the 1% annual chance flood elevation.

  - ***Performing other potential home improvements to mitigate damage from flooding***. FEMA suggests several measures to protect home utilities and belongings, including:

- Relocating valuable belongings above the 1% annual chance flood elevation to reduce the amount of damage caused during a flood event;
- Relocate or elevate water heaters, heating systems, washers, and dryers to a higher floor or to at least 12 inches above the high water mark (if the ceiling permits). A wooden platform of pressure-treated wood can serve as the base.
- Anchor the fuel tank to the wall or floor with non-corrosive metal strapping and lag bolts.
- Install a septic backflow valve to prevent sewer backup into the home.
- Install a floating floor drain plug at the lowest point of the lowest finished floor.
- Elevate the electrical box or relocate it to a higher floor, and elevate electric outlets to at least 12 inches above the high water mark.

❑ ***Encouraging property owners to purchase flood insurance under the NFIP and to make claims when damage occurs***. While having flood insurance will not prevent flood damage, it will help a family or business put things back in order following a flood event. 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.

All of the above *property protection* mitigation measures may be useful for Borough of Naugatuck residents to prevent damage from inland and nuisance flooding. The Borough may wish to work with property owners along Long Meadow Pond Brook, Hop Brook, Beacon Hill Brook, Cold Spring Brook, and Fulling Mill Brook to pursue wet floodproofing, dry floodproofing, or elevation of structures. If FEMA funds are to be pursued, a cost-benefit analysis for each strucutre will help determine whether wet floodproofing or dry floodproofing for a nonresidential structure, or elevation of any residential structure is most appropriate.

3.6.3 Emergency Services

A natural hazard pre-disaster mitigation plan addresses actions that can be taken before a disaster event. In this context, emergency services that would be appropriate mitigation measures for inland flooding include:

❑ Forecasting systems to provide information on the time of occurrence and magnitude of flooding;
❑ A system to issue flood warnings to the community and responsible officials;
❑ Emergency protective measures, such as an Emergency Operations Plan outlining procedures for the mobilization and position of staff, equipment, and resources to facilitate evacuations and emergency floodwater control; and
❑ Implementing an emergency notification system that combines database and GIS mapping technologies to deliver outbound emergency notifications to geographic areas; or specific groups of people, such as emergency responder teams.

Many of the above mitigation measures are already in practice to some degree in the Borough of Naugatuck. Based on the above guidelines, a number of specific proposals for improved *emergency services* are recommended to prevent damage from inland and nuisance flooding. These are common to all hazards in this plan, and are listed in Section 10.1.

3.6.4 Public Education and Awareness

The objective of public education is to provide an understanding of the nature of flood risk, and the means by which that risk can be mitigated on an individual basis. Public information materials should encourage individuals to be aware of flood mitigation techniques, including discouraging the public from changing channel and detention basins in their yards, and dumping in or otherwise altering watercourses and storage basins. Individuals should be made aware of drainage system maintenance programs and other methods of mitigation. The public should also understand what to expect when a hazard event occurs, and the procedures and time frames necessary for evacuation.

Based on the above guidelines, a number of specific proposals for improved *public education* are recommended to prevent damage from inland and nuisance flooding. These are common to all hazards in this plan, and are listed in Section 10.1.

3.6.5 Natural Resource Protection

Floodplains can provide a number of natural resources and benefits, including storage of floodwaters, open space and recreation, water quality protection, erosion control, and preservation of natural habitats. Retaining the natural resources and functions of floodplains can not only reduce the frequency and consequences of flooding but also minimize stormwater management and nonpoint pollution problems. Through natural resource planning, these objectives can be achieved at substantially reduced overall costs.

Projects that improve the natural condition of areas or restore diminished or destroyed resources can reestablish an environment in which the functions and values of these resources are again optimized. Acquisitions of floodprone property with conversion to open space are the most common of these types of projects. Acquisition of heavily damaged structures (particularly repetitive loss properties) after a flood may be an economical and practical means to accomplish this. In some cases, it may be possible to purchase floodprone properties adjacent to existing recreation areas which will allow for the expansion of such recreational use or the creation of floodplain storage areas. Administrative measures that assist such projects include the development of land reuse policies focused on resource restoration and review of community programs to identify opportunities for floodplain restoration.

> Measures for preserving floodplain functions and resources typically include:
>
> - ❑ Adoption of floodplain regulations to control or prohibit development that will alter natural resources
> - ❑ Development and redevelopment policies focused on resource protection
> - ❑ Information and education for both community and individual decision-makers
> - ❑ Review of community programs to identify opportunities for floodplain preservation

Based on the above guidelines, the following typical *natural resource protection* mitigation measures to help prevent damage from flooding include:

- ❑ Pursue additional open space properties in floodplains by purchasing repetitive loss properties and other floodprone structures and converting the parcels to open space;
- ❑ Pursue the acquisition of additional municipal open space properties as discussed in the *Plan of Conservation and Development*;

- Selectively pursue conservation objectives listed in the Plan of Conservation and Development and/or more recent planning studies and documents; and
- Continue to regulate development in protected and sensitive areas, including steep slopes, wetlands, and floodplains.

Municipalities should work with local land trusts to identify undeveloped properties (or portions thereof) worth acquiring that are within or adjacent to floodplains.

3.6.6 Structural Projects

Structural projects include the construction or modification of structures to lessen the impact of a flood event. Examples of structural projects include:

- Stormwater controls such as drainage systems, detention dams and reservoirs, and culvert resizing can be employed to modify flood flow rates.
- On-site detention can provide temporary storage of stormwater runoff.
- Barriers such as levees, floodwalls, and dikes physically control the hazard to protect certain areas from floodwaters.
- Channel alterations can be made to confine more water to the channel and modify flood flows.
- Individuals can protect private property by raising structures and constructing walls and levees around structures.

Care should be taken when using these techniques to ensure that problems are not exacerbated in other areas of the impacted watersheds. Given the many culverts and bridges in a typical community and the increasing rainfall rates in Connecticut described in Section 2.4, reevaluation of the drainage computations on culverts and bridges is often recommended.

3.7 Status of Mitigation Strategies and Actions

The prior mitigation strategies and actions for addressing riverine, drainage-related, and nuisance flooding are listed below with commentary regarding the status of each.

TABLE 3-8
Status of Previous Strategies and Actions

Strategy or Action	Status
Prevention	
Streamline the permitting process and work toward the highest possible education of a developer or applicant. Develop a checklist that cross-references the bylaws, regulations, and codes related to flood damage prevention that may be applicable to the proposed project. This list could be provided to an applicant at any Borough department. A sample checklist for the Borough of Naugatuck is included as Appended Table 3.	Partly accomplished but staff limitations have impeded full completion; strategy is carried forward.
Consider joining FEMA's Community Rating System.	The borough is still researching this and the strategy is being carried forward.

Strategy or Action	Status
Consider requiring buildings constructed in floodprone areas to be protected to the highest recorded flood level, regardless of being within a defined SFHA	This is ongoing and part of the borough's capabilities, therefore it can be removed.
Ensure new buildings be designed and graded to shunt drainage away from the building.	This is part of the building code and can be deleted.
After Map Mod has been completed, consider restudying local flood prone areas and produce new local-level regulatory floodplain maps using more exacting study techniques, including using more accurate contour information to map flood elevations provided with the FIRM.	This is not needed, as Map Mod is complete and the DFIRMs are effective.
Property & Natural Resource Protection	
Selectively pursue conservation recommendations listed in the Plan of Conservation and Development and other studies and documents.	This is ongoing and part of the borough's capabilities, therefore it can be removed.
Pursue the acquisition of additional municipal open space properties inside SFHAs and set it aside as greenways, parks, or other non-residential, non-commercial, or non-industrial use.	Partly accomplished but additional progress is desired as funds become available; strategy is carried forward.
Continue to regulate development in protected and sensitive areas, including steep slopes, wetlands, and floodplains	This is ongoing and part of the borough's capabilities, therefore it can be removed.
Consider local floodproofing or elevation options for floodprone homes along various watercourses in Naugatuck.	This is ongoing and part of the borough's capabilities, therefore it can be removed.
Structural Projects	
Consider performing a Borough-wide analysis to help identify undersized and failing portions of the stormwater and drainage systems. Prioritize repairs as needed. Incorporate anecdotal information where appropriate, such as observation described in this plan regarding the nuisance flooding at May Street.	Not complete due to funding limitations; strategy is carried forward
Upgrade the drainage systems in downtown Naugatuck where necessary to enhance drainage.	Not complete due to funding limitations; strategy is carried forward
Increase maintenance of the storm drainage system near the building on Arch Street near Long Meadow Pond Brook to prevent flooding of this area.	Not complete due to funding limitations; strategy is carried forward
If necessary, increase the conveyance capacity of Crown Spring Bridge over Hop Brook at Bridge Street.	Not complete due to funding limitations; strategy is carried forward
Assess dredging options for the sediment laden Union Ice Company Pond to potentially increase its potential for flood mitigation.	Dredging does not typically provide flood mitigation and the strategy can be removed.
Increase the conveyance capacity of the culvert for the tributary to Fulling Mill Brook under East Waterbury Road downstream of the Union Ice Company Pond.	Complete
Evaluate flood mitigation options, such as dredging of the silted pond adjacent to Nichols Garage/Irving Gas Station, where Pigeon Brook flows underground before entering Hop Brook.	Complete

Strategy or Action	Status
Pursue flood mitigation along the unnamed stream associated with the Spencer Street corridor, including increased conveyance capacity of the culverted portions of the stream, channel restoration or maintenance of the un-culverted section of the stream, and/or siting of detention systems.	Not complete due to funding limitations; strategy is carried forward

Portions of the above strategies and actions have been carried forward and are listed in the table of strategies in Appendix A. Several new strategies have been identified through the process of updating this plan:

- ❑ Obtain an HMGP grant to conduct drainage improvements along Nettleton Avenue and Cherry Street.
- ❑ Provide technical assistance regarding floodproofing measures to interested residents. Pursue funding for home elevations should any residents become interested.
- ❑ Encourage property owners to purchase flood insurance under the NFIP and to report claims when flooding damage occurs.
- ❑ Develop a plan to conduct routine catch basin maintenance.

4.0 HURRICANES

4.1 Setting

Hazards associated with tropical storms and hurricanes include winds, heavy rains, and flooding. While only some of the areas of Naugatuck are susceptible to flooding damage caused by hurricanes, wind damage can occur anywhere in the Borough. Hurricanes therefore have the potential to affect any area within the Borough of Naugatuck. A hurricane striking the Borough of Naugatuck is considered a possible event each year that could cause critical damage to the Borough and its infrastructure (refer to Tables 1-2 and 1-3).

4.2 Hazard Assessment

Hurricanes are a class of tropical cyclones which are defined by the National Weather Service as non-frontal, low pressure large scale systems that develop over tropical or subtropical water and have definite organized circulations. Tropical cyclones are categorized based on the speed of the sustained (1-minute average) surface wind near the center of the storm. These categories are: Tropical Depression (winds less than 39 mph), Tropical Storm (winds 39-74 mph, inclusive) and Hurricanes (winds at least 74 mph).

The geographical areas affected by tropical cyclones are called tropical cyclone basins. The Atlantic tropical cyclone basin is one of six in the world and includes much of the North Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico. The official Atlantic hurricane season begins on June 1 and extends through November 30 of each year, although occasionally hurricanes occur outside this period.

Inland Connecticut is vulnerable to hurricanes despite moderate hurricane occurrences when compared with other areas within the Atlantic Tropical Cyclone basin. Since hurricanes tend to weaken within 12 hours of landfall, inland areas are less susceptible to hurricane wind damages than coastal areas in Connecticut; however, the heaviest rainfall often occurs inland. Therefore, inland areas are most vulnerable to inland flooding along roadways, lakes, and streams during a hurricane.

The Saffir-Simpson Scale

The "Saffir-Simpson Hurricane Scale" was used prior to 2009 to categorize hurricanes based upon wind speed, central pressure and storm surge, relating these components to damage potential. In 2009, the scale was revised and is now called the "Saffir-Simpson Hurricane Wind Scale". The modified scale is more scientifically defensible and is predicated only on surface wind speeds. The following descriptions are from the 2014 *Connecticut Natural Hazard Mitigation Plan Update*.

A Hurricane Watch is an advisory for a specific area stating that a hurricane poses a threat to coastal and inland areas. Individuals should keep tuned to local television and radio for updates.

A Hurricane Warning is then issued when the dangerous effects of a hurricane are expected in the area within 24 hours.

- **Category One Hurricane:** Sustained winds 74-95 mph (64-82 kt). Minimal Damage: Damage is primarily to shrubbery, trees, foliage, and unanchored mobile homes. No real damage occurs in building structures. Some damage is done to poorly constructed signs.

- **Category Two Hurricane:** Sustained winds 96-110 mph (83-95 kt). Moderate Damage: Considerable damage is done to shrubbery and tree foliage, some trees are blown down. Major structural damage occurs to exposed mobile homes. Extensive damage occurs to poorly constructed signs. Some damage is done to roofing materials, windows, and doors; no major damage occurs to the building integrity of structures.

- **Category Three Hurricane:** Sustained winds 111-130 mph (96-113 kt). Extensive damage: Foliage torn from trees and shrubbery; large trees blown down. Practically all poorly constructed signs are blown down. Some damage to roofing materials of buildings occurs, with some window and door damage. Some structural damage occurs to small buildings, residences and utility buildings. Mobile homes are destroyed. There is a minor amount of failure of curtain walls (in framed buildings).

- **Category Four Hurricane:** Sustained winds 131-155 mph (114-135 kt). Extreme Damage: Shrubs and trees are blown down; all signs are down. Extensive roofing material and window and door damage occurs. Complete failure of roofs on many small residences occurs, and there is complete destruction of mobile homes. Some curtain walls experience failure.

- **Category Five Hurricane:** Sustained winds greater than 155 mph (135 kt). Catastrophic Damage: Shrubs and trees are blown down; all signs are down. Considerable damage to roofs of buildings. Very severe and extensive window and door damage occurs. Complete failure of roof structures occurs on many residences and industrial buildings, and extensive shattering of glass in windows and doors occurs. Some complete buildings fail. Small buildings are overturned or blown away. Complete destruction of mobile homes occurs.

4.3 Historic Record

Through research efforts by NOAA's National Climate Center in cooperation with the National Hurricane Center, records of tropical cyclone occurrences within the Atlantic Cyclone Basin have been compiled from 1851 to present. These records are compiled in NOAA's Hurricane database (HURDAT), which contains historical data recently reanalyzed to current scientific standards as well as the most current hurricane data. During HURDAT's period of record (1851-2012), 2 Category Three Hurricanes, 8 Category Two Hurricanes, 11 Category One Hurricanes, 54 tropical storms, and 8 tropical depressions have tracked within a 150 nautical mile radius of Naugatuck, Connecticut. The representative storm strengths were measured as the peak intensities for each individual storm passing within the 150-mile radius. The 21 hurricanes noted above occurred in August and September as noted in Table 4-1.

TABLE 4-1
Tropical Cyclones by Month within 150 Nautical Miles of Naugatuck Since 1851

Category	May	June	July	Aug.	Sept.	Oct.	Nov.
Tropical Depression	None	1	1	3	1	1	None
Tropical Storm	2	7	4	11	16	11	2
One	None	None	1	2	7	2	None
Two	None	None	None	3	6	None	None
Three	None	None	None	None	2	None	None
Total	**2**	**8**	**6**	**19**	**32**	**14**	**2**

A description of the more recent tropical cyclones near Naugatuck follows:

The most devastating hurricane to strike Connecticut, and believed to be the strongest hurricane to hit New England in recorded history, was believed to be a Category 3 hurricane. Dubbed the "Long Island Express of September 21, 1938", this name was derived from the unusually high forward speed of the hurricane, estimated to be 70 mph. The hurricane made landfall at Long Island, New York and moved quickly northward over Connecticut into northern New England.

The majority of damage was caused from storm surge and wind damage. Surges of 10 to 12 feet were recorded along portions of the Long Island and Connecticut Coast, and 130 mile per hour winds flattened forests, destroyed nearly 5,000 cottages, farms, and homes, and damaged an estimated 15,000 more throughout New York and southern New England. Overall, the storm left an estimated 700 dead and caused physical damages in excess of 300 million 1938 United States dollars (USD).

The "Great Atlantic Hurricane" hit the Connecticut coast in September 1944. This Category 3 hurricane brought rainfall in excess of six inches to most of the state and rainfall in excess of eight to ten inches in Fairfield County. Most of the wind damage from this storm occurred in southeastern Connecticut. Injuries and storm damage were lower in this hurricane than in 1938 because of increased warning time and the fewer structures located in vulnerable areas due to the lack of rebuilding after the 1938 storm.

Another Category 3 hurricane, Hurricane Carol, struck in August of 1954 shortly after high tide and produced storm surges of 10 to 15 feet in southeastern Connecticut. Rainfall amounts of six inches were recorded in New London, and wind gusts peaked at over 100 mph. Near the coast, the combination of strong winds and storm surge damaged or destroyed thousands of buildings, and the winds toppled trees that left most of the eastern part of the state without power. Overall damages were estimated at $461 million (1954 USD), and 60 people died as a direct result of the hurricane. Western Connecticut was largely unaffected by Hurricane Carol due to the compact nature of the storm.

The following year, back-to-back hurricanes Connie and Diane caused torrential rains and record-breaking floods in Connecticut. Hurricane Connie was a declining tropical storm when it hit Connecticut in August of 1955, producing heavy rainfall of four to six inches across the state. The saturated soil conditions exacerbated the flooding caused by Diane five days later, a Category 1 hurricane and the wettest tropical cyclone on record for the Northeast. Diane produced 14 inches of rain in a 30-hour period, causing destructive flooding conditions along nearly every major river system in the state.

The Mad and Still Rivers in Winsted, the Naugatuck, the Farmington, and the Quinebaug River in northeastern Connecticut caused the most damage. The floodwaters resulted in over 100 deaths, left 86,000 unemployed, and caused an estimated $200 million in damages (1955 USD). For comparison, the total property taxes levied by all Connecticut municipalities in 1954 amounted to $194.1 million. A description of damage caused by the storm in the Borough of Naugatuck was included in Section 3.3. As a result of the 1955 flooding, the ACOE installed flood control dams in the Naugatuck River watershed, as detailed in Section 3 and Section 8.

In September of 1985, hurricane Gloria passed over the coastline as a Category 2 hurricane. 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 which damaged structures and uprooted trees. Over 500,000 people suffered significant power outages.

Hurricane Bob was a Category Two Hurricane when its center made landfall in Rhode Island in August of 1991. The hurricane caused storm surge damage along the Connecticut coast but was more extensively felt in Rhode Island and Massachusetts. Heavy winds were felt across eastern Connecticut with gusts up to 100 mph, light to moderate tree damage, and the storm was responsible for six deaths in the state. Total damage in southern New England was approximately $680 million (1991 USD).

Tropical Storm Floyd in September 1999 produced widespread flooding and high winds (sustained at 50 knots) that caused power outages throughout New England and at least one death in Connecticut.

Tropical Storm Irene in August 2011 produced five to 10 inches of rainfall across western Connecticut resulting in widespread flash flooding and river flooding. Local wind gusts exceeded 60 miles per hour. The combination of strong winds and saturated soil led to numerous downed trees and power outages throughout the region. Borough officials reported that Irene caused power outages of three to six days, due to wind damage. Significant road clearing was conducted as a result of the storm.

Hurricane Sandy struck the Connecticut shoreline as a Category 1 Hurricane in late October 2012, causing power outages for 600,000 customers and at least $360 million in damages in Connecticut. The Borough fared pretty well during Hurricane Sandy and power outages lasted a couple days.

4.4 Existing Capabilities

Existing mitigation measures appropriate for inland flooding have been discussed in Section 3. These include ordinances, codes, and regulations that have been enacted to minimize flood damage. In addition, various structures exist to protect certain areas, including dams and riprap.

Wind loading requirements are addressed through the state building code. The 2005 Connecticut State Building Code was amended in 2011 and adopted with an effective date of October 6, 2011; and subsequently amended to adopt the 2009 International Residential Code (IRC), effective February 28, 2014. The code specifies the design wind speed for construction in all the

Connecticut municipalities, with the addition of split zones for some towns. For example, for towns along the Merritt Parkway such as Fairfield and Trumbull, wind speed criteria are different north and south of the parkway in relation to the distance from the shoreline. Effective December 31, 2005, the design wind speed for Naugatuck is 100 miles per hour. Naugatuck has adopted the Connecticut Building Code as its building code, and literature is available regarding design standards in the Building Department office. Naugatuck has adopted the Connecticut Building Code as its building code.

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

Parts or all of tall and older trees may fall during heavy wind events, potentially damaging structures, utility lines, and vehicles. Currently tree maintenance is coordinated by the Public Works Department. Mr. Robert Roland, the Department of Public Works Superintendent is the tree warden. The Borough has a $15,000 tree budget for maintenance and emergencies and subcontractors are used for this work. Connecticut Light & Power (CL&P) also performs tree maintenance and was under intense scrutiny after storms Irene and Alfred in 2011. However, the utility has reportedly done an adequate job trimming trees since 2011.

Landowners are primarily responsible for conducting tree maintenance on private property away from Borough property. The Borough attempts to close roads at convenient intersections rather than at the location of the downed tree or branch. In addition, all utilities in new subdivisions must be located underground whenever possible in order to mitigate storm-related damages.

As explained in Section 2.9, the Borough of Naugatuck has buildings that can be used as shelters for evacuees. However, as none of these buildings currently have generators, and as the Borough has limited staffing available, the Borough generally has residents shelter in place unless there is an immediate need for evacuation. As hurricanes generally pass an area within a day's time, additional shelters can be set up after the storm as needed for long-term evacuees, or regional mass care facilities operated by the American Red Cross could be utilized.

The Borough relies on radio and television to spread information on the location and availability of shelters. During a disaster, the Borough will notify residents of emergency information on a neighborhood basis using its CodeRED emergency notification service. Prior to severe storm events, the Borough ensures that warning/notification systems and communication equipment is working properly, and prepares for the possible evacuation of impacted areas.

In summary, many of Naugatuck's capabilities to mitigate for wind damage and prevent loss of life and property have improved slightly since the initial hazard mitigation plan was adopted. Furthermore, CL&P has increased its capabilities and response relative to tree and tree limb maintenance near utility lines.

4.5 Vulnerabilities and Risk Assessment

The previous HMP noted that "it is generally believed that New England is long overdue for another major hurricane strike." Subsequent to the adoption of the plan, Tropical Storm Irene and Superstorm Sandy struck Connecticut and neighboring states in 2011 and 2012, respectively.

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.

Table 4-2 presents return periods for various category hurricanes to impact Connecticut. The nearest two HURISK analysis points were New York City and Block Island, RI. For this analysis, these data are assumed to represent western Connecticut and eastern Connecticut, respectively.

TABLE 4-2
Return Period (in Years) for Hurricanes to Strike Connecticut

Category	New York City (Western Connecticut)	Block Island, RI (Eastern Connecticut)
One	17	17
Two	39	39
Three	68	70
Four	150	160
Five	370	430

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 hurricane approaches, which are only predictable within several days of the storm making landfall."

According to the 2014 *Connecticut Natural Hazard Mitigation Plan Update*, hurricanes have the greatest destructive potential of all natural disasters in Connecticut due to the potential combination of high winds, storm surge and coastal erosion, heavy rain, and flooding which can accompany the hazard. As shown in Table 4-2, NOAA estimates that the return period for a Category Two or Category Three storm to strike New Haven County to be 39 years and 68 years, respectively.

The 2014 *Connecticut Natural Hazard Mitigation Plan Update* also notes that some researchers have suggested that the intensity of tropical cyclones has increased over the last 35 years, with some believing that there is a connection between this increase in intensity and climate change.

While most climate simulations agree that greenhouse warming enhances the frequency and intensity of tropical storms, models of the climate system are still limited by resolution and computational ability. However, given the past history of major storms and the possibility of increased frequency and intensity of tropical storms due to climate change, it is prudent to expect that there will be hurricanes impacting Connecticut in the future that may be of greater frequency and intensity than in the past.
The Borough of Naugatuck is vulnerable to hurricane damage from wind and flooding, and from any tornadoes accompanying the storm. Areas of known and potential flooding problems are discussed in Section 3, and tornadoes will be discussed in Section 5. Hurricane-force winds can easily destroy poorly constructed buildings and mobile homes. 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), 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, so adequate fire protection is important.

There are five mobile home parks in the Borough of Naugatuck that are considered to be at increased risk of being damaged by high winds associated with tropical storm systems:

- Idleview Mobile Home Park on Lewis Hill off Duncan Avenue in the northwestern section of Naugatuck;
- Riverview Mobile Home Estates on Thunderbird Drive in the northern part of Naugatuck overlooking the Naugatuck River;
- The Davis Mobile Home Park at 117 Lewis Street;
- The Weber Mobile Home Park at 137 Lewis Street; and
- Gendron's Valley Mobile Home Park at 108 Clark Hill Road.

As the residents and businesses of the State 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 several weeks, rendering electronic devices and those that rely on utility towers and lines inoperative. According to the Connecticut DEEP, this is a significant risk that cannot be quantitatively estimated.

As the Borough of Naugatuck is not affected by storm surge, hurricane sheltering needs have not been calculated by the Army Corps of Engineers for the Borough. The Borough of Naugatuck determines sheltering need based upon areas damaged within the Borough. Under limited emergency conditions, a high percentage of evacuees will seek shelter with friends or relatives rather than go to established shelters. During extended power outages, it is believed that only 10% to 20% of the affected population of Naugatuck will relocate, though many of this number will again stay with friends or relatives rather than go to established shelters.

HAZUS-MH Simulation

In order to quantify potential hurricane damage, HAZUS-MH simulations were run for historical and probabilistic storms that could theoretically affect Naugatuck. For the historical simulations, the results estimate the potential maximum damage that would occur in the present day (based on year 2006 dollar values using year 2000 census data) given the same storm track and characteristics of each event. The probabilistic storms estimate the potential maximum damage that would occur based on wind speeds of varying return periods. Note that the simulations calculate damage for wind effects alone and not damages due to flooding or other non-wind effects. Thus, the damage and displacement estimates presented below are likely lower than would occur during a hurricane associated with severe rainfall. Results are presented in Appendix C and summarized below.

Figure 4-1 depicts the spatial relationship between the two historical storm tracks used for the HAZUS simulations (Hurricane Gloria in 1985 and the 1938 hurricane) and Naugatuck. These two storm tracks produced the highest winds to affect Naugatuck out of all the hurricanes in the HAZUS-MH software.

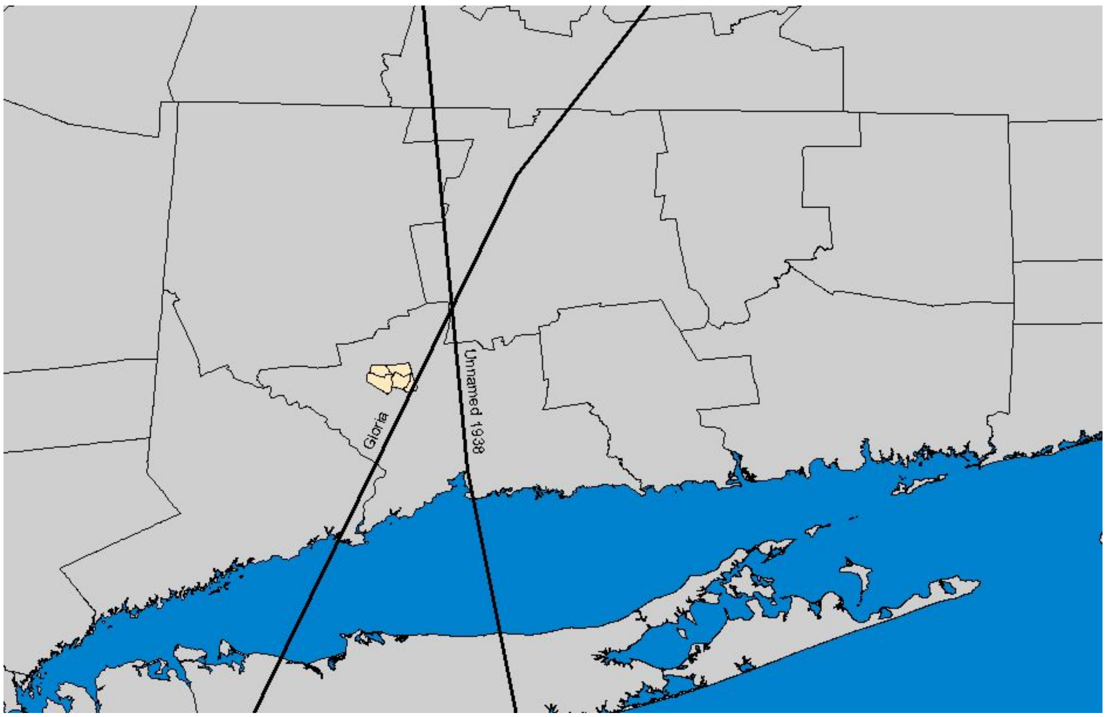


Figure 4-1: Historical Hurricane Storm Tracks

The FEMA default values were used for each census tract in the HAZUS simulations. A summary of the default building counts and values was shown in Table 3-3.

The FEMA *Hurricane Model HAZUS-MH Technical Manual* outlines various damage thresholds to classify buildings damaged during hurricanes. The five classifications are summarized below:

- **No Damage or Very Minor Damage**: Little or no visible damage from the outside. No broken windows or failed roof deck. Minimal loss of roof cover, with no or very limited water penetration.

- **Minor Damage**: Maximum of one broken window, door, or garage door. Moderate roof cover loss that can be covered to prevent additional water entering the building. Marks or dents on walls requiring painting or patching for repair.

- **Moderate Damage**: Major roof cover damage, moderate window breakage. Minor roof sheathing failure. Some resulting damage to interior of building from water.

- **Severe Damage**: Major window damage or roof sheathing loss. Major roof cover loss. Extensive damage to interior from water. Limited, local joist failures. Failure of one wall.

- **Destruction:** Essentially complete roof failure and/or more than 25% of roof sheathing. Significant amount of the wall envelope opened through window failure and/or failure of more than one wall. Extensive damage to interior.

Table 4-3 presents the peak wind speeds during each wind event simulated by HAZUS for Naugatuck. The number of expected residential buildings to experience various classifications of damage is presented in Table 4-3, and the total number of buildings expected to experience various classifications of damage is presented in Table 4-4. Minimal damage is expected to buildings for wind speeds less than 58 mph, with overall damages increasing with increasing wind speed.

TABLE 4-3
HAZUS Hurricane Scenarios – Number of Residential Buildings Damaged

Return Period or Storm	Peak Wind Gust (mph)	Minor Damage	Moderate Damage	Severe Damage	Total Destruction	Total
10-Years	42	None	None	None	None	None
20-Years	57-58	6	None	None	None	6
50-Years	76-77	64	5	None	None	69
Gloria (1985)	79	71	6	None	None	77
100-Years	88-90	417	46	1	None	464
200-Years	99-101	1,240	195	7	3	1,445
Unnamed (1938)	107	1,950	416	26	14	2,406
500-Years	111-113	2,628	742	71	43	3,484
1000-Years	120-122	3,383	1,406	236	151	5,176

TABLE 4-4
HAZUS Hurricane Scenarios – Total Number of Buildings Damaged

Return Period or Storm	Minor Damage	Moderate Damage	Severe Damage	Total Destruction	Total
10-Years	None	None	None	None	None
20-Years	8	None	None	None	8
50-Years	70	5	None	None	75
Gloria (1985)	77	6	None	None	83
100-Years	442	49	2	None	493
200-Years	1,313	211	10	3	1,537
Unnamed (1938)	2,068	457	33	15	2,573
500-Years	2,786	820	89	44	3,739
1000-Years	3,579	1,557	290	152	5,578

The HAZUS simulations consider a subset of critical facilities termed "essential facilities" which are important during emergency situations. Note that the essential facilities in HAZUS-MH may not necessarily be the same today as they were in 2000. Nevertheless, the information is useful from a planning standpoint. As shown in Table 4-5, minimal damage to essential facilities is expected for wind speeds less than 90 mph. Moderate damage to hospitals occurs for all greater wind events with a corresponding loss of service. Minor damage to schools occurs at wind speeds of approximately 99 mph and greater with a corresponding increase in damages.

TABLE 4-5
HAZUS-MH Hurricane Scenarios – Essential Facility Damage

Return Period or Storm	Fire Stations (1)	Police Stations (3)	Schools (15)
10-Years	None or Minor	None or Minor	None or Minor
20-Years	None or Minor	None or Minor	None or Minor
50-Years	None or Minor	None or Minor	None or Minor
Gloria (1985)	None or Minor	None or Minor	None or Minor
100-Years	None or Minor	None or Minor	None or Minor
200-Years	None or Minor	None or Minor	Minor Damage with loss of use to 12 schools
Unnamed (1938)	None or Minor	None or Minor	Minor damage with loss of use to all schools
500-Years	None or Minor	None or Minor	Minor damage with loss of use to all schools
1000-Years	None or Minor	None or Minor	Minor damage with loss of use to 5 schools; Moderate damage to 10 schools

Table 4-6 presents the estimated tonnage of debris that would be generated by wind damage during each HAZUS storm scenario. The model breaks the debris into four general categories based on the different types of material handling equipment necessary for cleanup. As shown in Table 4-6, minimal debris are expected for storms less than the 20-year event, and reinforced concrete and steel buildings are not expected to generate debris. Much of the debris that is generated is structure-related.

TABLE 4-6
HAZUS-MH Hurricane Scenarios – Debris Generation (Tons)

Return Period or Storm	Brick / Wood	Reinforced Concrete / Steel	Eligible Tree Debris	Other Tree Debris	Total
10-Years	None	None	None	None	None
20-Years	1	None	18	12	31
50-Years	377	None	177	140	694
Gloria (1985)	410	None	202	155	767
100-Years	1,838	None	3,006	2,263	7,107
200-Years	4,798	None	4,088	3,809	12,695
Unnamed (1938)	8,106	None	6,632	6,176	20,915
500-Years	12,783	None	10,890	9,894	33,567
1000-Years	24,503	None	19,253	18,485	62,241

Table 4-7 presents the potential sheltering requirements based on the various wind events simulated by HAZUS. The predicted sheltering requirements for <u>wind damage</u> are relatively minimal for wind events less than 90 mph. Larger wind events are expected to require significant shelter usage. In addition, it is likely that hurricanes will also produce heavy rain and flooding that will increase the overall sheltering need in Naugatuck.

TABLE 4-7
HAZUS Hurricane Scenarios – Shelter Requirements

Return Period or Storm	Number of Displaced Households	Short Term Sheltering Need (Number of People)
10-Years	None	None
20-Years	None	None
50-Years	None	None
Gloria (1985)	None	None
100-Years	None	None
200-Years	7	0
Unnamed (1938)	28	6
500-Years	84	13
1000-Years	358	67

Table 4-8 presents the predicted economic losses due to the various simulated wind events. Property damage loss estimates include the subcategories of building, contents, and inventory damages. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building or its contents. Business interruption loss estimates include the subcategories of lost income, relocation expenses, and lost wages. The business interruption losses are associated with the inability to operate a business due to the damage sustained during a hurricane, and also include temporary living expenses for those people displaced from their home because of the storm.

TABLE 4-8
HAZUS Hurricane Scenarios – Economic Losses

Return Period or Storm	Residential Property Damage Losses	Total Property Damage Losses	Business Interruption (Income) Losses	Total Losses
10-Years	None	None	None	None
20-Years	$72,500	$72,500	$580	$73,090
50-Years	$2,801,200	$2,901,340	$81,790	$2,983,130
Gloria (1985)	$3,039,050	$3,153,710	$94,000	$3,247,710
100-Years	$10,705,250	$11,378,680	$1,073,210	$12,451,880
200-Years	$26,834,040	$29,540,150	$3,300,880	$32,841,030
Unnamed (1938)	$48,294,380	$54,693,700	$6,734,330	$61,428,040
500-Years	$83,25,010	$96,492,580	$12,588,330	$109,080,910
1000-Years	$178,291,750	$211,509,600	$28,539,310	$240,048,920

Losses are minimal for storms with return periods of less than 20-years (58 mph) but increase rapidly as larger storms are considered. For example, a 1,000 year storm would cause approximately $240 million in wind damages to Naugatuck. As these damage values are based on 2006 dollars, it is likely that these estimated damages will be higher today due to inflation.

In summary, hurricanes are a very real and potentially costly hazard to Naugatuck. Based on the historic record and HAZUS-MH simulations of various wind events, the entire community is vulnerable to wind damage from hurricanes. These damages can include direct structural damages, interruptions to business and commerce, emotional impacts, and injury and possibly death.

4.6 Potential Mitigation Strategies and Actions

Many potential mitigation measures for hurricanes include those appropriate for inland flooding. These were presented in Section 3.6. However, hurricane mitigation measures must also address the effects of heavy winds that are inherently caused by hurricanes. Mitigation for wind damage is therefore emphasized in the subsections below.

4.6.1 Prevention

Although hurricanes and tropical storms cannot be prevented, a number of methods are available to continue preventing damage from the storms, and perhaps to mitigate damage. The following actions have been identified as potential preventive measures:

- ❑ Continue Borough-wide tree limb inspection and maintenance programs to ensure that the potential for downed power lines is diminished.
- ❑ Continue location of utilities underground in new developments or as related to redevelopment.
- ❑ As required by law, continue to review the currently enacted Emergency Operations Plan for the Borough and update when necessary.

4.6.2 Property Protection

Many people perform basic property protection measures in advance of hurricanes, including cutting dangerous tree limbs, boarding windows, and moving small items inside that could be carried away by heavy winds. Tree wardens may conduct education and outreach regarding dangerous trees on private property, particularly for trees near homes with dead branches overhanging the structure or nearby power lines. These limbs are the most likely to fall during a storm.

4.6.3 Public Education and Awareness

Tracking of hurricanes has advanced to the point where areas often have one week of warning time or more prior to a hurricane strike. The public should be made aware of available shelters and evacuation routes prior to a hurricane event, as well as potential measures to mitigate personal property damage.

4.6.4 Emergency Services

The Emergency Operation Plan of the Borough of Naugatuck includes guidelines and specifications for communication of hurricane warnings and watches, as well as for a call for evacuation. The public needs to be made aware in advance of a hurricane event of evacuation routes and the locations of public shelters, which could be accomplished by placing this information on the Borough website and by creating informational displays in local municipal buildings. In addition, Naugatuck should identify and prepare additional facilities for evacuation and sheltering needs. The Borough should also review its mutual aid agreements and update as necessary to ensure help is available as needed and ensure that the community is not hindered responding to its own emergencies as it assists with regional emergencies.

The Connecticut Public Utility Regulatory Authority is currently piloting a "micro-grid" program designed to provide backup power supplies to small areas critical to public supply distribution. These infrastructure improvements will allow for small areas of the power grid to be isolated and powered by emergency generators, such as those where supermarkets and gas stations are located. Naugatuck.

4.6.5 Structural Projects

While structural projects to completely eliminate wind damage are not possible, potential structural mitigation measures for buildings include designs for hazard-resistant construction and retrofitting techniques. These generally take the form of increased wind and flood resistance as well as the use of storm shutters over exposed glass and the inclusion of hurricane straps to hold roofs to buildings. The four categories of structural projects for wind damage mitigation in private homes and critical facilities include the installation of shutters, load path projects, roof projects, and code plus projects and are defined below.

- Shutter mitigation projects protect all windows and doors of a structure with shutters, lamentations, or other systems that meet debris impact and wind pressure design requirements. All openings of a building are to be protected, including garage doors on residential buildings, large overhead doors on commercial buildings, and apparatus bay doors at fire stations.
- Load path projects improve and upgrade the structural system of a building to transfer loads from the roof to the foundation. This retrofit provides positive connection from the roof framing to the walls, better connections within the wall framing, and connections from the wall framing to the foundation system.
- Roof projects involve retrofitting a building's roof by improving and upgrading the roof deck and roof coverings to secure the building envelope and integrity during a wind or seismic event.
- Code plus projects are those designed to exceed the local building codes and standards to achieve a greater level of protection.

Given the relative infrequency of hurricane wind damage in Connecticut, it is unlikely that any structural project for mitigating wind damage would be cost effective (and therefore eligible for grant funding) unless it was for a critical facility. Communities should encourage the above measures in new construction, and require it for new critical facilities. Continued compliance with the amended Connecticut Building Code for wind speeds is necessary. Literature should be made available by the Building Department to developers during the permitting process regarding these design standards.

4.7 Status of Mitigation Strategies and Actions

Strategies and actions described in Section 3.7 for the mitigation of flooding are also pertinent to mitigating tropical storm or hurricane related flooding, and are not repeated here. The prior mitigation strategies and actions for mitigation of hurricane and tropical storm winds are listed below with commentary regarding the status of each.

TABLE 4-9
Status of Previous Strategies and Actions

Strategy or Action	Status
Continue Borough-wide tree limb inspection and maintenance programs to ensure that the potential for downed power lines is diminished.	This is on-going and is now part of the Borough's capabilities, therefore it can be removed.
Focus tree limb maintenance and inspections along Route 63, Route 68, Spring Street, Union City Road, and other evacuation routes. Increase inspections of trees on private property near power lines and Borough right-of-ways.	This is on-going and is now part of the Borough's capabilities, therefore it can be removed.
Continue to require that utilities be placed underground in new developments and pursue funding to place them underground in existing developed areas.	The Borough still requires underground utilities for new developments and the strategy has become part of the Borough's overall capabilities, therefore it can be removed. The Borough does not wish to pursue placing utilities underground elsewhere, due to cost.
Review potential evacuation plans to ensure timely migration of people seeking shelter in all areas of Naugatuck, and post evacuation and shelter information on the Borough website and in municipal buildings.	The Borough has an evacuation plan and will continue to update the plan as needed; this strategy can be removed because it is a capability.
Provide for the Building Department to have literature available regarding appropriate design standards for wind.	This is on-going and is now part of the Borough's capabilities, therefore it can be removed.

One new strategy has been identified through the process of updating this plan:

- ❑ Review critical facilities and ensure that each one has adequate standby power. For those facilities that do not, consider acquiring standby power supplies.

Future editions of this plan will revisit the potential for replacing overhead utilities with underground utilities.

5.0 SUMMER STORMS AND TORNADOES

5.1 Setting

Like hurricanes and winter storms, summer storms and tornadoes have the potential to affect any area within the Borough of Naugatuck. Furthermore, because these types of storms and the hazards that result (flash flooding, wind, hail, and lightning) might have limited geographic extent, it is possible for a summer storm to harm one area within the Borough without harming another. The entire Borough of Naugatuck is therefore susceptible to summer storms (including heavy rain, flash flooding, wind, hail, and lightning) and tornadoes.

Based on the historic record, it is considered highly likely that a summer storm that includes lightning will impact the Borough of Naugatuck each year, although lightning strikes have a limited effect. Strong winds and hail are considered likely to occur during such storms but also generally have limited effects. A tornado is considered a possible event in New Haven County each year that could cause significant damage to a small area (refer to Appended Table 2).

5.2 Hazard Assessment

Heavy wind (including tornadoes and downbursts), lightning, heavy rain, hail, and flash floods are the primary hazards associated with summer storms. Flooding caused by heavy rainfall was covered in Section 3.0 of this plan and will not be discussed in detail herein.

Tornadoes

NOAA defines a tornado as "a violently rotating column of air extending from a thunderstorm to the ground." The two types of tornadoes include those that develop from supercell thunderstorms and those that do not. While the physics of tornado development are fairly well understood, there are many unknowns still being studied regarding the exact conditions in a storm event required to trigger a tornado, the factors affecting the dissipation of a tornado, and the effect of cloud seeding on tornado development.

Supercell thunderstorms are long-lived (greater than one hour) and highly organized storms feeding off an updraft that is tilted and rotating. This rotation is referred to as a "mesocyclone" when detected by Doppler radar. The figure below is a diagram of the anatomy of a supercell that has spawned a supercell tornado. Tornadoes that form from a supercell thunderstorm are a very small extension of the larger rotation; they are the most common and the most dangerous type of tornado, as most large and violent tornadoes are spawned from supercells.

Non-supercell tornadoes are defined by NOAA as circulations that form without a rotating updraft. Damage from these types of tornadoes tends to be F2 or less (see Fujita Scale, below). The two types of non-supercell tornadoes are gustnadoes and landspouts:

- ❑ A gustnado is a whirl of dust or debris at or near the ground with no condensation tunnel that forms along the gust front of a storm.

- ❑ A landspout is a narrow, rope-like condensation funnel that forms when the thunderstorm cloud is still growing and there is no rotating updraft. Thus, the spinning motion originates near the ground. Waterspouts are similar to landspouts but occur over water.

