Bristol

One of two cities in the region, Bristol serves as a transportation nexus for the outlying towns in the region. Major arterial roads (state routes 72, 6, and 69) provide interstate access for the towns of Burlington and Plymouth, while commercial development along Rte 6 makes Bristol a regional shopping destination. While the city's economic base was traditionally manufacturing and industry, today it is working to diversify while preserving and repurposing its richly historic building stock.

With 60,062 people living within its 26.8 square miles in 2000, Bristol was the second most dense municipality in the region, with 2,241 people per square mile. Correspondingly, there is greater variation in housing type—only 57.5% of housing in the city is single-family. Median age in Bristol is on par with the state as a whole at 40,and while the city is aging, it is not doing so as quickly as the more suburban towns in the region; by 2030 the Department of Transportation expects to see only a 36% increase in the number of residents aged 60 and older.

Challenges

Winter storms are the biggest natural hazard concerns for the City of Bristol. Snow and ice removal can become quite expensive, exceeding municipal budgets. The City handles plowing on its own roads and, when required, assists in keeping traffic moving on State Rte 6, a road which is vital to the region but of relatively low priority for the Department of Transportation. When the State cannot clear Rte 6 in a reasonable amount of time and the police department requests assistance, City forces will handle snow and ice removal along the state road. Higher elevations in the City have more trouble with snow and ice; generally, major thoroughfares and routes to the hospital are tended to first, followed by higher elevation areas.

The City also has the usual trouble with tree limbs downed by snow and ice; these take out power lines, block roads, and can leave people without electricity, heat, or communication lines when

they are already isolated. Burying power lines would alleviate these problems, but is prohibitively expensive on a citywide basis. The city's subdivision regulations state that utility lines will be bured wherever feasible, but there are no plans to bury older infrastructure.

Flooding is also a concern in the City; the Pequabuck River snakes directly through the downtown, with a number of old buildings built straddling the watercourse. Copper Mine Brook, on the east side of Bristol, floods frequently as well. At the confluence of the water bodies, where Copper Mine Brook empties into the Pequabuck, an existing railroad bridge causes flooding problems—the 3' high girders of the bridge act as a restricting dam, impounding water until the flow is sufficient to overtop the girders. This is a known problem, but high replacement costs and railroad ownership of the bridge prevent the City from taking action and replacing it. There are also issues with culvert capacity, although the City has worked to improve a number of culverts. Flooding can back up the sewer system; the City is currently working on a $13.5 million Sanitary Sewer Overflow Elimination project to address the problem, in addition to a phased Infiltration and Inflow Reduction project. The city has several flood control projects in the works that were identified in the Copper Mine Brook Drainage Evaluation document that may assist in mitigating the impacts of flooding on many of its repetitive loss properties. The projects require work on private property; the City is in the process of applying for funding to do the work.

Finally, the City's shelters are undersupplied and have not been used in the past 25 years. The majority of people in Bristol—as in other towns—shelter at home for winter storms, preferring to stay in place than travel about. In flood situations, the City finds that it is rarely confronted with need sufficient to merit opening shelters (even if they were fully equipped), noting that it is more cost-effective to put individuals up in local motels than to open the shelter for a handful of people.

Current Mitigation and Response Activities

- Flood Control Regulations limit the type of development that may occur in the flood plain, and require flood-proofing and on-site water storage.
- Uses NIMS to establish lead agency in a disaster
- The city's subdivision regulations authorize the Planning Commission to require that up to 15% of the land in a proposed subdivision be set aside for open space. The city's zoning regulations include provisions for an Open Space Development Zone, which requires, in

return for reducing minimum lot sizes or clustering dwelling units, the preservation of at least 25% of the land as open space.

- The City's subdivision regulations state that, wherever feasible, utilitiy lines shall be placed underground. Nearly every new subdivision since the mid 1990s has had underground utility lines.
- The City has an evacuation plan which is documented within its shelter plan; evacuation routes are not signed.
- The City is engaged in a $13.5 million Sanitary Sewer Overflow Elimination project as well as a phased Infiltration and Inflow Reduction project.
- Fire Department notifies residents of flood-prone areas when water levels begin to rise.
- Procedures outlined in the Emergency Operations Plan are tested periodically.
- The City participates in the statewide reverse-911 system
- Uses WebEOC to stay abreast of developments across the state
- The City participates in the National Flood Insurance Program.
- Bristol Hospital (a private hospital) has backup generators and is self-sufficient; hospital access roads are plowed first during winter storm events.
- The City provides extensive preparedness education information on its website.
- The City participates in DEMHS Region 3 and follows their Regional