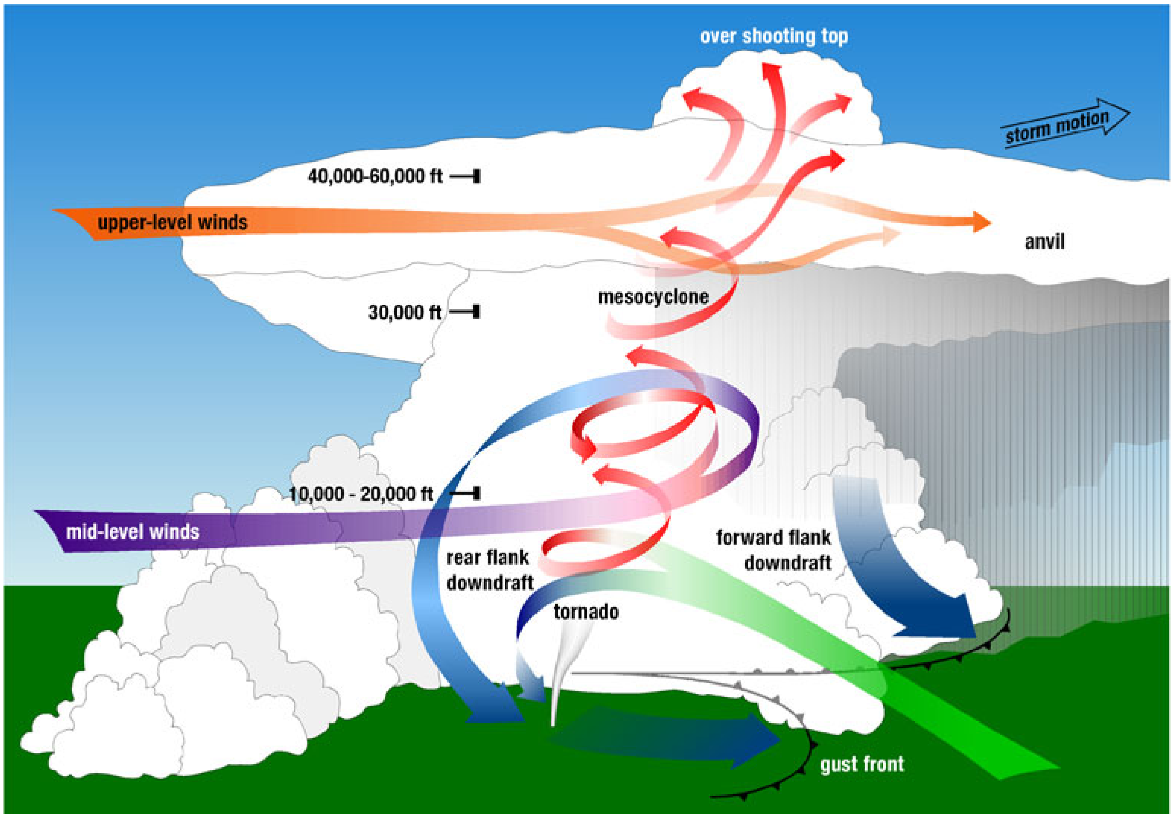
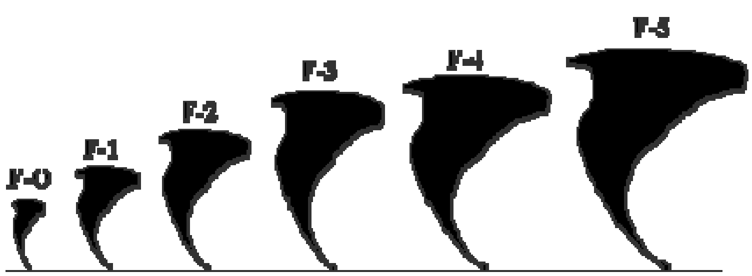


Figure 5-1: Anatomy of a Tornado. Image from NOAA National Severe Storms Laboratory.

The Fujita scale was accepted as the official classification system for tornado damage for many years following its publication in 1971. The Fujita scale rated the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure. The scale ranked tornadoes using the now-familiar notation of F0 through F5, increasing with wind speed and intensity. A description of the scale follows in Table 5-1.



Fujita Tornado Scale. Image courtesy of FEMA.

TABLE 5-1
Fujita Scale

F-Scale Number	Intensity	Wind Speed	Type of Damage Done
F0	Gale tornado	40-72 mph	Some damage to chimneys; branches broken off trees; shallow-rooted trees knocked over; damage to sign boards.
F1	Moderate tornado	73-112 mph	Peels surface off of roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off for some distance; cars thrown and large missiles generated
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile-sized missiles fly through the air in excess of 100 meters; trees de-barked; steel reinforced concrete structures badly damaged.

According to NOAA, weak tornadoes (F0 and F1) account for approximately 69% of all tornadoes. These tornadoes last an average of five to 10 minutes and account for approximately 3% of tornado-related deaths. Strong tornadoes (F2 and F3) account for approximately 29% of all tornadoes and approximately 27% of all tornado deaths. These storms may last for 20 minutes or more. Violent supercell tornadoes (F4 and above) are extremely destructive but rare and account for only 2% of all tornadoes. These storms sometimes last over an hour and result in approximately 70% of all tornado-related deaths.

The Enhanced Fujita Scale was released by NOAA for implementation on February 1, 2007. According to the NOAA web site, the Enhanced Fujita Scale was developed in response to a number of weaknesses to the Fujita Scale that were apparent over the years, including the subjectivity of the original scale based on damage, the use of the worst damage to classify the tornado, the fact that structures have different construction depending on location within the United States, and an overestimation of wind speeds for F3 and greater.

Similar to the Fujita Scale, the Enhanced F-scale is also a set of wind estimates based on damage. It uses three-second gusts estimated at the point of damage based on a judgment of eight levels of damage to 28 specific indicators. Table 5-2 relates the Fujita and enhanced Fujita scales.

TABLE 5-2
Enhanced Fujita Scale

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

Official records of tornado activity date back to 1950. According to NOAA, an average of 1,000 tornadoes is reported each year in the United States. The historic record of tornadoes near Naugatuck is discussed in Section 5.4. Tornadoes are most likely to occur in Connecticut in June, July, and August of each year

Lightning

Image courtesy of NOAA.

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.

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.

According to NOAA's National Weather Service, there is an average of 100,000 thunderstorms per year in the United States. An average of 41 people per year died and an average of 262 people were injured from lightning strikes in the United States from 2000 to 2009. 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.

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).*

It is difficult to find statistical data regarding frequency of downburst activity. 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 value suggests that downbursts are a relatively uncommon yet persistent hazard.

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 one centimeter (cm) diameter hailstone, to 48 m/s (107 mph) for an eight cm, 0.7 kilogram stone. While crops are the major victims of hail, larger hail is also a hazard to people, vehicles, and property.

According to NOAA's National Weather Service, hail caused four deaths and an average of 47 injuries per year in the United States from 2000 to 2009. Hailstorms typically occur in at least one part of Connecticut each year during a severe thunderstorm.

5.3 Historic Record

According to NOAA, the highest number of occurrences of tornadoes in Connecticut is Litchfield (22 events between 1950 and 2009) and Hartford counties, followed by New Haven and Fairfield counties, and then Tolland, Middlesex, Windham, and finally New London County. Naugatuck is located in northern New Haven County, bordering Litchfield County. Seven tornadoes have occurred in Litchfield County between January 1996 and April 2013, and 2 have occurred in New Haven County in that same period of time.

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. Table 5-3 summarizes the tornado events near Naugatuck through July 2013 based on the Wikipedia list.

TABLE 5-3
Tornado Events Near Naugatuck From 1648 to July 2013

Date	Location	Fujita Tornado Scale	Property Damage	Injuries / Deaths
August 21, 1951	Southwestern Litchfield County through northern Watertown and into Hartford County (40 miles)	F2	NR	9 injured
May 24, 1962	Northern New Haven and Southern Hartford Counties (11 miles)	F3	200 buildings destroyed, 600 damaged, $4,000,000 in damages	1 death, 50 injured
June 18, 1962	Eastern Litchfield County	F2	NR	NR
July 29, 1972	Downtown Waterbury	F3 / F2	Factory unroofed, houses damaged	2 injured
July 28, 1982	Central New Haven County	F1	NR	NR
July 10, 1989	Watertown to northern Waterbury	F2	50 homes unroofed or severely damaged	70 injured
July 23, 1995	Prospect	F0	Tractor trailer thrown 200 yards	NR
July 3, 1996	Downtown Waterbury	F1	Damage to high school	NR
July 31, 2009	Naugatuck	F1	Trees snapped and uprooted	NR

NR = Not Reported

Additional information regarding the July 31, 2009 tornado referenced in Table 5-3 was found on the NCDC Storm Events database and indicated that the significant amount of tree damage was indicative of a microburst with estimated maximum winds of about 95 mph.

Thunderstorms occur on 18 to 35 days each year in Connecticut. Only 17 lightning-related fatalities occurred in Connecticut between 1959 and 2009. Hail is often a part of such thunderstorms as seen in the historic record for Naugatuck. A selection of summer storm damage in the area, taken from the NCDC Storm Events database, is listed below:

- September 9, 1994 – Lightning strikes were reported from Milford to Naugatuck.
- April 4, 1995 – A roof was blown off of one house and two other homes were damaged by thunderstorm winds in Naugatuck.
- May 29, 1995: Severe thunderstorm winds were reported in the vicinity of Seymour and Naugatuck.
- August 2, 1995 – Severe thunderstorms were reported between Oxford and Naugatuck. The storm downed several trees and power lines as it moved across Connecticut.
- October 21, 1995 – A squall line generated thunderstorms that downed several trees and power lines. Several vehicles were damaged by the falling trees.
- July 15, 1997: Clusters of slow-moving severe thunderstorms produced high winds (50 miles per hour), hail, and heavy rain across New Haven County. Lightning struck four hilltop houses in eastern Naugatuck, causing minor damage.
- June 30, 1998: Two rounds of thunderstorms affected New Haven County, producing frequent lightning and heavy rain. Lightning struck a house in the Ridge Subdivision of Naugatuck, causing damage to a bedroom wall in the morning. In the afternoon, severe

thunderstorms produced high winds, large hail, and frequent lightning that downed many trees in New Haven County.

- August 11, 1998: An isolated severe thunderstorm produced a wet microburst of high winds and heavy rain over Naugatuck. The 61 mph winds caused a three-quarter of a mile wide area of widespread tree damage from Highland Avenue to Woodland Street (about one to one and a half miles in length). Two people were injured when a large tree fell on their second floor porch on High Street.
- January 18, 1999: Thunderstorms produced a brief period of high winds, lightning, and torrential rain. Lightning struck a house on Osborn Road in Naugatuck, and struck a house on Keefe Street in Waterbury. The rainfall caused minor flooding of low-lying and poor drainage areas including streets and basements.
- September 16, 1999 – In addition to the flooding damages described in Section 3.3, the remnants of Tropical Storm Floyd also produced wind gusts up to 60 miles per hour in New Haven County, causing widespread downing of trees and power lines. Significant power outages were reported.
- May 18, 2000: A line of severe thunderstorms produced damaging wind gusts up to 70 mph, primarily small hail, heavy rain, and lightning. Spotters reported downed trees, tree limbs, and wires in Waterbury, and one-half inch diameter hail was reported in Naugatuck.
- June 11, 2001: Locally severe thunderstorms produced high winds that downed trees and power lines across portions of southern Connecticut, and heavy rains that caused areas of flooding on roadways and in low-lying areas. 50 mph winds were reported in Naugatuck.
- June 16, 2002 – A severe thunderstorm produced large hail and damaging wind gusts as it moved east across Connecticut. Spotters reported 0.75-inch diameter hail in Waterbury, and high winds downed trees in Naugatuck.
- August 21, 2004 – Trees were downed in Beacon Falls and Southbury as a result of thunderstorms accompanied by 50 mph wind gusts.
- July 28, 2006 – Severe thunderstorms produced high winds up to 50 mph that downed many trees and power lines across the state, including in nearby Beacon Falls.
- June 5, 2007: Severe thunderstorms produced large hail (up to 1.75 inches in diameter) that accumulated up to one inch in depth along the Interstate 84 corridor. The storms also produced damaging winds and two to three inches of heavy rainfall that caused flash flooding throughout the area. The flash flooding resulted in lane closures on Prospect Street in Naugatuck.
- July 28, 2007: Thunderstorms produced torrential rain and high winds and flash flooding in parts of New Haven and Middlesex Counties. Old Firehouse Road in Naugatuck was closed due to flooding.
- May 27, 2008: Strong thunderstorms in advance of a cold front crossed the tri-state area producing isolated flash flooding in New Haven County.
- July 16, 2009: A pre-frontal trough spawned an isolated severe thunderstorm which impacted northern portions of New Haven and Middlesex Counties. The storm produced very heavy rain and resulted in isolated flash flooding.
- October 1, 2010: Low pressure tracked up the east coast and interacted with a stalled frontal boundary and approaching upper level low pressure system. Strong southerly flow allowed for the transport of tropical moisture, including the remnants of Tropical Storm Nicole, up the coast which resulted in heavy rain and flooding in portions of Fairfield and New Haven Counties.
- June 23, 2011: Waves of low pressure riding along a nearly stationary frontal boundary across the local area caused several rounds of thunderstorms, which resulted in flash flooding in portions of Southern Connecticut.

- On August 1, 2012, a localized heavy rainfall dropped 6" of rain in the Greater Naugatuck area in one hour. This storm caused drainage failures, flooding of streets and homes and the collapse of several retaining walls throughout the Borough. All of the Long Meadow Pond Brook culverts flooded.

Borough officials also noted that several years ago, Naugatuck experienced a significant hailstorm that damaged hundreds of roofs and damaged countless cars.

5.4 Existing Capabilities

Warning is the primary method of existing mitigation for tornadoes and thunderstorm-related hazards. The NOAA National Weather Service issues watches and warnings when severe weather is likely to develop or has developed, respectively. Tables 5-4 and 5-5 list the NOAA Watches and Warnings, respectively, as pertaining to actions to be taken by emergency management personnel in connection with summer storms and tornadoes.

> A severe thunderstorm watch is issued by the National Weather Service when the weather conditions are such that a severe thunderstorm (winds greater than 58 miles per hour, or hail three-fourths of an inch or greater, or can produce a tornado) is likely to develop.
>
> A severe thunderstorm warning is issued when a severe thunderstorm has been sighted or indicated by weather radar.

TABLE 5-4
NOAA Weather Watches

Weather Condition	Meaning	Actions
Severe Thunderstorm	Severe thunderstorms are possible in your area.	Notify personnel, and watch for severe weather.
Tornado	Tornadoes are possible in your area.	Notify personnel, and be prepared to move quickly if a warning is issued.
Flash Flood	It is possible that rains will cause flash flooding in your area.	Notify personnel to watch for street or river flooding.

TABLE 5-5
NOAA Weather Warnings

Weather Condition	Meaning	Actions
Severe Thunderstorm	Severe thunderstorms are occurring or are imminent in your area.	Notify personnel and watch for severe conditions or damage (i.e. downed power lines and trees. Take appropriate actions listed in local emergency plans.
Tornado	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.
Flash Flood	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.

Aside from warnings, several other methods of mitigation for wind damage are employed in Naugatuck. Continued location of utilities underground is an important method of reducing wind damage to utilities and the resulting loss of services. The Connecticut Building Codes include guidelines for Wind Load Criteria that are specific to each municipality, as explained in Section 4.0. In addition, specific mitigation measures address debris removal and tree trimming.

In the Borough of Naugatuck, the local utilities are responsible for tree branch removal and maintenance above and near their lines. In addition, all new developments in Naugatuck must place utilities underground wherever possible. The Public Works Department also performs annual tree maintenance on municipal right of ways.

Municipal responsibilities relative to tornado mitigation and preparedness include:

- ❑ Developing and disseminating emergency public information and instructions concerning tornado safety, especially guidance regarding in-home protection and evacuation procedures, and locations of public shelters.
- ❑ Designate appropriate shelter space in the community that could potentially withstand tornado impact.
- ❑ Periodically test and exercise tornado response plans.
- ❑ Put emergency personnel on standby at tornado 'watch' stage.
- ❑ Utilizing the "CodeRED" Emergency Notification System to send warnings into potentially affected areas.

In general, the protocols and regulations that the Borough of Naugatuck has in place, such as requiring that all new developments place utilities underground, are considered effective for mitigating wind and summer storm-related damage.

5.5 Vulnerabilities and Risk Assessment

Description – According to the 2014 *Natural Hazard Mitigation Plan Update*, New Haven County has a moderate to high risk of tornado activity based on historical occurrences. By virtue of its location in New Haven County, the Borough of Naugatuck has a moderate to high potential to experience tornado damage. In addition, 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.

Although tornadoes pose a threat to all areas of the state, their occurrence is not considered frequent enough to justify the construction of tornado shelters. Instead, the State has provided NOAA weather radios to all public schools as well as many local governments for use in public buildings. The general public continues to rely on mass media for knowledge of weather warnings. Warning time for tornadoes is very short due to the nature of these types of events, so pre-disaster response time can be limited. However, the NOAA weather radios provide immediate notification of all types of weather warnings in addition to tornadoes, making them very popular with communities.

The central and southern portions of the United States are at higher risk for lightning and thunderstorms than is the northeast. However, more deaths from lightning occur on the East Coast than elsewhere, according to FEMA. Lightning-related fatalities have declined in recent years due to increased education and awareness.

In general, thunderstorms and hailstorms in Connecticut are more frequent in the western and northern parts of the state, and less frequent in the southern and eastern parts. Thunderstorms are expected to impact Naugatuck at least 20 days each year. The majority of these events do not cause any measurable damage. Although lightning is usually associated with thunderstorms, it can occur on almost any day. The likelihood of lightning strikes in the Naugatuck area is very high during any given thunderstorm although no one area of the borough is at higher risk of lightning strikes. The risk of at least one hailstorm occurring in Naugatuck is considered moderate in any given year.

Most thunderstorm damage is caused by straight-line winds exceeding 100 mph. Straight-line winds occur as the first gust of a thunderstorm or from the downburst from a thunderstorm, and have no associated rotation. Naugatuck is particularly susceptible to damage from high winds due to its high elevation and heavily treed landscape.

Secondary damage from falling branches and trees is more common than direct wind damage to structures. Heavy winds can take down trees near power lines, leading to the start and spread of fires. Such fires can be extremely dangerous during the summer months during dry and drought conditions. Most downed power lines in Naugatuck are detected quickly and any associated fires are quickly extinguished. However, it is important to have adequate water supply for fire protection to ensure this level of safety is maintained.

According to Borough personnel, the most susceptible areas of Borough to wind damage are the mobile home parks listed in Section 4.5. Other areas of Borough are more susceptible to damage from falling branches and trees than from actual wind damage.

<u>Loss Estimates</u> – The 2014 Connecticut Natural Hazard Mitigation Plan provides annual estimated losses on a countywide basis for several hazards. Based on the population of Naugatuck relative to New Haven County, the annual estimated loss is $2,993 for thunderstorms and $312,343 for tornadoes. The figure for tornadoes is based on their infrequent occurrence coupled with high costs. The localized heavy rainfall of August 1, 2012 caused damages that exceeded this estimated annual loss figure for thunderstorms, demonstrating that severe localized events can occur with significant damage. In this particular case, most of the damage was from flooding. Likewise, the tornado that hit the borough in 2009 caused significant tree damage that exceeded the estimated annual loss figure for thunderstorms.

<u>Summary</u> – In summary, the entire community is at relatively equal risk for experiencing damage from summer storms and tornadoes. Based on the historic record, several severe thunderstorms and associated events like tornadoes have resulted in costly damages in Naugatuck. Most damages are relatively site-specific and occur to private property (and therefore are paid for by private insurance). For municipal property, the budget for tree removal and minor repairs may need to be adjusted from time to time to address storms. Based on the damage caused by the 2009 tornado, an estimate of several million dollars in damage may be reasonable for an EF2 tornado striking Naugatuck, and with a greater damage amount to be expected should an EF3 or stronger tornado strike.

5.6 Potential Mitigation Strategies and Actions

Strategies and actions described in Section 4.6 for wind are applicable to thunderstorms and tornadoes as well.

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:

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

NOAA information includes a discussion of family preparedness procedures and the best physical locations during a storm event. Residents should be encouraged to purchase a NOAA weather radio containing an alarm feature.

More information is available at:

FEMA – http://www.fema.gov/library/
NOAA – http://www.nssl.noaa.gov/NWSTornado/

Warnings are critical to mitigating damage from hail, lightning, and tornadoes. These hazards can appear with minimal warning such that the ability to quickly notify a large area is critical. The community alert system should be utilized to inform the public when severe weather events may occur.

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. This fact was evidenced most recently by the severe storm that struck Lake County, Florida on February 2, 2007. This powerful storm that included several tornadoes stuck at about 3:15 AM. According to National Public Radio, local broadcast stations had difficultly warning residents due to the lack of listeners and viewers and encouraged those awake to telephone warnings into the affected area.

Thus, the implementation of the CodeRED emergency notification system in Naugatuck is beneficial for warning residents of an impending tornado. The Emergency Management Department has a page on its website (http://www.naugatuck-ct.gov/Emergency_Management.htm) to encourage residents to become part of the CodeRED database.

5.7 Status of Mitigation Strategies and Actions

The prior mitigation strategies and actions for mitigation related to winds, hail, tornadoes, and downbursts are listed below with commentary regarding the status of each.

TABLE 5-6
Status of Previous Strategies and Actions

Strategy or Action	Status
Increase tree limb maintenance and inspections.	Complete. This has become part of the Borough's overall capabilities, therefore it can be removed.
Continue outreach regarding dangerous trees on private property.	Complete. This has become part of the Borough's overall capabilities, therefore it can be removed.
Continue to require that utilities be placed underground in new developments and pursue funding to place them underground in existing developed areas.	The Borough still requires underground utilities for new developments and the strategy has become part of the Borough's overall capabilities, therefore it can be removed. The Borough does not wish to pursue placing utilities underground elsewhere, due to cost.
Continue to require compliance with the amended Connecticut Building Code for wind speeds.	This is a building code requirement throughout Connecticut and can be removed as a strategy.
Provide for the Building Department or the Planning and Zoning Commission to make literature available during the permitting process regarding appropriate design standards.	This is a building code requirement throughout Connecticut and can be removed as a strategy.

The majority of the above strategies and actions have been completed and are listed in the table of strategies in Appendix A. The new strategy listed in Section 4.7 is also applicable to the hazards associated with thunderstorms:

- ❑ Review critical facilities and ensure that each one has adequate standby power. For those facilities that do not, consider acquiring standby power supplies.

6.0 WINTER STORMS

6.1 Setting

Similar to summer storms and tornadoes, winter storms have the potential to affect any area of the Borough of Naugatuck. However, unlike summer storms, winter events and the hazards that result (wind, snow, and ice) have more widespread geographic extent. The entire Borough of Naugatuck is susceptible to winter storms. In general, winter storms are considered highly likely to occur each year (major storms are less frequent), and the hazards that result (nor'easter winds, snow, and blizzard conditions) can potentially have a significant effect over a large area of the Borough (refer to Tables 1-2 and 1-3).

6.2 Hazard Assessment

This section focuses on those effects commonly associated with winter weather, including blizzards, freezing rain, ice storms, nor'easters, sleet, snow, and winter storms; and to a secondary extent, extreme cold.

- **Blizzards** include winter storm conditions of sustained winds or frequent gusts of 35 mph or greater that cause major blowing and drifting of snow, reducing visibility to less than one-quarter mile for 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 forecasted 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 1st and April 1st 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 which have a snow accumulation of more than six inches in 12 hours, or more than 12 inches in a 24-hour period.

According to the National Weather Service, 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.

Impacts from severe winter weather can become dangerous and a threat to people and property. Most winter weather events occur between December and March. Winter weather may include snow, sleet, freezing rain, and cold temperatures. According to NOAA, winter storms were responsible for the death of 33 people per year from 2000 to 2009. Most deaths from winter storms are indirectly related to the storm, such as from traffic accidents on icy roads and hypothermia from prolonged exposure to cold. Damage to trees and tree limbs and the resultant downing of utility cables are a common effect of these types of events. Secondary effects include loss of power and heat, and flooding as a result of snowmelt.

Until recently, the Northeast Snowfall Impact Scale (NESIS) was used by NOAA to characterize and rank high-impact northeast snowstorms. This ranking system has evolved into the currently used Regional Snowfall Index (RSI). The RSI ranks snowstorms that impact the eastern two thirds of the United States, placing them in one of five categories: Extreme, Crippling, Major, Significant, and Notable. The RSI is based on the spatial extent of the storm, the amount of snowfall, and the juxtaposition of these elements with population. RSI differs from NESIS in that it uses a more refined geographic area to define the population impact. NESIS had used the population of the entire two-thirds of the United States in evaluating impacts for all storms whereas RSI has refined population data into six regions. The result is a more region-specific analysis of a storm's impact. The use of population in evaluating impacts provides a measure of societal impact from the event. Table 6-1 presents the RSI categories, their corresponding RSI values, and a descriptive adjective.

TABLE 6-1
RSI Categories

Category	RSI Value	Description
1	1-3	Notable
2	3-6	Significant
3	6-10	Major
4	10-18	Crippling
5	18.0+	Extreme

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 196 of the most notable historic winter storms to impact the Northeast have been analyzed and categorized by RSI through March 2013.

6.3 Historic Record

A total of 16 extreme, crippling, and major winter storms have occurred in Connecticut during the past 30 years. One is listed for each of the years 1983, 1987, 1993, 1994, 1996, 2003, 2005, 2006, and 2007. More alarmingly, four are listed in the calendar year 2010 and two in 2011.

Considering nor'easters only, 11 major winter nor'easters have occurred in Connecticut during the past 30 years (in 1983, 1988, 1992, 1996, 2003, 2006, 2009, 2010, two in 2011, and 2013).

According to the NCDC, there have been 134 snow and ice events in the state of Connecticut between 1993 and April 2010, causing over $18 million in damages. Notably, heavy snow in December 1996 caused $6 million in property damage. Snow removal and power restoration for a winter storm event spanning March 31 and April 1, 1997 cost $1 million. On March 5, 2001, heavy snow caused $5 million in damages, followed by another heavy snow event four days later that caused an additional $2 million in damages.

Catastrophic ice storms are less frequent in Connecticut than the rest of New England due to the close proximity of the warmer waters of the Atlantic Ocean and Long Island Sound. However, winter storm Alfred from October 29-30, 2011 had an ice precipitation component to it. Although wet snow was the major problem, ice mixed in along and just to the north of the shoreline which slickened roadways and led to additional weight build-up on trees and utility lines and other infrastructure.

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. An ice storm in November 2002 that hit Litchfield and western Hartford Counties resulted in $2.5 million in public sector damages.

Additional examples of recent winter storms to affect New Haven County selected from the NCDC database include:

- East Coast Winter Storm, March 13-14, 1993 – A powerful storm carrying with it record low barometric pressure readings hit the state with blizzard conditions. Gale force winds accompanied by snow drifts several feet deep closed businesses, hindered travel, and forced residents to lose power. Federal aid was given to the state for snow removal.

- Heavy Snow, January 21, 2001 – Heavy snow and a period of sleet and freezing rain changing to snow impacted the region. In Seymour, a total of eight inches were reported, while nearby Bridgeport received a total of approximately six inches.

- Heavy Snowstorm, March 12, 2005 – Snow fall rates reached in excess of two inches per hour at several locations in the region. Storm snowfall amounts ranged from approximately five to nine inches. In Ansonia, a reported snowfall total of 8.1 inches fell while nearby Derby reported 6.3 inches and Seymour reported 7.8 inches.

- Blizzard, December 26-27, 2010 – An intense low pressure system moved across the region with bands of heavy snow with embedded thunderstorms and significant winds. The powerful blizzard brought the area 10 to 18 inches of snow with sustained winds of 25 to 40 mph with gusts in excess of 60 mph. The storm made all forms of travel extremely difficult to nearly impossible and service on Metro North and Amtrak lines were suspended due to high snow drift.

- Heavy Snow, January 11-12, 2011 – Very heavy snow developed across the region, producing snowfall rates of three to four inches per hour and snow totals ranging from 15 to 30 inches in southern Connecticut. The highest snowfall totals were seen across northern portions of Fairfield and New Haven counties.

- Heavy Snow Storm, January 26-27, 2011 – A period of moderate to heavy snow moved through the region, producing two to five inches before a second round of precipitation, consisting of very heavy snow, moved across the area. This system boasted snowfall rates of three to four inches per hour over a four to six hour period which raised snow totals to 12-20" of snow throughout much of the region.

The winter storms of January and February 2011 are listed as the 18th and 19th storms in the NESIS ranking. These storms produced snow, sleet, freezing rain, strong gusty winds, severely low temperatures, and coastal flooding. Snowfall totals for winter 2010-2011 in Connecticut averaged around 70 inches.

The snowfall, sleet, freezing rain, and rain that affected Connecticut during the 2010-2011 winter season proved to be catastrophic for a number of buildings. With severely low temperatures coupled with the absence of the removal of snow and ice buildup from roofs of buildings in Connecticut, numerous roofs collapsed during the winter season.

Using media reports, a list of roof/building collapses and damage due to buildup of frozen precipitation was compiled. The list (Table 6-2) includes 76 locations that span over a month of time from January 12, 2011 to February 17, 2011. Four properties are listed in Naugatuck.

TABLE 6-2
Reported Roof Collapse Damage, 2011

Address	Municipality	Date	Description
205 Wakelee Avenue	Ansonia	2/2/2011	Catholic Charities
Route 44	Barkhamsted	2/4/2011	Barkhamsted Highway Department Salt Shed
8 Railroad Avenue	Beacon Falls	2/2/2011	Manufacturing Corporation
20 Sargent Drive	Bethany	2/2/2011	Fairfield County Millworks
50 Hunters Trail	Bethany	2/2/2011	Sun Gold Stables
74 Griffin Road South	Bloomfield	2/14/2011	Home Depot Distribution Center
25 Blue Hill Road	Bozrah	1/27/2011	Kofkoff Egg Farm
135 Albany Turnpike	Canton	2/3/2011	Ethan Allen Design Center
520 South Main Street	Cheshire	1/12/2011	Cheshire Community Pool (Prior to recent ice storm)
1701 Highland Avenue	Cheshire	1/23/2011	Cox Communications
174 East Johnson Avenue	Cheshire	2/2/2011	First Calvary Life Family Worship Center
166 South Main Street	Cheshire	2/3/2011	George Keeler Stove Shop (Historic Building)
1755 Highland Avenue	Cheshire	2/7/2011	Nutmeg Utility Products
45 Shunpike Road (Route 372)	Cromwell	2/2/2011	K Mart (cracks inside and outside - no official collapse)
Cromwell Hills Drive	Cromwell	2/4/2011	Cromwell Gardens

Address	Municipality	Date	Description
98 West Street	Danbury	1/28/2011	Garage
142 N. Road (Route 140)	East Windsor	2/3/2011	Dawn Marie's Restaurant - Bassdale Plaza Shopping Center
3 Craftsman Road	East Windsor	2/4/2011	Info Shred
140 Mountain Road	Ellington	1/27/2011	Garage Collapse
100 Phoenix Avenue	Enfield	2/1/2011	Brooks Brothers
South Road	Enfield	2/2/2011	Bosco's Auto Garage
175 Warde Terrace	Fairfield	2/3/2011	Parish Court Senior Housing (Ceiling damage - 10 apartments)
19 Elm Tree Road	Glastonbury	2/6/2011	Residence
Unknown	Hampton	1/28/2011	Wood Hill Farm barn collapse - animals died
Gillette Street	Hartford	1/19/2011	Garage
West Street	Hebron	2/2/2011	Residential
Connecticut Route 101	Killingly	2/8/2011	Historic church converted to an office building
759 Boston Post Road	Madison	2/3/2011	Silver Moon, The Brandon Gallery, Madison Coffee Shop and Madison Cinemas (awning began to collapse)
478 Center Street	Manchester	1/28/2011	Lou's Auto Sales and Upholstery
1388 East Main Street	Meriden	1/28/2011	Jacoby's
260 Sherman Avenue	Meriden	2/6/2011	Engine 4 Fire Station
275 Research Parkway	Meriden	2/17/2011	Four Points by Sheraton Carport
1310 South Main Street	Middletown	1/30/2011	Passport Inn Building & Suites
505 Main Street	Middletown	2/2/2011	Accounting firm, converted, mixed use (3 story)
70 Robin Court	Middletown	2/3/2011	Madison at Northwoods Apartment
80 North Main Street	Middletown	2/7/2011	Abandoned warehouse
Pepe's Farm Road	Milford	1/30/2011	Vacant manufacturing building
282 Woodmont Road	Milford	2/2/2011	Kip's Tractor Barn
150 Main St # 1	Monroe	2/2/2011	Monroe Paint & Hardware (Slumping roof, weld broke loose from structural beam)
Route 63	Naugatuck	1/21/2011	Former Plumbing Supply House
410 Rubber Avenue	Naugatuck	2/2/2011	Thurston Oil Company
1210 New Haven Road	Naugatuck	2/4/2011	Rainbowland Nursery School (structural damage)
1100 New Haven Road	Naugatuck	2/17/2011	Walmart (structural damage)
290 Goffe Street	New Haven	2/7/2011	New Haven Armory
201 South Main Street	Newtown	2/9/2011	Bluelinx Corp.
80 Comstock Hill Avenue	Norwalk	1/27/2011	Silvermine Stable
5 Town Line Road	Plainville	1/27/2011	Classic Auto Body
130 West Main Street	Plainville	2/2/2011	Congregational Church of Plainville
Terryville Section	Plymouth	1/12/2011	Public Works Garage (Terryville section) - taking plow trucks out
286 Airline Avenue	Portland	1/27/2011	Midstate Recovery Systems, LLC (waste transfer station)
680 Portland-Cobalt Road (Route 66)	Portland	1/27/2011	Vacant commercial property (next to Prehistoric Mini Golf - former True Value Hardware building)
Tryon Street	Portland	1/27/2011	Residential home (sunroof)
Main Street	Portland	1/28/2011	Middlesex Marina
93 Elm Street	Rocky Hill	2/6/2011	Residential garage

Address	Municipality	Date	Description
99 Bridgeport Avenue	Shelton	2/3/2011	Shell Gas Station
100 Maple Street	Somers	1/27/2011	Lindy Farms (barn)
68 Green Tree Lane	Somers	2/2/2011	Residential
95 John Fitch Boulevard	South Windsor	2/3/2011	South Windsor 10 Pin Bowling Alley
595 Nutmeg Road North	South Windsor	2/8/2011	Waldo Brothers Company
45 Newell Street	Southington	2/2/2011	Yarde Metals
Furnace Avenue	Stafford Springs	2/2/2011	Abandoned mill building
370 South Main Street	Terryville	2/8/2011	Former American Modular
46 Hartford Turnpike	Tolland	2/3/2011	Colonial Gardens
364 High Street	Tolland	2/9/2011	Horse barn
61 Monroe Turnpike	Trumbull	2/1/2011	Trumbull Tennis Center
5065 Main St # L1207	Trumbull	Unknown	Taco Bell
Route 83	Vernon	1/31/2011	Former Clyde Chevrolet
136 Dudley Avenue	Wallingford	1/27/2011	Tri State Tires
1074 South Colony Road	Wallingford	1/29/2011	Zandri's Stillwood Inn
121 N. Main Street	Waterbury	2/2/2011	Former bowling alley (Sena's Lanes)
456 New Park Avenue	West Hartford	2/8/2011	Shell gas station
Island Lane	West Haven	1/27/2011	Commercial building
Unknown	Wethersfield	2/2/2011	Automotive center roof collapse; 10 cars damaged
50 Sage Park Road	Windsor	2/2/2011	Windsor High School (auditorium roof collapse)
1001 Day Hill Road	Windsor	2/7/2011	Mototown USA
27 Lawnacre Road	Windsor Locks	2/7/2011	Long View RV

As a result of the roof and building collapses, injury occurred to humans and animals, and significant and widespread damage to property took place. The overall storm impacts and damages of the winter 2010-2011 storms resulted in Presidential Disaster Declaration 1958-DR for Connecticut.

In Naugatuck, the January 2011 storm damaged at least 30 buildings. A single family home had to be demolished. Several commercial businesses were impacted as well. Specifically, the roof of Thurston's Oil collapsed, the trusses of a local machine shop snapped, and the Walmart suffered structural damage. In addition, the roofs of the local schools needed to be shoveled.

Later that year, Winter Storm Alfred (October 29-30, 2011) dumped up to 32" of snow and caused over 600,000 electrical customers in Connecticut to lose power for a significant amount of time. The entire state dealt with wet snow and ice and statewide power outages affecting Connecticut for a week or longer. The storm was unique in that much of the foliage had yet to fall from trees, which provided more surface area for snow to land and stick, therefore making the trees significantly heavier than if the storm was to occur when trees had lost their foliage. The storm resulted in the death of eight people in Connecticut, four from carbon monoxide poisoning. In all, approximately 90 shelters and 110 warming centers were opened state-wide. The overall storm impacts and damages resulted in another Presidential Disaster Declaration for Connecticut. Power outages in Naugatuck lasted approximately one week as a result of this storm.

A fierce nor'easter (dubbed "Nemo" by the Weather Channel) in February 2013 brought blizzard conditions to most of the Northeast, producing snowfall rates of five to six inches per hour in parts of Connecticut. Many areas of Connecticut experienced more than 40 inches of snowfall, and the storm caused more than 700,000 power outages. All roads in Connecticut were closed for two days. This storm was ranked as a "Major" storm by NESIS. The overall storm impacts and damages resulted in yet one more Presidential Disaster Declaration for Connecticut.

Borough officials indicated that no significant power outages were reported during Nemo. However, residents were unable to access the roads for three days due to the lack of large snow plows.

6.4 Existing Capabilities

Existing programs applicable to flooding and wind are the same as those discussed in Sections 3.0 and 4.0. Programs that are specific to winter storms are generally those related to preparing plows, sand and salt trucks; tree-trimming to protect power lines; and other associated snow removal and response preparations.

As it is almost guaranteed that winter storms will occur annually in Connecticut, it is important for municipalities to budget for and then allocate fiscal resources for snow management. The Borough ensures that all warning/notification and communications systems are ready before a storm, and ensures that appropriate equipment and supplies, especially snow removal equipment, are in place and in good working order. The Borough also prepares for the possible evacuation and sheltering of some populations which could be impacted by the upcoming storm (especially the elderly and special needs persons).

The Public Works Department has 22 routes for plowing throughout Naugatuck. A fleet of five large trucks and several smaller trucks are used to conduct the work. The Borough has indicated that only having five large trucks was part of the reason that the Borough's response to the February 2013 snowstorm (Nemo) was so poor. Each section of the Borough has a crew assigned to it. Plow trucks are first dispatched to the areas of Naugatuck with higher elevations as it begins to snow. During emergencies, a plow vehicle can be dispatched ahead of an emergency vehicle.

In summary, Naugatuck's capabilities to mitigate for winter storm damage and prevent loss of life and property has improved since the initial hazard mitigation plan was adopted, such as the increased attention to removing snow from buildings.

6.5 Vulnerabilities and Risk Assessment

Description – Based on the historic record in Section 6.3, Connecticut experiences at least one major nor'easter approximately every four years, although a variety of minor and moderate snow and ice storms occur nearly every winter. According to the 2014 *Connecticut Natural Hazard Mitigation Plan Update*, Connecticut residents can expect at least two or more severe winter weather events per season, including heavy snow storms, potential blizzards, nor'easters, and potential ice storms. Fortunately, catastrophic ice storms are relatively less frequent in Connecticut than the rest of New England due to the close proximity of the warmer waters of the Atlantic Ocean and Long Island Sound.

According to the 2014 *Connecticut Natural Hazard Mitigation Plan Update*, recent climate change studies predict a shorter winter season for Connecticut (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 the impact such storms have on the residents, roads, and utilities in the State.

As mentioned for summer storms, the heavily treed landscape in close proximity to densely populated residential areas in the Borough of Naugatuck poses problems in relation to blizzard condition damage. Tree limbs and some building structures may not be suited to withstand high wind and snow loads. Ice can damage or collapse power lines, render steep gradients impassable for motorists, undermine foundations, and cause "flood" damage from freezing water pipes in basements.

In addition, winter storms present additional problems for motorists all over the state. As the population of Connecticut and its dependence on transportation continues to increase, the vulnerability of the state to winter storms also increases. There is a high propensity for traffic accidents and traffic jams during heavy snow and even light icing events. Roads may become impassable, inhibiting the ability of emergency equipment to reach trouble spots and the accessibility to medical and shelter facilities. Stranded motorists, especially senior and/or handicapped citizens, are at particularly high risk of injury or death from exposure during a blizzard. After a storm, snow piled on the sides of roadways can inhibit line of sight and reflect a blinding amount of sunlight, making driving difficult. When coupled with slippery road conditions, poor sightlines and heavy glare create dangerous driving conditions.

As there is over 720 feet in elevation difference between the high point and low point in the Borough, Naugatuck can experience snow in the hills while it rains in the downtown area. The Borough relies on its personnel to report areas receiving snow in the higher elevations, as there are many hills in Naugatuck which can make driving difficult in icy weather.

As for other winter hazards, drifting snow is not as large a problem in Naugatuck as in other areas, but it can still occur. This problem is mitigated through municipal plowing efforts. Ice jams are not a problem in Naugatuck.

Recall from Figure 2-7, Figure 2-8, and Figure 2-9 that elderly, linguistically isolated, and disabled populations reside in the Borough of Naugatuck. It is possible that significant populations impacted by a severe winter storm could consist of the elderly, linguistically isolated households, and people with disabilities. Thus, it is important for Naugatuck's emergency personnel to be prepared to assist these special populations during emergencies such as winter storms.

Loss Estimates – The 2014 Connecticut Natural Hazard Mitigation Plan provides annual estimated losses on a countywide basis for several hazards. Based on the population of Naugatuck relative to New Haven County, the annual estimated loss is $232 for severe winter storms. The low figure is likely influenced by the difficulty in separating typical winter storm costs from those associated with extreme events. However, the Borough’s public assistance reimbursements for the last three winter storm disasters were significant. Furthermore, recall from Table 6-2 that four private roofs and/or buildings collapsed or experienced structural damage in Naugatuck in January and February 2014. The losses are believed to have totaled several million dollars.

Summary – In summary, the entire community is at relatively equal risk for experiencing damage from winter storms, although some areas may be more susceptible. Many damages are relatively site-specific and occur to private property (and therefore are paid for by private insurance), while repairs for power outages is often widespread and difficult to quantify to any one municipality.

6.6 Potential Mitigation Strategies and Actions

Potential mitigation measures for flooding caused by nor'easters include those appropriate for flooding. These were presented in Section 3.6. Winter storm mitigation measures must also address blizzard, snow, and ice hazards. These are emphasized below. Note that structural projects are generally not applicable to hazard mitigation for wind, blizzard, snow, and ice hazards.

6.6.1 Prevention

Cold air, wind, snow, and ice can not be prevented from impacting any particular area. Thus, mitigation should be focused on property protection and emergency services (discussed below) and prevention of damage as caused by breakage of tree limbs.

Previous strategies for tree limb inspections and maintenance in Sections 4.0 and 5.0 are thus applicable to winter storm hazards, as well. As mentioned previously, utilities in Naugatuck should continue to be placed underground where possible. This can occur in connection with new development and also in connection with redevelopment work. Underground utilities cannot be damaged by heavy snow, ice, and winter winds.

6.6.2 Property Protection

Property can be protected during winter storms through the use of shutters, storm doors, and storm windows. Heating coils may be used to remove snow from roofs, and pipes should be adequately insulated to protect against freezing and bursting. All of these recommendations should apply to new construction, although they may also be applied to existing buildings during renovations. Finally, as recommended in previous sections, compliance with the amended Connecticut Building Code for wind speeds is necessary.

> FEMA has produced a Snow Load Safety Guidance Document available at http://www.fema.gov/media-library/assets/documents/29670?id=6652. A copy is available in Appendix F of this plan.

Where flat roofs are used on structures, snow removal is important as the heavy load from collecting snow may exceed the bearing capacity of the structure. This can occur in both older buildings as well as newer buildings constructed in compliance with the most recent building codes. The Borough should develop plans to prioritize the removal of snow from critical facilities and other municipal buildings and have funding available for this purpose. Heating coils may also be used to melt or evaporate snow from publicly and privately-owned flat roofs.

6.6.3 Public Education and Awareness

The public is typically more aware of the hazardous effects of snow, ice, and cold weather than they are with regard to other hazards discussed in this plan. Nevertheless, people are still stranded in automobiles, get caught outside their homes in adverse weather conditions, and suffer heart failure while shoveling during each winter in Connecticut. Public education should therefore focus on safety tips and reminders to individuals about how to prepare themselves and their homes for cold and icy weather, including stocking homes, preparing vehicles, and taking care of themselves during winter storms.

Traffic congestion and safe travel of people to and from work can be mitigated by the use of staggered timed releases from work, pre-storm closing of schools, and later start times for companies. Many employers and school districts employ such practices. Communities should consider the use of such staggered openings and closings to mitigate congestion during and after severe weather events if traffic conditions warrant.

6.6.4 Emergency Services

Emergency services personnel and departments such as Police and Fire should identify areas which may be difficult to access during winter storm events and devise contingency plans to continue servicing those areas during moderate storms. The creation of through streets with new developments increases the amount of egress for residents and emergency personnel into neighborhoods.

The Borough of Naugatuck has established plowing routes that prioritize access to and from critical facilities. Residents should be made aware of the plow routes in order to plan how to best access critical facilities during storms, perhaps by posting the general routes on the Borough website. Such routes should also be posted other municipal buildings, such as the library and the post office. It is recognized that plowing critical facilities may not be a priority to all residents, as people typically expect their own roads to be cleared as soon as possible.

Available shelters should also be advertised and their locations known to the public prior to a storm event. Local schools, which are designated as shelters, should be equipped with emergency generators to provide backup power. Finally, mutual aid agreements with surrounding municipalities should be reviewed and updated as necessary to ensure help will be available when needed.

6.7 Status of Mitigation Strategies and Actions

The prior mitigation strategies associated with winds were addressed in earlier sections of this plan. Previous strategies and actions for snow and ice are listed below with commentary regarding the status of each.

TABLE 6-3
Status of Previous Strategies and Actions

Strategy or Action	Status
Increase tree limb maintenance and inspections, especially in downtown areas	Complete. This has become part of the Borough's overall capabilities, therefore it can be removed.
Review and post evacuation plans to ensure timely migration of people seeking shelter in all areas of Naugatuck.	The Borough has an evacuation plan and will continue to update the plan as needed; this strategy can be removed because it is a capability.
Post a list of Borough sheltering facilities and snow plow prioritization in the municipal offices and on the Borough's website so residents can best plan how to access to critical facilities during a winter storm event.	The Borough has an evacuation plan and will continue to update the plan as needed; this strategy can be removed because it is a capability.
Continue to encourage two modes of egress into every neighborhood by the creation of through streets.	This is ongoing and part of the Borough's capabilities, therefore it can be removed.

The above strategies and actions have become capabilities and they are not listed in the table in Appendix A, as they are ongoing. The following new strategies have been identified.

- ❑ Develop a plan to prioritize snow removal from the roof of critical facilities and other municipal buildings each winter. Ensure adequate funding is available in the Borough budget for this purpose.
- ❑ Continue to provide information on the dangers of cold-related hazards to people and property.
- ❑ The Building Department should provide literature regarding appropriate design standards for mitigating icing, insulating pipes, and retrofits for flat-roofed buildings such as heating coils.

7.0 EARTHQUAKES

7.1 Setting

The entire Borough of Naugatuck is susceptible to earthquakes. However, even though earthquakes have the potential to occur anywhere both in the Borough and in the northeastern United States, the effects may be felt differently in some areas based on the type of geology. In general, damaging earthquakes are considered a hazard that is unlikely to occur, but that may cause significant effects to a large area of the Borough if one occurred.

7.2 Hazard Assessment

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 is determined by the use of the Richter scale and the Mercalli scale, respectively.

The Richter scale defines the magnitude of an earthquake. 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 which have a common calibration. The magnitude of an earthquake is thus represented by a single, instrumentally determined value recorded by a seismograph, which record the varying amplitude of ground oscillations.

The magnitude of an earthquake is determined from 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 micro-earthquakes, 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.

The effect of an earthquake on the Earth's surface is called the intensity. The Modified Mercalli Intensity Scale consists of a series of key responses such as people awakening, movement of furniture, damage to chimneys, and total destruction. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It is an arbitrary ranking based on observed effects.

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 intra-plate 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. 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.

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.

> *The following is a description of the 12 levels of Modified Mercalli intensity from the USGS.*
>
> I. Not felt except by a very few under especially favorable conditions.
> II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
> III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.
> IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
> V. Felt by nearly everyone; many awakened. Some dishes and windows broken. Unstable objects overturned. Pendulum clocks may stop.
> VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
> VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
> VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
> IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
> 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 destroyed. Object thrown in the air.

7.3 Historic Record

According to the Northeast States Emergency Consortium and the Weston Observatory at Boston College, there were 139 recorded earthquakes in Connecticut between 1668 and 2011. The vast majority of these earthquakes had a magnitude of less than 3.0. The most severe earthquake in Connecticut's history occurred at East Haddam on May 16, 1791. Stone walls and chimneys were toppled during this quake. Additional instances of seismic activity occurring in and around Connecticut is provided below, based on information provided in USGS documents, the Weston Observatory, the 2014 *Connecticut Natural Hazard Mitigation Plan Update*, 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.
- In April 1837, a moderate tremor occurred at Hartford, causing alarm but little damage.
- In August 1840, another moderate tremor with its epicenter 10 to 20 miles north of New Haven shook Hartford buildings but caused little damage.
- In October 1845, an Intensity V earthquake occurred in Bridgeport. An Intensity V earthquake would be approximately 4.3 on the Richter scale.
- On June 30, 1858, New Haven and Derby were shaken by a moderate tremor.

- On July 28, 1875, an early morning tremor caused Intensity V damage throughout Connecticut and Massachusetts.
- The second strongest earthquake to impact Connecticut occurred near Hebron on November 14, 1925. No significant damage was reported.
- The Timiskarning, Ontario earthquake of November 1935 caused minor damage as far south as Cornwall, Connecticut. This earthquake affected one million square miles of Canada and the United States.
- An earthquake near Massena, New York in September 1944 produced mild effects in Hartford, Marion, New Haven, and Meriden, Connecticut.
- An Intensity V earthquake was reported in Stamford in March of 1953, causing shaking but no damage.
- On November 3, 1968, another Intensity V earthquake in southern Connecticut caused minor damage in Madison and Chester.
- Recent earthquake activity has been recorded near New Haven in 1988, 1989, and 1990 (2.0, 2.8, and 2.8 in magnitude, respectively), in Greenwich in 1991 (3.0 magnitude), and on Long Island in East Hampton, New York in 1992.
- A noticeable earthquake which occurred in Connecticut on March 11, 2008 was a 2.0 magnitude with its epicenter three miles northwest of the center of Chester.
- A magnitude 5.0 earthquake struck at the Ontario-Quebec border region of Canada on June 23, 2010. This earthquake did not cause damage in Connecticut but was felt by residents in Hartford and New Haven Counties.
- A magnitude 3.9 earthquake occurred 117 miles southeast of Bridgeport, Connecticut on the morning of November 30, 2010. The quake did not cause damage in Connecticut but was felt by residents along Long Island Sound.
- An earthquake with a magnitude 2.1 was recorded near southeastern Connecticut on November 29, 2013. The earthquake did not cause damage but was felt by residents from Montville to Mystic.
- A magnitude 2.7 quake occurred beneath the Town of Deep River on August 14, 2014.
- A series of quakes hit Plainfield, Connecticut on January 8, 9, and 12, 2015. These events registered magnitudes of 2.0, 0.4, and 3.1, respectively. Residents in the Moosup section of Plainfield reported minor damage such as the tipping of shelves and fallen light fixtures.

An earthquake of special consideration was a magnitude 5.8 earthquake which occurred 38 miles from Richmond, Virginia on August 23, 2011. 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 although widespread damage was constrained to an area from central Virginia to southern Maryland. According to Cornell University, the August 23 quake was the largest event to occur in the east central United States since instrumental recordings have been available to seismologists.

7.4 Existing Capabilities

The Connecticut Building Codes include design criteria for buildings specific to municipality, as adopted by the Building Officials and Code Administrators (BOCA). These include the seismic coefficients for building design in the Borough of Naugatuck. The Borough has adopted these codes for new construction and they are enforced by the Borough Building Inspector. Due to the infrequent nature of damaging earthquakes, land use policies in the Borough of Naugatuck do not directly address earthquake hazards.

The Zoning Regulations of the Borough of Naugatuck (Section 24.10) states no more than 25 percent of the Minimum Buildable Area shall contain slopes in excess of 25 percent. Section 36.1 of the Zoning Regulations requires a Sediment and Erosion Control Plan be submitted when the disturbed area of a site is greater than one-half acre. The Plan of Conservation and Development suggests that areas of greater than 15% slopes be defined as un-buildable area. In particular, Goal #3 item #4 of the Plan of Conservation and Development states "Establish development standards for single-family housing on slopes."

Naugatuck's capabilities to mitigate for earthquake damage and prevent loss of life and property have not necessarily changed since the initial hazard mitigation plan was adopted, although the State's building code has been updated and the borough has incorporated those changes. In the event that a damaging earthquake occurs, Naugatuck will activate its Emergency Operations Plan and initiate emergency response procedures as necessary.

7.5 Vulnerabilities and Risk Assessment

According to Cornell University, the earth's crust is far more efficient at propagating seismic waves in the eastern United States than in the west, so even a moderate earthquake can be felt at great distances and over a larger region. The cause of intraplate earthquakes remains a fundamental mystery and this, coupled with the large areas affected, resulted in the August 2011 earthquake in Virginia to be of particular interest to seismologists.

In terms of felt effects and damage, ground motion at the level of several percent of gravity corresponds to the threshold of damage to buildings and houses (an earthquake intensity of approximately V). For comparison, reports of "dishes, windows and doors disturbed" corresponds to an intensity of about IV, or about 2% of gravity. Reports of "some chimneys broken" correspond to an intensity of about VII, or about 10% to 20% of gravity. According to the USGS National Seismic Hazard Mapping Project (2008), an earthquake impacting the Borough of Naugatuck has a 2% chance of exceeding a peak acceleration of 10-12% of the force of gravity in a 50-year period.

> ***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, especially the finer textured soils.

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, reducing the ability of soil to support building foundations or bridges is reduced. Increased shaking and liquefaction can cause greater damage to buildings and structures, and a greater loss of life.

As explained in Section 2.3, several areas in the Borough of Naugatuck are underlain by sand and gravel. Figure 2-5 depicts surficial materials in the Borough. Structures in these areas are at increased risk from earthquakes due to amplification of seismic energy and/or collapse. The best mitigation for future development in areas of sandy material may be application of the most stringent building codes, or possibly the prohibition of certain types of vulnerable construction in these areas. The areas that are not at increased risk during an earthquake due to unstable soils are the areas in Figure 2-5 underlain by glacial till.

One inactive fault is located in Naugatuck in the far southeast corner of the Borough. Even though this fault is inactive, the best mitigation for future development in the area of this fault would be to preserve or convert the fault area into municipal open space. Much of the fault area lies within the Naugatuck State Forest and the area is already set aside as rural.

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. For this Plan, dam failure has been addressed separately in Section 9.0.

> The AEL is the expected losses due to earthquakes each year. Note that this number represents a long-term average; thus, actual earthquake losses may be much greater or nonexistent for a particular year.

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 (AEL) for the United States. Based on the results of this study, FEMA calculated the AEL for Connecticut to be $11,622,000. This value placed Connecticut 30th out of the 50 states in terms of AEL. The magnitude of this value stems from the fact that Connecticut has a large building inventory that would be damaged in a severe earthquake and takes into account the lack of damaging earthquakes in the historical record.

According to the 2014 Connecticut Natural Hazard Mitigation Plan Update, Connecticut is at a low to moderate risk for experiencing an earthquake of a magnitude greater than 3.5 and at a moderate risk of an experiencing an earthquake of a magnitude less than 3.0 in the future. No earthquake with a magnitude greater than 3.5 has occurred in Connecticut within the last 30 years, and the USGS currently ranks Connecticut 43rd out of the 50 states for overall earthquake activity.

Nevertheless, it is likely that Connecticut will continue to experience minor earthquakes (magnitude less than 3.0) in the future. While the risk of an earthquake affecting Naugatuck is relatively low over the short-term, long-term probabilities suggest that a damaging earthquake (magnitude greater than 5.0) could occur within the vicinity of Naugatuck.

Because a damaging earthquake would likely affect a large area beyond Naugatuck, it is likely that the community may not be able to receive regional aid for a few days. It is important for municipal facilities and departments to have adequate backup plans and backup supplies to ensure that restoration activities may begin and continue until outside assistance can be provided.

HAZUS-MH Simulations

The 2014 *Connecticut Natural Hazard Mitigation Plan Update* utilizes four "maximum plausible" earthquake scenarios (three historical, one potential) within HAZUS-MH to generate potential earthquake risk to the State of Connecticut. These same four scenarios were simulated within HAZUS-MH (using the default year 2000 building inventories and census data) to generate potential damages in Naugatuck. The four events are as follows:

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

The results for each HAZUS-MH earthquake simulation are presented in Appendix C and presented below. These results are believed conservative and considered appropriate for planning purposes in Naugatuck. Note that potentially greater impacts could also occur.

Table 7-1 presents the number of residential buildings (homes) damaged by the various earthquake scenarios, while Table 7-2 presents the total number of buildings damaged by each earthquake scenario. A significant percentage of building damage is to residential buildings, while other building types include agriculture, commercial, education, government, industrial, and religious buildings. The exact definition of each damage state varies based on building construction. See Chapter 5 of the *HAZUS-MH Earthquake Model Technical Manual*, available on the FEMA website, for the definitions of each building damage state based on building construction.

TABLE 7-1
HAZUS-MH Earthquake Scenarios – Number of Residential Buildings Damaged

Epicenter Location and Magnitude	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage	Total
Haddam – 5.7	910	239	25	2	1,176
Portland – 5.7	1,008	275	30	2	1,315
Stamford – 5.7	420	88	8	0	516
East Haddam – 6.4	1,445	470	66	7	1,988

TABLE 7-2
HAZUS-MH Earthquake Scenarios – Total Number of Buildings Damaged

Epicenter Location and Magnitude	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage	Total
Haddam – 5.7	993	280	31	2	1,306
Portland – 5.7	1,100	324	38	3	1,465
Stamford – 5.7	458	102	9	0	569
East Haddam – 6.4	1578	565	88	10	2241

The HAZUS simulations consider a subset of critical facilities termed "essential facilities" which are important during emergency situations. As shown in Table 7-3, minor damage to essential facilities is expected for each earthquake scenario.

TABLE 7-3
HAZUS-MH Earthquake Scenarios – Essential Facility Damage

Epicenter Location and Magnitude	Fire Stations (1)	Police Stations (3)	Schools (15)
Haddam – 5.7	Minor damage (70% functionality)	Minor damage (70% functionality)	Minor damage (69% functionality)
Portland – 5.7	Minor damage (68% functionality)	Minor damage (68% functionality)	Minor damage (67% functionality)
Stamford – 5.7	Minor damage (81% functionality)	Minor damage (81% functionality)	Minor damage (81% functionality)
East Haddam – 6.4	Minor damage (59% functionality)	Minor damage (59% functionality)	Minor damage (59% functionality)

Table 7-4 presents potential damage to utilities and infrastructure based on the various earthquake scenarios. The HAZUS-MH software assumes that the Naugatuck transportation network and utility network includes the following:

- Highway: 31 major roadway bridges and 10 important highway segments;
- Railway: 2 important railway segments;
- Bus: One bus facility;
- A potable water system consisting of 223 total kilometers of pipelines;
- A waste water system consisting of 134 total kilometers of pipelines and one treatment facility; and
- A total of 89 kilometers of natural gas lines.

As shown in Table 7-4, highway bridges, the rail facility, and the bus facility are predicted to experience minor damage under each earthquake scenario. In terms of utilities, the waste water treatment facilities are expected to experience expensive damages, although it will still be able to operate at greater than 50% capacity under each earthquake scenario. While water, sewer, and gas lines are expected to have leaks and breaks, no loss of potable water or electrical service is expected. Only minor displacement is expected due to ignitions following the earthquake.

TABLE 7-4
HAZUS-MH Earthquake Scenarios – Utility, Infrastructure, and Fire Damage

Epicenter Location and Magnitude	Transportation Network	Utilities	Fire Damage
Haddam – 5.7	Minor damage to transportation infrastructure ($4.11 million to bridges, $0.08 million to bus facility)	5 leaks and 1 major breaks in potable water system ($0.02 million), 3 leaks and 1 major breaks in waste water system ($0.01 million), 1 leaks and 0 major breaks in natural gas system (less than $0.01 million), minor damage to wastewater facilities ($1.73 million) and communication facilities ($0.01 million). No loss of service expected. Total damage: Approximately $2 million	Fire damage will displace no people.

Epicenter Location and Magnitude	Transportation Network	Utilities	Fire Damage
Portland – 5.7	Minor damage to transportation infrastructure ($0.88 million to bridges, $0.04 million to bus facility)	6 leaks and 2 major breaks in potable water system ($0.01 million), 3 leaks and 1 major break in waste water system (less than $0.01 million), 1 leaks and 0 major breaks in natural gas system (less than $0.01 million), minor damage to wastewater facilities ($0.44 million) and communication facilities (less than $0.01 million). No loss of service expected. Total damage: Approximately $480,000	Fire damage will displace no people.
Stamford – 5.7	Minor damage to transportation infrastructure ($2.1 million to bridges, $0.03 million to bus facility)	2 leaks and 1 major break in potable water system ($0.02 million), 1 leaks and 0 major breaks in waste water system ($0.01 million), 0 leak or breaks in natural gas system ($0.01 million), minor damage to wastewater facilities ($0.90 million) and communication facilities (<$0.01 million). No loss of service expected. Total damage: Approximately $1 million.	Fire damage will displace 2 people.
East Haddam – 6.4	Minor damage to transportation infrastructure ($17.24 million to bridges; $0.11 million to bus facility)	17 leaks and 4 major breaks in potable water system ($0.08 million), 9 leaks and 2 major breaks in waste water system ($0.04 million), 3 leaks and 1 major break in natural gas system ($0.01 million), minor damage to wastewater facilities ($2.92 million) and communication facilities ($0.01 million). No loss of service expected. Total damage: Approximately $3 million	Fire damage will displace no people.

Table 7-5 presents the estimated tonnage of debris that would be generated by earthquake damage during each HAZUS-MH scenario. As shown in Table 7-5, significant debris is expected for each of the four earthquake scenarios, with the East Haddam earthquake scenario generating the most debris in the community.

TABLE 7-5
HAZUS-MH Earthquake Scenarios – Debris Generation (Tons)

Epicenter Location and Magnitude	Brick / Wood	Reinforced Concrete / Steel	Total	Estimated Cleanup Truckloads (25 Tons / Truck)
Haddam – 5.7	6,400	3,600	10,000	400
Portland – 5.7	6,200	3,800	10,000	400
Stamford – 5.7	1,440	560	2,000	80
East Haddam – 6.4	9,010	7,990	17,000	680

Table 7-6 presents the potential sheltering requirements based on the various earthquake events simulated by HAZUS-MH. The predicted sheltering requirements for earthquake damage (not including fire damage in Table 7-6) are relatively significant for all but the Stamford scenario. However, it is possible that an earthquake could also produce a dam failure (flooding) or be a contingent factor in another hazard event that could increase the overall sheltering need in the community.

TABLE 7-6
HAZUS-MH Earthquake Scenarios – Shelter Requirements

Epicenter Location and Magnitude	Number of Displaced Households	Short Term Sheltering Need (Number of People)
Haddam – 5.7	24	14
Portland – 5.7	29	17
Stamford – 5.7	8	5
East Haddam – 6.4	60	35

Table 7-7 presents the casualty estimates generated by HAZUS-MH for the various earthquake scenarios. Casualties are broken down into four severity levels that describe the extent of injuries. The levels are as follows:

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed;
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening;
- Severity Level 3: Injuries will require hospitalization and can become life-threatening if not promptly treated; and
- Severity Level 4: Victims are killed by the earthquake.

TABLE 7-7
HAZUS-MH Earthquake Scenarios – Casualty Estimates

Epicenter Location - Magnitude	2 AM Earthquake	2 PM Earthquake	5 PM Earthquake
Haddam – 5.7	6 (Level 1); 1 (Level 2), 0 (Level 3), 0(Level 4)	5 (Level 1); 1 (Level 2), 0 (Level 3), 0 (Level 4)	5 (Level 1); 1 (Level 2), 0 (Level 3), 0 (Level 4)
Portland – 5.7	7 (Level 1); 1 (Level 2), 0 (Level 3), 0 (Level 4)	6 (Level 1); 1 (Level 2), 0 (Level 3), 0 (Level 4)	6 (Level 1); 1 (Level 2), 0 (Level 3), 0 (Level 4)
Stamford – 5.7	2 (Level 1); 0 (Level 2), 0 (Level 3), 0 (Level 4)	2 (Level 1); 0 (Level 2), 0 (Level 3), 0 (Level 4)	2 (Level 1); 0 (Level 2), 0 (Level 3), 0 (Level 4)
East Haddam – 6.4	12 (Level 1); 2 (Level 2), 0 (Level 3), 0 (Level 4)	14 (Level 1); 3 (Level 2), 0 (Level 3), 1 (Level 4)	14 (Level 1); 3 (Level 2), 2 (Level 3), 1 (Level 4)

Some casualties are expected due to earthquake damage in Naugatuck for the four earthquake scenarios, with the East Haddam scenario producing the highest level of casualties. The casualty categories include commuters, educational, hotels, industrial, other-residential, and single family residential, and are accounted for during the night, in the early afternoon, and during afternoon rush-hour.

Table 7-8 presents the total estimated losses and direct economic impact that may result from the four earthquake scenarios created for Naugatuck as estimated by the HAZUS-MH software.

Capital damage loss estimates include the subcategories of building, contents, and inventory damages. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building or its contents. Business interruption loss estimates include the subcategories of lost income, relocation expenses, and lost wages. The business interruption losses are associated with the inability to operate a business due to the damage sustained during a hurricane, and also include temporary living expenses for those people displaced from their home because of the storm. Note that these damages do not include transportation, utility, or fire damage in Table 7-4.

TABLE 7-8
HAZUS-MH Estimated Direct Losses from Earthquake Scenarios

Epicenter Location and Magnitude	Estimated Total Capital Losses	Estimated Total Income Losses	Estimated Total Losses
Haddam – 5.7	$22,960.000	$4,670.000	$27,630.000
Portland – 5.7	$27,470.000	$5,620.000	$33,090.000
Stamford – 5.7	$7,290.000	$1,640.000	$8,940.000
East Haddam – 6.4	$48,410.000	$11,650.000	$60,060.000

The maximum simulated damage considering direct losses and infrastructure losses is approximately $60 million for the East Haddam scenario. Note that the losses are presented in 2006 dollars, which implies that they will be greater in the future due to inflation. It is also believed that the next plan update will be able to utilize 2010 census data within HAZUS-MH, providing a more recent dataset for analysis.

Despite the low probability of occurrence of damaging earthquakes, this analysis demonstrates that earthquake damage presents a potential hazard to Naugatuck. Additional infrastructure not modeled by HAZUS-MH, such as water treatment plants, sewer pumping stations, and water storage tanks, could be affected by an earthquake.

7.6 Potential Mitigation Strategies and Actions

As earthquakes are difficult to predict and can affect the entire Borough of Naugatuck, potential mitigation can only include adherence to building codes, education of residents, and adequate planning.

Requiring adherence to current State building codes for new development and redevelopment is necessary to minimize the potential risk of earthquake damage. Communities may consider preventing new residential development in areas that are most at risk to collapse or liquefaction. Many Connecticut communities already have regulations restricting development on steep slopes. Additional regulations could be enacted to buffer development a certain distance from the bottom of steep slopes, or to prohibit development on fill materials and areas of fine sand and clay. The State Geologist indicates that such deposits have the highest risk for seismic wave amplification. Other regulations could specify a minimum level of compaction for filled areas before it is approvable for development.

Departments providing emergency services should have backup plans and adequate backup facilities such as portable generators in place in case earthquake damage occurs to critical facilities, particularly public water and the waste water treatment facilities. The Public Works

Department should also have adequate backup plans and facilities to ensure that roads can be opened as soon as possible after a major earthquake.

The fact that damaging earthquakes are rare occurrences in Connecticut heightens the need to educate the public about this potential hazard. An annual pamphlet outlining steps each family can take to be prepared for disaster is recommended. Also, because earthquakes generally provide little or no warning time, municipal personal and students should be instructed on what to do during an earthquake in a manner similar to fire drills.

Critical facilities may be retrofitted to reduce potential damage from seismic events. Potential mitigation activities may include bracing of critical equipment such as generators, identifying and hardening critical lifeline systems (such as water and sewer lines), utilizing flexible piping where possible, and installing shutoff valves and emergency connector hoses where water mains cross fault lines. Potential seismic mitigation measures for all buildings include strengthening and retrofitting non-reinforced masonry buildings and non-ductile concrete facilities that are particularly vulnerable to ground shaking, retrofitting building veneers to prevent failure, installing window films to prevent injuries from shattered glass, anchoring rooftop-mounted equipment, and reinforcing masonry chimneys with steel bracing.

7.7 Status of Mitigation Strategies and Actions

The prior mitigation strategies associated with earthquakes are listed below with commentary regarding the status of each.

TABLE 7-9
Status of Previous Strategies and Actions

Strategy or Action	Status
Continue to require adherence to the state building codes.	This is part of the state building code and can be removed from the table of strategies.
Preserve or convert areas of inactive faults to municipal open space.	These are already mostly protected open space and state forest and the strategy will be removed.
Consider preventing certain types of development, such as residential development, in areas prone to collapse.	This is ongoing and part of the borough's capabilities, therefore it can be removed.
Ensure the future implementation of Goal #3 item #4 of the Plan of Conservation and Development ("Establish development standards for single-family housing on slopes") considers earthquake risks.	This is ongoing and part of the borough's capabilities, therefore it can be removed.
Continue regulating development of slopes greater than 20% and consider setting a prohibition on development of steep slopes.	This is ongoing and part of the borough's capabilities, therefore it can be removed.
Ensure that municipal departments have adequate backup facilities in case earthquake damage occurs.	This is ongoing and part of the borough's capabilities, therefore it can be removed.

The above strategies and actions have become capabilities and they are not listed in the table in Appendix A, as they are ongoing. One new strategy has been identified through the process of updating this plan.

- ❑ Consider bracing system for assets and equipment inside critical facilities. This could help protect IT systems, important records and files.

8.0 DAM FAILURE

8.1 Setting

Dam failures can be triggered suddenly, with little or no warning, from other natural disasters such as floods and earthquakes. Dam failures often occur during flooding when the dam breaks under the additional force of floodwaters. In addition, a dam failure can cause a chain reaction where the sudden release of floodwaters causes the next dam downstream to fail.

With 16 registered dams and potentially several other minor dams in the Borough, dam failure can occur almost anywhere in Naugatuck. In addition, parts of the Borough lie within inundation areas for several Class C dams. While flooding from a dam failure generally has a small geographic extent, the effects are potentially catastrophic. Fortunately, a major dam failure is considered only a possible natural hazard event in any given year (See Tables 1-2 and 1-3).

8.2 Hazard Assessment

The Connecticut DEEP administers the statewide Dam Safety Program, and designates a classification to each state-registered dam based on its potential hazard.

- *Class AA* dams are negligible hazard potential dams that upon failure would result in no measurable damage to roadways and structures, and negligible economic loss.
- *Class A* dams are low hazard potential dams that upon failure would result in damage to agricultural land and unimproved roadways, with minimal economic loss.
- *Class BB* dams are moderate hazard potential dams that upon failure would result in damage to normally unoccupied storage structures, damage to low volume roadways, and moderate economic loss.
- *Class B* dams are significant hazard potential dams that upon failure would result in possible loss of life, minor damage to habitable structures, residences, hospitals, convalescent homes, schools, and the like, damage or interruption of service of utilities, damage to primary roadways, and significant economic loss.
- *Class C* dams are high potential hazard dams that upon failure would result in loss of life and major damage to habitable structures, residences, hospitals, convalescent homes, schools, and main highways with great economic loss.

As of 1996, there were 16 DEEP-registered dams within the Borough of Naugatuck, of which three are Class A, five are Class BB, four are Class B, three are Class C and one is undefined. The list of Class B and C dams was updated by the DEEP in 2007. These are listed in Table 8-1.

TABLE 8-1
Dams Registered with the DEEP in the Borough of Naugatuck

Number	Name	Class
8801	Candee Reservoir Dam	BB
8802	Thurston Pond Dam	C
8803	May Street Pond South Dam	B
8804	May Street Pond North Dam	B
8805	Mulberry Reservoir Dam	C
8806	Union Ice Company Pond Dam	BB
8807	Schildgen Pond Dam	BB*
8808	Baummer Dam	A
8809	Armory Pond Dam	A
8810	Uniroyal Diversion Dam	-
8811	Straitsville Pond Dam	A
8812	Union City Dam	BB
8813	Straitsville Reservoir Dam	B
8814	Hop Brook Dam	C
8815	Ridge Lower Pond Dam	BB
8816	Ridge Upper Pond Dam	BB

*Rated a Class B dam in 1996, but was no longer rated Class B in 2007.

This section discusses only the possible effects of failure of significant and high hazard (Class B & C) dams. Failure of a Class C dam has the potential for loss of life and property damage totaling millions of dollars. Failure of a Class B dam has the potential for loss of life and minor damage to property and critical facilities.

The three Class C dams located in the Borough of Naugatuck include the Thurston Pond Dam, the Mulberry Reservoir Dam, and the Hop Brook Dam. In addition, there are four other Class C dams upstream of Naugatuck whose failure would impact Borough residents, as listed in Table 8-2 below. Because the hazard areas overlap, these Class B and C dams, along with their dam failure inundation areas are shown in Figures 8-1 and 8-2.

TABLE 8-2
Class C Dams Upstream of the Borough of Naugatuck

Number	Name	Watercourse in Naugatuck	Municipality
803	Long Hill Reservoir Dam	Beacon Hill Brook	Bethany
14001	Thomaston Dam	Naugatuck River	Thomaston
14007	Black Rock Dam	Naugatuck River	Thomaston
14008	Northfield Brook Dam	Naugatuck River	Thomaston

Note that the Black Rock Dam, Hop Brook Dam, and Thomaston Dam have progressively larger inundation areas depicted on Figure 8-1. For example, the Thomaston Dam inundation area (purple) is only visible at the edges of the Black Rock Dam inundation area (yellow) although it completely underlies (is wider than) the Black Rock Dam inundation area.

8.3 Historic Record

Approximately 200 notable dam and reservoir failures occurred worldwide in the twentieth century. More than 8,000 people died in these disasters. The following is a listing of some of the more catastrophic dam failures in Connecticut's recent history:

- 1938 and 1955: Exact numbers of dam failures caused by these floods are unavailable, but Connecticut DEEP believes that more dams were damaged in these events than in the 1982 or 2005 flooding events.
- 1961: Crystal Lake dam in Middletown failed, injuring three and severely damaging 11 homes.
- 1963: Failure of the Spaulding Pond Dam in Norwich caused six deaths and six million dollars in damage (1963 dollars).
- June 5-6, 1982: Connecticut experienced a severe flood that caused 17 dams to fail and seriously damaged 31 others. Failure of the Bushy Hill Pond Dam in Deep River caused $50 million in damages, and the remaining dam failures caused nearly $20 million in damages.

More recently, the NCDC reports that flash flooding on April 16, 1996 caused three small dams in Middletown and one in Wallingford to breach, and the Connecticut DEEP reported that the sustained heavy rainfall from October 7 to 15, 2005 caused 14 complete or partial dam failures and damage to 30 other dams throughout the State. A sample of damaged dams is summarized in Table 8-3:

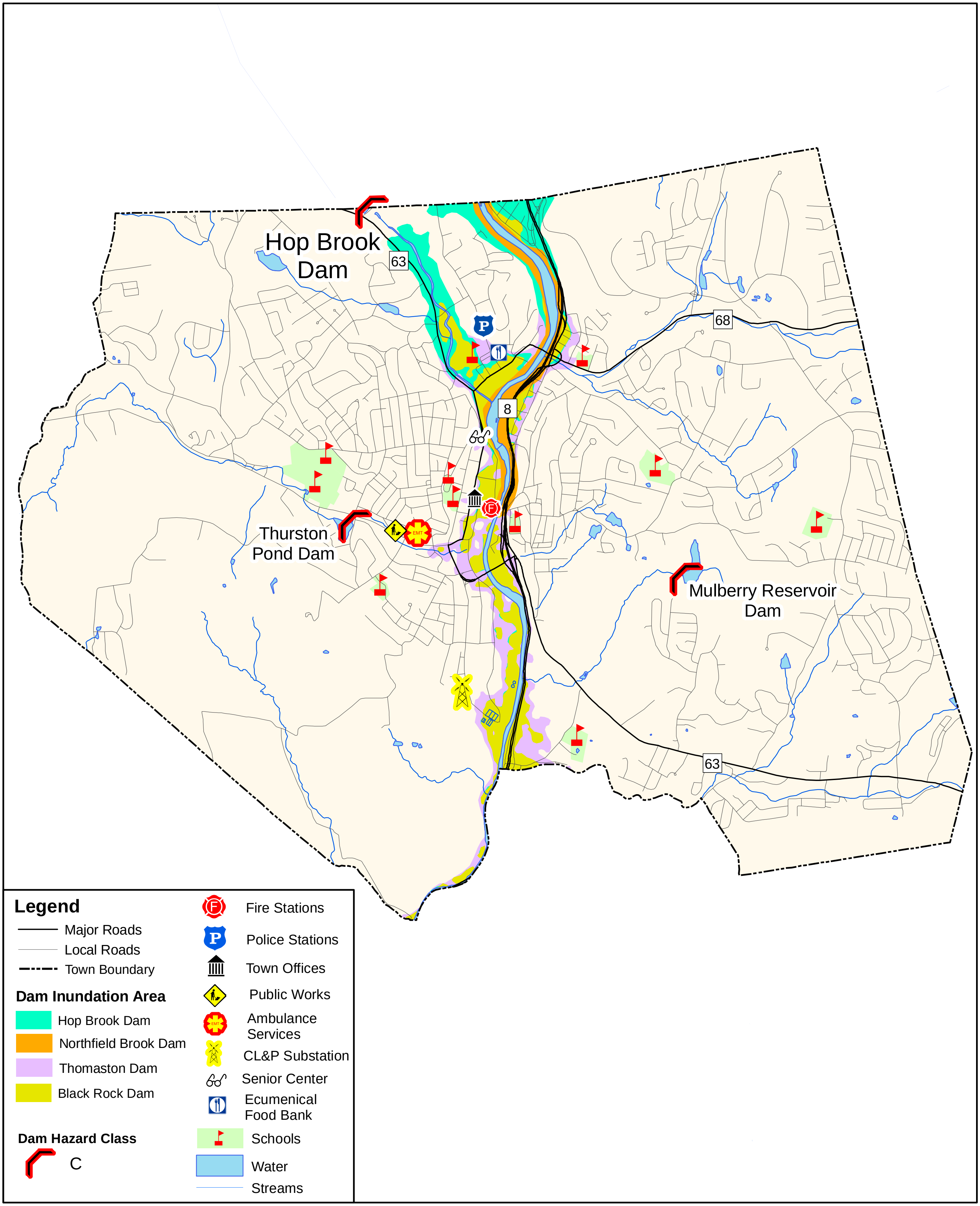
TABLE 8-3
Dams Damaged Due to Flooding from October 2005 Storms

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

The Association of State Dam Safety Officials states that no one knows precisely how many dam failures have occurred, but they have been documented in every state. From January 1, 2005 through January 1, 2009, state dam safety programs reported 132 dam failures and 434 incidents requiring intervention to prevent failure.

No major dam failures have occurred in the Borough of Naugatuck. According to Borough personnel, the dams throughout Borough are in varying stages of condition, with the Class C Hop Brook Dam (maintained by the ACOE) believed to be in good to excellent condition.

Figure 8-1: High Hazard Dams in Naugatuck



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", "Dams", DEP
"Facilities", Naugatuck
For general planning purposes only. Delineations may not be exact.
October 2008

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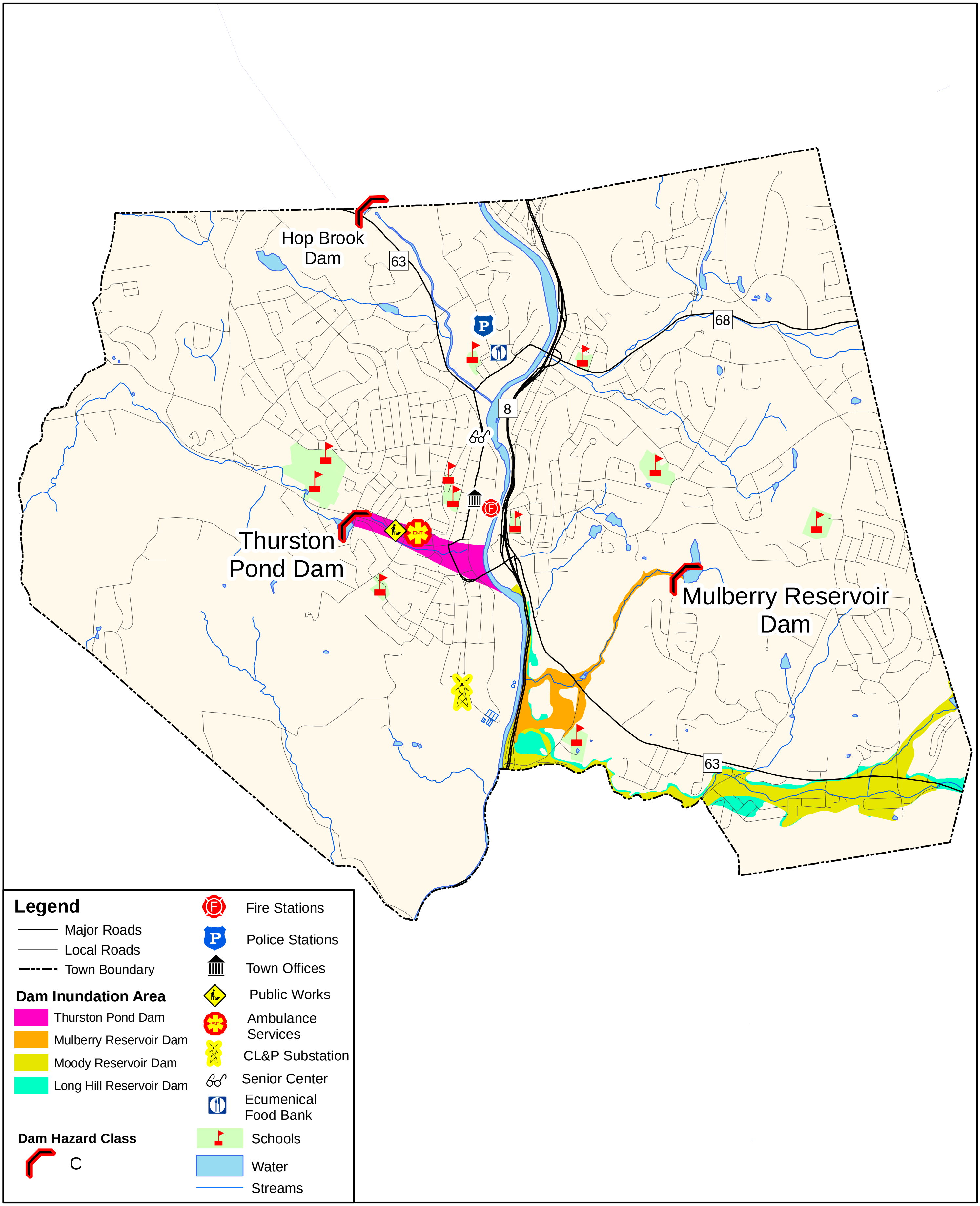
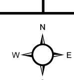
COUNCIL OF GOVERNMENTS
CENTRAL NAUGATUCK VALLEY

Figure 8-2: High Hazard Dams in Naugatuck



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", "Dams", DEP
"Facilities", Naugatuck
For general planning purposes only. Delineations may not be exact.
October 2008



COUNCIL OF GOVERNMENTS
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The upstream flood control dams described in Section 3.4 are also reportedly in good to excellent condition. The following paragraphs provide a description and highlight the general condition of each Class C and B dam based on information available at the Connecticut DEEP.

Class C Dams Located within the Borough of Naugatuck

- Thurston Pond Dam – This dam, also known as the New Dam, is owned by Chemtura Corporation. Thurston pond is located on Long Meadow Pond Brook at the southwest corner of the intersection of Rubber Avenue and Melbourne Street and covers a surface area of approximately 4.5 acres. It consists of an of an earth embankment with a stone masonry overflow spillway located at the right end of the dam, and outlet works located at the right abutment. The total length of the dam, including the spillway section, is 510 feet. The maximum height is 20 feet. The stone masonry overflow spillway section has an upstream earth embankment of unknown section, a concrete cap and a batter of six inches per vertical foot on the downstream face. The outlet works consist of a concrete intake structure with inlet and outlet gates which can discharge water through a 24-inch concrete pipe to downstream locations or through an 18-inch concrete pipe into the stream below the dam. The spillway capacity is 2,500 cfs, or 37% of the Test Flood Outflow. The dam is believed to be in good condition.

  According to Borough official's maintenance activities were recently conducted at Thurston's Dam to address washouts and repair the emergency spillway.

- Mulberry Reservoir Dam – The Mulberry Reservoir is owned by the Connecticut Water Company and is used for public water supply. The reservoir covers a surface area of approximately 8.3 acres and it receives its inflow from a 2.4 acre wetland located approximately 1,040 feet upstream on an unnamed tributary. The dam consists of an earth embankment, constructed of impervious materials with a pervious zone and toe drain on the downstream side. The dam is 580 feet in length with a top width of 20 feet, a maximum height of 66 feet, and upstream and downstream slopes of two feet horizontal to one foot vertical. A 40-foot long concrete spillway with discharge chute and stilling basin is located near the right end of the dam. The outlet works located near the center of the dam consist of a 12-inch cast iron blowoff and a 12-inch cast iron supply main through the dam, both controlled by manually operated gates located in an upstream gatehouse. The dam is considered to be in good condition. ACOE hydraulic analyses indicate that the capacity of the existing spillway is 1,600 cfs with the reservoir at elevation 574.78 (at top of dam). The calculations show the spillway is capable of passing 400% of the probable maximum flood without overtopping the dam.

- Hop Brook Dam – This ACOE flood control dam is located on Hop Brook at the Waterbury and Naugatuck corporate boundary. It consists of a rolled-earth fill with rock slope 520 feet long with a maximum height of 97 feet above the river bed. Outlet works include a three foot by five foot concrete rectangular conduit founded in rock. The dam is maintained by the ACOE and is believed to be in excellent condition. The ACOE conducted repairs in 2013 to address washouts.

Class C Dams Located Upstream of the Borough of Naugatuck

- Thomaston Dam – This ACOE flood control dam is located on the Naugatuck River in northeastern Thomaston and consists of an earth and rock-fill dam that was completed in 1970. The dam is 142 feet high and 2,000 feet long. Outlet works are founded on bedrock under the dam, and there is a side channel spillway 450 feet long on the left abutment. The reservoir has a storage capacity of 42,000 acre-feet. At spillway height, a 950 acre pool would extend about 6.5 miles upstream. The ACOE owns all the land behind the dam that would be affected by the backwater conditions up to 465 feet, and has flood easements in this area up to an elevation of 499 feet, which is 5 feet above the spillway. The dam is maintained by the ACOE and is believed to be in excellent condition.

- Black Rock Dam – This ACOE flood control dam is located on Branch Brook downstream of Wigwam Dam along the Thomaston-Watertown boundary in Black Rock State Park. It consists of an earth-fill dam 933 feet long and 154 feet high and was completed in 1970. Outlet works include a gated four-foot by five-foot concrete conduit in the right abutment of the dam, and a chute spillway with a 140-foot long crest adjacent to the right abutment. The reservoir has a storage capacity of 8,700 acre-feet. At spillway height, a 190 acre pool would extend approximately 1.8 miles upstream. The ACOE owns all the land behind the dam that would be affected by the backwater conditions and has easements up to the spillway crest elevation. The dam is maintained by the ACOE and is believed to be in excellent condition.

- Northfield Brook Dam – This ACOE flood control dam is located on Northfield Brook approximately 1.3 miles upstream of the Naugatuck River in the Town of Thomaston. It consists of an earth-fill dam 810 feet long and 118 feet high and was completed in 1966. Outlet works include a chute spillway with an ogee weir that is 72 feet long, and a three-by-three-foot gate controlling discharged into a 36-inch conduit founded on rock in the right abutment. The reservoir has a storage capacity of 2,430 acre-feet. At spillway height, a 67 acre pool would extend approximately 1.25 miles upstream. The dam is maintained by the ACOE and is believed to be in excellent condition.

Class B Dams Located within the Borough of Naugatuck

- May Street Pond North Dam – The May Street Pond North Dam (Vanasse's Pond) is owned by James, John and Robert Vanasse. The pond covers a surface area of approximately 2.5 acres and receives its inflow from an unnamed brook that drains a private pond located approximately 600 feet upstream and approximately 260 feet west of Gabriel Drive. The dam is an earthen dam with a concrete spillway at the southwestern portion of the dam, and is believed to be in good condition.

- May Street Pond South Dam – The May Street Pond South (Griesbach's Pond) Dam is owned by Dr. Hans Griesbach, a resident of May Street in Naugatuck. The pond covers a surface area of approximately 2.06 acres and receives its inflow primarily from groundwater. The dam is an earthen dam with a concrete spillway at the southeastern portion of the dam, and is believed to be in good condition.

- Long Hill Reservoir Dam – The Long Hill Reservoir, also known as the New Naugatuck Reservoir, is owned by the Connecticut Water Company and used for water supply. The reservoir covers a surface area of approximately 87.4 acres in the Towns of Bethany and

Prospect, and the reservoir receives its inflow from Beacon Hill Brook and several unnamed tributaries. The dam is an earthen dam with a rock fill slope with a concrete spillway in the southeastern portion of the dam. The dam is maintained by the Connecticut Water Company and believed to be in good to excellent condition.

- Straitsville Reservoir Dam – The Straitsville Reservoir is owned by the Connecticut Water Company and is used for water supply. The reservoir covers a surface area of approximately 2.07 acres in Naugatuck and Prospect, and the reservoir receives its inflow from Marks Brook. The dam is an earthen dam with a rock fill slopes with a spillway at the southeastern portion of the dam, and is believed to be in good to excellent condition.

8.4 Existing Capabilities

The Dam Safety Section of the 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 statutes are codified in Section 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 which govern the registration, classification, and inspection of dams. Dams must be inventoried by the owner with the DEEP, according to Connecticut Public Act 83-38.

> Dams permitted by the DEEP must be designed to pass the 100-year 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 100-year rainfall event.

Dam Inspection Regulations require that nearly 700 dams in Connecticut be inspected annually. The DEEP currently performs inspections of those dams which pose the greatest potential threat to downstream persons and properties, and also performs inspections as complaints are registered.

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 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 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.

Owners of Class C dams have traditionally been required to maintain Emergency Operation Plans (EOPs). Guidelines for dam EOPs were published by DEEP in 2012, creating a uniform approach for development of EOPs. As dam owners develop EOPs using the new guidance, DEEP anticipates that the quality of EOPs will improve, which will ultimately help reduce vulnerabilities to dam failures.

Important dam safety program changes are underway in Connecticut. Public Act 13-197, *An Act Concerning the Dam safety Program and Mosquito Control*, passed in June 2013 and describes new requirements for dams related to registration, maintenance, and EOPs, which will be called emergency action plans (EAPs) moving forward. This bill requires owners of certain unregistered dams or similar structures to register them by October 1, 2015. The bill generally shifts regularly scheduled inspection and reporting requirements from the DEEP to the owners of dams. The bill also makes owners generally responsible for supervising and inspecting construction work and establishes new reporting requirements for owners when the work is completed.

Effective October 1, 2013, the owner of any high or significant hazard dam (Class B and C) must develop and implement an EAP after the Commissioner of DEEP adopts regulations. The EAP shall be updated every two years, and copies shall be filed with DEEP and the chief executive officer of any municipality that would potentially be affected in the event of an emergency. New regulations shall establish 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 who are responsible for the warning and evacuation of residents in the inundation zone in the event of an emergency.

The Connecticut DEEP also administers the Flood and Erosion Control Board program, which can provide noncompetitive state funding for repair of municipality-owned dams. Funding is limited by the State Bond Commission. State statute 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.

Naugatuck's capabilities to mitigate for dam failure and prevent loss of life and property have increased since the initial hazard mitigation plan was adopted, mainly as a result of recent statewide legislative actions described above. In the next few years, dam safety programs will continue to strengthen.

8.5 Vulnerabilities and Risk Assessment

The dam failure inundation areas described below for the four ACOE Class C dams were redrawn from inundation maps provided by the ACOE. Thus, the dam failure inundation areas shown in Figure 8-1 are for planning purposes only and do not replace the official ACOE maps. Similarly, the dam failure inundation areas for Long Hill Reservoir Dam, Mulberry Reservoir Dam, and Moody Reservoir Dam was redrawn from mapping provided by the Connecticut Water Company, and is for planning purposes only.

> Inundation areas are considered by the ACOE to be sensitive information. Figure 8-1 in this Plan may not be reprinted as stand-alone information; it may only be disseminated within the confines of this Plan. For any questions regarding the use or disposition of this map please contact the ACOE Security Officer at (978) 318-8007.

By definition, failure of Class C dams may cause catastrophic loss of life and property. Of the seven Class C dams whose failure would be likely to impact the Borough of Naugatuck, the failure of Hop Brook Dam or Thomaston Dam would likely have the highest impact on the residents and infrastructure of the Borough of Naugatuck. However, the failure of any of these dams would have significant impacts within the Borough. These impacts are described in general detail below.

Black Rock Dam

Black Rock Dam is owned by the ACOE and provides flood control along Branch Brook in Black Rock State Park. Based on dam failure inundation maps provided by the ACOE, a dam failure at full pool height would cause flooding along the Branch Brook and Naugatuck River corridors all the way to downtown Beacon Falls. Flood heights would be outside the 500-year floodplain in the center of the Borough, though flood heights would be less than a failure of Hop Brook Dam. As with a Hop Brook Dam failure, several critical facilities in the downtown area would be flooded.

Hop Brook Dam

Hop Brook Dam is owned by the ACOE and provides flood control along Hop Brook. Based on dam failure inundation maps provided by the ACOE, a dam failure at full pool height would cause flooding along Hop Brook and the Naugatuck River corridors all the way to Derby. The most concentrated damage would likely occur along the Route 63 corridor, and many of the critical facilities in the downtown area would be flooded.

Long Hill Reservoir Dam

Long Hill Reservoir is owned by the Connecticut Water Company. The downstream corridor is developed with many residential and some commercial and industrial properties. The dam failure inundation area extends along Route 63 and Beacon Valley Road. Critical facilities in the Borough of Naugatuck are not in the inundation area, but many residential structures south of Route 63 in the southeast section of the Borough would be flooded if the dam failed. A dam failure could trap residents in the Cotton Hollow Road area as well if the bridge were undermined.

Mulberry Reservoir Dam

Mulberry Reservoir is owned by the Connecticut Water Company. The downstream corridor is undeveloped forested land for approximately 650 feet, after which there is a large area of residential developments. The dam failure inundation area follows the unnamed tributary to the Naugatuck River and would not appear to directly affect the residential developments south and southeast of the dam. The inundation area becomes wider after the unnamed tributary passes under Route 63, encompassing a large portion of Grove and St. James Cemeteries. Critical facilities in the Borough of Naugatuck are not located in the inundation area.

Northfield Brook Dam

The Northfield Book impoundment is contained by the ACOE-owned flood control dam. The downstream corridor is developed with many residential properties. Based on dam failure inundation maps provided by the ACOE, a dam failure at full pool height would cause flooding along Northfield Brook and the Naugatuck River all the way into central Naugatuck. The inundation area is nearly coincidental with that of the Black Rock Dam failure inundation area.

Flood heights would be less than the 500-year floodplain in the center of the Borough, however many of the critical facilities in the downtown area would be flooded.

Thomaston Dam

Thomaston Dam is owned by the ACOE and is designed to impound floodwaters from the Naugatuck River and Leadmine Brook. Based on dam failure inundation maps provided by the ACOE, a dam failure at full pool height (worst-case scenario) would cause flooding along the Naugatuck River corridor all the way to the Housatonic River in Derby. Much of downtown Naugatuck would experience some degree of flooding, including many of the critical facilities in the Borough (Figure 8-1). Such a failure would cause backwater conditions along Beacon Hill Brook and past St. James Cemetery up to the western end of Beacon Valley Road. A breach at full height would cause flooding greater than the mapped 500-year flood event for Naugatuck.

Thurston Pond Dam

Thurston pond is owned by Chemtura Corporation. The downstream corridor is a mixture of medium density residential development and commercial and industrial developments. Based on dam failure inundation maps in the Emergency Operations Plan on file at the DEEP, a dam failure at full pool height would cause flooding along Long Meadow Brook all the way to the central portion of the Borough along the Naugatuck River. Critical facilities such as Public Works and Ambulance Services would be affected by this flooding. The dam is believed to be in good condition.

Other Dams

There are other dams within and around Naugatuck that could impact on the residents or infrastructure of the Borough if they failed. Some are Class B (significant hazard) dams, while the others are lower hazard or minor dams with problems have been brought to the attention of the Borough.

- May Street Pond North (Vanasse's Pond) Dam: Should this Class B dam fail, 10-15 houses along June Street, Bird Road, Spruce Drive, and Homestead Avenue could experience flooding.

- May Street Pond South (Griesbach's Pond) Dam: Should this Class B dam fail, a few houses along the dead-end streets of Hickory Road and Woodland Street would likely experience flooding, and a few homes on High Street could also be flooded.

- Straitsville Reservoir Dam: Should this Class B dam fail, the initial impact area would be the condominium development along Horton Road. It is anticipated that the peak outflow of 6,200 cfs would raise the water elevation downstream between one foot and six feet, with a maximum of three to four feet of flooding expected within the condominiums. It is expected that the condominiums would flood within minutes and hit maximum flood level in ten to fifteen minutes. Flooding in this area would be exacerbated if the failure of Moody Reservoir Dam (a Class B dam located upstream in Prospect) triggered the failure of Straitsville Reservoir Dam. In this scenario, the dam failure inundation area would be similar to the inundation area shown for Moody Reservoir Dam on Figure 8-2.

- Ridge Lower Pond Dam: This Class BB dam impounds a retention pond located at the end of Warren Avenue below the Ridge Development. Borough officials noted that repairs at this dam have been completed and the pond functioned well during recent flooding.

- Donovan Road Dam: This unregistered dam on the pond labeled as "Water Company Pond No. 1" on USGS Topographic Maps was mentioned at the data collection meeting as having the potential to cause flooding.

Loss Estimates – Flooding from breaches of the above dams would cause damage along the Naugatuck River, Hop Brook, Long Meadow Pond Brook, and Beacon Hill Brook throughout their lengths in the Borough of Naugatuck. Therefore, losses estimated by HAZUS-MH in Chapter 3 were utilized to estimate the potential effects of dam failure along these four streams and rivers. The underlying assumption is that a flood from a dam breach would be approximated by a 1% annual chance flood for each of the four streams and rivers.

The HAZUS-MH simulation estimates that none of the Borough's essential facilities will be damaged by floods caused by dam breaches along these four watercourses. The HAZUS-MH simulation estimated the following tons of debris would be generated by flood damage.

Table 8-4
Debris Generation

Stream	Tons
Beacon Hill Brook (Long Hill Res., Straitsville Res., and Moody Res. dams)	15
Hop Brook (Hop Brook dam)	1
Long Meadow Brook (Thurston Pond dam)	34
Naugatuck River (various upstream dams)	412

HAZUS-MH calculated the potential sheltering requirement for the dam failure scenarios. Displacement includes households evacuated from within or very near to the inundated areas.

Table 8-5
Households and People Seeking Shelter

Stream	Households	People
Beacon Hill Brook (Long Hill Res., Straitsville Res., and Moody Res. dams)	10	5
Hop Brook (Hop Brook dam)	2	0
Long Meadow Brook (Thurston Pond dam)	16	11
Naugatuck River (various upstream dams)	22	30

HAZUS-MH also calculated the predicted economic losses due to two dam failure scenarios. Economic losses are categorized between building-related losses and business interruption losses.

Table 8-6
Building-Related Losses (Millions)

Stream	Building Losses	Business Interruption Losses
Beacon Hill Brook (Long Hill Res., Straitsville Res., and Moody Res. dams)	$0.38	$0
Hop Brook (Hop Brook dam)	$0.08	$0
Long Meadow Brook (Thurston Pond dam)	$1.85	$0.01
Naugatuck River (various upstream dams)	$9.66	$0.06

The HAZUS-MH results do not provide casualty estimates. However, it is assumed that casualties would occur under either flood scenario.

8.6 Potential Mitigation Strategies and Actions

Preventive measures associated with dam failure include semi-annual or annual inspections of each dam. Dam inspections in the State of Connecticut are required to be conducted by a licensed professional engineer. In addition, local communities should maintain a dialogue with Connecticut DEEP regarding the development of EAPs and Dam Failure Analysis for dams not owned by the municipality, and encourage Connecticut DEEP to approach dam owners of Class B and Class C dams to develop or update such plans as needed. Some of this will be forthcoming with the recent legislation.

The Borough of Naugatuck should work with Connecticut DEEP to stay up to date on the evolution of Emergency Operations Plans and Dam Failure Analyses for the Class C ACOE dams and Connecticut Water Company dams in Thomaston, Naugatuck, Prospect and Bethany, as well as the three Class C dams within the Borough. When possible, copies of these documents should be made available at the Borough Offices for reference and public viewing.

Regarding lower hazard dams, the Borough should assess the condition and performance of the Donovan Road Dam and upgrade as necessary, and upgrade and repair the Ridge Lower Pond Dam located along Warren Avenue. The latter project should be coordinated with the DEEP. The Borough should also consider implementing occasional Borough inspections of lower hazard dams in the Borough.

Communities containing or located downstream from high and significant hazard dams should maximize their emergency preparedness for a potential dam failure. This can be done by having copies of the EOP/EAP for each dam on file with the local emergency manager and the local engineering department as well as by including potential inundation areas in an emergency notification database. It is important to maintain up to date dam failure inundation mapping in order to properly direct notifications into potentially affected areas. Dam failure inundation areas should be mapped for all community-owned significant and high hazard dams. For dams without a mapped failure inundation area, the 100-year and 500-year floodplains described in Section 3 could be utilized to provide approximate failure inundation areas for the notification database.

Public education and awareness should be directed at dam owners in the community in order to keep them up to date on maintenance resources, repair resources, funding sources, and regulatory changes. Public education for residents will be similar to those for flooding, but should also be directed to residents in potential inundation areas. Such residents should be given information regarding preparing evacuation kits and potential evacuation procedures.

The Borough of Naugatuck should consider including dam failure areas in its CodeRED emergency notification system. This system combines database and GIS mapping technologies to deliver outbound emergency notifications to geographic areas or specific groups of people such as emergency responder teams at a rate of up to 60,000 calls per hour. This technology should be used to warn downstream residents of an impending dam failure and facilitate evacuation.

Structural projects for preventing dam failure are typically focused on maintaining and repairing subject dams to be in good condition, resizing spillways to pass a larger flood event without causing damage, and maintaining upstream dams such that sequential failures do not occur

8.7 Status of Mitigation Strategies and Actions

The prior mitigation strategy associated with dam failure is listed below with commentary regarding the status.

TABLE 8-7
Status of Previous Strategies and Actions

Strategy or Action	Status
Consider including dam failure areas in its CodeRED emergency notification system. This system combines database and GIS mapping technologies to deliver outbound emergency notifications to geographic areas or specific groups of people such as emergency responder teams at a rate of up to 60,000 calls per hour. This technology should be used to warn downstream residents of an impending dam failure and facilitate evacuation.	Complete; strategy can be removed.
Stay current on the development of EOPs and Dam Failure Analyses for Class C and B dams whose failure could impact Naugatuck	This is ongoing and part of the Borough's capabilities, therefore it can be removed.
Assess the condition and performance of the Donovan Road dam and upgrade as necessary	Complete; strategy can be removed
Upgrade and repair the Ridge Lower Pond Dam along Warren Avenue	Complete; strategy can be removed
Consider implementing Borough inspections of lower hazard dams	This strategy can be deleted as Borough does not have the resources or expertise to conduct these inspections.

The above strategies and actions have become capabilities and they are not listed in the table in Appendix A, as they are ongoing. Two new strategies have been identified through the process of updating this plan. With the legislature passed in 2013, dam assessment and management capabilities will continue to increase in the state. The next edition of this plan will revisit dams and discuss the outcomes of the legislation and any new regulations administered by the Connecticut DEEP.

- ❑ Keep abreast of changes in the requirements for Class A, AA and unranked dams and compile information for these dams as it becomes available.
- ❑ Obtain EOP's/EAP's once they are completed.

9.0 WILDFIRES

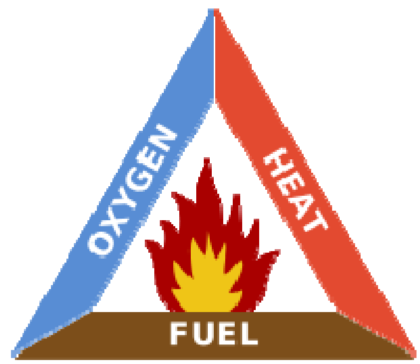
9.1 Setting

The ensuing discussion about wildfires is focused on the undeveloped wooded and shrubby areas of Naugatuck, along with low-density and medium density suburban type development found at the margins of these areas known as the wildland interface. Structural fires in higher density areas are not considered.

The Borough of Naugatuck is considered a low-risk area for wildfires. Wildfires are of particular concern in wooded areas and other areas with poor access for fire-fighting equipment. Figure 9-1 presents the wildfire risk areas for the Borough of Naugatuck. Hazards associated with wildfires include property damage and loss of habitat. Wildfires of any type are considered a likely event each year, but when one occurs it is generally contained to a small range with limited damage to non-forested areas. The Borough of Naugatuck is a low-risk area for large wildfires.

9.2 Hazard Assessment

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 U.S. Bureau of Land Management, each of three elements (known as the fire triangle) must be present in order to have any type of fire:

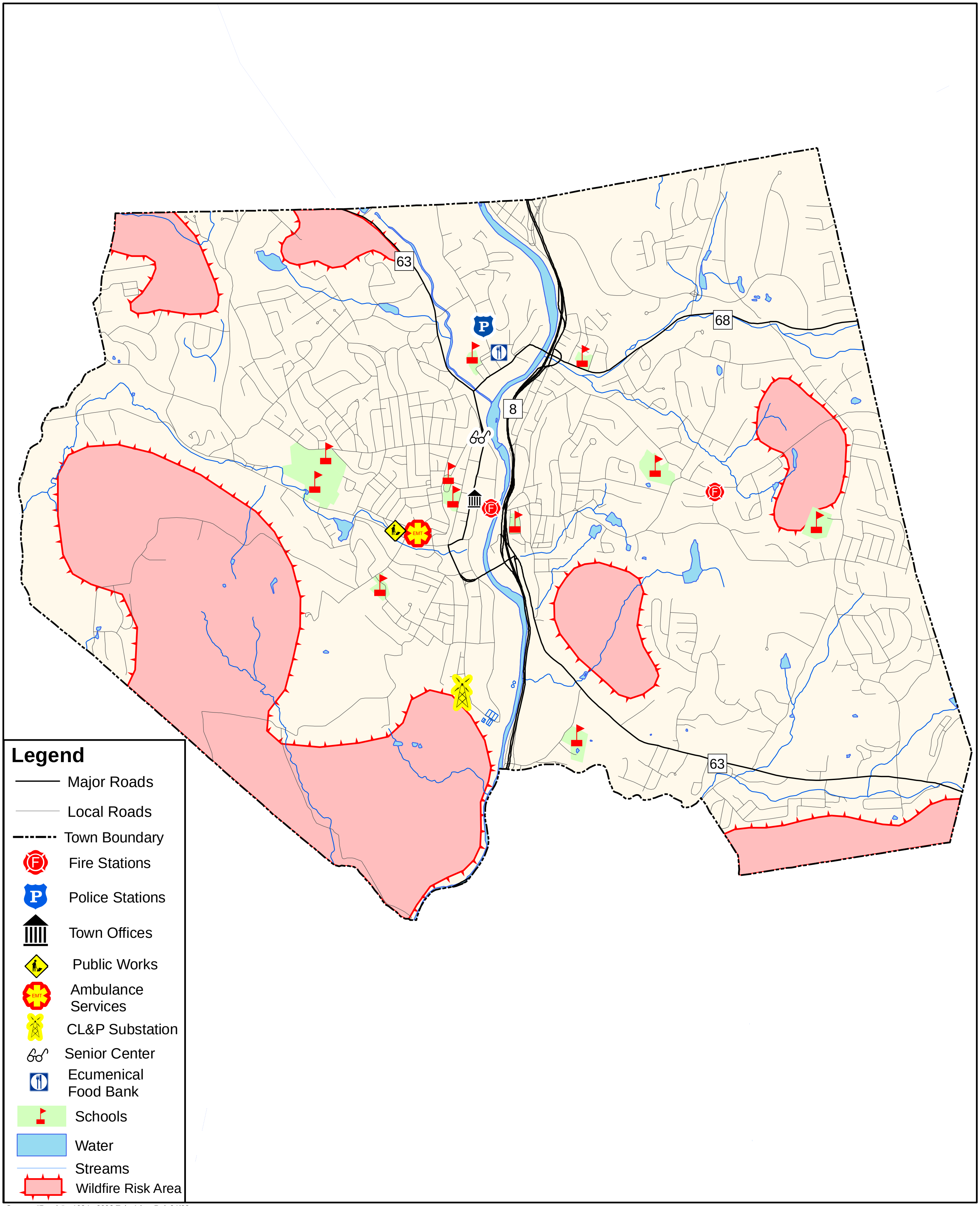


The Fire Triangle. Public Domain Image Hosted by Wikimedia Commons.

- ❑ 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. 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; and
  - Canopy Fuels, consisting of tree crowns

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

Figure 9-1: Naugatuck Wildfire Risk Area



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", DEP
"Facilities", Naugatuck
"Wildfire", COGCNV
For general planning purposes only. Delineations may not be exact.
October 2008

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

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

9.3 Historic Record

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.

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 4,361 acres of land burned in Connecticut from 2002 through 2012 due to 2,334 non-prescribed wildfires, an average of 1.5 acres per fire and 313 acres per year (Table 9-1). The Connecticut DEEP Forestry Division estimates the wildland fires burn approximately 1,300 acres per year.

The 2014 *Connecticut Natural Hazard Mitigation Plan Update* states that in seven of the eight counties in Connecticut, the primary cause of wildland fires is unknown. The secondary cause is identified as incendiary (arson) and debris burning.

TABLE 9-1
Wildland Fire Statistics for Connecticut

Year	Number of Wildland Fires	Acres Burned	Number of Prescribed Burns	Acres Burned	Total Acres Burned
2012	180	417	4	42	459
2011	196	244	7	42	286
2010	93	262	6	52	314
2009	264	246	6	76	322
2008	330	893	6	68	961
2007	361	288	7	60	348
2006	322	419	6	56	475
2005	316	263	10	130	393
2004	74	94	12	185	279
2003	97	138	8	96	234
2002	101	184	13	106	290
Total	**2,334**	**3,448**	**85**	**913**	**4,361**

Source: National Interagency Fire Center

Up to 14% of the land area of Naugatuck is publicly protected open space with an additional 15% being privately held open space, and fires have occurred in wildlands throughout the Borough. Specifically, personnel from the Borough of Naugatuck noted that fires have occurred in the Huntington Hill section of the Naugatuck State Forest in Naugatuck. Such fires are usually caused by arson or from campfires that spread out of control. Fires that start in Naugatuck in this area are sometimes allowed to burn due to the topography, and the fires can spread to other parts of the forest near the urban/wildland interface or south into Beacon Falls. The Borough typically has a few wildfires per year that average five to ten acres in size.

9.4 Existing Capabilities

Existing mitigation for wildland fire control is typically focused on the Borough of Naugatuck Fire Department (NFD) training and maintaining an adequate supply of equipment. The Borough of Naugatuck Zoning Regulations and Subdivision Regulations require that the Fire Marshal review all plans for subdivisions and commercial developments to ensure that the requirements for fire safety are met. The Fire Marshal's Office is also responsible for the enforcement of the State of Connecticut Life Safety Code, investigation of fire safety complaints, fire investigation and fire prevention programs.

Unlike wildfires on the west coast of the United States where the fires are allowed to burn toward development and then stopped, the NFD goes to the fires whenever possible. This proactive approach is believed to be effective for controlling wildfires. The Fire Department has some water storage capability, but primarily relies on Connecticut Water Company's water service to fight fires in the central part of Borough. In the remainder of the Borough, the NFD relies on the use of local water bodies and its tanker trucks to supply fire fighting water, and water cisterns installed in more recent outlying subdivisions.

The NFD is often a first responder for fires that happen in the Naugatuck State Forest, and coordinates with the Beacon Falls, Oxford, and Bethany Fire Departments to control these forest fires. The Fire Department has two fire station s in the Borough; one station is located on Maple Avenue in the downtown area, and the other is located on May Street on the east side of the Naugatuck River. The Fire Department has two Class A pump trucks, a 105-foot rear mount ladder truck with a fire pump, and a rescue truck. The NFD is equipped for structure fires, confined space entry, trench rescue, motor vehicle rescue, basic hazardous materials response, and surface water/ice rescue. The NFD also has two spare Class A pump trucks, and the Borough also has mutual aid agreements with all of its neighbors.

The Connecticut DEEP Division of Forestry monitors the weather each day during non-winter months as it relates to fire danger. The Division 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. In addition, 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.

The Connecticut DEEP has recently changed its Open Burning Program. It now requires individuals to be nominated and designated by the Chief Executive Officer in each municipality that allows open burning to take an online training course and exam to become certified as an "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 post burn activity. The regulated activity is then overseen by the town.

Regulations regarding fire protection are outlined in the *Subdivision Regulation*s:

- ***The Borough of Naugatuck Subdivision Regulations*** outline the following***:***

    - Driveways to interior lots shall be designed and constructed to accommodate fire apparatus and other emergency equipment.
    - Applicants shall provide sufficient information to establish that an adequate water supply is available to serve the domestic and fire protection needs of the proposed subdivision.
    - Where public water is not required, a private well may be permitted for each lot. Adequate water supply for fire protection shall be established in accordance with Borough standards.

Other capabilities for reducing wildfire risk include:

- Encouraging property owners to widen access roads such that fire trucks and other emergency vehicles can access remote locations.
- Continuing intermunicipal cooperation in firefighting efforts.
- Providing outreach programs on how to properly manage burning and campfires on private property.
- Patrolling Borough-owned open space and parks to prevent unauthorized campfires.
- Enforcing regulations and permits for open burning.

Aside from moderate changes in State policy, the Borough's capabilities to mitigate for wildfires and prevent loss of life and property have not changed significantly since the initial hazard mitigation plan was adopted. However, it should be noted that the borough has updated their regulations to require underground tanks in subdivisions that are not located in a public water system service area.

9.5 Vulnerabilities and Risk Assessment

The most common causes of wildfires are arson, lightning strikes, and fires started from downed trees hitting electrical lines. Thus, wildfires have the potential to occur anywhere and at any time in both undeveloped and lightly developed areas. The extensive forests and fields covering the state are prime locations for a wildfire. In many areas, structures and subdivisions are built abutting forest borders, creating areas of particular vulnerability. 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.

According to the Connecticut DEEP, the actual forest fire risk in Connecticut is low due to several factors. First, the overall incidence of forest fires is very low. Secondly, as the wildfire/forest fire prone areas become fragmented due to development, the local fire departments have increased access to those neighborhoods for fire fighting equipment. Third, the problematic interface areas are site specific, such as driveways too narrow to permit emergency vehicles. Finally, trained fire fighters at the local and state level are readily available to fight fires in the state, and inter-municipal cooperation on such instances is common.

The 2001 Plan of Conservation and Development indicated that there are several streets in the Borough which are inaccessible to fire trucks due to either steep grades or the narrowness of the road. These include Aetna Place, Bosco Drive, Highland Circle, Hughes Street, Joseph Road, Mitchell Street and Theresa Street. Although this document is primarily concerned with the Borough's ability to address wildfires versus structural fires, the existing problem is indicative of issues with current development standards. While this is not specifically addressed in the 2013 Plan of Conservation and Development, it is essential that any future development on steep slopes be reviewed with an extra level of attention to ensure that new developments are not burdened by the same type of problems.

Based on the historic record presented in Section 9.3, most wildfires in Connecticut are relatively small. In the drought year of 1999, the average wildfire burned five acres. In comparison, the most extreme wildfires recorded since 1986 each burned 300 acres. Given the availability of fire fighting water in the Borough (including the use of nearby water bodies), the proactive stance regarding fires, and long-standing mutual aid assurances the NFD has with neighboring communities, it is believed that the low end of this acreage is possible in Naugatuck as well, with the larger acreage reserved for very infrequent severe events.

The wildfire risk areas presented in Figure 9-1 were defined as being contiguous wooded areas greater than 50 acres in size that have limited access in areas near public water service, and contiguous wooded areas greater than 20 acres in size with limited access in the remainder of the Borough. These areas are generally associated with wooded water company lands, state owned forests, and Borough-owned and privately held open space. As each area borders residential sections of the Borough, residents on the outskirts of these risk areas are the most vulnerable to fire, heat, and smoke effects of wildfires.

The 2001 Plan of Conservation and Development also indicated that the NFD has expressed concerns regarding response times to developments in the northwest and southeast portions of the Borough. Additionally, the water pressure in some areas, particularly around the perimeter of the Borough, has been identified as a problem. These areas exhibit low-pressure situations which may inhibit the department's ability to deal with fires. The Borough requires that new developments provide adequate water for fire protection, either by water mains from the Connecticut Water Company or underground cisterns at a minimum size of 25,000 gallons. Subsequent to the Plan of Conservation and Development publication in 2001, additional water lines have been extended up May Street towards the Eastside Fire Station and on Wooster Street. While this issue is not specifically mentioned in the 2013 Plan of Conservation and Development, the borough continues to ensure that their fire protection regulations are reviewed and updated as needed.

Despite having a large amount of forest/urban interface, the overall risk of wildfires occurring in the Borough of Naugatuck is also considered to be low. Such fires fail to spread far due speed of detection and strong fire response. As most of the Borough has fire-fighting water available nearby, a large amount of water can be made readily available for fire fighting equipment, and tankers from other towns can provide additional fire support for outlying fires.

Recall from Figure 2-6, Figure 2-7, and Figure 2-8 that elderly, linguistically isolated, and disabled populations reside in the Borough of Naugatuck. In comparing these figures with the wildfire risk areas presented in Figure 9-1, it is possible that up to a thousand of the population impacted by a wildfire could consist of the elderly, several tens could consist of linguistically isolated households, and many residents with disabilities could reside near wildfire impact areas. Thus, it is important for the Borough of Naugatuck to be prepared to assist these special populations during emergencies, including wildfires.

In summary, limited access forest areas in the outskirts of the Borough near new development are considered most at risk from wildfires, primarily as a result of limited supplies of fire-fighting water and emergency vehicle access. In addition, there is special concern about fires in the Naugatuck State Forest in the southern part of the Borough. Fires in these areas are particularly difficult to access due to topography can spread to or from nearby municipalities. The Borough has the support of the owners of the tracts of open space to provide access to their lands in case of a wildfire.

Should a wildfire occur, it seems reasonable to estimate that the average area to burn would be five acres, consistent with the state average during long period of drought. In the case of an extreme wildfire during a long drought on forested lands, it is estimated that up to 300 acres could burn before containment due to the limited access of those lands. Residential areas bordering such lands would also be vulnerable to wildfire, but would likely be more impacted by heat and smoke than by structure fires due to the strong fire response in the Borough and its mutual aid agreements.

<u>Loss Estimates</u> – The 2014 Connecticut Natural Hazard Mitigation Plan provides annual estimated losses on a countywide basis for several hazards. Based on the population of

Naugatuck relative to New Haven County, the annual estimated loss is $2,071 for wildfires. This figure is considered reasonable for Naugatuck.

9.6 Potential Mitigation Strategies and Actions

Potential mitigation measures for wildfires include a mixture of prevention, education, and emergency planning. Although educational materials are available through the Fire Department, they should be made available at other municipal offices as well. Education of homeowners on methods of protecting their homes is far more effective than trying to steer growth away from potential wildfire areas, especially given that the available land that is environmentally appropriate for development may be forested. Water system improvements are an important class of potential mitigation for wildfires.

9.7 Status of Mitigation Strategies and Actions

The prior mitigation strategies associated with wildfires are listed below with commentary regarding the status of each.

TABLE 9-2
Status of Previous Strategies and Actions

Strategy or Action	Status
The Connecticut Water Company should continue to extend the public water supply systems into areas that require water for fire protection.	CWC must extend its system as funding allows, and as these extensions fit into its overall capital improvement program. This strategy will be carried forward.
The Connecticut Water Company should continue to identify and upgrade those portions of the public water supply systems that are substandard from the standpoint of adequate pressure and volume for fire-fighting purposes.	This is ongoing and part of the borough's capabilities, therefore it can be removed.
The Borough of Naugatuck should consider the construction of dry hydrants throughout the Borough to provide a more reliable supply of firefighting water in areas without public water supply.	This is ongoing and part of the borough's capabilities, therefore it can be removed.
The Borough should also continue to require fire protection tanks for subdivisions away from public water service.	This is ongoing and part of the borough's capabilities, therefore it can be removed.
Continue to promote inter-municipal cooperation in firefighting efforts.	This is ongoing and part of the borough's capabilities, therefore it can be removed.
Continue to support public outreach programs to increase awareness of forest fire danger and how to use common firefighting equipment.	This is ongoing and part of the borough's capabilities, therefore it can be removed.
Provide outreach programs on how to properly manage burning and campfires on private property.	This is ongoing and part of the borough's capabilities, therefore it can be removed.
Patrol Borough-owned open space and parks to prevent unauthorized campfires.	This is ongoing and part of the borough's capabilities, therefore it can be removed.
Enforce regulations and permits for open burning.	This is ongoing and part of the borough's capabilities, therefore it can be removed.

The above strategies and actions have become capabilities and they are not listed in the table in Appendix A, as they are ongoing. Two new strategies have been identified through the update process.

- Explore other fire protection solutions when water main extensions are not feasible, such as the use of cisterns, fire ponds and dry hydrants.
- Revise and enhance the town’s website concerning the local regulatory requirements concerning open burning.

10.0 MITIGATION STRATEGIES AND ACTIONS

10.1 Additional Strategies

Strategies that are applicable to a small number of hazards were discussed in the applicable subsections of Sections 3.0 through 10.0. For example, placing utilities underground is a strategy for hurricane, summer storm, winter storm, and wildfire mitigation. A remaining class of "all-hazard" strategies is applicable to all hazards, because it includes actions for improving public safety and planning for emergency response. Instead of repeating these strategies in each of this Plan, these are described below.

Naugatuck has made great progress with most of the all-hazard strategies described in the previous HMP. Preparedness and disaster-related information is continuously provided in municipal facilities, and the Borough subscribes to the CodeRED notification system. The Borough's EOP is reviewed annually and updated as needed. These previous strategies are now considered capabilities.

Two new all-hazard strategies are proposed in this plan. The first strategy includes the acquisition and installation of additional standby power supplies (generators). Several critical facilities require standby power supplies. Consider, for example, that power outages caused by storms Irene, Sandy, and Alfred caused outages at some of the borough's facilities. The Borough would prefer to avoid these situations, going forward. The second strategy requires the development of a plan to incorporate Condominium Associations into hazard mitigation planning.

10.2 Summary of Proposed Strategies and Actions

Strategies and actions have been presented throughout this document in individual sections as related to each natural hazard. To prioritize recommended mitigation measures, 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. The STAPLEE method was used in the previous HMP.

Overview of the STAPLEE Prioritization Process

Benefit-cost review was emphasized in the prioritization process. Criteria were divided into potential benefits (pros) and potential costs (cons) for each mitigation strategy. The following questions were asked about the proposed mitigation strategies:

- **Social**:
  - Benefits: Is the proposed strategy socially acceptable to the jurisdiction?
  - Costs: Are there any equity issues involved that would mean that one segment of the region could be treated unfairly? Will the action disrupt established neighborhoods,

break up voting districts, or cause the relocation of lower-income people? Is the action compatible with present and future community values?

- **Technical**:

  - Benefits: Will the proposed strategy work? Will it reduce losses in the long term with minimal secondary impacts?

  - Costs: Is the action technically feasible? Will it create more problems than it will solve? Does it solve the problem or only a symptom?

- **Administrative**:

  - Benefits: Does the project make it easier for each community to administer future mitigation or emergency response actions?

  - Costs: Does each community have the capability (staff, technical experts, and/or funding) to implement the action, or can it be readily obtained? Can the community perform the necessary maintenance? Can the project be accomplished in a timely manner?

- **Political**:

  - Benefits: Is the strategy politically beneficial? Is there public support both to implement and maintain the project? Is there a local champion willing to see the project to completion? Can the mitigation objectives be accomplished at the lowest cost to the community (grants, etc.)?

  - Costs: Have political leaders participated in the planning process? Do project stakeholders support the project enough to ensure success? Have the stakeholders been offered the opportunity to participate in the planning process?

- **Legal**:

  - Benefits: Is there a technical, scientific, or legal basis for the mitigation action? Are the proper laws, ordinances, and resolutions in place to implement the action?

  - Costs: Does the community have the authority to implement the proposed action? Are there any potential legal consequences? Will the community be liable for the actions or support of actions, or for lack of action? Is the action likely to be challenged by stakeholders who may be negatively affected?

- **Economic**:

  - Benefits: Are there currently sources of funds that can be used to implement the action? What benefits will the action provide? Does the action contribute to community goals, such as capital improvements or economic development?

- <u>Costs</u>: 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? Should the considered action be tabled for implementation until outside sources of funding are available?

- **Environmental**:

  - <u>Benefits</u>: Will this action beneficially affect the environment (land, water, endangered species)?

  - <u>Costs</u>: 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 (x2) in the final sum of scores.

- The total benefit score and cost score for each mitigation strategy were summed to determine each strategy's final STAPLEE score. The highest possible score is 9.0, while the lowest possible score is -9.0.

An evaluation matrix with the total scores from each suggested action is presented in Appendix A. Page 1 of the STAPLEE matrix lists all of the strategies and actions from the previous edition of this HMP with commentary for each, plus new strategies and actions. The commentary in the matrix is based on the status of each as presented in the applicable sections of chapters 3 through 10. Page 2 lists only those previous strategies that are carried forward plus the new strategies and actions. Page 2 of the STAPLEE matrix presents the summary of scores. The highest scoring is determined to be of more importance economically, socially, environmentally, and politically and, hence, prioritized over those with lower scoring. In addition, structural projects were also evaluated qualitatively. Note that the scoring system inherently favors actions that have minimal incremental costs, such as modifying regulations (which is accomplished by existing municipal personnel and commissions).

Although a community may implement actions as prioritized by the STAPLEE method, an additional consideration is important for those actions that may be funded under the FEMA mitigation grant programs. To receive federal funding, the majority of mitigation actions require the calculation of a benefit-cost ratio (BCR) that exceeds one; namely, that the benefits of the project outweigh its costs. Calculation of the BCR is typically conducted using FEMA's Benefit Cost Analysis (BCA) toolkit. The calculation may be complex, vary with the mitigation action of interest, and is dependent on detailed information such as property value appraisals, design and construction costs for structural projects, and tabulations of previous damages or NFIP claims.

Calculation of cost estimates for actions is not appropriate for a HMP, as this information can be misleading or inaccurate in several years and lead to problems when municipal personnel receive cost estimates from contractors. Potential costs of each action is therefore listed as "minimal", "low", "intermediate", or "high" on the STAPLEE matrix. These identifiers are defined as follows:

- "Minimal" costs only include printing, copying, or meetings of personnel. Direct expenditures are expected to be less than $1,000 (staff time is not included).

- "Low" costs can typically be handled by existing personnel with few outside expenses. These projects typically cost less than $10,000.

- "Intermediate" costs would require less than $100,000 to implement and may include studies, investigations, or small improvement projects. Such projects often require the use of outside consultants.

- "High" costs would require greater expenditures and may require grant funding to successfully complete the project. Such projects typically include capital expenditures for construction or infrastructure along with associated permitting and engineering costs.

10.3 Priority Strategies and Actions

As discussed in Section 1.4, the STAPLEE method was used to score mitigation activities. The STAPLEE matrix in Appendix A ranks the mitigation activities proposed in Section 10.1 and 10.2 and also lists possible funding sources. The Borough's top six priority strategies and actions are the following:

1. Obtain an HMGP grant to conduct drainage improvements along Nettleton Avenue and Cherry Street.
2. Consider joining CRS.
3. Develop a plan to conduct routine catch basin maintenance.
4. Consider a Borough-wide analysis to identify undersized and failing portions of drainage systems, and prioritize repairs as needed.
5. Review critical facilities and ensure that each one has adequate standby power. For those facilities that do not, consider acquiring standby power.
6. Explore other fire protection solutions when water main extensions are not feasible, such as the use of cisterns, fire ponds and dry hydrants.

10.4 Sources of Funding

The following sources of funding and technical assistance may be available for the priority projects listed above. This information comes from the FEMA website (http://www.fema.gov/government/grant/index.shtm). Funding requirements and contact information is given in Section 11.4.

Community Disaster Loan Program
http://www.fema.gov/government/grant/fs_cdl.shtm

This program provides funds to any eligible jurisdiction in a designated disaster area that has suffered a substantial loss of tax and other revenue. The assistance is in the form of loans not to exceed twenty-five percent of the local government's annual operating budget for the fiscal year in which the major disaster occurs, up to a maximum of five million dollars.

Continuing Training Grants (CTG)
http://www.grants.gov/web/grants/search-grants.html

This program provides funds to develop and deliver innovative training programs that are national in scope and meet emerging training needs in local communities.

Emergency Food and Shelter Program
http://www.fema.gov/government/grant/efs.shtm

This program was created in 1983 to supplement the work of local social service organizations, both private and governmental, to help people in need of emergency assistance.

Emergency Management Institute
http://training.fema.gov/

Provides training and education to the floodplain managers, fire service, emergency management officials, its allied professions, and the general public.

Emergency Management Performance Grants
http://www.fema.gov/emergency/empg/empg.shtm

The Emergency Management Performance Grant (EMPG) is designed to assist local and state governments in maintaining and strengthening the existing all-hazards, natural and man-made, emergency management capabilities. Allocations if this fund is authorized by the 9/11 Commission Act of 2007, and grant amount is determined demographically at the state and local level.

Flood Mitigation Assistance (FMA) Program
http://www.fema.gov/government/grant/fma/index.shtm

The FMA was created as part of the National Flood Insurance Reform Act of 1994 with the goal of reducing or eliminating claims under the NFIP. FEMA provides funds in the form of planning grants for Flood Mitigation Plans and project grants to implement measures to reduce flood losses, including elevation, acquisition, or relocation of NFIP-insured structures. Repetitive loss properties are prioritized under this program. This grant program is administered through DEMHS.

Hazard Mitigation Grant Program (HMGP)
http://www.fema.gov/government/grant/hmgp/index.shtm

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. This grant program is administered through DEMHS.

Homeland Security Grant Program (HSGP)
http://www.fema.gov/government/grant/hsgp/index.shtm

The objective of the HSGP is to enhance the response, preparedness, and recovery of local, State, and tribal governments in the event of a disaster or terrorist attack. Eligible applicants include all 50 states, the District of Columbia, Puerto Rico, American Samoa, Guam, Northern Mariana Islands, and the Virgin Islands. Risk and effectiveness, along with a peer review, determine the amount allocated to each applicant.

Intercity Passenger Rail (IPR) Program
http://www.fema.gov/fy-2013-intercity-passenger-rail-ipr-amtrak-0

This program provides funding to the National Passenger Railroad Corporation (Amtrak) to protect critical surface transportation infrastructure and the traveling public from acts of terrorism, and to increase the resilience of the Amtrak rail system.

National Flood Insurance Program (NFIP)
http://www.fema.gov/library/viewRecord.do?id=3005

This program enables property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. Municipalities that join the associated Community Rating System can gain discounts of flood insurance for their residents.

Nonprofit Security Grant Program (NSGP)
http://www.fema.gov/fy-2014-urban-areas-security-initiative-uasi-nonprofit-security-grant-program-nsgp

This program provides funding support for hardening and other physical security enhancements to nonprofit organizations that are at high risk of terrorist attack and located within one of the specific Urban Areas Security Initiative (UASI)-eligible Urban Areas. The program seeks to integrate the preparedness activities of nonprofit organizations that are at high risk of terrorist attack with broader state and local preparedness efforts, and serve to promote coordination and collaboration in emergency preparedness activities among public and private community representatives and state and local government agencies.

Pre-Disaster Mitigation (PDM) Grant Program
http://www.fema.gov/government/grant/pdm/index.shtm

The purpose of the PDM program is to fund communities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. PDM grants are provided to states, territories, Indian tribal governments, communities, and universities, which, in turn, provide sub-grants to local governments. PDM grants are awarded on a competitive basis. This grant program is administered through DEMHS.

Public Assistance Grant Program
http://www.fema.gov/government/grant/pa/index.shtm

The Public Assistance Grant Program (PA) is designed to assist State, Tribal and local governments, and certain types of private non-profit organizations in recovering from major disasters or emergencies. Along with helping to recover, this grant also encourages prevention against potential future disasters by strengthening hazard mitigation during the recovery process. The first grantee to apply and receive the PA would usually be the State, and the State could then allocate the granted funds to the sub-grantees in need of assistance.

Small Town Economic Assistance Program
http://www.ct.gov/opm/cwp/view.asp?Q=382970&opmNav

The Small Town Economic Assistance Program (STEAP) funds economic development, community conservation and quality of life projects for localities that are ineligible to receive Urban Action bonds. This program is administered by the Connecticut Office of Policy and Management (OPM). Connecticut municipalities may receive up to $500,000 per year if (1) they are not designated as a distressed municipality or a public investment community, and (2) the State Plan of Conservation and Development does not show them as having a regional center. Public Act 05-194 allows an Urban Act Town that is not designated as a regional center under the State Plan of Conservation and Development to opt out of the Urban Action program and become a STEAP town for a period of four years.

Transit Security Grant Program (TSGP)
http://www.fema.gov/government/grant/tsgp/index.shtm

The purpose of TSGP is to bolster security and safety for public transit infrastructure within Urban Areas throughout the United States. Applicable grantees include only the state Governor and the designated State Administrative Agency (SAA) appointed to obligate program funds to the appropriate transit agencies.

<u>U.S. Fire Administration</u>

Assistance to Firefighters Grant Program (AFGP)
http://www.firegrantsupport.com/afg/
http://www.usfa.dhs.gov/fireservice/grants/

The primary goal of the Assistance to Firefighters Grants (AFG) is to meet the firefighting and emergency response needs of fire departments and nonaffiliated emergency medical services organizations. Since 2001, AFG has helped firefighters and other first responders to obtain critically needed equipment, protective gear, emergency vehicles, training, and other resources needed to protect the public and emergency personnel from fire and related hazards. The Grant Programs Directorate of the Federal Emergency Management Agency administers the grants in cooperation with the U.S. Fire Administration.

Fire Prevention & Safety Grants (FP&S)

http://www.firegrantsupport.com/fps/

The Fire Prevention and Safety Grants (FP&S) are part of the Assistance to Firefighters Grants (AFG) and are under the purview of the Grant Programs Directorate in the Federal Emergency Management Agency. FP&S grants support projects that enhance the safety of the public and firefighters from fire and related hazards. The primary goal is to target high-risk populations and mitigate high incidences of death and injury. Examples of the types of projects supported by FP&S include fire prevention and public safety education campaigns, juvenile firesetter interventions, media campaigns, and arson prevention and awareness programs.

National Fire Academy Education and Training
http://www.usfa.dhs.gov/nfa/

Provides training to increase the professional level of the fire service and others responsible for fire prevention and control.

Reimbursement for Firefighting on Federal Property
http://www.usfa.dhs.gov/fireservice/grants/rfff/

Reimbursement may be made to fire departments for fighting fires on property owned by the federal government for firefighting costs over and above normal operating costs. Claims are submitted directed to the U.S. Fire Administration.

Staffing for Adequate Fire & Emergency Response (SAFER)
http://www.firegrantsupport.com/safer/

The goal of SAFER is to enhance the local fire departments' abilities to comply with staffing, response and operational standards established by NFPA and OSHA (NFPA 1710 and/or NFPA 1720 and OSHA 1910.134 - see http://www.nfpa.org/SAFERActGrant for more details). Specifically, SAFER funds should assist local fire departments to increase their staffing and deployment capabilities in order to respond to emergencies whenever they may occur. As a result of the enhanced staffing, response times should be sufficiently reduced with an appropriate number of personnel assembled at the incident scene. Also, the enhanced staffing should provide that all front-line/first-due apparatus of SAFER grantees have a minimum of four trained personnel to meet the OSHA standards referenced above. Ultimately, a faster, safer and more efficient incident scene will be established and communities will have more adequate protection from fire and fire-related hazards.

<u>Other Grant Programs</u>

<u>Flood Mitigation</u>

- U.S. Army Corps of Engineers – *50/50 match funding for floodproofing and flood preparedness projects.*
- U.S. Department of Agriculture – *financial assistance to reduce flood damage in small watersheds and to improve water quality.*

- CT Department of Energy and Environmental Protection – *assistance to municipalities to solve flooding and dam repair problems through the Flood and Erosion Control Board Program.*

Erosion Control and Wetland Protection

- U.S. Department of Agriculture – *technical assistance for erosion control.*
- North American Wetlands Conservation Act Grants Program – *funding for projects that support long term wetlands acquisition, restoration, and/or enhancement. Requires a 1-to-1 funds match.*

11.0 PLAN IMPLEMENTATION

11.1 Implementation Strategy and Schedule

The Borough of Naugatuck is authorized to update this HMP as needed, coordinate its adoption with the Borough of Naugatuck, and guide it through the FEMA approval process.

Local Coordinator – As individual actions of the hazard mitigation plan are implemented they must be implemented by the municipal departments that oversee those activities. The Office of the Mayor and the Department of Public Works in the Borough of Naugatuck will primarily be responsible for developing and implementing selected projects, those some projects will also be implemented by other departments. A "local coordinator" will be selected as the primary individual in charge; this is the Public Works Director. Appendix A incorporates an implementation strategy and schedule, detailing the responsible department and anticipated time frame for the specific recommendations listed throughout this document.

Incorporation into Plans, Regulations, and Capital Improvement Plans – Upon adoption, the Plan will be made available to all Borough departments and agencies as a planning tool to be used in conjunction with existing documents. It is expected that revisions to other Borough plans and regulations, such as the Plan of Conservation and Development, department annual budgets, and the Zoning and Subdivision Regulations will reference this plan and its updates. The local coordinator and the Office of the Mayor will be responsible for ensuring that the actions identified in this plan are incorporated into ongoing Borough planning activities, and that the information and requirements of this plan are incorporated into existing planning documents within five years from the date of adoption or when other plans are updated, whichever is sooner.

Since the adoption of the initial Hazard Mitigation Plan, **it has not been directly incorporated** into the Plan of Conservation and Development. However, the initial hazard mitigation plan **has been incorporated** into revisions to the Zoning, Subdivision, and Inland Wetland Regulations that occurred between 2009 and 2013. The updated versions of these regulations are described on pages 3-6 through 3-8 of this hazard mitigation plan update[1].

Although the initial hazard mitigation plan was not directly incorporated into the Plan of Conservation and Development when it was updated in 2013, the update includes several aspects of hazard mitigation. For example the 2013 Plan of Conservation and Development promotes creation of an Open Space land use category that should include existing preserved open spaces and passive recreational lands as well as greenways, <u>the Naugatuck River floodplain</u>, and lands targeted for future preservation. The plan also recommends <u>acquiring property along the Naugatuck River whenever such property becomes available</u>.

The local coordinator and the Office of the Mayor will be responsible for assigning appropriate Borough officials to update the Plan of Conservation and Development, Zoning Regulations, Subdivision Regulations, Wetlands Regulations, and Emergency Operations Plan to include the provisions in this plan. Should a general revision be too cumbersome or cost prohibitive, simple addendums to these documents will be added that include the provisions of this plan. In particular, the Plan of Conservation and Development is currently being updated, and various elements of this hazard mitigation plan will be incorporated as applicable.

[1] Additionally, the Zoning Regulations were amended in accordance with the DFIRMS adopted in 2010

Finally, information and projects in this planning document will be included in the annual budget and capital improvement plans as part of implementing the projects recommended in this plan. This will primarily include the annual budget and capital improvement projects lists maintained and updated by the Department of Public Works. Actions from the initial Hazard Mitigation Plan **were incorporated** into capital improvement plans over the last five years as budgets allowed.

11.2 Progress Monitoring and Public Participation

The local coordinator will be responsible for monitoring the successful implementation of this HMP update, and will provide the linkage between the multiple departments involved in hazard mitigation at the local level relative to communication and participation. As the plans will be adopted by the local government, coordination is expected to be able to occur without significant barriers.

Site reconnaissance for Specific Suggested Actions – The local coordinator, with the assistance of appropriate department personnel, will annually perform reconnaissance-level inspections of sites that are associated with specific actions. This will ensure that the suggested actions remain viable and appropriate. Examples include home acquisitions or elevations, structural projects such as culvert replacements, roadway elevations, and water main extensions for increased fire suppression capabilities. The worksheet in Appendix C 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 repetitive loss properties (RLPs) in the community each year. This list is available from the State NFIP Coordinator. 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 and other basic information. Some of the reconnaissance-level inspections could occur incidentally during events such as flooding when response is underway.

Annual Reporting and Meeting – The local coordinator will be responsible for holding an annual meeting to review the plan. Matters to be reviewed on an annual basis include the goals and objectives of the HMP, 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 also. A meeting should be conducted in March or April of each year, at least two months before the annual application cycle for grants under the HMA program[2]. 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.

Post-Disaster Reporting and Metering – Subsequent to federally-declared disasters in the State of Connecticut for New Haven County, 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

[2] PDM and FMA applications are typically due to the State in summer of any given year.

or recent mitigation activities for discussion and review at the HMGP meeting. Public outreach may be solicited for HMGP applications at a *separate* public meeting.

Continued Public Involvement – Continued public involvement will be sought regarding the monitoring, evaluating, and updating of the HMP. Public input can be solicited through community meetings, presentations on local cable access channels, and input to web-based information gathering tools. Public comment on changes to the HMP may be sought through posting of public notices and notifications posted on the city's web site and the COGCNV website.

11.3 Updating the Plan

The Borough of Naugatuck will update the hazard mitigation plan if a consensus to do so is reached by the Mayor and Burgesses, or at least once every five years. Updates to this HMP will be coordinated by the local coordinator. The Borough understands that this HMP will be considered current for a period of five years from the date of approval with the expiration date reported by FEMA via the approval letter. The local coordinator will be responsible for compiling the funding required to update the HMP in a timely manner such that the current plan will not expire while the plan update is being developed; the assistance of COGCNV may be solicited from time to time for this purpose.

Table 11-1 presents a schedule to guide the preparation for the plan update and then the actual update of the plan. The schedule assumes that the current version of this plan was adopted in February 2015 and will therefore expire in February 2020.

TABLE 11-1
Schedule for Hazard Mitigation Plan Update

Month and Year	Tasks
February 2016	Annual meeting to review plan content and progress
February 2017	Annual meeting to review plan content and progress
February 2018	Annual meeting to review plan content and progress
June 2018	Ensure that funding for the plan update is included in the fiscal year 2018-2019 budget
February 2019	Annual meeting to review plan content and progress
February 2019	Secure consultant to begin updating the plan, or begin updating in-house
August 2019	Forward draft updated plan to State for review
September 2019-November 2019	Process edits from State and FEMA and obtain the Approval Pending Adoption (APA)
February 2020	Adopt updated plan

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 HMP. A committee will be formed consisting of representatives of many of the same departments solicited for input to this plan. In addition, local business leaders, community and neighborhood group leaders, relevant private and non-profit interest groups, and the eight neighboring municipalities will be invited to participate, including the following:

- Town of Watertown;
- Town of Southbury
- Town of Middlebury;
- Town of Oxford;
- Town of Prospect; and
- The City of Waterbury.

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 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 from the HMP while preparing this update because they had become institutionalized capabilities, they were successfully completed, or they were subsumed by more specific local or State actions.

11.4 Technical and Financial Resources

This Section is comprised of a list of resources to be considered for technical assistance and potentially financial assistance for completion of the actions outlined in this Plan. This list is not all-inclusive and is intended to be updated as necessary.

Federal Resources

Federal Emergency Management Agency
Region I
99 High Street, 6th floor
Boston, MA 02110
(617) 956-7506
http://www.fema.gov/

<u>Mitigation Division</u>

The Mitigation Division is comprised of three branches that administer all of FEMA's hazard mitigation programs. The **Risk Analysis Branch** applies planning and engineering principles to identify hazards, assess vulnerabilities, and develop strategies to manage the risks associated with natural hazards. The **Risk Reduction Branch** promotes the use of land use controls and building practices to manage and assess risk in both the existing built developments and future development areas in both pre- and post-disaster environments. The **Risk Insurance Branch** mitigates flood losses by providing affordable flood insurance for property owners and by encouraging communities to adopt and enforce floodplain management regulations.

FEMA Programs administered by the Risk Analysis Branch include:

- *Flood Hazard Mapping Program*, which maintains and updates National Flood Insurance Program maps
- *National Dam Safety Program*, which provides state assistance funds, research, and training in dam safety procedures
- *National Hurricane Program*, which conducts and supports projects and activities that help protect communities from hurricane hazards
- *Mitigation Planning*, a process for states and communities to identify policies, activities, and tools that can reduce or eliminate long-term risk to life and property from a hazard event

FEMA Programs administered by the Risk Reduction Branch include:

- *Hazard Mitigation Grant Program (HMGP)*, which provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration
- *Flood Mitigation Assistance Program (FMA)*, which provides funds to assist states and communities to implement measures that reduce or eliminate long-term risk of flood damage to structures insurable under the National Flood Insurance Program
- *Pre-Disaster Mitigation Grant Program (PDM)*, which provides program funds for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event
- *Community Rating System (CRS)*, a voluntary incentive program under the National Flood Insurance Program that recognizes and encourages community floodplain management activities
- *National Earthquake Hazards Reduction Program (NEHRP)*, which in conjunction with state and regional organizations supports state and local programs designed to protect citizens from earthquake hazard

The Risk Insurance Branch oversees the *National Flood Insurance Program (NFIP)*, which enables property owners in participating communities to purchase flood insurance. The NFIP assists communities in complying with the requirements of the program and publishes flood hazard maps and flood insurance studies to determine areas of risk.

FEMA also can provide information on past and current acquisition, relocation, and retrofitting programs, and has expertise in many natural and technological hazards. FEMA also provides funding for training state and local officials at Emergency Management Institute in Emmitsburg, Maryland.

The Mitigation Directorate also has *Technical Assistance Contracts (TAC)* in place that support FEMA, states, territories, and local governments with activities to enhance the effectiveness of natural hazard reduction program efforts. The TACs support FEMA's responsibilities and legislative authorities for implementing the earthquake, hurricane, dam safety, and floodplain management programs. The range of technical assistance services provided through the TACs varies based on the needs of the eligible contract users and the natural hazard programs. Contracts and services include:

- *The Hazard Mitigation Technical Assistance Program (HMTAP) Contract*- supporting post-disaster program needs in cases of large, unusual, or complex projects; situations where resources are not available; or where outside technical assistance is determined to be needed. Services include environmental and biological assessments, benefit/cost analyses, historic preservation assessments, hazard identification, community planning, training, and more.

Response & Recovery Division

As part of the National Response Plan, this division provides information on dollar amounts of past disaster assistance including Public Assistance, Individual Assistance, and Temporary Housing, as well as information on retrofitting and acquisition/ relocation initiatives. The Response & Recovery Division 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.

The division also coordinates federal disaster assistance programs. The Public Assistance Grant Program (PA) that provides 75% grants for mitigation projects to protect eligible damaged public and private non-profit facilities from future damage. "Minimization" grants at 100% are available through the Individuals and Family Grant Program. The Hazard Mitigation Grant Program and the Fire Management Assistance Grant Program are also administered by this division.

Computer Sciences Corporation
New England Regional Insurance Manager
Bureau and Statistical Office
(781) 848-1908

Corporate Headquarters
3170 Fairview Park Drive
Falls Church, VA 22042
(703) 876-1000
http://www.csc.com/

A private company contracted by the Federal Insurance Administration as the National Flood Insurance Program Bureau and Statistical Agent, CSC provides information and assistance on flood insurance, including handling policy and claims questions, and providing workshops to leaders, insurance agents, and communities.

Small Business Administration
Region I
10 Causeway Street, Suite 812
Boston, MA 02222-1093
(617) 565-8416
http://www.sba.gov/

SBA 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. (SBA is triggered by a FEMA declaration, however.) SBA 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.

Environmental Protection Agency
Region I
1 Congress Street, Suite 1100
Boston, MA 02114-2023
(888) 372-7341

Provides grants for restoration and repair, and educational activities, including:

- *Capitalization Grants for Clean Water State Revolving Funds*: Low interest loans to governments to repair, replace, or relocate wastewater treatment plans damaged in floods. Does not apply to drinking water or other utilities.

- *Clean Water Act Section 319 Grants*: Cost-share grants to state agencies that can be used for funding watershed resource restoration activities, including wetlands and other aquatic habitat (riparian zones). Only those activities that control non-point pollution are eligible. Grants are administered through the CT DEEP.

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 (CDBG)* to communities with populations greater than 50,000, who may contact HUD directly regarding CDGB. One program objective is to improve housing conditions for low and moderate income families. Projects can include acquiring floodprone homes or protecting them from flood damage. Funding is a 100% grant; can be used as a source of local matching funds for other funding programs such as FEMA's "404" Hazard Mitigation Grant Program. 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 CDBG program participated in by the State of Connecticut.

U.S. Army Corps of Engineers
Institute for Water Resources
7701 Telegraph Road
Alexandria, VA 22315
(703) 428-8015
http://www.iwr.usace.army.mil/

The Corps provides 100% funding for floodplain management planning and technical assistance to states and local governments under several flood control acts and the Floodplain Management Services Program (FPMS). Specific programs used by the Corps for mitigation are listed below.

- *Section 205 – Small Flood Damage Reduction Projects*: This section of the 1948 Flood Control Act authorizes the Corps to study, design, and construct small flood control projects in partnership with non-Federal government agencies. Feasibility studies are 100 percent federally-funded up to $100,000, with additional costs shared equally. Costs for preparation of plans and construction are funded 65 percent with a 35 percent non-federal match. In certain cases, the non-Federal share for construction could be as high as 50 percent. The maximum federal expenditure for any project is $7 million.

- *Section 14 – Emergency Streambank and Shoreline Protection:* This section of the 1946 Flood Control Act authorizes the Corps to construct emergency shoreline and streambank protection works to protect public facilities such as bridges, roads, public buildings, sewage treatment plants, water wells, and non-profit public facilities such as churches, hospitals, and schools. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $1.5 million.

- *Section 103 – Hurricane and Storm Damage Reduction Projects:* This section of the 1962 River and Harbor Act authorizes the Corps to study, design, and construct small coastal storm damage reduction projects in partnership with non-Federal government agencies. Beach nourishment (structural) and floodproofing (non-structural) are examples of storm damage reduction projects constructed under this authority. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $5 million.

- *Section 208 – Clearing and Snagging Projects:* This section of the 1954 Flood Control Act authorizes the Corps to perform channel clearing and excavation with limited embankment construction to reduce nuisance flood damages caused by debris and minor shoaling of rivers. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $500,000.

- *Section 206 – Floodplain Management Services:* This section of the 1960 Flood Control Act, as amended, authorizes the Corps to provide a full range of technical services and planning guidance necessary to support effective floodplain management. General technical assistance efforts include determining the following: site-specific data on obstructions to flood flows, flood formation, and timing; flood depths, stages, or floodwater velocities; the extent, duration, and frequency of flooding; information on natural and cultural floodplain resources; and flood loss potentials before and after the use of floodplain management measures. Types of studies conducted under FPMS include floodplain delineation, dam failure, hurricane evacuation, flood warning, floodway, flood damage reduction, stormwater management, floodproofing, and inventories of floodprone structures. When funding is available, this work is 100 percent federally funded.

In addition, the Corps also provides emergency flood assistance (under Public Law 84-99) after local and state funding has been used. This assistance can be used for both flood response and post-flood response. Corps assistance is limited to the preservation of life and improved property; direct assistance to individual homeowners or businesses is not permitted. In addition, the Corps can loan or issue supplies and equipment once local sources are exhausted during emergencies.

U.S. Department of Commerce
National Weather Service
Northeast River Forecast Center
445 Myles Standish Blvd.
Taunton, MA 02780
(508) 824-5116
http://www.nws.noaa.gov/

The National Weather Service prepares and issues flood, severe weather, and coastal storm warnings. Staff hydrologists can work with communities on flood warning issues and can give technical assistance in preparing flood warning plans.

U.S. Department of the Interior
National Park Service
Steve Golden, Program Leader
Rivers, Trails, & Conservation Assistance
15 State Street
Boston, MA 02109
(617) 223-5123
http://www.nps.gov/rtca/

The National Park Service provides technical assistance to community groups and local, state, and federal government agencies to conserve rivers, preserve open space, and develop trails and greenways as well as identify nonstructural options for floodplain development.

U.S. Fish and 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 Fund and

Partners for Wildlife programs. It also administers the *North American Wetlands Conservation Act Grants Program,* which provides matching grants to organizations and individuals who have developed partnerships to carry out wetlands projects in the United States, Canada, and Mexico. Funds are available for projects focusing on protecting, restoring, and/or enhancing critical habitat.

<u>U.S. Department of Agriculture</u>
Natural Resources Conservation Service
Connecticut Office
344 Merrow Road, Suite A
Tolland, CT 06084-3917
(860) 871-4011

The Natural Resources Conservation Service provides technical assistance to individual landowners, groups of landowners, communities, and soil and water conservation districts on land use and conservation planning, resource development, stormwater management, flood prevention, erosion control and sediment reduction, detailed soil surveys, watershed/river basin planning and recreation, and fish and wildlife management. Financial assistance is available to reduce flood damage in small watersheds and to improve water quality. Financial assistance is available under the Emergency Watershed Protection Program, the Cooperative River Basin Program, and the Small Watershed Protection Program.

<u>Regional Resources</u>

<u>Northeast States Emergency Consortium</u>
1 West Water Street, Suite 205
Wakefield, MA 01880
(781) 224-9876
http://www.serve.com/NESEC/

The Northeast States Emergency Consortium (NESEC) develops, promotes, and coordinates "all-hazards" emergency management activities throughout the northeast. NESEC works in partnership with public and private organizations to reduce losses of life and property. They provide support in areas including interstate coordination and public awareness and education, along with reinforcing interactions between all levels of government, academia, nonprofit organizations, and the private sector.

<u>State Resources</u>

<u>Connecticut Department of Administrative Services, Division of Construction Services</u>
165 Capitol Avenue
Hartford, CT 06106
(860) 713-5850
http://www.ct.gov/dcs/site/default.asp

Office of the State Building Inspector **-** The Office of the State Building Inspector 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
http://www.ct.gov/ecd/

The Connecticut Department of Economic and Community Development administers HUD's State CDBG Program, awarding smaller communities and rural areas grants for use in revitalizing neighborhoods, expanding affordable housing and economic opportunities, and improving community facilities and services.

Connecticut Department of Energy and Environmental Protection
79 Elm Street
Hartford, CT 06106-5127
(860) 424-3000
http://www.dep.state.ct.us/

The Department includes several divisions with various functions related to hazard mitigation:

Bureau of Water Management, Inland Water Resources Division **-** This division is generally responsible for flood hazard mitigation in Connecticut, including administration of the National Flood Insurance Program. Other programs within the division include:

- *National Flood Insurance Program State Coordinator*: Provides flood insurance and floodplain management 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.

- *Flood & Erosion Control Board Program*: Provides assistance to municipalities to solve flooding, beach erosion, and dam repair problems. Have the power 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 on a noncompetitive basis.

- *Inland Wetlands and Watercourses Management Program*: Provides training, technical, and planning assistance to local Inland Wetlands Commissions, reviews and approves municipal regulations for localities. Also controls flood management and natural disaster mitigations.

- *Dam Safety Program*: Charged with the responsibility for administration and enforcement of Connecticut's dam safety laws. 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.

Planning and Standards Division **-** Administers the Clean Water Fund and many other programs directly and indirectly related to hazard mitigation including the Section 319 nonpoint source pollution reduction grants and municipal facilities program which deals with mitigating pollution from wastewater treatment plants.

Office of Long Island Sound Programs (OLISP) - Administers the Coastal Area Management Act (CAM) program and Long Island Sound License Plate Program.

Connecticut Department of Emergency Services and Public Protection
1111 Country Club Road
Middletown, CT 06457
(860) 685-8190
http://www.ct.gov/dps/

Connecticut Division of Emergency Management and Homeland Security
25 Sigourney Street, 6th Floor
Hartford, CT 06106-5042
(860) 256-0800
http://www.ct.gov/demhs/

DEMHS is the lead division responsible for emergency management. Specifically, responsibilities include emergency preparedness, response and recovery, mitigation, and an extensive training program. DEMHS is the state point of contact for most FEMA grant and assistance programs and oversees hazard mitigation planning and policy; administration of the Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, and Pre-Disaster Mitigation Program; and the responsibility for making certain that the State Natural Hazard Mitigation Plan is updated every five years. DEMHS administers the Earthquake and Hurricane programs described above under the FEMA resource section. Additionally, DEMHS operates a mitigation program to coordinate mitigation throughout the state with other government agencies. Additionally, the agency is available to provide technical assistance to sub-applicants during the planning process.

DEMHS operates and maintains the CT “Alert” emergency notification system powered by Everbridge. This system uses the state’s Enhanced 911 database for location-based notifications to the public for life-threatening emergencies. The database includes traditional wire-line telephone numbers and residents have the option to register other numbers on-line in addition to the land line.

DEMHS employs the *State Hazard Mitigation Officer*, who is in charge of hazard mitigation planning and policy; oversight of administration of the Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, and Pre-Disaster Mitigation Program, and has the responsibility of making certain that the State Natural Hazard Mitigation Plan is updated every five years.

Connecticut Department of Transportation
2800 Berlin Turnpike
Newington, CT 06131-7546
(860) 594-2000
http://www.ct.gov/dot/

The Department of Transportation administers the federal Intermodal Surface Transportation Efficiency Act (ISTEA) 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. CT DOT is also involved in traffic improvements and bridge repairs that could be mitigation related.

<u>Connecticut Office of Policy and Management</u>
450 Capitol Avenue
Hartford, CT 06106
(860) 418-6200
http://www.ct.gov.opm

Small Town Economic Assistance Program

The Small Town Economic Assistance Program (STEAP) funds economic development, community conservation and quality of life projects for localities that are ineligible to receive Urban Action bonds. This program is administered by the Connecticut Office of Policy and Management (OPM). Connecticut municipalities may receive up to $500,000 per year if (1) they are not designated as a distressed municipality or a public investment community, and (2) the State Plan of Conservation and Development does not show them as having a regional center. Public Act 05-194 allows an Urban Act Town that is not designated as a regional center under the State Plan of Conservation and Development to opt out of the Urban Action program and become a STEAP town for a period of four years. Projects eligible for STEAP funds include:

1) economic development projects such as (a) constructing or rehabilitating commercial, industrial, or mixed-use structures and (b) constructing, reconstructing, or repairing roads, access ways, and other site improvements;
2) recreation and solid waste disposal projects;
3) social service-related projects, including day care centers, elderly centers, domestic violence and emergency homeless shelters, multi-purpose human resource centers, and food distribution facilities;
4) housing projects;
5) pilot historic preservation and redevelopment programs that leverage private funds; and
6) other kinds of development projects involving economic and community development, transportation, environmental protection, public safety, children and families and social service programs.

In recent years, STEAP grants have been used to help fund many types of projects that are consistent with the goals of hazard mitigation. Projects funded in 2013 and 2014 include streambank stabilization, dam removal, construction of several emergency operations centers (EOCs) in the state, conversion of a building to a shelter, public works garage construction and renovations, design and construct a public safety communication system, culvert replacements, drainage improvements, bridge replacements, generators, and open space acquisition.

<u>Private and Other Resources</u>

<u>Association of State Dam Safety Officials (ASDSO)</u>
450 Old Vine Street
Lexington, KY 40507
(859) 257-5140

http://www.damsafety.org

ASDSO is a non-profit organization of state and federal dam safety regulators, dam owners/operators, dam designers, manufacturers/suppliers, academia, contractors and others interested in dam safety. The 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 an unified community of dam safety advocates.

The Association of State Floodplain Managers (ASFPM)
2809 Fish Hatchery Road, Suite 204
Madison, WI 53713
(608) 274-0123
http://www.floods.org/

ASFPM is a professional association of state employees that assist communities with the NFIP with a membership of over 1,000. ASFMP 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 (CAFM)
P.O. Box 960
Cheshire, CT 06410
ContactCAFM@gmail.com

CAFM is a professional association of private consultants and local floodplain managers that provides training and outreach regarding flood management techniques. CAFM is the local state chapter of ASFPM.

Institute for Business & Home Safety
4775 East Fowler Avenue
Tampa, FL 33617
(813) 286-3400
http://www.ibhs.org/

A nonprofit organization put together by the insurance industry to research ways of reducing the social and economic impacts of natural hazards. 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 (MCEER)
University at Buffalo
State University of New York
Red Jacket Quadrangle
Buffalo, New York 14261
(716) 645-3391
http://mceer.buffalo.edu/

A source for earthquake statistics, research, and for engineering and planning advice.

The National Association of Flood & Stormwater Management Agencies (NAFSMA)
1301 K Street, NW, Suite 800 East
Washington, DC 20005
(202) 218-4122
http://www.nafsma.org

NAFSMA is an organization of public agencies who strive to protect lives, property, and economic activity from the adverse impacts of stormwater by advocating public policy, encouraging technology, and conducting educational programs. NAFSMA is a voice in national politics on water resources management issues concerning stormwater management, disaster assistance, flood insurance, and federal flood management policy.

National Emergency Management Association (NEMA)
P.O. Box 11910
Lexington, KY 40578
(859)-244-8000
http://www.nemaweb.org/

A national association of state emergency management directors and other emergency management officials, the NEMA Mitigation Committee is a strong voice to FEMA in shaping all-hazard mitigation policy in the nation. NEMA is also an excellent source of technical assistance.

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 includes the Floodplain Management Resource Center, a free library and referral service of the ASFPM for floodplain management publications. The Natural Hazards Center is located at the University of Colorado in Boulder. Staff can use keywords to identify useful publications from the more than 900 documents in the library.

Volunteer Organizations **-** Volunteer organizations including the American Red Cross, the Salvation Army, Habitat for Humanity, and the Mennonite Disaster Service are often available to help after disasters. Service Organizations such as the Lions Club, Elks Club, and the Veterans of Foreign Wars are also available. Habitat for Humanity and the Mennonite Disaster Service provide skilled labor to help rebuild damaged buildings while incorporating mitigation or floodproofing concepts. The office of individual organizations can be contacted directly or the FEMA Regional Office may be able to assist.

Flood Relief Funds **-** After a disaster, local businesses, residents, and out-of-town groups often donate money to local relief funds. They may be managed by the local government, one or more local churches, or an ad hoc committee. No government disaster declaration is needed.

Local officials should recommend that the funds be held until an applicant exhausts all sources of public disaster assistance, allowing the funds to be used for mitigation and other projects that cannot be funded elsewhere.

Americorps **-** Americorps is the National Community Service Organization. It is a network of local, state, and national service programs that connects volunteers with nonprofits, public agencies, and faith-based and community organizations to help meet our country's critical needs in education, public safety, health, and the environment. Through their service and the volunteers they mobilize, AmeriCorps members address critical needs in communities throughout America, including helping communities respond to disasters. Some states have trained Americorps members to help during flood-fight situations such as by filling and placing sandbags.

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APPENDIX A
STAPLEE MATRIX

Part 1: Previous Actions and Strategies for Naugatuck	Status Is the strategy in the prior edition of the plan?	Explanation/Comment	Outcome	Associated Report Sections: Flooding	Ice Jams	Hurricanes	Summer Storms and Tornadoes	Winter Storms	Earthquakes	Dam Failure	Wildfires
ALL HAZARDS											
Dissemination of informational pamphlets regarding natural hazards to public locations	Yes	Continuously provided by print and web site	Remove	x	x	x	x	x	x	x	x
Add pages to the Borough website dedicated to citizen education and preparation for natural hazard events	Yes	Will complete	Carry forward	x	x	x	x	x	x	x	x
Continue implementation of CodeRED emergency notification system	Yes	CodeRED is used in Naugatuck	Delete	x	x	x	x	x	x	x	x
Encourage residents to purchase and use NOAA weather radios with alarm features	Yes	CodeRED is used in Naugatuck, strategy not needed	Remove	x	x	x	x	x	x	x	x
Continue to review and update Emergency Operations Plan at least once annually	Yes	Updated annually	Remove	x	x	x	x	x	x	x	x
Continue reviewing subdivision applications to ensure new neighborhoods are sized to accommodate emergency vehicles	Yes	Reviewed by Fire Commission	Remove			x	x	x	x		x
Upgrade at least one secondary shelter to a primary shelter, and attempt to have the resources to shelter 10% of population	Yes	High School will become shelter	Carry Forward			x	x	x	x		x
Continue to encourage two modes of access into every neighborhood by the creation of through streets	Yes	Required in New Development	Remove								
FLOOD - Prevention											
Streamline the permitting process and develop a checklist to ensure maximum education of developer or applicant	Yes	Mostly complete	Carry Forward	x		x	x			x	x
Consider joining FEMA's Community Rating System	Yes	Will review Program	Carry Forward	x		x	x			x	
Continue to require application approval for activities within SFHAs	Yes	Ongoing	Remove	x		x	x			x	
Consider requiring new buildings constructed in flood prone areas to be protected to the highest recorded flood level	Yes	Ongoing	Remove	x		x	x			x	
Ensure that new buildings be designed and graded to shunt drainage away from the building	Yes	Not necessary; part of State code	Delete	x		x	x			x	
After the MapMod Program, use Borough two-foot contour maps to develop more exact regulatory flood maps using FEMA flood elevations	Yes	Not necessary; new digital FIRMs are sufficient	Delete	x		x	x			x	
FLOOD - Property and Natural Resource Protection											
Acquire open space properties within SFHAs and set aside as greenways, parks, or other non-residential, non-commercial, or non-industrial use	Yes	No funding at this time	Carry forward	x	x	x	x			x	
Selectively pursue conservation objectives listed in the Plan of Conservation & Development	Yes	Complete and ongoing	Remove	x		x	x			x	
Continue to regulate development in protected and sensitive areas, including steep slopes, wetlands, and floodplains	Yes	Complete and ongoing	Remove	x		x	x			x	
Consider local floodproofing or elevation options for floodprone homes along various watercourses in Naugatuck	Yes	Not feasible	Modify	x		x	x			x	
Provide technical assistance regarding floodproofing measures to interested residents. Pursue funding for home elevations should any residents become interested.	No	New Strategy	New Strategy								
Encourage property owners to purchase flood insurance under the NFIP and to report claims when flooding damage occurs.	No	New Strategy	New Strategy								
FLOOD - Structural Projects											
Consider a Borough-wide analysis to identify undersized and failing portions of drainage systems, and prioritize repairs as needed	Yes	Planned and ongoing	Carry Forward	x		x	x				
Upgrade the drainage systems in downtown areas to enhance drainage	Yes	Planned - Funding not available	Carry Forward	x		x	x				
Increase maintenance of drainage systems on Arch Street near Long Meadow Pond Brook	Yes	Planned	Carry Forward	x		x	x				
If necessary, increase conveyance of Crown Spring Bridge over Hop Brook at Bridge Street	Yes	Bridge owned bu CT DOT	Carry Forward	x		x	x				
Assess dredging options for Union Ice Company Pond to potentially increase its potential for flood mitigation	Yes	Remove, dredging does not typically provide flood mitigation	Delete	x		x	x				
Increase conveyance capacity of culvert under East Waterbury Road downstream of Union Ice Company Pond	Yes	Complete	Delete	x		x	x				
Evaluate flood mitigation options near underground culvert along Pigeon Brook	Yes	Completed by Metro North	Delete	x		x	x				
Pursue flood mitigation options along unnamed stream in Spencer Street corridor	Yes	Planned	Carry Forward	x		x	x				
Obtain an HMGP grant to conduct drainage improvements along Nettleton Avenue and Cherry Street.	No	New Strategy	New Strategy	x		x	x				
Develop a plan to conduct routine catch basin maintenance	No	New Strategy	New Strategy	x		x	x				
WIND DAMAGE RELATED TO HURRICANES, SUMMER STORMS, AND WINTER STORMS											
Continue Borough-wide tree limb inspection and maintenance to diminish potential for downed power lines	Yes	On-going - Limited Budget	Remove			x	x	x			
Focus tree limb maintenance and inspections along Route 63 & 68, Spring Street, Union City Road, and other evacuation routes	Yes	On-going - Limited Budget	Remove			x	x	x			
Increase inspections of trees on private property near power lines and Borough right-of-ways	Yes	On-going - Limited Budget	Remove			x	x	x			
Continue to require that utilities be placed underground in new developments and pursue funding to move them underground in existing areas	Yes	Utilities are required underground/to expensive to bury existing	Remove/delete			x	x	x			
Review and disseminate evacuation plans to ensure timely evacuation of shelterees from all areas of Town	Yes	Not appropriate for public to have detailed evacuation plans	Delete			x	x	x			
Provide for the Building Department to make literature available during the permitting process regarding appropriate design standards	Yes	On-going	Remove			x	x	x			
Review critical facilities and ensure that each one has adequate standby power. For those facilities that do not consider acquiring standby power supplies	No	New Strategy	New Strategy								
WINTER STORMS											
Compile and post a final list of plowing routes, prioritizing egress to shelters and critical facilities	Yes	Ongoing	Remove					x			
Develop a plan to prioritize snow removal from the roof of critical facilities and other municipal buildings each winter. Ensure adequate funding is available in the Town budget for this purpose.	No	New Strategy	New Strategy					x			
Provide public information on the dangers of cold-related hazards to people and property.	No	New Strategy	New Strategy					x			
The Building Department should have funding available to provide literature regarding appropriate design standards for mitigating icing, insulating pipes, and retrofits for flat-roofed buildings such as heating coils.	No	New Strategy	New Strategy					x			
EARTHQUAKES											
Continue to require adherence to the state building codes	Yes	Current regulations are believed sufficient	Delete						x		
Preserve or convert areas of inactive faults to municipal open space	Yes	Regulating development near slopes is ongoing	Remove						x		
Consider preventing residential development in areas prone to collapse, such as on or below steep slopes	Yes	This is part of the building code and can be deleted	Remove						x		
Ensure that future implementation of Goal #3 Item #4 of the Plan of Conservation and Development considers earthquake risks	Yes	Partly complete (EOC has a backup location)	Remove						x		

Part 1: Previous Actions and Strategies for Naugatuck	Status Is the strategy in the prior edition of the plan?	Explanation/Comment	Outcome	Associated Report Sections							
				Flooding	Ice Jams	Hurricanes	Summer Storms and Tornadoes	Winter Storms	Earthquakes	Dam Failure	Wildfires
Consider regulating development in areas on or below steep slopes (slopes exceeding 20%)	Yes	Regulating development near slopes is ongoing	Remove						x		
Ensure that municipal departments have adequate backup facilities (power generation, heat, water, etc.) in case earthquake damage occurs	Yes	On-going	Remove						x		
Consider bracing system for assets and equipment inside critical facilities. This could help protect IT systems, important records and files.	No	New Strategy	New Strategy						x		
DAM FAILURE											
Stay current on the development of EOPs and Dam Failure Analyses for Class C and B dams whose failure could impact Naugatuck	Yes	CT DEEP will be addressing this	Modify							x	
Include dam failure inundation areas in the CodeRED contact database	Yes	New strategy	Carry Forward							x	
Assess the condition and performance of the Donovan Road dam and upgrade as necessary	Yes	CT DEEP will be addressing this	Delete							x	
Upgrade and repair the Ridge Lower Pond Dam along Warren Avenue	Yes	CT DEEP will be addressing this	Delete							x	
Consider implementing Borough inspections of lower hazard dams	Yes	The borough cannot inspect these dams	Modify							x	
Keep abreast of changes in the requirements for Class A, AA and unranked dams and compile information for these dams as it becomes available.	No	New Strategy	New Strategy							x	
Obtain EOP's/EAP's once they are completed.	No	New Strategy	New Strategy							x	
WILDFIRES											
Continue to have CTWC extend/upgrade the public water supply systems into areas requiring water for fire protection	Yes	No major extensions have been completed	Carry forward								x
Encourage CTWC to identify and upgrade those portions of the water system that are substandard for fire protection	Yes	No major improvements have been completed	Remove								x
Consider constructing dry hydrants to provide an additional supply of firefighting water in areas without water service	Yes	Ongoing	Remove								x
Continue to require storage tanks in subdivisions away from water service	Yes	Ongoing	Remove								x
Continue to promote inter-municipal cooperation in fire-fighting efforts	Yes	Ongoing	Remove								x
Continue to support public outreach programs to increase awareness of forest fire danger and how to use common fire fighting equipment	Yes	Ongoing	Remove								x
Provide outreach programs on how to properly manage burning and campfires on private property	Yes	Ongoing	Remove								x
Patrol Borough-owned open space and parks to prevent campfires	Yes	Not complete; other outreach is sufficient	Remove								x
Enforce regulations and permits for open burning	Yes	Ongoing	Remove								x
Revise and enhance the town's website concerning the local regulatory requirements concerning Open Burning.	No	New Strategy	New Strategy								x
Explore other fire protection solutions when water main extensions are not feasible, such as the use of cisterns.	No	New Strategy	New Strategy								x

Carry forward: strategy is carried forward to the updated plan
Delete: strategy may be deleted from the plan because it has been completed or is no longer applicable or necessary
Remove: activity is ongoing and will continue in its current capacity and level of effort, so the strategy is now a capability
Modify: strategy has been modified and the new strategy is provided in the line below
Modify and remove: activity has been partly completed but the result is ongoing and will continue in its current capacity and level of effort, so the strategy is now a capability
New strategy: strategy was not in the last edition of the plan

	Part 2: Current Strategies and Actions for Naugatuck	Category 1. Prevention 2. Property Protection 3. Natural Resource Prot. 4. Structural Projects 5. Public Information 6. Emergency Services	Responsible Department[1]	Timeframe	Cost Low = Minimal[2] Intermediate = <$100,000 High = >$100,000	Potential Funding Sources[3]	Weighted STAPLEE Criteria[4]																Total STAPLEE Score
							Benefits								Costs								
							Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	
	All HAZARDS																						
1	Add pages to the Borough website dedicated to citizen education and preparation for natural hazard event	1,5,6	EMS	7/2015-12/2015	Low	Municipal/OB	1	1	1	1	1	0	0	**6.0**	0	0	0	0	0	0	0	**0.0**	**6.0**
2	Upgrade at least one secondary shelter to a primary shelter, and attempt to have the resources to shelter 10% of populatior	6	EMS	7/2017-6/2018	Intermediate	Municipal, EOC	1	1	1	1	1	0	0	**6.0**	0	0	-0.5	0	0	-0.5	0	**-1.5**	**4.5**
3	Include Condominium Associations into emergency management planning	5,6	PZ, EMS	7/2015-12/2015	Intermediate	Municipal/OB	1	1	1	1	1	0	0	**6.0**	0	0	-0.5	0	0	0	0	**-0.5**	**5.5**
	FLOODING																						
4	Streamline the permitting process and develop a checklist to ensure maximum education of developer or applican	1	PZ	7/2015-12/2015	Low	Municipal/OB	1	1	1	1	0	0	1	**6.0**	0	0	-0.5	0	0	0	0	**-0.5**	**5.5**
5	Consider joining FEMA's Community Rating Systerr	1	Mayor	7/2015-12/2015	High	Municipal/OB	1	1	0	1	0	1	1	**7.0**	0	0	-0.5	0	0	0	0	**-0.5**	**6.5**
6	Obtain an HMGP grant to conduct drainage improvements along Nettleton Avenue and Cherry Street	2,4	PW	7/2016-6/2019	Intermediate	HMA*, Municipal	1	1	1	1	1	1	1	**9.0**	0	0	-0.5	0	0	-1	0	**-2.5**	**6.5**
7	Provide technical assistance regarding floodproofing measures to interested residents. Pursue funding for home elevations should any residents become interested.	2,5	PW	7/2015-6/2017	Intermediate	Municipal/OB	1	1	0	1	0	0.5	1	**6.0**	0	0	0	0	0	0	0	**0.0**	**6.0**
8	Encourage property owners to purchase flood insurance under the NFIP and to report claims when flooding damage occurs	2	PW	7/2015-6/2017	Low	Municipal/OB	1	1	0	1	0	0	1	**5.0**	0	0	-0.5	0	0	0	0	**-0.5**	**4.5**
9	Develop a plan to conduct routine catch basin maintenance.	1,4	PW	7/2016-6/2017	Low	Municipal/OB	1	1	1	1	1	1	1	**9.0**	0	0	0	0	0	-0.5	0	**-1.0**	**8.0**
10	Pursue the acquisition of additional municipal open space properties inside SFHAs and set those aside as greenways, parks, etc	3	Mayor	7/2016-6/2020	High	Municipal and Private Funds	1	1	1	1	1	0.5	1	**8.0**	0	0	0	0	0	-1	0	**-2.0**	**6.0**
11	Consider a Borough-wide analysis to identify undersized and failing portions of drainage systems, and prioritize repairs as neede	2,4	PW	7/2016-6/2017	High	Municipal/OB	1	1	1	1	1	0.5	1	**8.0**	0	0	0	0	0	-0.5	0	**-1.0**	**7.0**
12	Pursue flood mitigation options along unnamed stream in Spencer Street corridor	2,4	PW	7/2017-6/2018	High	HMA*, Municipal	1	1	1	1	1	0.5	1	**8.0**	0	0	0	0	0	-1	0	**-2.0**	**6.0**
13	Upgrade the drainage systems in downtown areas to enhance drainage	2,4	PW	7/2017-6/2018	High	HMA*, Municipal	1	1	1	1	1	0.5	1	**8.0**	0	0	0	0	0	-1	0	**-2.0**	**6.0**
14	Increase maintenance of drainage systems on Arch Street near Long Meadow Pond Brook	2,4	PW	7/2018-6/2019	High	HMA*, Municipal	1	1	1	1	1	0.5	1	**8.0**	0	0	0	0	0	-1	0	**-2.0**	**6.0**
15	If necessary, increase conveyance of Crown Spring Bridge over Hop Brook at Bridge Street	2,4	PW	7/2018-6/2019	High	HMA*, Municipal	1	1	1	1	1	0.5	1	**8.0**	0	0	0	0	0	-1	0	**-2.0**	**6.0**
	WIND DAMAGE RELATED TO HURRICANES AND SUMMER STORMS																						
16	Review critical facilites and ensur that each one has adequate standby power. For those facilities that do not, consider acquiring standby power supplies	4	EMS	7/2017-6/2019	High	HMA*, Municipal	1	1	1	1	1	1	0	**8.0**	0	0	0	0	0	-0.5	0	**-1.0**	**7.0**
	WINTER STORMS																						
17	Continue to provide information on the dangers of cold-related hazards to people and property	1,5	EMS	7/2015-12/2015	Low	Municipal/OB	1	1	0	0	0	0	0	**3.0**	0	0	0	0	0	0	0	**0.0**	**3.0**
18	Consider posting the snow plowing routes in Town buildings each winter to increase public awareness	5	EMS	7/2015-12/2015	Low	Municipal/OB	1	1	1	0	0	0	0	**4.0**	0	0	0	0	0	0	0	**0.0**	**4.0**
19	The Building Department should provide literature regarding appropriate design standards for mitigating icing, insulating pipes, and retrofits for flat-roofe	5	BD	7/2015-12/2015	Low	Municipal/OB	1	1	1	0	0	0	0	**4.0**	0	0	0	0	0	0	0	**0.0**	**4.0**
	EARTHQUAKES																						
20	Evaluate critical facilities to determine if any interior systems should be braced	6	PW	7/2016-6/2017	Intermediate	Municipal, EOC	1	1	1	0	0	0.5	0	**5.0**	0	0	0	0	0	-0.5	0	**-1.0**	**4.0**
	DAM FAILURE																						
21	Obtain EOPs/EAPs when they are completed	1	PW	7/2015-6/2016	Low	Municipal/OB	1	1	1	1	0	0	0	**5.0**	0	0	0	0	0	0	0	**0.0**	**5.0**
22	Keep abreast of changes in the requirements for Class A, AA, and unranked dams; and compile information for these dams as it becomes availabl	1	PW	7/2016-6/2020	Low	Municipal/OB	1	1	1	1	0	0	0	**5.0**	0	0	-0.5	0	0	0	0	**-0.5**	**4.5**
	WILDFIRES																						
23	Continue to have CTWC extend/upgrade the public water supply systems into areas requiring water for fire protectior	2	Fire & EMS	7/2016-6/2020	High	CWC	1	1	1	1	0	1	0	**7.0**	0	0	-0.5	0	0	-0.5	0	**-1.5**	**5.5**
24	Revise and enhance the town's website concerning the local regulatory requirements concerning open burning.	2	Fire & EMS	7/2015-12/2015	Low	Municipal/OB	1	1	1	1	1	0	0	**6.0**	0	0	0	0	0	-0.5	0	**-1.0**	**5.0**
25	Explore other fire protection solutions when water main extensions are not feasible, such as the use of cisterns, fire ponds and dry hydrants.	2	Fire & EMS	7/2016-6/2020	High	Municipal/CI	1	1	1	1	1	1	0	**8.0**	0	0	-0.5	0	0	-0.5	0	**-1.5**	**6.5**

Notes:
1. Departments:
   - EMS = Emergency Management Services
   - PW = Department of Public Works
   - BD = Building Department
   - PZ = Planning & Zoning
2. Low = To be completed by staff or volunteers where costs are primarily printing, copying, or meetings and costs are less than $10,000; Moderate = Costs are less than $100,000; High = Costs are > than $100,000
3. Funding sources:
   - HMA = Hazard Mitigation Assistance
   - A * by "HMA" indicates that it has a potential for a benefit-cost ratio above 1.0
   - Municipal/OB = through operating budgets; Municipal/CI = through capital improvement fund
   - EOC = Emergency Operations Center grant (not currently active)
   - Private funds = Naugatuck Land Trust
   - CWC = Connecticut Water Company
4. A beneficial or favorable rating = 1; an unfavorable rating = -1. Technical and Financial benefits and costs are double-weighted (i.e. their values are counted twice in each subtotal)

APPENDIX B
RECORD OF MUNICIPAL ADOPTION

CERTIFICATE OF ADOPTION
BOROUGH OF NAUGATUCK BOARD OF MAYOR AND BURGESSES

A RESOLUTION ADOPTING THE BOROUGH OF NAUGATUCK HAZARD MITIGATION PLAN UPDATE, 2015

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, 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 2009; and

WHEREAS, the Borough of Naugatuck has developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for its Hazard Mitigation Plan Update, 2014 under the requirements of 44 CFR 201.6; and

WHEREAS, committee meetings were held in 2013 and 2014 and public input was gathered by several methods regarding the development and review of the Hazard Mitigation Plan Update, 2015; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for the Borough of Naugatuck; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact the Borough of Naugatuck, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make the Borough of Naugatuck eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the 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 Selectmen.

Adopted this ______ day of _______, 2015 by the Mayor and Burgesses of Naugatuck, Connecticut

____
Mayor

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of the Borough of Naugatuck this _____ day of _______, 2015.

____
Clerk

APPENDIX C
MITIGATION PROJECT STATUS WORKSHEET

Mitigation Action Progress Report Form

Progress Report Period	From Date:	To Date:
Action/Project Title		
Responsible Agency		
Contact Name		
Contact Phone/Email		
Project Status	❏ Project completed ❏ Project canceled ❏ Project on schedule ❏ Anticipated completion date:__________ ❏ Project delayed Explain __________	

Summary of Project Progress for this Report Period

1. What was accomplished for this project during this reporting period?

2. What obstacles, problems, or delays did the project encounter?

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

4. Other comments

Plan Update Evaluation Worksheet

Plan Section	Considerations	Explanation
Planning Process	Should new jurisdictions and/or districts be invited to participate in future plan updates?	
	Have any internal or external agencies been invaluable to the mitigation strategy?	
	Can any procedures (e.g., meeting announcements, plan updates) be done differently or more efficiently?	
	Has the Planning Team undertaken any public outreach activities?	
	How can public participation be improved?	
	Have there been any changes in public support and/or decision- maker priorities related to hazard mitigation?	
Capability Assessment	Have jurisdictions adopted new policies, plans, regulations, or reports that could be incorporated into this plan?	
	Are there different or additional administrative, human, technical, and financial resources available for mitigation planning?	
	Are there different or new education and outreach programs and resources available for mitigation activities?	
	Has NFIP participation changed in the participating jurisdictions?	
Risk Assessment	Has a natural and/or technical or human-caused disaster occurred?	
	Should the list of hazards addressed in the plan be modified?	
	Are there new data sources and/or additional maps and studies available? If so, what are they and what have they revealed? Should the information be incorporated into future plan updates?	
	Do any new critical facilities or infrastructure need to be added to the asset lists?	
	Have any changes in development trends occurred that could create additional risks?	
	Are there repetitive losses and/or severe repetitive losses to document?	

Worksheet 7.2

Plan Update Evaluation Worksheet

Plan Section	Considerations	Explanation
Mitigation Strategy	Is the mitigation strategy being implemented as anticipated? Were the cost and timeline estimates accurate?	
	Should new mitigation actions be added to the Action Plan? Should existing mitigation actions be revised or eliminated from the plan?	
	Are there new obstacles that were not anticipated in the plan that will need to be considered in the next plan update?	
	Are there new funding sources to consider?	
	Have elements of the plan been incorporated into other planning mechanisms?	
Plan Maintenance Procedures	Was the plan monitored and evaluated as anticipated?	
	What are needed improvements to the procedures?	

APPENDIX D
DOCUMENTATION OF PLAN DEVELOPMENT

APPENDIX D
PREFACE

An extensive data collection, evaluation, and outreach program was undertaken to compile information about existing hazards and mitigation in the Borough of Naugatuck as well as to identify areas that should be prioritized for hazard mitigation. Documentation of this process is provided within the following sets of meeting minutes and field reports.

Meeting Agenda
HAZARD MITIGATION PLAN UPDATE FOR BOROUGH OF NAUGATUCK
September 23, 2013

---

1. Purpose and Need for Hazard Mitigation Plan
   a. Disaster Mitigation Act of 2000
   b. Status of Naugatuck's hazard mitigation plan (approved 9/9/09; expires 9/9/14)

2. Update on Hazard Mitigation Grant Programs (PDM, HMGP)
   a. Congressional role
   b. Connecticut has funds to distribute under HMGP
   c. Types of projects that get funded

3. What's New with Local Plan Updates and Approvals
   a. HAZUS analysis
   b. Improved public involvement and outreach to neighboring towns
   c. Make plan maintenance more specific
   d. Incorporate effects of recent disasters into plan
   e. Incorporation of hazard mitigation plan into other town plans
   f. FEMA reviews changed ("crosswalk" is out, *Local Plan Review Tool* is in)
   g. State review has shifted from DEEP to DESPP/DEMHS

4. Project Scope
   a. Data collection, outreach
   b. Update vulnerability analysis and run HAZUS
   c. Revisit strategies and update plan
   d. DESPP/DEMHS and FEMA review and approval

5. Project Schedule

6. Review of Hazards and Events from 2007-2013 (Table attached)

7. Data Collection Needs and Discussion

8. Review of Table of Strategies from Last Plan

9. Outreach and Public Involvement
   a. Letters to surrounding communities
   b. Public meeting vs. surveymonkey survey

10. Next Steps

11. Matching Grant

BOROUGH OF NAUGATUCK HAZARD MITIGATION PLAN UPDATE
ADVISORY COMMITTEE MEETING
SEPTEMBER 23, 2013

A meeting was held on September 23, 2013 to review the previous hazard mitigation plan and discuss issues and potential mitigation strategies for inclusion in the update. A brief power point presentation was used to provide structure for the meeting. A copy is attached.

The meeting attendees included:

- James R. Stewart, Public Works Director
- Sandra Lucas-Ribeiro, Public Works Department
- Wayne Zirobbs, Borough Engineer
- Bill Hereman, Building Official
- Ken Hanks, Naugatuck Fire Chief
- Keith Rosenfield, Planning and Zoning
- David Murphy, P.E., CFM, Milone & MacBroom, Inc.
- Maryellen Edwards, Milone & MacBroom, Inc.

The following were discussion points:

- Critical facilities:
  - All critical facilities remain the same.
  - 81 million dollars worth of renovations are being made to the high school. The renovations will include a new generator. Upon completion, the high school will be the primary shelter.
  - The Public Works Department has a plug in for temporary power and they bring in a light tower generator for limited standby.

- Development trends:
  - Several new lots are on record but have not been built.
  - The Borough owns all of the renaissance land but it has not been developed.
  - Phase I Nettleton drainage was done last year.
  - Several buildings have been torn down, including the candy factory.
  - Parcels "C" and "B" have been remediated.
  - Utilities are still required to be underground.

- Ken and Jim are responsible for receiving and tracking drainage complaints. Jim maintains a database of the most repeated complaints. Wayne does inspections of individual areas. Basements can only be pumped after the rain stops. An HMGP application was submitted last year for Cherry Street drainage improvements. A response was never received from FEMA.

- During the snow load disaster in January 2011, at least 30 buildings were damaged.

    - A single family home had to be torn down.
    - The roof at Thurston's Oil collapsed.
    - A machine shop had trusses snap.
    - Wal-Mart had structural damage.
    - The schools all had their roofs shoveled.
    - Many other buildings were damaged.

- Irene caused power outages of three to six days, due to wind damage. A lot of road clearing occurred.

- During Winter Storm Alfred later that year, the maximum power outage was a week.

- The Borough fared pretty well during Sandy. No power outages were reported.

- An August 2012 localized rainstorm caused 6" of rain within one hour. There was approximately 6" of water in St. Francis Church. All of the Long Meadow Pond Brook culverts flooded. A lot of retaining walls collapsed. The whole wall behind the high school collapsed. Ken will provide photographs of the impacts from the event.

- In February 2013 (Nemo), no significant power outages were reported. However, people were unable to access roads for three days due to the lack of large snow plows.

- The Borough has some capacity to deal with snow and ice. The Public Works department has 22 routes. They only have five large trucks. The remainder are small trucks. According to Jim, the lack of large trucks is part of the reason that their response to the February 2013 storm was so poor. Subcontractors are used for this work.

- There are no typical areas that are prone to icing.

- Jim is the tree warden. The budget is $15,000 for required maintenance and emergencies. Subcontractors are used for this work.

- Dams remain unchanged in Naugatuck. The "Thurston dam" was recently repaired due to some washouts. The ACOE did a major repair of the Hop Brook dam to address washouts.

- The risk of wildfire remains the same. Wildfires average approximately five to ten acres and they typically have a few each year. New subdivisions need an underground tank for fire protection.

- A few of the mitigation strategies were reviewed. Comments and changes were made. They are still working to add pages to the borough website dedicated to citizen education and preparation for natural hazard events. The meeting was cut short due to the swearing in of a police officer. Jim and Ken will review the remaining strategies and provide comments to David Murphy.

Hazard Mitigation Plan Update
Naugatuck, Connecticut

Presented by:
David Murphy, P.E., CFM
Milone & MacBroom, Inc.

September 23, 2013

MILONE & MACBROOM

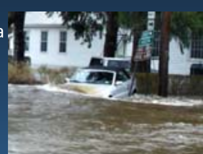
Purpose and Need for Hazard Mitigation Plan

- **Authority**
  - Disaster Mitigation Act of 2000 (amendments to Stafford Act of 1988)
- **Goal of Disaster Mitigation Act**
  - Encourage disaster preparedness
  - Encourage hazard mitigation measures to reduce losses of life and property
- **Status of Naugatuck's Plan**
  - Developed 2008-2009
  - Adopted 2009
  - Expires 2014

MILONE & MACBROOM

What is a Natural Hazard?

- An extreme natural event that poses a risk to people, infrastructure, and resources



MILONE & MACBROOM

What is Hazard Mitigation?

- Actions that reduce or eliminate long-term risk to people, property, and resources from natural hazards and their effects

MILONE & MACBROOM

Update on Hazard Mitigation Grant Programs

- Local communities must have a FEMA-approved Hazard Mitigation Plan in place to receive Federal Grant Funds for Hazard Mitigation Projects
  - PDM (Pre-Disaster Mitigation)
  - HMGP (Hazard Mitigation Grant Program)
  - FMA (Flood Mitigation Assistance)
- Connecticut has >$20M to distribute under HMGP

MILONE & MACBROOM

Update on Hazard Mitigation Grant Programs

- Grants can be used for:
  - Building acquisitions or elevations
  - Culvert replacements
  - Drainage projects
  - Riverbank stabilization
  - Landslide stabilization
  - Wind retrofits
  - Seismic retrofits
  - Snow load retrofits
  - Standby power supplies for critical facilities
  - NEW COST EFFECTIVENESS MEMO

This home in Trumbull was acquired and demolished using a FEMA grant

MILONE & MACBROOM

Update on Hazard Mitigation Grant Programs

Culvert Replacement to be funded by HMGP

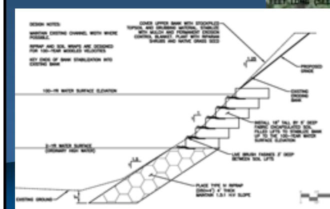
Floyd 1999

Irene 2011

MILONE & MACBROOM®

Update on Hazard Mitigation Grant Programs

Riverbank Stabilization to be funded by HMGP



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What's New with Local Plan Updates and Approvals

- HAZUS analysis
- Improve public involvement and outreach to neighboring towns
- Make plan maintenance more specific
- Incorporate effects of recent disasters
- Show how the plan will be incorporated into other town plans
- FEMA review process has changed from "crosswalk" to "Local Plan Review Tool"
- State administration moved from DEEP to DESPP/DEMHS as of July 2013

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Project Scope of Services

- Task 1 – Project Initiation and Data Collection
- Task 2 – Risk and Vulnerability Assessment
- Task 3 – Strategy Update and Plan Development
- Task 4 – DEMHS and FEMA Review and Plan Adoption

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Project Schedule

- Task 1 – Project Initiation and Data Collection: September 2013
- Task 2 – Risk and Vulnerability Assessment: October and November 2013
- Task 3 – Strategy Update and Plan Development: December 2013
- Task 4 – DEMHS and FEMA Review and Plan Adoption: January 2014 continuing as needed

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Review of Hazards and Events, 2007-2013

- Declared Disasters since last plan:
  - Flooding of March 2010
  - Snow, January 2011
  - Irene, August 2011
  - Winter Storm Alfred, October 2011
  - Superstorm Sandy, October 2012
  - Winter Storm Nemo, February 2013

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Data Collection and Discussion

- Have Naugatuck's critical facilities changed?
- Shelters and evacuation routes
- Standby power supplies
- Development and redevelopment trends
- Utilities above/below ground?
- Areas of flooding
- How are drainage and flooding complaints received and tracked?
- Repetitive loss properties

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Data Collection and Discussion

- Areas prone to wind damage
- Tree maintenance and tree warden budget
- Snow and ice removal routes and capabilities
- Areas prone to icing in winter
- Dams and effects of dam failure
- Areas with fire protection
- Areas without fire protection and use of dry hydrants and cisterns
- Areas prone to wildfires, fire department capabilities, coordination with nearby municipalities

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Review of Hazard Mitigation Strategies

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Examples of Hazard Mitigation Strategies

- Elevate or remove flood-prone buildings
- Wet and dry floodproofing
- Move critical facilities from flood zones
- Strengthen or reinforce the shelters
- Remove and replace undersized and/or failing bridges and culverts
- Replace overhead utilities with underground utilities
- Organize tree maintenance priorities and scheduling
- Enhance fire suppression capabilities
- Public education programs – dissemination of public safety information

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Review the Previous Hazard Mitigation Strategies

- Completed?
- Carried forward?
- Ongoing? – then it becomes a capability
- Modify?
- Cancel?
- What one or two things would be done in Naugatuck if money was not a concern?

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Outreach and Public Involvement

- Letters to surrounding municipalities
- Public meeting vs. using surveymonkey.com

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Next Steps

- Dates for survey or public information meeting
- Date for receipt of any materials resulting from this meeting

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Matching Grant

- Track your time
- Report to Carol Hubert in Southbury Office of the First Selectman

Milone & MacBroom®

Help Update the Naugatuck Hazard Mitigation Plan

Posted by David Murphy , October 15, 2013 at 08:11 AM

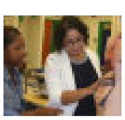
Tropical Storm Irene, October snowstorm Alfred, and Superstorm Sandy are recent events that caused severe damage and resulted in Federal disaster declarations. Local events such as the intense rain of August 1, 2012 were not statewide disasters but severely impacted Naugatuck. Flooding, heavy snow, wind, and downed power lines cause damage to property, disrupt our daily routines, close our schools and businesses, and jeopardize the health and safety of the citizens of Naugatuck.

What can be done to minimize our vulnerabilities to natural hazards? The Borough is updating its hazard mitigation plan to identify activities that can be undertaken before natural hazards occur in order to minimize property damage, risk of life, and the costs that are shared by all. The plan will discuss the occurrence and consequences of floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, and dam failure. The plan will outline the steps that Naugatuck can take to mitigate for future natural hazards.

In order to gain input to the hazard mitigation plan, the Borough has developed an internet-based survey. Residents and business owners are invited to take the survey and offer ideas for minimizing the damage that occurs and the costs that are borne by all of us. Please go to https://www.surveymonkey.com/s/NaugatuckHMP

For more information, please contact Naugatuck's Emergency Management Director or the Council of Governments Central Naugatuck Valley, or leave a comment in the survey.

Related Stories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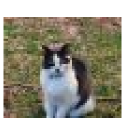
MISSING Cat in Naugatuck

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COMMUNITY NEWS

Mitigation Updates Underway

Print Page

Published:
Wednesday, August 28, 2013 7:07 AM EDT

OXFORD — When Waterbury and 12 surrounding towns prepared hazard mitigation plans in 2007 and 2008, municipal officials struggled to remember damaging natural hazards such as flood and hurricanes.

Aside from a few nor'easters and strong thunderstorms, the region had not experienced a threatening hurricane or memorable flood since Tropical Floyd in 1999.

Now, with hazard mitigation plan updates underway, the 13 towns of the Central Naugatuck Valley Region — Waterbury and Beacon Falls, Bethlehem, Cheshire, Middlebury, Naugatuck, Oxford, Prospect, Southbury, Thomaston, Watertown, Wolcott and Woodbury — have much to discuss.

Tropical Storm Irene, October snowstorm Alfred, Superstorm Sandy and Winter Storm Nemo are recent events that caused severe damage in the region and have resulted in Federal disaster declarations in 2011, 2012 and 2013.

Flooding, heavy snow, wind and downed power lines have caused damage to property, closed schools and businesses and jeopardized health and safety of citizens in the Waterbury region.

Meanwhile, the nation is beginning to understand the ramification of the Biggert-Waters Act of 2012.

The act will cause unprecedented increases in the flood insurance policies for millions of Americans including many home and business owners in the Waterbury region, who own structures in FEMA's delineated floodplains.

Now more than ever, municipalities are looking for opportunities to mitigate flooding and flood-causing disasters, like hurricanes.

The 13 towns of the Central Naugatuck Valley Regional planning area are each in different stages of the hazard mitigation plan update process. Watertown, Woodbury and Oxford, for example, are participating in an internet-based survey to gather public input.

Those interested in survey participation may visit www.surveymonkey.com/s/hazardmitigationplanupdate.

While Waterbury, Cheshire, Prospect and Wolcott have already hosted surveys and a public meeting, residents still have time to participate in the planning process.

The remaining six communities, Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury and Thomaston, will begin the planning process in September, followed by informational meetings and internet-based surveys.

The updated plans will discuss the occurrence and consequences of floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, landslides and dam failure.

Assistant Director of the Council of Governments Central Naugatuck Valley, Sam Gold, is helping to coordinate the updates to the 13 plans.

Those seeking further information or interested in providing ideas for the hazard mitigation plans, may contact Mr. Gold at comments@cogcnv.org, and are asked to write "Hazard Mitigation Plan" in

Coppa. The league, which meets every Friday afternoon, has one rule: Nobody under 60 is allowed. See story on Page 3B.

VISIT REP-AM.COM FOR A VIDEO ON THE LEAGUE

WEB EXTRAS
TODAY AT REP-AM.COM

>> IN THE RED ZONE View a photo galleries and video highlights from the Oxford-Notre Dame of Fairfield and Cheshire-West Haven games. Also, watch a video from the Pomperaug-New Milford game.

>> UCONN FOOTBALL Watch a video of Coach P. talking about the team's energy heading into today's game at Buffalo.

>> SENIOR BOWLING Watch a video report on the Sky Top Lanes senior league.

High **70**
Low **45**

Plenty of sun today; Dress for chilly weather tonight. Page **8A**

6 34373 12494 2

34 pages.

Established 1881,
Waterbury, Connecticut

Read it at rep-am.com

Ready for nature's nastiness

Towns need plans to be eligible for funds

BY QUANNAH LEONARD
REPUBLICAN-AMERICAN

In Watertown, whenever the Steele Brook rises, it first floods The Gowans-Knight Co. Inc. on Knight Street.

That business, which builds and refurbishes fire trucks, floods before Bradshaw Chrysler Jeep on Main Street and well before Watertown Plaza off Route 63, said Charles Berger Jr., Watertown's town engineer. The Gowans-Knight Co. is at the lowest point along Steele Brook, he said.

It's a tiny brook and then it's a nightmare, said Day Palmer, vice president of The Gowans-Knight Co. Every

See **FLOOD**, *Page* **7A**

DARLENE DOUTY REPUBLICAN-AMERICAN

Day Palmer, vice president of Gowans-Knight Co. in Watertown, holds a photo taken when the business was flooded after tropical storm Lee in 2011. Cities and towns in Greater Waterbury are updating their plans to mitigate natural hazards.

Keno ge step clo to appr

Legislators s OK of video

BY MARK PAZNIO
©THE CONNECTICUT M

The Connecticut took a step Thursda bringing keno to bar rants and other out year, while legisl Hartford began a stu feasibility of int video slots to pari-n cilities in Bridgep Haven and Windsor

Keno seems a su The General Asseml ed its authorization

See **KENO,**

LOTTERY

Keno is ex to expand tery's netw vendors by as 600 new

NORTHWEST CONNECTICUT FIVE-DAY FORECAST
SUNDAY MONDAY TUESDAY WEDNESDAY
SATURDAY, SEPTEMBER 28, 2013
REPUBLICAN-AMERICAN L W

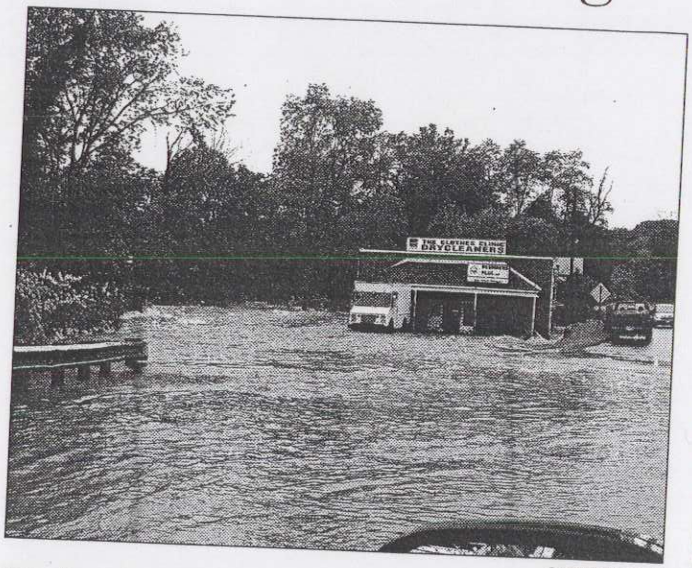
FLOOD: Plans in various stages

Continued from Page One

time it rains, the business has to be on alert, so it can be ready to move trucks and other equipment, she said outside her business Thursday morning.

"We understand that the town is trying to correct the problem, but the amount of money it's going to cost to correct the problem is probably ... it's never going to happen," Palmer said. "So therefore, every time we have a flood, we do more things when we're doing our repairs to make it not affect us as much."

Reducing the persistent flooding along Steele Brook is just one example of the projects in Greater Waterbury that could qualify for federal hazard mitigation funds through the Federal Emergency Management Agency. To be eligible for those funds, though, communities must have an approved natural hazard mitigation plan, state and local officials said.



CONTRIBUTED

Flooding along Steele Brook in Watertown spills over and floods this business on Riverside Street in 2011. Cities and towns in Greater Waterbury are updating their plans to mitigate natural hazards. Communities must do this to be eligible for FEMA funds for certain projects.

WATERTOWN AND 12 other towns in the Central Naugatuck Valley Region have plan updates underway, with the municipalities at different stages of the process, said David Murphy, managing project engineer in water resources with Milone & MacBroom, Cheshire, the consulting firm hired to write the plans. The updated plans will discuss the occurrence and consequences of floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, landslides and dam failure.

Watertown, Woodbury and Oxford have completed a first draft, which is in the reviewing process, said Murphy, project manager.

Waterbury, Cheshire, Prospect and Wolcott finished drafts in the spring, and already have done surveys and hosted a public meeting. Some of those communities are now reviewing the drafts, he said.

The remaining six towns, Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury and Thomaston,

small portion is set aside for addressing future known issues, he said.

Scott Devico, spokesman for the state Division of Emergency Management and Homeland Security, said the state division provides assistance and recommendations on hazard mitigation plans if asked by towns. It's a joint venture with the state Department of Energy and Environmental Protection, he said.

In Waterbury, the city has applied for FEMA hazard mitigation funding to pay for drainage improvements at the Chase Building on Grand Street. Waterbury can't receive that funding until the city's plan is updated, Murphy said.

The project cost estimate is $221,000, said Lou Spina, the city's provisional director of public works. The project entails installing a storm drain that would connect to an existing storm drain system on Leavenworth Street, said Mark Pronovost, Waterbury's city engineer.

During an intense storm, water builds up in a low spot in that parking area. Workers from streets and public works typically will put down about 40 to 50 sandbags to protect the basement, Spina said. He

proofing, Berger said.

Watertown has applied to FEMA for hazard mitigation grant funds to flood proof all businesses along Steele Brook that are subject to significant flooding, he said. That application is under review, he said.

Total project costs for that option is about $1.9 million, Berger said. If approved, FEMA would pay 75 percent, or about $1.5 million. Property owners would be responsible for 25 percent.

Berger said the plan update is a reinforcement of what the town knows it needs to address as far as hazard mitigation, as well as looking for new ideas.

"The whole goal is to be prepared as we can, take as many steps as we can ahead of time and be prepared to react afterward if something gets significantly damaged," Berger said.

At The Gowans-Knight Co., Day has pictures in her office of the flooding that occurred on site when Storm Lee hit in 2011. The company got two-and-a-half feet of water, she said.

The company has spent $150,000 in the last two years to protect itself against flooding, Palmer said. That doesn't

KENO: L

Continued from Page One

the Malloy administration is negotiating profit-sharing terms with tribal casinos and, now, the lottery's board has authorized developing the infrastructure necessary to produce the game by June 1, 2014.

The odds are less certain for the introduction of video slot machines at three pari-mutuel facilities. The study was initiated by lawmakers in those communities who say slots might be necessary to hang onto gambling revenues in the face of growing competition in New York and Massachusetts.

The confluence of the day's events underlined the importance and the volatility of the gambling industry in the Northeast, where a rapid expansion of casinos and other betting facilities is undercutting Connecticut's two tribal casinos, Foxwoods and Mohegan Sun.

"The fact of the matter is the state of Connecticut is in the gaming industry, and we've been seeing revenues continue to drop," said Sen. Andres Ayala, D-Bridgeport, as lawmakers began their public look at video slots.

From a high of $718 million in 2006, the state saw its annual gambling income drop to $612 million last year. The revenue comes primarily from two sources: the shrinking slots revenue from the tribal casinos and the growing profits of the lottery.

Keno represents a twofold expansion for the lottery: It is a new game, and it also is

Watertown, Woodbury and Oxford have completed a first draft, which is in the reviewing process, said Murphy, project manager.

Waterbury, Cheshire, Prospect and Wolcott finished drafts in the spring, and already have done surveys and hosted a public meeting. Some of those communities are now reviewing the drafts, he said.

The remaining six towns, Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury and Thomaston, have started the planning process and have or will host informational meetings and online surveys sometime soon, he said.

Towns in the Litchfield Hills Council of Elected Officials region have begun to update their plans, and those in the Northwestern Connecticut Council of Governments have just started their first mitigation plans, Murphy said.

Samuel Gold, acting executive director of the Council of Governments Central Naugatuck Valley, which is coordinating the updates, said the hazard mitigation plans are only good for five years.

WHEN A NATURAL DISASTER OCCURS, and when a disaster is declared in Connecticut, a small portion of FEMA funds are available to address known hazards that could be a future problem, Gold said. Most money is spent for recovery, while a

phy said.

The project cost estimate is $221,000, said Lou Spina, the city's provisional director of public works. The project entails installing a storm drain that would connect to an existing storm drain system on Leavenworth Street, said Mark Pronovost, Waterbury's city engineer.

During an intense storm, water builds up in a low spot in that parking area. Workers from streets and public works typically will put down about 40 to 50 sandbags to protect the basement, Spina said. He said the city is trying to avoid any expensive damage and to keep the building online to conduct city business.

Watertown has its first draft posted on the town website, www.watertownct.org. for public comment.

Berger said the town doesn't have a preferred alternative yet for the Steele Brook flood mitigation project.

WATERTOWN HAS CONDUCTED A NUMBER OF STUDIES and has been looking at a number of alternatives over the years, he said. Those alternatives range from buying out people who are in the flood plain and relocating their businesses to a flood-free site, to more of a structural project, where the town would build flood walls and pump stations to try to protect properties where they are now.

And in between those alternatives are several more alternatives, including flood

prepared as we can, take as many steps as we can ahead of time and be prepared to react afterward if something gets significantly damaged," Berger said.

At The Gowans-Knight Co., Day has pictures in her office of the flooding that occurred on site when Storm Lee hit in 2011. The company got two-and-a-half feet of water, she said.

The company has spent $150,000 in the last two years to protect itself against flooding, Palmer said. That doesn't include the $7,000 it paid to repair pavement damaged by flooding, she said.

The business now stores everything six inches to a foot-and-a-half off the floor in the shop. It also has installed an interior mezzanine for securing welding equipment and bought two additional sets of lifts for lifting up fire trucks.

"We are doing our own hazard mitigation because we know it's just going to keep happening and we can't afford to move somewhere else," Palmer said. "Because the cost of moving is astronomical, even though we've looked into it numerous times."

Residents and business owners can email ideas about the plans to the Council of Governments Central Naugatuck Valley at comments@cogcnv.org.

Contact Quannah Leonard at qleonard@rep-am.com, on Facebook at RA The Valley or on Twitter @RA_Quannah.

expansion for the lottery: It is a new game, and it also is

SPY: Violators allowed to retire

Continued from Page One

prosecution, Ellard's letter said. In some cases, U.S. prosecutors declined to take action but in nearly every case the employees were allowed to retire without punishment.

In one case, a worker was suspended without pay then retired; in another case, a worker's promotion was canceled; in two cases, military employees suffered a reduction in rank, extra duty and brief reduction in salary for two months.

Public concerns about how telephone and Internet surveillance data is handled by the NSA have intensified in the wake of leaks about the

TODAY'S POLL
VOTE ONLINE AT REP-AM.COM

If you had access to the technology, would you spy on a spouse, boyfriend or girlfriend?

FIND RESULTS OF YESTERDAY'S QUESTION ON PAGE 2A.

correct internal problems that led to the NSA's accidental collection of 56,000 emails and other communications by Americans, and they insisted that willful abuse of surveillance data by officials is almost non-existent.

Grassley, who had asked Ellard last month to provide more information about the 12

his foreign girlfriend's telephone number in 2004. The official also tried to retrieve data about his own phone but was prevented because internal mechanisms prevented queries on domestic phone numbers without authorization. The matter was referred to the Justice Department. The official retired in 2012 before internal disciplinary action could be taken.

In another case, the foreign girlfriend of a U.S official reported her suspicions that the official was listening to her telephone calls.

An internal investigation found that the official had made internal surveillance

Engineering, Planning,
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November 25, 2013

To:

Rob Sibley, Deputy Director of Planning and Land Use, Town of Newtown	Scott Pelletier, EMD, Town of Oxford
Anne Marie Lindblom, assistant to the First Selectman, Town of Bridgewater	Tom Eighmie, EMD, Town of Seymour
Barbara Henry, First Selectman, Town of Roxbury	Clark Hurlbut, Deputy EMD/CERT Coordinator, Town of Bethany
Randy Ashmore, EMD, Town of Woodbury	Robert Chatfield, Mayor, Town of Prospect
Mark Lyon, First Selectman, Town of Washington	Sam Gold, Acting Executive Director, COGCNV
Tony Gedraitis, EMD, Town of Morris	Jocelyn Ayer, Executive Director, NWCCOG
Chuck Berger, Town Engineer, Town of Watertown	Rick Lynn, Planning Director, LHCEO
Tom O'Hare, EMD, Town of Litchfield	David Hannon, Deputy Director, HVCEO
Vincent Wheeler, EMD, Town of Harwinton	Carl Amento, Executive Director, SCRCOG
Tony Lorenzetti, Director of Public Works, Town of Plymouth	Carl Stephani, Executive Director, CCRPA
Mark Pronovost, City Engineer, Waterbury	Rick Dunne, Executive Director, VCOG

RE: Hazard Mitigation Plan Updates for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston
MMI #2097-11

Milone & MacBroom, Inc. (MMI) is working with Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston to update the hazard mitigation plans that were approved by FEMA in 2009. In recent years, FEMA has emphasized the need for communities to work together to address hazards that span municipal boundaries. Thus, these municipalities are interested in coordinating with your jurisdictions relative to hazards that could cross municipal boundaries such as flooding, as well as strategies for hazard mitigation that could be addressed by two or more communities.

We understand that you are the representative that has been involved with hazard mitigation plans in your municipality, and therefore will have the most valuable input for the update of the Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, or Thomaston hazard mitigation plan. Please take a moment to share your thoughts for the following:

1. Does your municipality face any shared hazards with Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, or Thomaston that could be addressed by both communities? Examples could be flooding along a stream that flows across a town boundary or wind storms that damage power lines that cross the town boundary.
2. Can you think of any strategies for hazard mitigation that could benefit both communities?
3. Does your municipality currently cooperate with Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, or Thomaston on any of the following:
   - Local emergency communications or response
   - Road maintenance, drainage system maintenance, public works, etc.
   - Communications with water, electric, and other utility providers

You may contact either of the undersigned via email (davem@miloneandmacbroom.com or scottb@miloneandmacbroom.com) or telephone (203-271-1773). A written response is not necessary. Thank you for your time.

David Murphy, P.E., CFM
Associate

Scott Bighinatti, CFM
Senior Environmental Scientist

2097-11-3-o1513-ltr.docx

Borough of Naugatuck
Hazard Mitigation Assistance Grant Application
for
Nettleton Avenue
and
Cherry Street Areas

December 6, 2012

Meeting Minutes

NATURAL HAZARD PRE-DISASTER MITIGATION PLAN FOR NAUGATUCK
Council of Governments Central Naugatuck Valley
Initial Data Collection Meeting
January 23, 2008

I. Welcome & Introductions

The following individuals attended the data collection meeting:

- David Murphy, P.E., Milone & MacBroom, Inc. (MMI)
- Samuel Eisenbeiser, Fitzgerald & Halliday, Inc. (FHI)
- Shawn Goulet, Milone & MacBroom, Inc. (MMI)
- Virginia Mason, Council of Governments Central Naugatuck Valley (CGCNV)
- Mike Bronko, Naugatuck Mayor
- Al Pistarelli, Naugatuck Mayoral Aide
- Fran Dambowsky, Naugatuck Emergency Management & Homeland Security
- Ken Hanks, Naugatuck Deputy Fire Chief
- James R. Stewart, Naugatuck Engineer
- Keith Rosenfeld, Naugatuck Town Planner/Wetlands Enforcement Officer
- Hank Witkoski, Jr., Superintendent of Public Works/Streets

II. Description and Need for Hazard Mitigation Plans / Disaster Mitigation Act of 2000

Virginia and David described the basis for the natural hazard planning process and possible outcomes. Naugatuck is responsible for a 1/8 cost share through in-kind services. Mayor Bronko assigned Fran as the point of contact person for the project. Copies of the Waterbury and New Haven plans were passed around.

III. Project Scope and Schedule

The project scope was described, including project initiation and data collection, the vulnerability assessment, public meetings, development of recommendations, and the FEMA Review and Plan adoption. A 14-month schedule was presented.

IV. Hazards to Address

The Naugatuck plan will likely address flooding, hurricanes and tropical storms, winter storms and nor'easters, summer storms and tornadoes, earthquakes, dam failure, and wildfires.

V. Discussion of Hazard Mitigation Procedures in Effect & Problem Areas

It was mentioned that utilities must be located underground and that connectivity needs to be encouraged throughout the Borough. Keith said that an updated Plan of Conservation and Development Plan will likely be put into the budget for next year. New development in the Borough deals with flooding largely by avoiding crossings and using setbacks. The FEMA study is from 1979 and is in need of updating. Lastly, there was mention that someone from the Borough will investigate any filings with FEMA from residents of the Borough regarding flooding and any associated damage(s) to their properties.

The informational public meeting was scheduled for the first Monday in March (March 3rd) at 6:00 PM before the Burgesses. An example of a prior press release will be sent to all attendees.

A. *Emergency Response Capabilities & Evacuation Routes*

The Borough has implemented the CodeRED Emergency Notification System for emergency notifications. Evacuation routes are regionally defined by the Regional Evacuation Plan. No local evacuation plan exists. Ken stated that he would forward a copy of the Emergency Operations Plan to those attendees who wished to review it.

Zoning and Subdivision Regulations

Keith mentioned that all pertinent regulations are on the Borough website (Borough of Naugatuck, CT-Zoning Regulations) and if there are any questions or problems regarding their download to contact him.

B. *Noted Flooding and/or Drainage Problem Areas*

Complaints associated with flooding and/or drainage problems eventually reach the Borough's Engineering Department.

- Due to its high density of residential housing, the location of Spencer Street/Cherry Street/Pleasant Avenue was determined, after discussion, to be the highest rated flooding problem area in the Borough. A review of historical topographic maps reveals that a stream was located in this area in 1947 but not in 1954. Currently, there is a detention pond near this area with an adjacent swale from the hillside; and a stream to the west of Lewis Street. The result of these modifications is the flooding of streets within the development, and with the right scenario, homes. Water levels can rise so rapidly that a "geyser" has formed when water gets backed up in the storm drainage system following periods of high rainfall. The Grant House on Cherry Street Extension was damaged due to pressures within the stormwater system.

- Determined as the second area of flooding is the location adjacent to the upper Meadow Pond Brook and its tributary near Rubber Avenue and Harlow Court. This is north of the Baummer Dam. There have been approximately four residential or commercial sites that have been flooded in this location. The road becomes inundated with water following heavy rainfall. The flooding at this site is associated with water entering from Webb Road.

- The site of Nichols Garage (Irvin Gas Station) is where Pigeon Brook flows underground before entering Hop Brook. There is a silted pond adjacent to the garage at this site. There may be flooding problems at this location.

- The portion of East Waterbury Road below the Union Ice Company Pond Dam becomes flooded after heavy rains as a result of the pond being filled with sediment. During substantial rain events, the dam and pond overtop and water spills onto East Waterbury Road. The water runs down the road and eventually re-enters the tributary to Fulling Mill Brook. With the right elements, water does enter homes.

- The Ridge Lower Pond dam located along Warren Avenue is in need of repair. The dam's insufficiency poses a threat to the residents of the Ridge Development. There was some discussion of possible DEP involvement in the repair.

- Repeated flooding has taken place along Beacon Valley Road (near Beacon Falls) which becomes inundated with water from Beacon Hill Brook after heavy rains.

- The Crown Spring Bridge located on Bridge Street has recurring issues with flooding after periods of heavy rainfall.

- Highland Avenue near Galpin Street becomes flooded after substantial rain events.

- The bottom of Arch Street receives three feet of standing water during large rainfall events. A storm drain near a vacant building is not normally cleaned, causing storm water to back-up and build in the street during these storms. On one account, the standing water caused a dumpster to float.

- Last July a sinkhole of approximately 100 feet formed along Church Street near Town Hall. The sinkhole was the result of the failure of an old storm drain.

- The Donovan Road Dam was listed as a place of potential flooding, but may not need to be addressed for this project.

C. *Approved Developments*

The following housing developments have been approved or are underway:

- A 264 home subdivision located near Hunters Mountain. This subdivision has connections to Andrews Mountain Road and Hunters Mountain Road.
- A development of 30 condominiums ("Springbrook").
- A development of 30 homes at Maple Hill Road and Salem Road near Fulling Mill Brook.
- A 95 home development located off of Maple Hill Road, between Mulberry Street and Victoria Lane.
- The development of 150 homes situated between Candee Road and Osborn Road. This development has connections to Candee Road and Osborn Road.
- 20 single-family units are located along Rt. 63 (Church Street) near Hop Brook and Mill Street.
- 15 single-family units are situated around Barbers Pond off of King Street.

D. *Potential Developments*

- A development of 85 single-family units is planned between Andrews Mountain Road and Guntown Road close to Long Meadow Pond Brook.
- There is a proposed Senior Housing development located near School Street.
- Renaissance Place is proposed to lie along Water Street and adjacent to the Naugatuck River.
- Uniroyal is planned to be redeveloped at some time in the future.
- Additional commercial development along Rt. 63 (New Haven Road) is planned in the Straitsville section of Naugatuck.
- The Peter Paul factory will eventually be redeveloped.

VI. Acquisitions

- *A Profile of the Central Naugatuck Valley Region: 2007* (CGCNV)

Name	Department	Phone Number	Email Address
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SAM EISENBEISER	FITZGERALD & HALLIDAY	860-446-2102	skeisenbeiser@fhiplan.com
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COGCNV field notes
Field inspection on February 13, 2008
Notes typed February 18, 2008
David Murphy

Background

Connecticut experienced a period of heavy rains on frozen ground on February 13, 2008. Precipitation measured 1.35 inches over approximately 9 hours in nearby Litchfield and 1.62 inches in Waterbury. Areas of potential flooding compiled during the initial data collection meeting (in Naugatuck) and areas near mapped floodplains and watercourses (in Beacon Falls) were targeted for inspections. The data collection meeting in Beacon Falls (scheduled for February 19, 2008) will help identify potential flood areas for subsequent inspections.

Photographs

<u>*Naugatuck*</u>

1. East Waterbury Road, downstream of road
2. East Waterbury Road, upstream of road
3. East Waterbury Road
4. Brook Street at Cold Spring Circle
5. May Street at Bird Road (view of drainage where it jumped the curb and washed out a yard)
6. Arch Street
7. Harlow Court at Field Street (facing southeast from Field)
8. Northwest fork of brook at Webb Road
9. Northeast fork of brook at Webb Road
10. Brook at Webb Road (downstream)
11. Dam at propane facility
12. Dam at propane facility
13. Downstream (east) from Lewis Street near Spencer Street
14. Same brook at Sharon Avenue

<u>*Beacon Falls*</u>

15. Stream at Skokorat Road
16. Stream at Skokorat Road
17. Stream junction at Skokorat Road & Bethany Road
18. Hockanum Brook at Blackberry Hill Road
19. Hockanum Brook at intersection
20. Along south side of Blackberry Hill Road
21. Along east side of Skokorat Road
22. Hockanum Brook along Bethany Road
23. Trailer park along Naugatuck River
24. Trailer park drainage swale

25. Swamp Brook at Lancaster Drive
26. Low spot along Lopus Road
27. Along Beacon Valley Road on south side of Beacon Hill Brook

Naugatuck again

28. Along Little River Drive

Naugatuck Discussion

Downstream of Union Ice Company Pond – Photos 1-3 depict this area along East Waterbury Road. The stream was high but it was flowing through the culvert under the road and had not jumped the road. However, a large amount of stormwater was running down the road.

1


2


3


Cold Spring Brook – Although not mentioned at the data collection kick-off meeting, this corridor was investigated. The brook is very close to Brook Street and could affect homes and access to Cold Spring Circle.

4

Unnamed Stream along May Street – This stream may have jumped the culvert at the intersection with Bird Road. Photo 5 shows a washout in a resident's yard.

5

Unnamed stream along Hickory & Woodland Streets – This area was inspected but the brook was not visible and drainage problems were not apparent.

Highland Street near Galpin Street – This area was inspected but the alleged drainage problems were not apparent.

Long Meadow Pond Brook – This stream corridor and its tributary were noted as floodprone during the data collection meeting. Photos 6-12 correspond to this area. Photo 6 shows the commercial property that floods when stormwater can't enter the brook, which is adjacent to the property. Photos 7-10 show the unnamed brook that flows under Webb Road from the north, beneath Harlow Court, and then joins Long Meadow Pond Brook at Rubber Avenue & Neumann Stream. Photo 7 shows the proximity to the homes and yards, whereas Photos 8-10 show the low level of the road in relation to the two forks of the tributary stream.


6


7


8


9


10

Photos 11 and 12 show the dam immediately adjacent to the fuel facility at New Dam Pond.


11


12

Spencer Street Corridor – This area was cited as a major floodprone area during the data collection meeting. A review of historical topographic maps revealed that a stream was formerly located in this area, but it has been mainly buried in a culvert. Photos 13 and 14 show the stream where it is not underground, although it is apparent that the channel has been modified.


13


14

Beacon Hill Brook Corridor – This area was mentioned in the data collection meeting. Photo 28 shows the elevation of Little River Road (a dead-end street along the floodplain) in relation to Beacon Hill Brook.

28

Beacon Falls Discussion

<u>Stream along Burton Road</u> – Problems were not observed along this stream.

<u>Hockanum Brook Corridor</u> – This brook flows from east to west, generally along Route 42 (Bethany Road). A number of streams converge at the Blackberry Hill Road and Munson Road intersection, creating a potential flood situation. All photos show areas that are in 100 and 500-year floodplains. Photos 15, 16, 17, and 21 show the unnamed stream that flows down along Skokorat Road. Photo 18 is Hockanum Brook before the tributary joins it, and Photo 19 shows the combined stream. Photo 20 is the other tributary along Blackberry Hill Road, and Photo 22 is Hockanum Brook further downstream along Route 42.


15


16


17


18


19


20


21


22

Naugatuck River – Old Turnpike Road abuts the river and homes along the north end (Shasta Terrace) are in the 500-year floodplain. Likewise, homes along Nancy & Hubbell Avenues and Railroad Avenue are in the floodplain. However, problems were not noted in these areas for this storm event. The industries south of Railroad Avenue are visible across the river from South Main Street, and the potential for flooding was apparent, with the river already in the trees for this storm event. The elevations of the warehouses are not much higher than the river, and the warehouses are in the 500-year floodplain.

River Trailer Parks – The trailer parks near the Seymour town line are partly located in the 100-year floodplain and entirely located in the 500-year floodplain. Photo 23 shows the edge of the park at the river, and photo 24 shows an internal drainage swale. Although the river was high, it was not in danger of flooding the trailer park.


23


24

Swamp Brook Corridor – Problems were not evident at the large industrial building on Route 42 located in the floodplain, but a beaver dam and high pond level (near the road) were observed downstream at Lancaster Road. It is possible that the impoundment can flood the road.


25

Lopus Road – A low point in the road was observed with evidence of strong drainage to both sides. This area crosses a small stream.


26

Beacon Hill Brook Corridor – This area was mentioned in the Naugatuck data collection meeting. Photo 27 shows the elevation of Beacon Valley Road in relation to Beacon Hill Brook. Parts of the road lie along the margin of the floodplain.

27

COUNCIL OF GOVERNMENTS CENTRAL NAUGATUCK VALLEY

60 NORTH MAIN STREET. • 3RD FLOOR • WATERBURY, CT 06702-1403 (203) 757-0535
Web Site: www.cogcnv.org *E-Mail:* cogcnv@cogcnv.org

February 26, 2008

James Jordan
Chairman
Planning Commission
29 Elmwood Street
Naugatuck, CT 06770

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Mr. Jordan,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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Bethlehem	*To Be Determined*		

Correspondence will be mailed within the next two weeks with a date, time, and location for the meeting in Bethlehem. Please contact the COGCNV at 203-757-0535 or vmason@cogcnv.org if you have any questions about the planning process or the meetings.

We hope that you will assist in this very important project, and we look forward to seeing you soon.

Sincerely,

Virginia Mason, sA

Virginia Mason

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February 26, 2008

David Prendergast
CEO
Naugatuck Economic Development Corporation
195 Water Street
Naugatuck, CT 06770

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Mr. Prendergast,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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Virginia Mason. SA

Virginia Mason

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February 26, 2008

Diana Raczkowski
Borough of Naugatuck
1042 May Street
Naugatuck, CT 06770

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Ms. Raczkowski,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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Sincerely,

Virginia Mason *sd*

Virginia Mason

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February 26, 2008

Jason Bashura
Emergency Response Coordinator
Naugatuck Valley Health District
98 Bank Street
Seymour, CT 06483

**Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston**

Dear Mr. Bashura,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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Sincerely,

Virginia Mason AA

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February 26, 2008

Kristen Bulkovitch
President
United Way of Greater Waterbury
P.O. Box 2688
Waterbury, CT 06723-2688

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Ms. Bulkovitch,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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February 26, 2008

Bob Gregorski
President
Naugatuck River Watershed Association
PO Box 122
Middlebury, CT 06762

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Mr. Gregorski,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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Virginia Mason, at

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February 26, 2008

Michael Ciacciarella
Chairman
Zoning Commission
34 Donovan Road
Naugatuck, CT 06770

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Mr. Ciacciarella,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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February 26, 2008

Chester Cornacchia
Chairman
Economic Development Commission
PO Box 66
Naugatuck, CT 06770

**Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston**

Dear Mr. Cornacchia,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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February 26, 2008

Mary Davis
Chairman
Inland Wetlands Commission
PO Box 345
Naugatuck, CT 06770

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Ms. Davis,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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BEACON FALLS BETHLEHEM CHESHIRE MIDDLEBURY NAUGATUCK OXFORD PROSPECT SOUTHBURY THOMASTON WATERBURY WATERTOWN WOLCOTT WOODBURY

COUNCIL OF GOVERNMENTS CENTRAL NAUGATUCK VALLEY

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February 26, 2008

Eileen Gordon
Executive Director
American Red Cross
22 Park Place
Naugatuck, CT 06770

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Ms. Gordon,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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Web Site: www.cogcnv.org E-Mail: cogcnv@cogcnv.org

February 28, 2008

Richard Stubbs
American Red Cross Waterbury Area
64 Holmes Avenue
Waterbury, CT 06710

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Mr. ~~Stubbs~~ Rick,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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Bethlehem	*To Be Determined*		

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We hope that you will assist in this very important project, and we look forward to seeing you soon.

Sincerely,

Virginia

Virginia Mason

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COUNCIL OF GOVERNMENTS CENTRAL NAUGATUCK VALLEY
60 NORTH MAIN STREET. • 3RD FLOOR • WATERBURY, CT 06702-1403 (203) 757-0535
Web Site: www.cogcnv.org E-Mail: cogcnv@cogcnv.org

February 28, 2008

Nicki Pelletier
Naugatuck Chamber of Commerce
195 Water Street
Naugatuck, CT 06770

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Ms. Pelletier,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

In order to successfully develop the local mitigation plans, a significant public outreach effort is required by FEMA. In addition, FEMA requests that stakeholders such as land trusts, neighborhood groups, chambers of commerce, health districts, watershed associations, and educational institutions be invited to provide input. Therefore, COGCNV invites your participation at one or more of the public informational meetings listed below:

Meeting	*Date*	*Time*	*Location*
Naugatuck	March 3, 2008	6:00 PM	Town Hall
Southbury	March 19, 2008	6:30 PM	Town Hall
Thomaston	March 24, 2008	7:00 PM	Town Hall
Beacon Falls	April 3, 2008	7:00 PM	Town Hall
Middlebury	April 7, 2008	6:30 PM	Town Hall
Bethlehem	*To Be Determined*		

Correspondence will be mailed within the next two weeks with a date, time, and location for the meeting in Bethlehem. Please contact the COGCNV at 203-757-0535 or vmason@cogcnv.org if you have any questions about the planning process or the meetings.

We hope that you will assist in this very important project, and we look forward to seeing you soon.

Sincerely,

Virginia Mason

Virginia Mason

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A-53

straint, third-degree strangulation and driving a motor vehicle while under suspension.

Natural disasters meeting scheduled in Naugatuck

NAUGATUCK — Borough residents can attend a meeting next week on the importance of planning to avoid effects of natural disasters in the community.

The meeting will take place at 6 p.m. Monday at the Borough Hall. Naugatuck is one of six municipalities that successfully applied through the Council of Governments of the Central Naugatuck Valley for a planning grant to identify natural hazards and ways the town can reduce their impact.

Milone & MacBroom Inc., the consultants, is seeking input from the public about possible local natural hazards such as hurricanes, floods, severe thunderstorms, wildfires and earthquakes.

The consultants will develop a plan to identify actions that can be taken before a disaster to reduce the loss of life and property, and it will be submitted to the Federal Emergency Management Agency.

Oxford awarded grant to give presentation on substance abuse

OXFORD — School and police officials recently received a grant to conduct a presentation in May on substance abuse for students at Oxford High School.

Officer David Ives, who is also the school resource officer, and Assistant Principal Glenn Lungarini applied for the Valley United Way's Youth

Natural Hazard Pre-Disaster Mitigation Plan Naugatuck, Connecticut

Presented by:

David Murphy, P.E. – Associate

Milone & MacBroom, Inc.

Sam Eisenbeiser, AICP

Fitzgerald & Halliday, Inc.

March 3, 2008

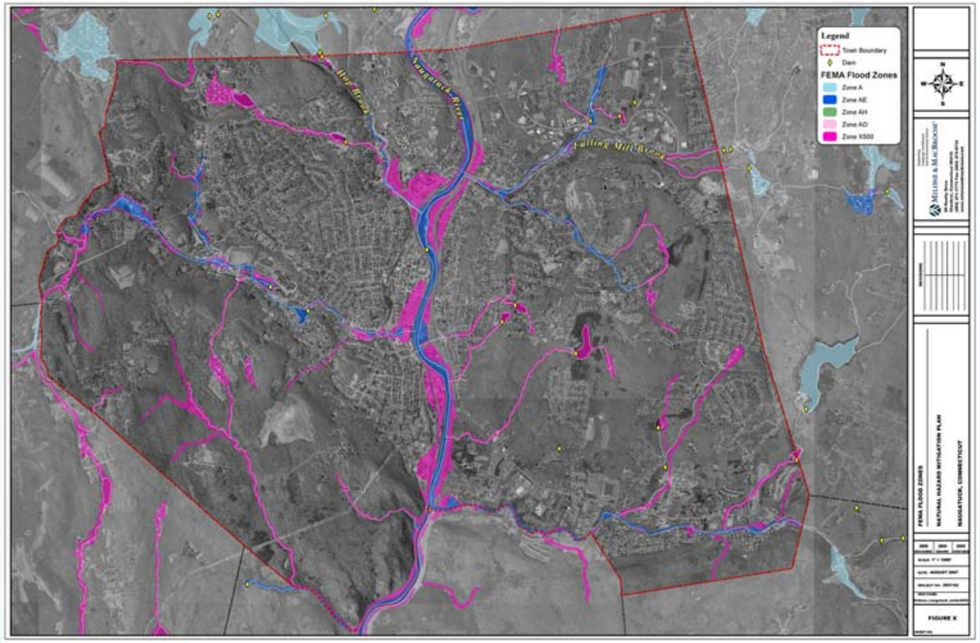
History of Hazard Mitigation Plans

- **<u>Authority</u>**
  - Disaster Mitigation Act of 2000 (amendments to Stafford Act of 1988)

- **<u>Goal of Disaster Mitigation Act</u>**
  - Encourage disaster preparedness
  - Encourage hazard mitigation measures to reduce losses of life and property

Municipalities Currently Involved in the Regional Mitigation Planning Process

- **Beacon Falls**
- **Bethlehem**
- **Middlebury**
- **Naugatuck**
- **Southbury**
- **Thomaston**



Local municipalities must have a FEMA approved Hazard Mitigation Plan in place to receive federal grant funds for hazard mitigation projects

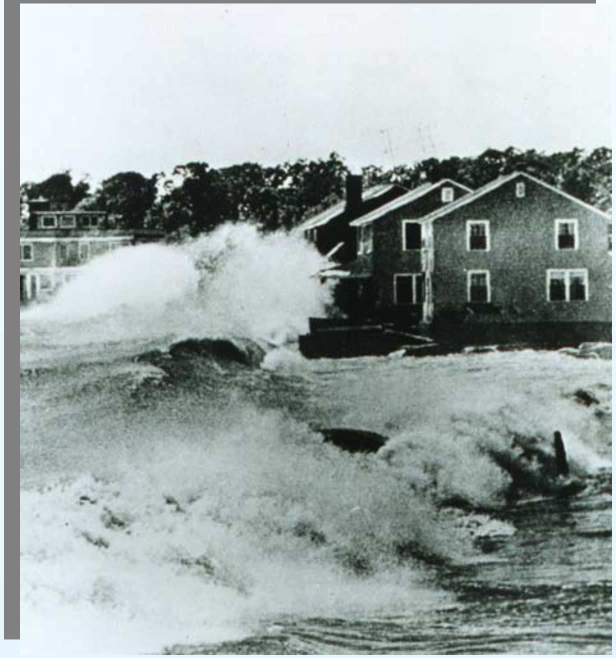
Selection of FEMA Pre-Disaster Mitigation Grants: 2003-2006

List does not include seismic, wind retrofit, home acquisition, and planning projects

State	Description	Grant
Colorado	Detention pond	$3,000,000
Oregon	Water conduit replacement	$3,000,000
Washington	Road elevation	$3,000,000
Oregon	Floodplain restoration	$2,984,236
Colorado	Watershed mitigation	$2,497,216
Georgia	Drainage improvements	$1,764,356
Massachusetts	Pond flood hazard project	$1,745,700
Oregon	Ice storm retrofit	$1,570,836
North Dakota	Power transmission replacement	$1,511,250
Texas	Home elevations	$1,507,005
Florida	Storm sewer pump station	$1,500,000
Massachusetts	Flood hazard mitigation project	$1,079,925
Kansas	Effluent pump station	$765,000
South Dakota	Flood channel restoration	$580,657
Massachusetts	Culvert project	$525,000
Texas	Storm shelter	$475,712
Massachusetts	Housing elevation and retrofit	$473,640
Utah	Fire station retrofit	$374,254
Washington	Downtown flood prevention project	$255,000
New York	WWTP Floodwall construction	$223,200
Massachusetts	Road mitigation project	$186,348
Massachusetts	Flood mitigation project	$145,503
Vermont	Road mitigation project	$140,441
New Hampshire	Water planning for firefighting	$134,810
Oregon	Bridge scour relocation project	$116,709
New Hampshire	Box culvert project	$102,000
Missouri	Bank stabilization	$48,750
Tennessee	Utility protection	$40,564
Wisconsin	Waterway stabilization	$12,909

What is a Natural Hazard ?

- An extreme natural event that poses a risk to people, infrastructure, and resources



What is Hazard Mitigation?

- ***Pre-disaster*** actions that reduce or eliminate long-term risk to people, property, and resources from natural hazards and their effects

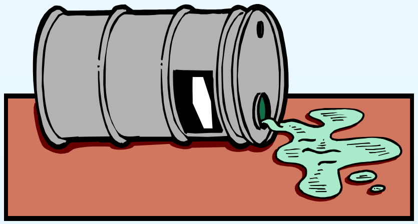
A Road Closure During / After a Large Scale Rainfall Event is a Type of Hazard Mitigation

Long-Term Goals of Hazard Mitigation

- Reduce loss / damage to life, property, and infrastructure
- Reduce the cost to residents and businesses
- Educate residents and policy-makers about natural hazard risk and vulnerability
- Connect hazard mitigation planning to other community planning efforts
- Enhance and preserve natural resource systems in the community

What a Hazard Mitigation Plan Does Not Address

- Terrorism and Sabotage
- Disaster Response and Recovery
- Human Induced Emergencies (some fires, hazardous spills and contamination, disease, etc.)



Components of Hazard Mitigation Planning Process

- Identify natural hazards that could occur in Naugatuck
- Evaluate the vulnerability of structures and populations and identify critical facilities and areas of concern
- Assess adequacy of mitigation measures currently in place
- Evaluate potential mitigation measures that could be undertaken to reduce the risk and vulnerability
- Develop recommendations for future mitigation actions

Naugatuck's Critical Facilities

- Emergency Services – Police, Fire, Ambulance
- Municipal Facilities – Borough Hall, Municipal Buildings, Department of Public Works
- High Schools – Used as Shelters

Naugatuck Fire Department

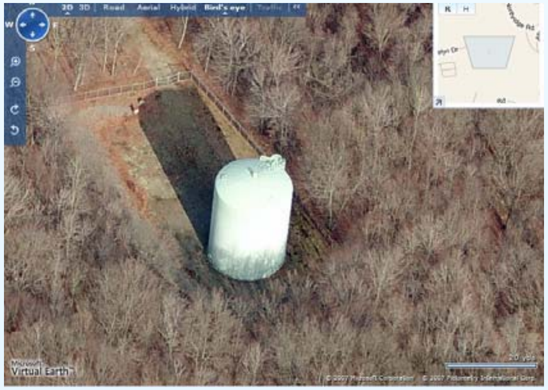
Western School

Naugatuck's Critical Facilities

- Health Care and Assisted Living

- Water Utilities – Tanks, Pumping Stations

- Wastewater Utilities – Pumping Stations and Treatment Plants



MILONE & MACBROOM

Fitzgerald & Halliday, Inc.

Potential Mitigation Measures

- Utilization of CodeRED Emergency Notification System
- Adopt local legislation that limits or regulates development in vulnerable areas
- Public education programs – dissemination of public safety information
- Construction of structural measures
- Allocate technical and financial resources for mitigation programs
- Preserve critical land areas and natural systems
- Research and / or technical assistance for local officials

Primary Natural Hazards Facing Naugatuck

- Inland flooding
- Winter storms, nor'easters, heavy snow, blizzards, ice storms
- Hurricanes
- Summer storms, tornadoes, thunderstorms, lightning, hail
- Dam failure
- Wildfires
- Earthquakes

Modified Channels Pose Threats During Heavy Rain Storms

Hurricanes

- Winds
- Heavy rain / flooding

1955 Flooding

Church Street & Park Place

Church Street Road Damage

Summer Storms and Tornadoes

Lightning over Boston

Tornado in KS

- Heavy wind / tornadoes / downbursts
- Lightning
- Heavy rain
- Hail

Flooding in MN

Winter Storms

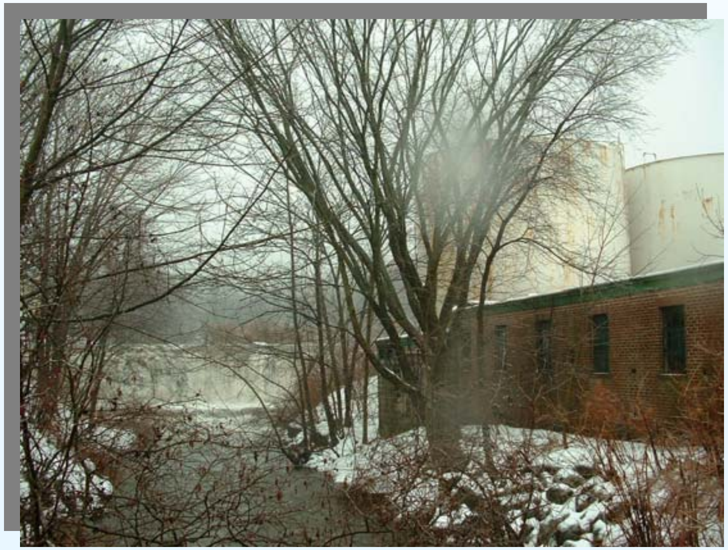
- Blizzards and nor'easters
- Heavy snow and drifts
- Freezing rain / ice

CT River April 2007

Blizzard of 1978 - CT

Dam Failure

- Severe rains or earthquakes can cause failure
- Possibility of loss of life and millions of dollars in property damage



Dam Adjacent to the Fuel Facility off Rubber Avenue

Wildfires

- Naugatuck has low to moderate risk of wildfires
- Fire
- Heat
- Smoke

Photo courtesy of FEMA

Earthquakes

- Naugatuck is in an area of minor seismic activity
- Can cause dam failure
  - Shaking
  - Liquefaction
  - Secondary (Slides/Slumps)

Photos courtesy of FEMA

Area-Specific Problems

- Roadway and property flooding at rivers and streams
  - Long Meadow Pond Brook
  - Spencer Street Area
  - Downstream of Union Ice Company Pond
  - Along Beacon Hill Brook
  - Other Streams and Localized Problems
- Flooding caused by poor drainage

Flooding at Rivers and Streams

- Long Meadow Pond Brooks and its tributaries

Arch Street

Harlow Court at Field Street

Webb Road

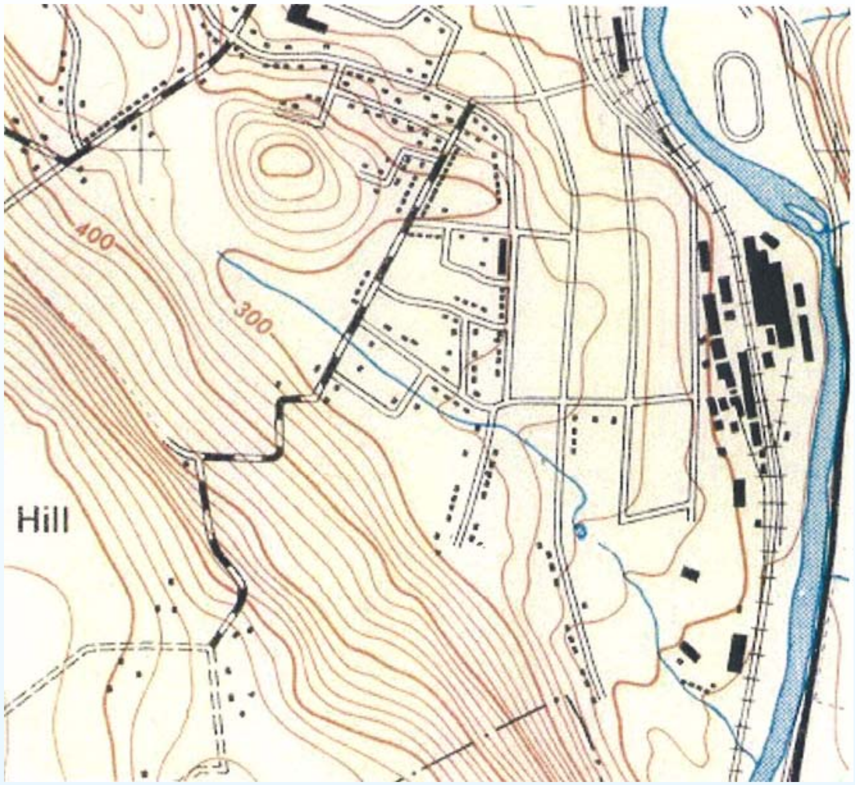
Flooding at Rivers and Streams

- Spencer Street Corridor:
  - In close proximity to homes and streets within the Spencer Street neighborhood
  - Portions of stream are in culverts

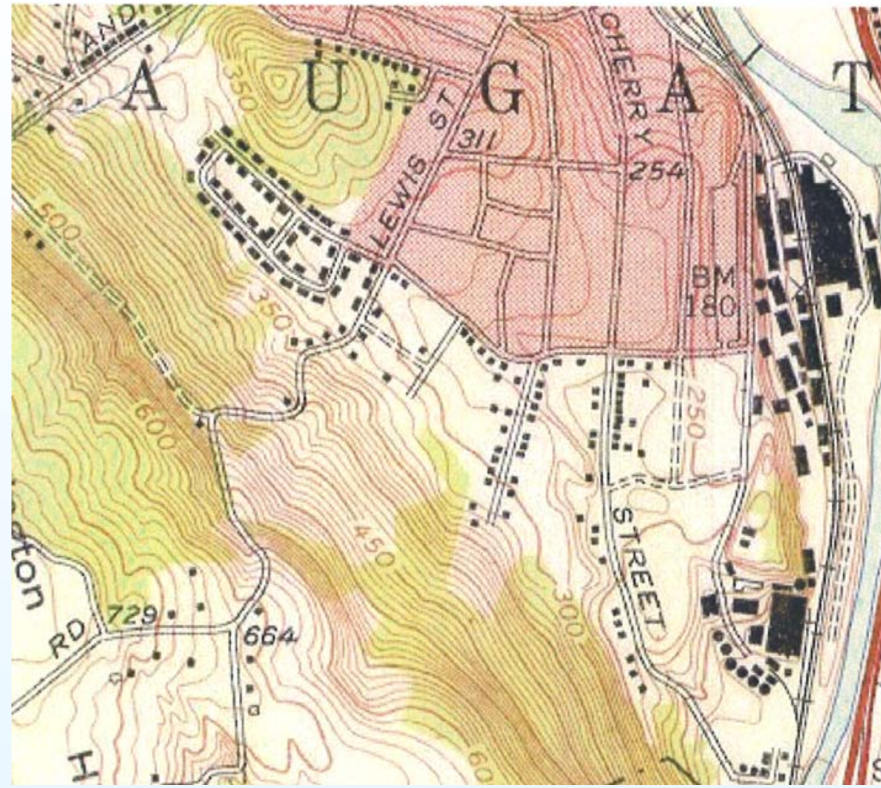
Lewis Street

Sharon Avenue

Flooding at Rivers and Streams



The Spencer Street area that experiences flooding, in 1947



By 1954, the stream was gone and development had increased

Flooding at Rivers and Streams

- Downstream of Union Ice Company Pond:

East Waterbury Road

Flooding at Rivers and Streams

- Along Beacon Hill Brook:

Little River Drive at Beacon Hill Brook

Flooding at Rivers and Streams

- Other Streams and Localized Problems:

Brook Street near Cold Spring Circle

Flooding Caused by Poor Drainage

- Locations Damaged During February 13, 2008 Storm:
  - Unnamed Stream along May Street may have jumped the culvert at the intersection with Bird Road

A wash out along May Street

Next Steps

- Incorporate input from residents
- Rank hazard vulnerability
- Develop a response strategy
- Prepare the draft plan with recommendations for review by the Borough and the public
- Adopt and implement the plan

Questions and Additions

Meeting Minutes

NATURAL HAZARD PRE-DISASTER MITIGATION PLAN FOR NAUGATUCK
Council of Governments Central Naugatuck Valley
Public Information Meeting
March 3, 2008

I. Welcome & Introductions

The following individuals attended the public meeting:

- David Murphy, P.E., Milone & MacBroom, Inc. (MMI)
- Shawn Goulet, MMI
- Samuel Eisenbeiser, Fitzgerald & Halliday, Inc. (FHI)
- Virginia Mason, Council of Governments Central Naugatuck Valley (CGCNV)
- Ken Hanks, Naugatuck FD
- James Ricci, Jr., Naugatuck FD

Ms. Mason introduced the project team and the project, explaining the COG's role in the project, the goals of the Disaster Mitigation Act, and the relationship to the FEMA pre-disaster and post-disaster funding processes.

II. Power Point: "Natural Hazard Pre-Disaster Mitigation Plan, Bethlehem, Connecticut"

Because nobody from the public was in attendance, Mr. Murphy presented the power point slideshow using the handouts.

III. Questions, Comments, and Discussion

- Fulling Mill Brook along Route 68 should be described in the plan, as flooding can occur.

- Hop Brook Dam is Class C but considered to be in good condition.

June 9, 2008

Mr. Steven A. Andon
United States Army Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742

RE: Natural Hazard Pre-Disaster Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston
MMI #2937-02

Dear Steve:

As I discussed with you in our phone conversation on Friday, June 6, 2008, the Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for the municipalities of Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston, Connecticut. Milone & MacBroom, Inc. (MMI) has been hired by the COGCNV to assist in the preparation of these six plans. These plans are being funded under a grant from the Federal Emergency Management Agency (FEMA) under its Pre-Disaster Mitigation (PDM) program.

The purpose of these plans is two-fold. First, plan development and adoption is required in order for each municipality to be eligible for certain pre-disaster mitigation funds from FEMA under the PDM program, as well as a greater portion of post-disaster funding under the Hazard Mitigation Grant Program (HMGP). Second, these plans are designed to be used as planning documents in each municipality, similar to existing Plans of Conservation and Development. The plans will be used by the municipalities in land use, development, emergency operations, and other long-range planning decisions. One of the main emphases of the plan is to provide a list of problematic areas related to natural hazards (flooding, wind, blizzards, lightning, hail, earthquakes, dam failure, and wildfires) and a list of proposed projects that can reduce or eliminate the effect of the hazard to that area. Thus, these plans will also be used in the formulation of capital budget decisions. As such, these plans must be officially adopted by the local municipality and approved by FEMA in order to be considered valid. Once adopted, information in these plans is in the public domain and available in the local town halls and library.

MMI has already prepared four plans for the COGCNV, three of which have been approved by FEMA and adopted by its respective municipality. The fourth is conditionally approved by FEMA but not yet adopted by the town. During the review process for the initial plans, FEMA requested "hazards with a geographic boundary (wildfire, dam failure…) must specifically address where the hazard will occur." This request is shown at the bottom of page 6 of the attached crosswalk for the town of Cheshire.

In the previous four plans, no dams managed by the United States Army Corps of Engineers (ACOE) were present, and dam failure inundation areas were available for several of these dams at the Connecticut Department of Environmental Protection (DEP) to fulfill the FEMA requirement. Unfortunately, the dam failure analyses for the ACOE dams in Thomaston (Thomaston Dam, Black Rock Dam, and Northfield Dam) and Naugatuck (Hop Brook Dam) were not available at the time of our review. DEP personnel suggested contacting the ACOE directly to review the inundation areas for inclusion in the current set of plans.

MMI would like to obtain copies of the dam failure inundation area mapping for the above-mentioned dams managed by the ACOE in the municipalities of Thomaston and Naugatuck, Connecticut. If provided, these areas will be presented in the plans but will be labeled "for planning purposes only." The ACOE documents will remain the official source of the hazard area.

MMI understands that much of the information contained within the Dam Failure Analysis for each dam is now considered sensitive information for official use only and that this request is subject to internal ACOE legal review. We hope that you will be able to assist in this very important project, and we look forward to hearing from you soon. If you have any additional questions regarding this project, please feel free to contact me or David Murphy at (203) 271-1773.

Very truly yours,

MILONE & MACBROOM, INC.

Scott J. Bighinatti
Environmental Scientist

Attachment

2937-02-jn908-ltr.doc

From: KNadeau@ctwater.com
Sent: Thursday, August 14, 2008 9:25 AM
To: Scott Bighinatti
Subject: Re: Hazard Mitigation Planning in CTWC service areas

Scott,
I will scan the inundation maps that I have and email them to you, and then see what we have or think for expanded service area.
Keith

From: "Scott Bighinatti" <scottb@miloneandmacbroom.com>
To: <KNadeau@ctwater.com>
Cc:
Sent: 08/13/2008 03:18 PM
Subject: Hazard Mitigation Planning in CTWC service areas

Hi Keith,

As you may be aware, David Murphy and I are writing Natural Hazard Mitigation Plans for the Council of Governments of the Central Naugatuck Valley. These plans will cover several natural hazards that could cause damages and/or loss of life due to flooding, wildfires, dam failure, hurricanes, etc. Municipalities that have these plans in place will be able to apply for funding for hazard mitigation projects through various FEMA grant programs before and after a disaster event. Would you be willing to assist us in this project by providing us the following information?

1. A brief description of any plans Connecticut Water Company has to expand or upgrade water service for fire protection in Thomaston, Middlebury, and Naugatuck (plans to expand water service will be included in the "Wildfires" section of the associated plans to show where the existing wildfire risk area will be reduced in the near future);

2. A copy of the Dam Failure Inundation Maps from the EOPs for the following Connecticut Water Company dams (such mapping has been requested by FEMA for these plans for Class C and B dams which may impact infrastructure and critical facilities):
    a. New Naugatuck Reservoir Dam in Bethany (Beacon Hill Brook which flows into Beacon Falls)
    b. Mulberry Reservoir Dam in Naugatuck
    c. Straitsville Reservoir Dam in Naugatuck
    d. Plymouth Reservoir in Plymouth (outflows into Thomaston)

In the case of the dam failure inundation maps, the figures in each plan will not replace those within the EOP for the respective dam. These figures will instead show a general inundation area in relation to critical facilities. A pdf copy of these maps would be perfect.

Please let myself or David Murphy know if you can assist us in this important project. If you have any questions, please feel free to contact us.

Thanks for your help,

Scott

Scott J. Bighinatti
Environmental Scientist
Milone & MacBroom, Inc.
99 Realty Drive
Cheshire, CT 06410
(203) 271-1773 Phone
(203) 272-9733 Fax
scottb@miloneandmacbroom.com

APPENDIX E
HAZUS DOCUMENTATION

Hazus-MH: Flood Event Report

Region Name: Naugatuck

Flood Scenario: BeaconHill-100

Print Date: Monday, December 02, 2013

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16 square miles and contains 332 census blocks. The region contains over 12 thousand households and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 10,204 buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 92.80% of the buildings (and 78.07% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religion	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	89,338	82.2%
Commercial	15,450	14.2%
Industrial	2,951	2.7%
Agricultural	50	0.0%
Religion	902	0.8%
Government	0	0.0%
Education	0	0.0%
Total	**108,691**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 15 schools, 1 fire station, 3 police stations and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Naugatuck
Scenario Name:	BeaconHill-100
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**0**		**0**		**0**		**0**		**0**		**0**	

Table 4: Expected Building Damage by Building Type

	1-10		11-20		21-30		31-40		41-50		Substantially	
Building Type	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	1	0	0	0
Hospitals	0	0	0	0
Police Stations	3	0	0	0
Schools	15	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 15 tons of debris will be generated. Of the total amount, Finishes comprises 100% of the total, Structure comprises 0% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 1 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 10 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 5 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 0.38 million dollars, which represents 0.35 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 0.38 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 41.10% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	0.08	0.05	0.00	0.00	0.13
	Content	0.08	0.15	0.01	0.01	0.25
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.16**	**0.20**	**0.02**	**0.01**	**0.38**
Business Interruption						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
ALL	**Total**	**0.16**	**0.20**	**0.02**	**0.01**	**0.38**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Total Study Region	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Flood Event Report

Region Name: Naugatuck

Flood Scenario: cold spring 100

Print Date: Tuesday, December 03, 2013

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social

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General Description of the Region

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The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16 square miles and contains 332 census blocks. The region contains over 12 thousand households and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 10,204 buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 92.80% of the buildings (and 78.07% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religion	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	99,708	88.4%
Commercial	4,198	3.7%
Industrial	5,533	4.9%
Agricultural	124	0.1%
Religion	1,649	1.5%
Government	0	0.0%
Education	1,613	1.4%
Total	**112,825**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 15 schools, 1 fire station, 3 police stations and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Naugatuck
Scenario Name:	cold spring 100
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**0**		**0**		**0**		**0**		**0**		**0**	

Table 4: Expected Building Damage by Building Type

	1-10		11-20		21-30		31-40		41-50		Substantially	
Building Type	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	1	0	0	0
Hospitals	0	0	0	0
Police Stations	3	0	0	0
Schools	15	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 11 tons of debris will be generated. Of the total amount, Finishes comprises 100% of the total, Structure comprises 0% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 6 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 1 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 0.17 million dollars, which represents 0.15 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 0.17 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 71.08% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	0.08	0.00	0.00	0.00	0.09
	Content	0.04	0.01	0.01	0.01	0.08
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.12**	**0.01**	**0.02**	**0.01**	**0.17**
Business Interruption						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
ALL	**Total**	**0.12**	**0.01**	**0.02**	**0.01**	**0.17**

Appendix A: County Listing for the Region

Connecticut
- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Total Study Region	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Flood Event Report

Region Name: Naugatuck

Flood Scenario: Fulling Mill 100yr

Print Date: Tuesday, December 03, 2013

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16 square miles and contains 332 census blocks. The region contains over 12 thousand households and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 10,204 buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 92.80% of the buildings (and 78.07% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religion	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	69,725	53.5%
Commercial	35,887	27.5%
Industrial	22,077	16.9%
Agricultural	206	0.2%
Religion	1,704	1.3%
Government	35	0.0%
Education	748	0.6%
Total	**130,382**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 15 schools, 1 fire station, 3 police stations and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Naugatuck
Scenario Name:	Fulling Mill 100yr
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**0**		**0**		**0**		**0**		**0**		**0**	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	1	0	0	0
Hospitals	0	0	0	0
Police Stations	3	0	0	0
Schools	15	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 33 tons of debris will be generated. Of the total amount, Finishes comprises 100% of the total, Structure comprises 0% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 1 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 12 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 12 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 0.63 million dollars, which represents 0.48 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 0.63 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 61.05% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	0.25	0.03	0.02	0.00	0.30
	Content	0.13	0.12	0.04	0.04	0.32
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.38**	**0.15**	**0.05**	**0.04**	**0.63**
Business Interruption						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
ALL	**Total**	**0.38**	**0.15**	**0.05**	**0.04**	**0.63**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Total Study Region	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Flood Event Report

Region Name: Naugatuck

Flood Scenario: Hop Brook 100 Year Flood

Print Date: Tuesday, December 03, 2013

Disclaimer:

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The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Connecticut

Note:
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There are an estimated 10,204 buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 92.80% of the buildings (and 78.07% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

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Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religion	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	33,518	65.4%
Commercial	9,160	17.9%
Industrial	7,872	15.4%
Agricultural	0	0.0%
Religion	706	1.4%
Government	0	0.0%
Education	0	0.0%
Total	**51,256**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 15 schools, 1 fire station, 3 police stations and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Naugatuck
Scenario Name:	Hop Brook 100 Year Flood
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**0**		**0**		**0**		**0**		**0**		**0**	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	1	0	0	0
Hospitals	0	0	0	0
Police Stations	3	0	0	0
Schools	15	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 1 tons of debris will be generated. Of the total amount, Finishes comprises 72% of the total, Structure comprises 8% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 2 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 0 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 0.08 million dollars, which represents 0.15 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 0.08 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 0.00% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	0.00	0.01	0.00	0.00	0.01
	Content	0.00	0.06	0.01	0.00	0.07
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.07**	**0.01**	**0.00**	**0.08**
Business Interruption						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
ALL	**Total**	**0.00**	**0.07**	**0.01**	**0.00**	**0.08**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Total Study Region	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Flood Event Report

Region Name: Naugatuck

Flood Scenario: Long Meadow 100 year

Print Date: Tuesday, December 03, 2013

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16 square miles and contains 332 census blocks. The region contains over 12 thousand households and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 10,204 buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 92.80% of the buildings (and 78.07% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religion	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	72,931	47.2%
Commercial	73,052	47.3%
Industrial	6,054	3.9%
Agricultural	488	0.3%
Religion	1,148	0.7%
Government	756	0.5%
Education	125	0.1%
Total	**154,554**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 15 schools, 1 fire station, 3 police stations and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Naugatuck
Scenario Name:	Long Meadow 100 year
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**0**		**0**		**0**		**0**		**0**		**0**	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	1	0	0	0
Hospitals	0	0	0	0
Police Stations	3	0	0	0
Schools	15	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 34 tons of debris will be generated. Of the total amount, Finishes comprises 95% of the total, Structure comprises 2% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 1 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 16 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 11 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 1.85 million dollars, which represents 1.20 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 1.85 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 11.13% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	0.14	0.32	0.03	0.00	0.49
	Content	0.07	1.14	0.06	0.01	1.28
	Inventory	0.00	0.07	0.01	0.00	0.08
	Subtotal	**0.21**	**1.53**	**0.10**	**0.01**	**1.85**
Business Interruption						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.01**	**0.00**	**0.00**	**0.01**
ALL	**Total**	**0.21**	**1.54**	**0.10**	**0.01**	**1.85**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Total Study Region	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Flood Event Report

Region Name: Naugatuck

Flood Scenario: Naugatuck 100 year

Print Date: Tuesday, December 03, 2013

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social

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The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16 square miles and contains 332 census blocks. The region contains over 12 thousand households and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 10,204 buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 92.80% of the buildings (and 78.07% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religion	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	55,016	64.7%
Commercial	24,511	28.8%
Industrial	2,612	3.1%
Agricultural	0	0.0%
Religion	0	0.0%
Government	1,862	2.2%
Education	1,041	1.2%
Total	**85,042**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 15 schools, 1 fire station, 3 police stations and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Naugatuck
Scenario Name:	Naugatuck 100 year
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Building Damage

General Building Stock Damage

Hazus estimates that about 3 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the scenario. There are an estimated 2 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	0	0.00	0	0.00	0	0.00	1	33.33	2	66.67
Total	**0**		**0**		**0**		**0**		**1**		**2**	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	100.00
Masonry	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	0	0.00	0	0.00	0	0.00	1	50.00	1	50.00

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	1	0	0	0
Hospitals	0	0	0	0
Police Stations	3	0	0	0
Schools	15	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 412 tons of debris will be generated. Of the total amount, Finishes comprises 35% of the total, Structure comprises 37% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 16 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 22 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 30 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 9.72 million dollars, which represents 11.43 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 9.66 million dollars. 1% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 23.88% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	1.52	2.47	0.09	0.03	4.11
	Content	0.80	4.37	0.12	0.17	5.47
	Inventory	0.00	0.06	0.02	0.00	0.08
	Subtotal	**2.32**	**6.91**	**0.23**	**0.20**	**9.66**
Business Interruption						
	Income	0.00	0.02	0.00	0.00	0.02
	Relocation	0.00	0.01	0.00	0.00	0.01
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.02	0.00	0.02	0.03
	Subtotal	**0.00**	**0.04**	**0.00**	**0.02**	**0.06**
ALL	**Total**	**2.32**	**6.95**	**0.23**	**0.22**	**9.72**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Total Study Region	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Flood Event Report

Region Name: Naugatuck

Flood Scenario: Schlidgen Pond Brook 100 Year

Print Date: Tuesday, December 03, 2013

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social

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The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16 square miles and contains 332 census blocks. The region contains over 12 thousand households and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 10,204 buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 92.80% of the buildings (and 78.07% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

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Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religion	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	43,504	53.5%
Commercial	22,711	27.9%
Industrial	14,512	17.8%
Agricultural	206	0.3%
Religion	451	0.6%
Government	0	0.0%
Education	0	0.0%
Total	**81,384**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 15 schools, 1 fire station, 3 police stations and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Naugatuck
Scenario Name:	Schlidgen Pond Brook 100 Year
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Building Damage

General Building Stock Damage

Hazus estimates that about 3 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the scenario. There are an estimated 2 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	0	0.00	0	0.00	0	0.00	1	33.33	2	66.67
Total	**0**		**0**		**0**		**0**		**1**		**2**	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	0	0.00	0	0.00	0	0.00	1	33.33	2	66.67

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	1	0	0	0
Hospitals	0	0	0	0
Police Stations	3	0	0	0
Schools	15	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 174 tons of debris will be generated. Of the total amount, Finishes comprises 35% of the total, Structure comprises 39% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 7 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 13 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 17 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 1.46 million dollars, which represents 1.80 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 1.46 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 90.57% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	0.88	0.02	0.02	0.00	0.92
	Content	0.45	0.06	0.04	0.00	0.55
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**1.33**	**0.08**	**0.06**	**0.00**	**1.46**
Business Interruption						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
ALL	**Total**	**1.33**	**0.08**	**0.06**	**0.00**	**1.46**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Total Study Region	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Flood Event Report

Region Name: Naugatuck

Flood Scenario: Webb Brook 100 Year

Print Date: Tuesday, December 03, 2013

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16 square miles and contains 332 census blocks. The region contains over 12 thousand households and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 10,204 buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 92.80% of the buildings (and 78.07% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religion	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	73,518	55.7%
Commercial	56,560	42.9%
Industrial	1,000	0.8%
Agricultural	124	0.1%
Religion	421	0.3%
Government	0	0.0%
Education	350	0.3%
Total	**131,973**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 15 schools, 1 fire station, 3 police stations and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Naugatuck
Scenario Name:	Webb Brook 100 Year
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**0**		**0**		**0**		**0**		**0**		**0**	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	1	0	0	0
Hospitals	0	0	0	0
Police Stations	3	0	0	0
Schools	15	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 6 tons of debris will be generated. Of the total amount, Finishes comprises 91% of the total, Structure comprises 3% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 12 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 17 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 0.08 million dollars, which represents 0.06 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 0.08 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 41.77% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	0.02	0.01	0.00	0.00	0.03
	Content	0.01	0.03	0.00	0.01	0.05
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.03**	**0.03**	**0.01**	**0.01**	**0.08**
Business Interruption						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
ALL	**Total**	**0.03**	**0.03**	**0.01**	**0.01**	**0.08**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Total Study Region	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Hurricane Event Report

Region Name: Naugatuck

Hurricane Scenario: UN-NAMED-1938-4

Print Date: Friday, August 23, 2013

Disclaimer:
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16.43 square miles and contains 5 census tracts. There are over 11 thousand households in the region and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 10 thousand buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 93% of the buildings (and 78% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religious	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 15 schools, 1 fire stations, 3 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	UN-NAMED-1938-4
Type:	Historic
Max Peak Gust in Study Region:	107 mph

Building Damage

General Building Stock Damage

Hazus estimates that about 505 buildings will be at least moderately damaged. This is over 5% of the total number of buildings in the region. There are an estimated 15 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	18	74.23	4	17.59	1	5.30	1	2.56	0	0.31
Commercial	357	77.18	75	16.18	27	5.74	4	0.90	0	0.01
Education	12	78.00	3	16.27	1	5.24	0	0.49	0	0.00
Government	8	75.98	2	17.03	1	6.38	0	0.61	0	0.00
Industrial	149	78.18	29	15.30	10	5.37	2	1.07	0	0.08
Religion	26	77.50	6	17.71	1	4.43	0	0.37	0	0.00
Residential	7,062	74.58	1,950	20.60	416	4.39	26	0.27	14	0.15
Total	**7,631**		**2,068**		**457**		**33**		**15**	

Table 3: Expected Building Damage by Building Type

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	43	77.51	9	16.10	3	5.99	0	0.39	0	0.00
Masonry	590	70.77	148	17.77	89	10.67	6	0.72	1	0.07
MH	308	97.05	6	1.92	3	0.84	0	0.02	1	0.17
Steel	265	78.21	50	14.69	21	6.06	4	1.04	0	0.01
Wood	6,172	74.91	1,767	21.44	267	3.24	20	0.25	13	0.16

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Police Stations	3	0	0	3
Schools	15	0	0	0

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 20,915 tons of debris will be generated. Of the total amount, 6,176 tons (30%) is Other Tree Debris. Of the remaining 14,739 tons, Brick/Wood comprises 55% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 326 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 6,588 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 28 households to be displaced due to the hurricane. Of these, 6 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 61.4 million dollars, which represents 2.69 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 61 million dollars. 2% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 86% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	40,200.09	2,820.76	1,169.20	459.22	44,649.26
	Content	8,094.29	937.40	716.36	133.10	9,881.16
	Inventory	0.00	34.22	126.36	2.70	163.29
	Subtotal	**48,294.38**	**3,792.38**	**2,011.93**	**595.01**	**54,693.70**
Business Interruption Loss						
	Income	0.00	328.16	17.75	52.23	398.14
	Relocation	2,689.27	571.19	83.76	88.89	3,433.11
	Rental	1,917.15	296.58	15.64	9.40	2,238.77
	Wage	0.00	342.71	27.74	293.87	664.31
	Subtotal	**4,606.42**	**1,538.65**	**144.88**	**444.39**	**6,734.33**
Total						
	Total	**52,900.80**	**5,331.03**	**2,156.81**	**1,039.40**	**61,428.04**

Appendix A: County Listing for the Region

Connecticut
- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Study Region Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Hurricane Event Report

Region Name: Naugatuck

Hurricane Scenario: GLORIA

Print Date: Friday, August 23, 2013

Disclaimer:
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16.43 square miles and contains 5 census tracts. There are over 11 thousand households in the region and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 10 thousand buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 93% of the buildings (and 78% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religious	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 15 schools, 1 fire stations, 3 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	GLORIA
Type:	Historic
Max Peak Gust in Study Region:	79 mph

Building Damage

General Building Stock Damage

Hazus estimates that about 6 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	24	99.19	0	0.76	0	0.04	0	0.01	0	0.00
Commercial	458	99.10	4	0.86	0	0.04	0	0.00	0	0.00
Education	16	99.11	0	0.89	0	0.00	0	0.00	0	0.00
Government	10	99.05	0	0.95	0	0.00	0	0.00	0	0.00
Industrial	188	99.05	2	0.93	0	0.02	0	0.00	0	0.00
Religion	33	99.25	0	0.73	0	0.02	0	0.00	0	0.00
Residential	9,392	99.19	71	0.75	6	0.06	0	0.00	0	0.00
Total	**10,121**		**77**		**6**		**0**		**0**	

Table 3: Expected Building Damage by Building Type

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	55	98.93	1	1.06	0	0.00	0	0.00	0	0.00
Masonry	816	98.01	14	1.70	2	0.28	0	0.01	0	0.00
MH	317	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	336	99.04	3	0.93	0	0.03	0	0.00	0	0.00
Wood	8,189	99.40	48	0.58	2	0.02	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Police Stations	3	0	0	3
Schools	15	0	0	15

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 767 tons of debris will be generated. Of the total amount, 155 tons (20%) is Other Tree Debris. Of the remaining 612 tons, Brick/Wood comprises 67% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 16 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 204 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 3.2 million dollars, which represents 0.14 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 3 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 96% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	2,847.13	79.93	22.60	12.12	2,961.79
	Content	191.92	0.00	0.00	0.00	191.92
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**3,039.05**	**79.93**	**22.60**	**12.12**	**3,153.71**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	39.23	1.52	0.03	0.05	40.83
	Rental	53.17	0.00	0.00	0.00	53.17
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**92.40**	**1.52**	**0.03**	**0.05**	**94.00**
Total						
	Total	**3,131.45**	**81.45**	**22.64**	**12.17**	**3,247.71**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Study Region Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Hurricane Event Report

Region Name: Naugatuck

Hurricane Scenario: Probabilistic 10-year Return Period

Print Date: Friday, August 23, 2013

Disclaimer:
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16.43 square miles and contains 5 census tracts. There are over 11 thousand households in the region and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 10 thousand buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 93% of the buildings (and 78% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religious	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 15 schools, 1 fire stations, 3 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 10 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	24	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	462	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	16	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	10	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	190	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	33	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	9,469	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**10,204**		**0**		**0**		**0**		**0**	

Table 3: Expected Building Damage by Building Type : 10 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	56	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	833	100.00	0	0.00	0	0.00	0	0.00	0	0.00
MH	317	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	339	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	8,239	100.00	0	0.00	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Police Stations	3	0	0	3
Schools	15	0	0	15

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0 tons of debris will be generated. Of the total amount, 0 tons (0%) is Other Tree Debris. Of the remaining 0 tons, Brick/Wood comprises 0% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 0 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 0.0 million dollars, which represents 0.00 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 0 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 0% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	0.00	0.00	0.00	0.00	0.00
	Content	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Total						
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Study Region Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Hurricane Event Report

Region Name: Naugatuck

Hurricane Scenario: Probabilistic 20-year Return Period

Print Date: Friday, August 23, 2013

Disclaimer:
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16.43 square miles and contains 5 census tracts. There are over 11 thousand households in the region and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 10 thousand buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 93% of the buildings (and 78% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

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Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religious	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 15 schools, 1 fire stations, 3 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 20 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	24	99.83	0	0.17	0	0.00	0	0.00	0	0.00
Commercial	461	99.77	1	0.23	0	0.00	0	0.00	0	0.00
Education	16	99.75	0	0.25	0	0.00	0	0.00	0	0.00
Government	10	99.73	0	0.27	0	0.00	0	0.00	0	0.00
Industrial	190	99.74	0	0.26	0	0.00	0	0.00	0	0.00
Religion	33	99.80	0	0.20	0	0.00	0	0.00	0	0.00
Residential	9,462	99.93	6	0.07	0	0.00	0	0.00	0	0.00
Total	**10,196**		**8**		**0**		**0**		**0**	

Table 3: Expected Building Damage by Building Type : 20 - year Event

	None		Minor		Moderate		Severe		Destruction	
Building Type	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	56	99.70	0	0.30	0	0.00	0	0.00	0	0.00
Masonry	830	99.64	3	0.34	0	0.01	0	0.00	0	0.00
MH	317	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	338	99.73	1	0.27	0	0.00	0	0.00	0	0.00
Wood	8,237	99.98	2	0.02	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Police Stations	3	0	0	3
Schools	15	0	0	15

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 31 tons of debris will be generated. Of the total amount, 12 tons (39%) is Other Tree Debris. Of the remaining 19 tons, Brick/Wood comprises 5% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 18 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 0.1 million dollars, which represents 0.00 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 0 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 100% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	64.16	0.00	0.00	0.00	64.16
	Content	8.35	0.00	0.00	0.00	8.35
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**72.50**	**0.00**	**0.00**	**0.00**	**72.50**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.58	0.00	0.00	0.00	0.58
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.58**	**0.00**	**0.00**	**0.00**	**0.58**
Total						
	Total	**73.09**	**0.00**	**0.00**	**0.00**	**73.09**

Appendix A: County Listing for the Region

Connecticut
- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
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New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Study Region Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Hurricane Event Report

Region Name: Naugatuck

Hurricane Scenario: Probabilistic 50-year Return Period

Print Date: Friday, August 23, 2013

Disclaimer:
Totals only reflect data for those census tracts/blocks included in the user's study region.

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Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 15 schools, 1 fire stations, 3 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 5 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 50 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	24	99.23	0	0.73	0	0.04	0	0.01	0	0.00
Commercial	458	99.14	4	0.82	0	0.04	0	0.00	0	0.00
Education	16	99.15	0	0.84	0	0.00	0	0.00	0	0.00
Government	10	99.08	0	0.92	0	0.00	0	0.00	0	0.00
Industrial	188	99.11	2	0.88	0	0.01	0	0.00	0	0.00
Religion	33	99.29	0	0.70	0	0.02	0	0.00	0	0.00
Residential	9,400	99.27	64	0.68	5	0.05	0	0.00	0	0.00
Total	**10,128**		**70**		**5**		**0**		**0**	

Table 3: Expected Building Damage by Building Type : 50 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	55	98.98	1	1.01	0	0.00	0	0.00	0	0.00
Masonry	817	98.12	13	1.61	2	0.26	0	0.01	0	0.00
MH	317	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	336	99.09	3	0.89	0	0.02	0	0.00	0	0.00
Wood	8,195	99.47	42	0.51	2	0.02	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Police Stations	3	0	0	3
Schools	15	0	0	15

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 694 tons of debris will be generated. Of the total amount, 140 tons (20%) is Other Tree Debris. Of the remaining 554 tons, Brick/Wood comprises 68% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 15 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 180 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 3.0 million dollars, which represents 0.13 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 3 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 97% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	2,636.00	72.80	16.04	11.29	2,736.14
	Content	165.20	0.00	0.00	0.00	165.20
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**2,801.20**	**72.80**	**16.04**	**11.29**	**2,901.34**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	33.27	1.45	0.02	0.04	34.78
	Rental	47.02	0.00	0.00	0.00	47.02
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**80.29**	**1.45**	**0.02**	**0.04**	**81.79**
Total						
	Total	**2,881.49**	**74.25**	**16.06**	**11.33**	**2,983.13**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Study Region Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Hurricane Event Report

Region Name: Naugatuck

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Friday, August 23, 2013

Disclaimer:
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16.43 square miles and contains 5 census tracts. There are over 11 thousand households in the region and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 10 thousand buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 93% of the buildings (and 78% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religious	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 15 schools, 1 fire stations, 3 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 51 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	23	95.31	1	3.86	0	0.60	0	0.22	0	0.01
Commercial	444	96.12	16	3.41	2	0.43	0	0.04	0	0.00
Education	15	96.45	1	3.38	0	0.17	0	0.00	0	0.00
Government	10	95.93	0	3.86	0	0.22	0	0.00	0	0.00
Industrial	183	96.38	6	3.31	1	0.26	0	0.05	0	0.00
Religion	32	96.39	1	3.44	0	0.17	0	0.01	0	0.00
Residential	9,004	95.09	417	4.40	46	0.49	1	0.02	0	0.00
Total	**9,711**		**442**		**49**		**2**		**0**	

Table 3: Expected Building Damage by Building Type : 100 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	54	96.23	2	3.58	0	0.19	0	0.00	0	0.00
Masonry	771	92.52	45	5.43	16	1.97	1	0.07	0	0.00
MH	317	99.89	0	0.09	0	0.02	0	0.00	0	0.00
Steel	327	96.36	11	3.22	1	0.38	0	0.04	0	0.00
Wood	7,870	95.52	351	4.26	17	0.21	1	0.01	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Police Stations	3	0	0	3
Schools	15	0	0	15

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 7,107 tons of debris will be generated. Of the total amount, 2,623 tons (37%) is Other Tree Debris. Of the remaining 4,484 tons, Brick/Wood comprises 41% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 73 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 2,654 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 12.5 million dollars, which represents 0.54 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 12 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 93% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	9,856.04	386.84	113.59	59.31	10,415.77
	Content	849.22	68.89	29.51	7.15	954.77
	Inventory	0.00	2.45	5.50	0.18	8.13
	Subtotal	**10,705.25**	**458.18**	**148.60**	**66.64**	**11,378.68**
Business Interruption Loss						
	Income	0.00	47.27	1.23	8.83	57.33
	Relocation	430.35	58.60	5.05	5.84	499.85
	Rental	418.66	30.80	1.23	0.54	451.24
	Wage	0.00	41.99	2.03	20.77	64.79
	Subtotal	**849.02**	**178.66**	**9.54**	**35.99**	**1,073.21**
Total						
	Total	**11,554.27**	**636.84**	**158.14**	**102.63**	**12,451.88**

Appendix A: County Listing for the Region

Connecticut
- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Study Region Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Hurricane Event Report

Region Name: Naugatuck

Hurricane Scenario: Probabilistic 200-year Return Period

Print Date: Friday, August 23, 2013

Disclaimer:
Totals only reflect data for those census tracts/blocks included in the user's study region.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16.43 square miles and contains 5 census tracts. There are over 11 thousand households in the region and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 10 thousand buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 93% of the buildings (and 78% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religious	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 15 schools, 1 fire stations, 3 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 224 buildings will be at least moderately damaged. This is over 2% of the total number of buildings in the region. There are an estimated 3 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 200 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	20	84.94	3	11.14	1	2.62	0	1.19	0	0.11
Commercial	403	87.33	47	10.07	11	2.31	1	0.29	0	0.00
Education	14	88.18	2	10.02	0	1.73	0	0.07	0	0.00
Government	9	87.02	1	10.74	0	2.16	0	0.09	0	0.00
Industrial	167	88.00	18	9.59	4	2.02	1	0.37	0	0.02
Religion	29	87.65	4	10.77	0	1.51	0	0.07	0	0.00
Residential	8,024	84.74	1,240	13.09	195	2.06	7	0.08	3	0.03
Total	**8,667**		**1,313**		**211**		**10**		**3**	

Table 3: Expected Building Damage by Building Type : 200 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	49	87.83	6	10.11	1	2.01	0	0.05	0	0.00
Masonry	677	81.26	102	12.29	51	6.12	3	0.31	0	0.02
MH	313	98.89	3	0.82	1	0.24	0	0.00	0	0.05
Steel	299	88.12	31	9.22	8	2.33	1	0.32	0	0.00
Wood	7,017	85.17	1,106	13.42	107	1.30	5	0.06	3	0.03

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Police Stations	3	0	0	3
Schools	15	0	0	3

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 12,695 tons of debris will be generated. Of the total amount, 3,809 tons (30%) is Other Tree Debris. Of the remaining 8,886 tons, Brick/Wood comprises 54% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 191 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 4,100 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters . The model estimates 7 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 32.8 million dollars, which represents 1.44 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 33 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 89% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	23,435.22	1,298.35	507.31	206.34	25,447.22
	Content	3,398.82	328.90	261.87	42.23	4,031.82
	Inventory	0.00	12.63	47.36	1.12	61.11
	Subtotal	**26,834.04**	**1,639.87**	**816.54**	**249.70**	**29,540.15**
Business Interruption Loss						
	Income	0.00	186.65	7.66	28.03	222.34
	Relocation	1,206.00	253.75	32.10	34.00	1,525.86
	Rental	1,079.62	132.88	6.49	3.57	1,222.57
	Wage	0.00	187.18	12.11	130.82	330.12
	Subtotal	**2,285.62**	**760.47**	**58.37**	**196.43**	**3,300.88**
Total						
	Total	**29,119.65**	**2,400.34**	**874.91**	**446.12**	**32,841.03**

Appendix A: County Listing for the Region

Connecticut
- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Study Region Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Hurricane Event Report

Region Name: Naugatuck

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Friday, August 23, 2013

Disclaimer:
Totals only reflect data for those census tracts/blocks included in the user's study region.

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The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16.43 square miles and contains 5 census tracts. There are over 11 thousand households in the region and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 10 thousand buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 93% of the buildings (and 78% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religious	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 15 schools, 1 fire stations, 3 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 953 buildings will be at least moderately damaged. This is over 9% of the total number of buildings in the region. There are an estimated 44 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 500 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	15	62.20	6	23.69	2	8.98	1	4.44	0	0.69
Commercial	302	65.30	100	21.60	50	10.80	11	2.28	0	0.02
Education	11	66.47	3	21.59	2	10.33	0	1.61	0	0.00
Government	6	64.91	2	21.51	1	11.68	0	1.91	0	0.00
Industrial	126	66.07	39	20.52	20	10.63	5	2.61	0	0.18
Religion	22	65.45	8	24.13	3	9.12	0	1.30	0	0.00
Residential	5,985	63.21	2,628	27.75	742	7.83	71	0.75	43	0.46
Total	**6,466**		**2,786**		**820**		**89**		**44**	

Table 3: Expected Building Damage by Building Type : 500 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	37	65.57	12	20.95	7	12.03	1	1.44	0	0.00
Masonry	497	59.67	187	22.41	135	16.23	13	1.51	2	0.18
MH	297	93.70	11	3.50	7	2.14	0	0.12	2	0.54
Steel	225	66.23	66	19.40	40	11.66	9	2.70	0	0.02
Wood	5,220	63.36	2,404	29.18	517	6.27	59	0.71	39	0.48

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Police Stations	3	0	0	3
Schools	15	0	0	0

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 33,567 tons of debris will be generated. Of the total amount, 9,894 tons (29%) is Other Tree Debris. Of the remaining 23,673 tons, Brick/Wood comprises 54% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 516 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 10,762 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters . The model estimates 84 households to be displaced due to the hurricane. Of these, 13 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 109.1 million dollars, which represents 4.77 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 109 million dollars. 2% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 85% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	66,170.54	5,450.19	2,415.84	856.72	74,893.29
	Content	17,079.47	2,196.45	1,649.09	307.59	21,232.60
	Inventory	0.00	79.91	281.43	5.35	366.69
	Subtotal	**83,250.01**	**7,726.54**	**4,346.36**	**1,169.66**	**96,492.58**
Business Interruption Loss						
	Income	0.08	347.44	32.02	55.25	434.79
	Relocation	5,943.13	1,095.05	178.73	173.22	7,390.14
	Rental	3,374.23	570.05	31.81	17.65	3,993.74
	Wage	0.18	380.32	50.34	338.82	769.66
	Subtotal	**9,317.62**	**2,392.85**	**292.91**	**584.94**	**12,588.33**
Total						
	Total	**92,567.64**	**10,119.40**	**4,639.27**	**1,754.60**	**109,080.91**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Study Region Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Hurricane Event Report

Region Name: Naugatuck

Hurricane Scenario: Probabilistic 1000-year Return Period

Print Date: Friday, August 23, 2013

Disclaimer:
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16.43 square miles and contains 5 census tracts. There are over 11 thousand households in the region and has a total population of 30,989 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 10 thousand buildings in the region with a total building replacement value (excluding contents) of 2,287 million dollars (2006 dollars). Approximately 93% of the buildings (and 78% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 10,204 buildings in the region which have an aggregate total replacement value of 2,287 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,785,053	78.1%
Commercial	327,455	14.3%
Industrial	121,046	5.3%
Agricultural	3,249	0.1%
Religious	26,783	1.2%
Government	8,961	0.4%
Education	14,021	0.6%
Total	**2,286,568**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 15 schools, 1 fire stations, 3 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 2,000 buildings will be at least moderately damaged. This is over 20% of the total number of buildings in the region. There are an estimated 152 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 1000 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	10	42.31	7	30.97	4	16.26	2	8.64	0	1.83
Commercial	209	45.17	124	26.75	96	20.70	34	7.31	0	0.07
Education	7	45.96	4	26.62	3	20.73	1	6.69	0	0.00
Government	4	43.58	3	25.49	2	22.66	1	8.27	0	0.00
Industrial	87	45.99	47	24.99	39	20.60	15	7.94	1	0.47
Religion	15	45.26	10	30.84	6	18.61	2	5.29	0	0.00
Residential	4,293	45.34	3,383	35.73	1,406	14.85	236	2.49	151	1.59
Total	**4,626**		**3,579**		**1,557**		**290**		**152**	

Table 3: Expected Building Damage by Building Type : 1000 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	25	45.36	14	24.50	13	23.92	3	6.22	0	0.00
Masonry	352	42.28	224	26.94	217	26.08	34	4.12	5	0.57
MH	276	87.02	18	5.72	16	4.97	2	0.52	6	1.76
Steel	156	46.01	78	22.99	75	22.20	30	8.72	0	0.08
Wood	3,720	45.15	3,133	38.03	1,053	12.78	196	2.38	137	1.67

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Police Stations	3	0	0	3
Schools	15	10	0	0

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 62,241 tons of debris will be generated. Of the total amount, 18,485 tons (30%) is Other Tree Debris. Of the remaining 43,756 tons, Brick/Wood comprises 56% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 986 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 19,098 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 358 households to be displaced due to the hurricane. Of these, 67 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 240.0 million dollars, which represents 10.50 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 240 million dollars. 2% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 83% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	133,864.58	13,179.21	5,564.69	2,044.24	154,652.73
	Content	44,427.17	6,431.26	4,160.79	920.58	55,939.80
	Inventory	0.00	225.20	680.15	11.73	917.08
	Subtotal	**178,291.75**	**19,835.67**	**10,405.63**	**2,976.56**	**211,509.60**
Business Interruption Loss						
	Income	6.02	836.49	81.96	62.48	986.96
	Relocation	14,281.86	2,544.43	406.90	416.64	17,649.83
	Rental	6,904.07	1,391.52	72.30	45.94	8,413.82
	Wage	14.19	971.87	130.53	372.10	1,488.70
	Subtotal	**21,206.14**	**5,744.31**	**691.69**	**897.17**	**28,539.31**
Total						
	Total	**199,497.89**	**25,579.98**	**11,097.31**	**3,873.73**	**240,048.92**

Appendix A: County Listing for the Region

Connecticut
- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
New Haven	30,989	1,785,053	501,515	2,286,568
Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**
Study Region Total	**30,989**	**1,785,053**	**501,515**	**2,286,568**

Hazus-MH: Earthquake Event Report

Region Name: Naugatuck

Earthquake Scenario: East Haddam

Print Date: August 26, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

Disclaimer:
The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16.42 square miles and contains 5 census tracts. There are over 11 thousand households in the region which has a total population of 30,989 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 10 thousand buildings in the region with a total building replacement value (excluding contents) of 2,286 (millions of dollars). Approximately 93.00 % of the buildings (and 78.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 689 and 76 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 10 thousand buildings in the region which have an aggregate total replacement value of 2,286 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 81% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 15 schools, 1 fire stations, 3 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 3 dams identified within the region. Of these, 2 of the dams are classified as 'high hazard'. The inventory also includes 39 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 765.00 (millions of dollars). This inventory includes over 38 kilometers of highways, 31 bridges, 445 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	31	412.70
	Segments	10	259.80
	Tunnels	0	0.00
		Subtotal	**672.50**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	2	15.40
	Tunnels	0	0.00
		Subtotal	**15.40**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	1	1.30
		Subtotal	**1.30**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	0	0.00
	Runways	0	0.00
		Subtotal	**0.00**
		Total	**689.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	4.50
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**4.50**
Waste Water	Distribution Lines	NA	2.70
	Facilities	1	76.60
	Pipelines	0	0.00
		Subtotal	**79.30**
Natural Gas	Distribution Lines	NA	1.80
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.80**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	2	0.20
		Subtotal	**0.20**
		Total	**85.70**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	East Haddam
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-72.40
Latitude of Epicenter	41.50
Earthquake Magnitude	6.40
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Building Damage

Building Damage

Hazus estimates that about 663 buildings will be at least moderately damaged. This is over 6.00 % of the buildings in the region. There are an estimated 10 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	16	0.20	5	0.29	3	0.45	1	0.67	0	0.76
Commercial	304	3.81	84	5.31	59	10.39	14	15.57	2	20.95
Education	11	0.13	3	0.18	2	0.36	0	0.48	0	0.76
Government	7	0.08	2	0.11	1	0.24	0	0.32	0	0.49
Industrial	119	1.50	35	2.19	28	4.98	7	7.55	1	11.25
Other Residential	1,594	20.02	349	22.10	185	32.68	37	42.31	4	40.47
Religion	24	0.30	5	0.33	3	0.52	1	0.73	0	0.87
Single Family	5,888	73.95	1,096	69.49	285	50.38	29	32.37	3	24.46
Total	**7,962**		**1,578**		**565**		**88**		**10**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	6,706	84.23	1234	78.19	297	52.48	23	26.29	1	12.53
Steel	236	2.97	72	4.58	66	11.74	16	17.70	3	28.18
Concrete	77	0.97	20	1.30	18	3.17	3	3.25	0	3.86
Precast	16	0.20	3	0.20	3	0.57	1	1.19	0	0.31
RM	171	2.15	24	1.53	22	3.93	6	6.30	0	0.82
URM	556	6.98	152	9.65	94	16.67	24	27.45	4	38.64
MH	200	2.51	72	4.55	65	11.43	16	17.81	2	15.66
Total	**7,962**		**1,578**		**565**		**88**		**10**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	0	0	0	0
Schools	15	0	0	15
EOCs	0	0	0	0
PoliceStations	3	0	0	3
FireStations	1	0	0	1

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	10	0	0	10	10
	Bridges	31	0	0	31	31
	Tunnels	0	0	0	0	0
Railways	Segments	2	0	0	2	2
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	0	0	1	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	2	0	0	2	2

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	223	17	4
Waste Water	134	9	2
Natural Gas	89	3	1
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	11,829	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.02 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 53.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 680 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 60 households to be displaced due to the earthquake. Of these, 35 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

· Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
· Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
· Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
· Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	7	1	0	0
	Single Family	5	1	0	0
	Total	**12**	**2**	**0**	**0**
2 PM	Commercial	7	1	0	0
	Commuting	0	0	0	0
	Educational	3	1	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	1	0	0	0
	Single Family	1	0	0	0
	Total	**14**	**3**	**0**	**1**
5 PM	Commercial	7	1	0	0
	Commuting	1	1	1	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	3	0	0	0
	Single Family	2	0	0	0
	Total	**14**	**3**	**2**	**1**

Economic Loss

The total economic loss estimated for the earthquake is 80.47 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 60.06 (millions of dollars); 19 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 58 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.20	1.86	0.16	0.11	2.34
	Capital-Related	0.00	0.08	1.59	0.10	0.02	1.80
	Rental	0.37	1.14	1.20	0.06	0.04	2.82
	Relocation	1.36	0.95	1.79	0.30	0.29	4.70
	Subtotal	**1.73**	**2.37**	**6.45**	**0.63**	**0.46**	**11.65**
Capital Stock Losses							
	Structural	2.65	1.60	2.57	0.86	0.32	8.00
	Non_Structural	12.03	8.12	5.89	2.39	0.90	29.34
	Content	4.03	2.03	2.68	1.50	0.42	10.67
	Inventory	0.00	0.00	0.10	0.31	0.00	0.41
	Subtotal	**18.71**	**11.76**	**11.24**	**5.06**	**1.64**	**48.41**
	Total	**20.44**	**14.14**	**17.69**	**5.69**	**2.10**	**60.06**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	259.83	$0.00	0.00
	Bridges	412.69	$17.24	4.18
	Tunnels	0.00	$0.00	0.00
	Subtotal	**672.50**	**17.20**	
Railways	Segments	15.41	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**15.40**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	1.25	$0.11	9.01
	Subtotal	**1.30**	**0.10**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	0.00	$0.00	0.00
	Runways	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
	Total	**689.20**	**17.30**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	4.50	$0.08	1.75
	Subtotal	**4.46**	**$0.08**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	76.60	$2.92	3.81
	Distribution Lines	2.70	$0.04	1.47
	Subtotal	**79.26**	**$2.96**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.80	$0.01	0.75
	Subtotal	**1.78**	**$0.01**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Communication	Facilities	0.20	$0.01	4.17
	Subtotal	**0.23**	**$0.01**	
	Total	**85.73**	**$3.06**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

New Haven,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	New Haven	30,989	1,785	501	2,286
Total State		**30,989**	**1,785**	**501**	**2,286**
Total Region		**30,989**	**1,785**	**501**	**2,286**

Hazus-MH: Earthquake Event Report

Region Name: Naugatuck

Earthquake Scenario: Haddam

Print Date: August 26, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

Disclaimer:
The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16.42 square miles and contains 5 census tracts. There are over 11 thousand households in the region which has a total population of 30,989 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 10 thousand buildings in the region with a total building replacement value (excluding contents) of 2,286 (millions of dollars). Approximately 93.00 % of the buildings (and 78.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 689 and 76 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 10 thousand buildings in the region which have an aggregate total replacement value of 2,286 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 81% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 15 schools, 1 fire stations, 3 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 3 dams identified within the region. Of these, 2 of the dams are classified as 'high hazard'. The inventory also includes 39 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 765.00 (millions of dollars). This inventory includes over 38 kilometers of highways, 31 bridges, 445 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	31	412.70
	Segments	10	259.80
	Tunnels	0	0.00
		Subtotal	**672.50**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	2	15.40
	Tunnels	0	0.00
		Subtotal	**15.40**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	1	1.30
		Subtotal	**1.30**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	0	0.00
	Runways	0	0.00
		Subtotal	**0.00**
		Total	**689.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	4.50
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**4.50**
Waste Water	Distribution Lines	NA	2.70
	Facilities	1	76.60
	Pipelines	0	0.00
		Subtotal	**79.30**
Natural Gas	Distribution Lines	NA	1.80
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.80**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	2	0.20
		Subtotal	**0.20**
		Total	**85.70**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Haddam
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-72.55
Latitude of Epicenter	41.47
Earthquake Magnitude	5.70
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Building Damage

Building Damage

Hazus estimates that about 313 buildings will be at least moderately damaged. This is over 3.00 % of the buildings in the region. There are an estimated 2 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	20	0.23	3	0.27	1	0.38	0	0.56	0	0.57
Commercial	380	4.27	52	5.21	25	9.10	4	12.95	0	17.16
Education	13	0.15	2	0.17	1	0.30	0	0.37	0	0.61
Government	8	0.09	1	0.11	1	0.19	0	0.22	0	0.33
Industrial	155	1.74	22	2.17	12	4.15	2	5.42	0	7.89
Other Residential	1,827	20.53	232	23.38	97	34.58	13	40.28	1	40.06
Religion	28	0.31	3	0.35	2	0.54	0	0.81	0	1.12
Single Family	6,466	72.67	678	68.34	142	50.76	12	39.39	1	32.27
Total	8,898		993		280		31		2	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	7,359	82.70	752	75.74	141	50.53	9	28.99	0	8.61
Steel	322	3.61	43	4.38	25	8.85	3	10.27	0	15.52
Concrete	99	1.11	12	1.25	7	2.44	1	1.76	0	2.06
Precast	19	0.21	2	0.21	2	0.61	0	1.34	0	0.24
RM	195	2.19	15	1.55	11	3.98	2	6.35	0	0.47
URM	644	7.24	113	11.35	59	21.09	13	40.05	2	68.70
MH	261	2.93	55	5.52	35	12.50	4	11.24	0	4.41
Total	8,898		993		280		31		2	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	0	0	0	0
Schools	15	0	0	15
EOCs	0	0	0	0
PoliceStations	3	0	0	3
FireStations	1	0	0	1

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	10	0	0	10	10
	Bridges	31	0	0	31	31
	Tunnels	0	0	0	0	0
Railways	Segments	2	0	0	2	2
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	0	0	1	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	2	0	0	2	2

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	223	5	1
Waste Water	134	3	1
Natural Gas	89	1	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	11,829	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.01 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 64.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 280 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 24 households to be displaced due to the earthquake. Of these, 14 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

· Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
· Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
· Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
· Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	3	0	0	0
	Single Family	3	0	0	0
	Total	**6**	**1**	**0**	**0**
2 PM	Commercial	2	0	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	1	0	0	0
	Single Family	0	0	0	0
	Total	**5**	**1**	**0**	**0**
5 PM	Commercial	2	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	1	0	0	0
	Single Family	1	0	0	0
	Total	**5**	**1**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 33.60 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 27.63 (millions of dollars); 17 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 62 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.07	0.68	0.05	0.04	0.84
	Capital-Related	0.00	0.03	0.57	0.03	0.01	0.64
	Rental	0.18	0.54	0.47	0.02	0.01	1.22
	Relocation	0.65	0.44	0.66	0.11	0.11	1.97
	Subtotal	**0.84**	**1.07**	**2.38**	**0.22**	**0.18**	**4.67**
Capital Stock Losses							
	Structural	1.38	0.75	0.90	0.29	0.12	3.44
	Non_Structural	6.18	3.97	2.52	1.06	0.40	14.13
	Content	2.00	1.00	1.29	0.70	0.20	5.20
	Inventory	0.00	0.00	0.05	0.14	0.00	0.19
	Subtotal	**9.56**	**5.72**	**4.76**	**2.19**	**0.72**	**22.96**
	Total	**10.40**	**6.79**	**7.14**	**2.40**	**0.90**	**27.63**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	259.83	$0.00	0.00
	Bridges	412.69	$4.11	1.00
	Tunnels	0.00	$0.00	0.00
	Subtotal	**672.50**	**4.10**	
Railways	Segments	15.41	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**15.40**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	1.25	$0.08	6.37
	Subtotal	**1.30**	**0.10**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	0.00	$0.00	0.00
	Runways	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
	Total	**689.20**	**4.20**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	4.50	$0.02	0.55
	Subtotal	**4.46**	**$0.02**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	76.60	$1.73	2.26
	Distribution Lines	2.70	$0.01	0.46
	Subtotal	**79.26**	**$1.74**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.80	$0.00	0.24
	Subtotal	**1.78**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Communication	Facilities	0.20	$0.01	2.52
	Subtotal	**0.23**	**$0.01**	
	Total	**85.73**	**$1.77**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

New Haven,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	New Haven	30,989	1,785	501	2,286
Total State		**30,989**	**1,785**	**501**	**2,286**
Total Region		**30,989**	**1,785**	**501**	**2,286**

Hazus-MH: Earthquake Event Report

Region Name: Naugatuck

Earthquake Scenario: Portland

Print Date: August 26, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

Disclaimer:
The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 16.42 square miles and contains 5 census tracts. There are over 11 thousand households in the region which has a total population of 30,989 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 10 thousand buildings in the region with a total building replacement value (excluding contents) of 2,286 (millions of dollars). Approximately 93.00 % of the buildings (and 78.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 689 and 76 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 10 thousand buildings in the region which have an aggregate total replacement value of 2,286 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 81% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 15 schools, 1 fire stations, 3 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 3 dams identified within the region. Of these, 2 of the dams are classified as ‘high hazard’. The inventory also includes 39 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 765.00 (millions of dollars). This inventory includes over 38 kilometers of highways, 31 bridges, 445 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	31	412.70
	Segments	10	259.80
	Tunnels	0	0.00
		Subtotal	**672.50**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	2	15.40
	Tunnels	0	0.00
		Subtotal	**15.40**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	1	1.30
		Subtotal	**1.30**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	0	0.00
	Runways	0	0.00
		Subtotal	**0.00**
		Total	**689.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	4.50
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**4.50**
Waste Water	Distribution Lines	NA	2.70
	Facilities	1	76.60
	Pipelines	0	0.00
		Subtotal	**79.30**
Natural Gas	Distribution Lines	NA	1.80
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.80**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	2	0.20
		Subtotal	**0.20**
		Total	**85.70**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Portland
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-72.60
Latitude of Epicenter	41.60
Earthquake Magnitude	5.70
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Building Damage

Hazus estimates that about 365 buildings will be at least moderately damaged. This is over 4.00 % of the buildings in the region. There are an estimated 3 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	20	0.22	3	0.27	1	0.39	0	0.57	0	0.60
Commercial	368	4.21	58	5.26	30	9.35	5	13.41	1	18.13
Education	13	0.15	2	0.18	1	0.32	0	0.40	0	0.67
Government	8	0.09	1	0.11	1	0.19	0	0.23	0	0.37
Industrial	149	1.71	24	2.20	14	4.34	2	5.82	0	8.64
Other Residential	1,786	20.44	255	23.18	111	34.24	15	40.19	1	39.47
Religion	27	0.31	4	0.35	2	0.54	0	0.81	0	1.11
Single Family	6,367	72.86	753	68.46	164	50.63	15	38.57	1	31.00
Total	**8,738**		**1,100**		**324**		**38**		**3**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	7,247	82.93	838	76.17	165	50.93	11	29.08	0	9.15
Steel	308	3.53	49	4.48	31	9.45	4	11.55	1	17.84
Concrete	95	1.09	14	1.28	8	2.60	1	2.02	0	2.42
Precast	18	0.21	2	0.21	2	0.60	1	1.32	0	0.26
RM	191	2.19	17	1.54	13	3.96	2	6.39	0	0.71
URM	628	7.18	121	10.97	65	20.16	14	37.81	2	64.78
MH	251	2.87	59	5.36	40	12.30	5	11.84	0	4.83
Total	**8,738**		**1,100**		**324**		**38**		**3**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	15	0	0	15
EOCs	0	0	0	0
PoliceStations	3	0	0	3
FireStations	1	0	0	1

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 % After Day 1	With Functionality > 50 % After Day 7
Highway	Segments	10	0	0	10	10
	Bridges	31	0	0	31	31
	Tunnels	0	0	0	0	0
Railways	Segments	2	0	0	2	2
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	0	0	1	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	2	0	0	2	2

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	223	6	2
Waste Water	134	3	1
Natural Gas	89	1	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	11,829	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.01 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 62.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 320 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 29 households to be displaced due to the earthquake. Of these, 17 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	4	0	0	0
	Single Family	3	0	0	0
	Total	**7**	**1**	**0**	**0**
2 PM	Commercial	3	0	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	1	0	0	0
	Single Family	1	0	0	0
	Total	**6**	**1**	**0**	**0**
5 PM	Commercial	3	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	1	0	0	0
	Single Family	1	0	0	0
	Total	**6**	**1**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 40.43 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 33.09 (millions of dollars); 17 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 61 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.08	0.82	0.07	0.05	1.03
	Capital-Related	0.00	0.03	0.70	0.04	0.01	0.78
	Rental	0.21	0.63	0.57	0.03	0.02	1.45
	Relocation	0.76	0.52	0.81	0.14	0.14	2.36
	Subtotal	**0.97**	**1.26**	**2.90**	**0.28**	**0.21**	**5.62**
Capital Stock Losses							
	Structural	1.58	0.88	1.12	0.37	0.15	4.10
	Non_Structural	7.22	4.74	3.06	1.33	0.47	16.82
	Content	2.41	1.22	1.56	0.88	0.25	6.32
	Inventory	0.00	0.00	0.06	0.18	0.00	0.24
	Subtotal	**11.20**	**6.84**	**5.81**	**2.75**	**0.87**	**27.47**
	Total	**12.17**	**8.10**	**8.70**	**3.03**	**1.08**	**33.09**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	259.83	$0.00	0.00
	Bridges	412.69	$5.22	1.26
	Tunnels	0.00	$0.00	0.00
	Subtotal	**672.50**	**5.20**	
Railways	Segments	15.41	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**15.40**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	1.25	$0.09	7.23
	Subtotal	**1.30**	**0.10**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	0.00	$0.00	0.00
	Runways	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
	Total	**689.20**	**5.30**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	4.50	$0.03	0.64
	Subtotal	**4.46**	**$0.03**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	76.60	$1.98	2.59
	Distribution Lines	2.70	$0.01	0.53
	Subtotal	**79.26**	**$1.99**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.80	$0.00	0.27
	Subtotal	**1.78**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Communication	Facilities	0.20	$0.01	2.91
	Subtotal	**0.23**	**$0.01**	
	Total	**85.73**	**$2.03**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

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Total State		**30,989**	**1,785**	**501**	**2,286**
Total Region		**30,989**	**1,785**	**501**	**2,286**

Hazus-MH: Earthquake Event Report

Region Name: Naugatuck

Earthquake Scenario: Stamford

Print Date: August 26, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

Disclaimer:
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Building and Lifeline Inventory

Building Inventory

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For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 15 schools, 1 fire stations, 3 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 3 dams identified within the region. Of these, 2 of the dams are classified as 'high hazard'. The inventory also includes 39 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 765.00 (millions of dollars). This inventory includes over 38 kilometers of highways, 31 bridges, 445 kilometers of pipes.

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		Subtotal	**672.50**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	2	15.40
	Tunnels	0	0.00
		Subtotal	**15.40**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	1	1.30
		Subtotal	**1.30**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	0	0.00
	Runways	0	0.00
		Subtotal	**0.00**
		Total	**689.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	4.50
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**4.50**
Waste Water	Distribution Lines	NA	2.70
	Facilities	1	76.60
	Pipelines	0	0.00
		Subtotal	**79.30**
Natural Gas	Distribution Lines	NA	1.80
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.80**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	2	0.20
		Subtotal	**0.20**
		Total	**85.70**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Stamford
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-73.60
Latitude of Epicenter	41.15
Earthquake Magnitude	5.70
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Building Damage

Building Damage

Hazus estimates that about 111 buildings will be at least moderately damaged. This is over 1.00 % of the buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	22	0.23	1	0.27	0	0.38	0	0.52	0	0.50
Commercial	427	4.43	25	5.43	9	8.97	1	12.50	0	15.22
Education	15	0.15	1	0.18	0	0.29	0	0.36	0	0.55
Government	9	0.10	1	0.12	0	0.19	0	0.22	0	0.32
Industrial	176	1.83	10	2.11	4	3.53	0	4.31	0	5.30
Other Residential	2,009	20.85	118	25.67	39	37.94	4	41.70	0	45.25
Religion	30	0.32	2	0.39	1	0.63	0	0.95	0	1.31
Single Family	6,945	72.09	302	65.83	49	48.08	4	39.43	0	31.56
Total	**9,634**		**458**		**102**		**9**		**1**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	7,884	81.84	329	71.82	46	44.87	2	25.02	0	0.00
Steel	367	3.81	19	4.06	7	6.75	1	6.46	0	7.30
Concrete	111	1.16	5	1.18	2	1.78	0	0.87	0	0.82
Precast	21	0.22	1	0.25	1	0.76	0	1.62	0	0.13
RM	209	2.17	8	1.84	5	4.80	1	6.97	0	0.00
URM	730	7.57	67	14.54	29	28.17	5	51.41	1	90.39
MH	311	3.23	29	6.31	13	12.88	1	7.66	0	1.36
Total	**9,634**		**458**		**102**		**9**		**1**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	0	0	0	0
Schools	15	0	0	15
EOCs	0	0	0	0
PoliceStations	3	0	0	3
FireStations	1	0	0	1

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	10	0	0	10	10
	Bridges	31	0	0	31	31
	Tunnels	0	0	0	0	0
Railways	Segments	2	0	0	2	2
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	1	0	0	1	1
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	2	0	0	2	2

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	223	2	1
Waste Water	134	1	0
Natural Gas	89	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	11,829	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 72.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 80 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 8 households to be displaced due to the earthquake. Of these, 5 people (out of a total population of 30,989) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

· Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
· Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
· Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
· Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	1	0	0	0
	Single Family	1	0	0	0
	Total	**2**	**0**	**0**	**0**
2 PM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**2**	**0**	**0**	**0**
5 PM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**2**	**0**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 10.31 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 8.94 (millions of dollars); 18 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 63 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.02	0.24	0.01	0.02	0.29
	Capital-Related	0.00	0.01	0.20	0.01	0.00	0.22
	Rental	0.06	0.21	0.17	0.01	0.01	0.45
	Relocation	0.22	0.17	0.22	0.03	0.04	0.68
	Subtotal	**0.28**	**0.41**	**0.83**	**0.06**	**0.07**	**1.64**
Capital Stock Losses							
	Structural	0.51	0.30	0.31	0.08	0.05	1.26
	Non_Structural	1.97	1.34	0.83	0.29	0.14	4.56
	Content	0.49	0.28	0.40	0.18	0.06	1.42
	Inventory	0.00	0.00	0.01	0.04	0.00	0.05
	Subtotal	**2.98**	**1.92**	**1.55**	**0.59**	**0.24**	**7.29**
	Total	**3.26**	**2.34**	**2.38**	**0.65**	**0.31**	**8.94**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Hazus estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	259.83	$0.00	0.00
	Bridges	412.69	$0.88	0.21
	Tunnels	0.00	$0.00	0.00
	Subtotal	**672.50**	**0.90**	
Railways	Segments	15.41	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**15.40**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	1.25	$0.04	3.21
	Subtotal	**1.30**	**0.00**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	0.00	$0.00	0.00
	Runways	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
	Total	**689.20**	**0.90**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	4.50	$0.01	0.21
	Subtotal	**4.46**	**$0.01**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	76.60	$0.44	0.57
	Distribution Lines	2.70	$0.00	0.18
	Subtotal	**79.26**	**$0.44**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.80	$0.00	0.09
	Subtotal	**1.78**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Communication	Facilities	0.20	$0.00	0.43
	Subtotal	**0.23**	**$0.00**	
	Total	**85.73**	**$0.46**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

New Haven,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	New Haven	30,989	1,785	501	2,286
Total State		**30,989**	**1,785**	**501**	**2,286**
Total Region		**30,989**	**1,785**	**501**	**2,286**

APPENDIX F
FEMA SNOW LOAD GUIDANCE

FEMA Snow Load Safety Guidance

FEMA

www.FEMA.gov

This flyer summarizes warning signs of overstress conditions during a snow event, key safety issues and risks a snow event poses to buildings, and what to do after a snow event.

Warning Signs of Overstress Conditions during a Snow Event

Overstressed roofs typically display some warning signs. Wood and steel structures may show noticeable signs of excessive ceiling or roof sagging before failure. The following warning signs are common in wood, metal, and steel constructed buildings:

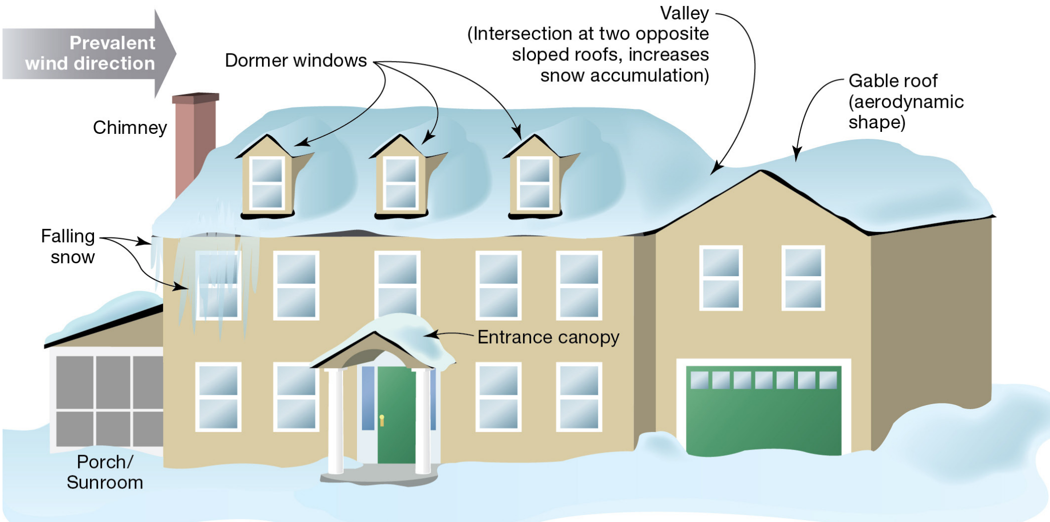
- Sagging ceiling tiles or boards, ceiling boards falling out of the ceiling grid, and/or sagging sprinkler lines and sprinkler heads
- Sprinkler heads deflecting below suspended ceilings
- Popping, cracking, and creaking noises
- Sagging roof members, including metal decking or plywood sheathing
- Bowing truss bottom chords or web members
- Doors and/or windows that can no longer be opened or closed
- Cracked or split wood members
- Cracks in walls or masonry
- Severe roof leaks
- Excessive accumulation of water at nondrainage locations on low slope roofs

Warning! If any of these warning signs are observed, the building should be promptly evacuated and a local building authority and/or a qualified design professional should be contacted to perform a detailed structural inspection.

Key Safety Issues and Risks

Snow accumulation in excess of building design conditions can result in structural failure and possible collapse. Structural failure due to roof snow loads may be linked to several possible causes, including but not limited to the following:

- **Unbalanced snow load from drifting and sliding snow.** When snow accumulates at different depths in different locations on a roof, it results in high and concentrated snow loads that can potentially overload the roof structure.
- **Rain-on-snow load.** Heavy rainfall on top of snow may cause snow to melt and become further saturated, significantly increasing the load on the roof structure.
- **Snow melt between snow events.** If the roof drainage system is blocked, improperly designed or maintained, ice dams may form, which creates a concentrated load at the eaves and reduces the ability of sloped roofs to shed snow. On flat or low slope roof systems, snow melt may accumulate in low areas on roofs, creating a concentrated load.
- **Roof geometry.** Simple roofs with steep slopes shed snow most easily. Roofs with geometric irregularities and obstructions collect snow drifts in an unbalanced pattern. These roof geometries include flat roofs with parapets, stepped roofs, saw-tooth roofs, and roofs with obstructions such as equipment or chimneys.



Unbalanced Snow Load from Drifting and Sliding Snow on Residential Structure

What to Do After a Snow Event

After a snow event, snow removal may be in order. To determine whether snow removal is necessary, one may enlist valuable resources such as a local building authority and/or a qualified design professional, who will be familiar with the snow conditions of the region and the design capacities of local buildings per the building code. If it is determined that the snow should be removed, snow removal should only be performed by qualified individuals. The qualified individual should follow necessary protocols for safe snow removal to minimize risk of personal injury and lower the potential for damaging the roof covering during the snow removal process.

> Warning! Snow removal is a dangerous activity that should only be done by qualified individuals following safety protocols to minimize risks. If at any time there is concern that snow loads may cause a collapse of the roof structure, cease all removal activity and evacuate the building.

If subsequent snow events are anticipated, removing snow from the roof will minimize the risk of accumulating snow causing structural damage. One benefit of immediate snow removal is that the effort required to remove the snow from the rooftop is reduced.

Safety Measures for Snow Removal

Below are some safety measures to take during snow removal to minimize risk of personal injury.

- Any roof snow removal should be conducted following proper OSHA protocol for work on rooftops. Use roof fall arrest harnesses where applicable.
- Always have someone below the roof to keep foot traffic away from locations where falling snow or ice could cause injuries.
- Ensure someone confirms that the area below removal site is free of equipment that could be damaged by falling snow or ice.
- Whenever snow is being removed from a roof, be careful of dislodged icicles. An icicle falling from a short height can still cause damage or injury.
- When using a non-metallic snow rake, be aware that roof snow can slide at any moment. Keep a safe distance away from the eave to remain outside of the sliding range.
- Buried skylights pose a high risk to workers on a roof removing snow. Properly mark this hazard as well as other rooftop hazards.

Methods of Snow Removal

Below are some recommended methods of snow removal that allow the qualified individual to remove snow safely and minimize risk of personal injury and property damage.

- Removing snow completely from a roof surface can result in serious damage to the roof covering and possibly lead to leaks and additional damage. At least a couple of inches of snow should be left on the roof.
- Do not use mechanical snow removal equipment. The risk of damaging the roof membrane or other rooftop items outweighs the advantage of speed.
- Do not use sharp tools, such as picks, to remove snow. Use plastic rather than metal shovels.
- Remove drifted snow first at building elevation changes, parapets, and around equipment.
- Once drifted snow has been removed, start remaining snow removal from the center portion of the roof.
- Remove snow in the direction of primary structural members. This will prevent unbalanced snow loading.
- Do not stockpile snow on the roof.
- Dispose of removed snow in designated areas on the ground.
- Keep snow away from building exits, fire escapes, drain downspouts, ventilation openings, and equipment.
- If possible, remove snow starting at the ridge and moving toward the eave for gable and sloped roofs.
- In some cases a long-handled non-metallic snow rake can be used from the ground, thereby reducing the risk. Metal snow rakes can damage roofing material and pose an electrocution risk and should be avoided.
- Upon completion of snow removal, the roofing material should be inspected for any signs of damage. Additionally, a quick inspection of the structural system may be prudent after particularly large snow events.

If you have any additional questions on this topic or other mitigation topics, contact the FEMA Building Science Helpline at FEMA-Buildingsciencehelp@fema.dhs.gov or 866-927-2104.

You may also subscribe to the FEMA Building Science e-mail list serve, which is updated with publication releases and FEMA Building Science activities.

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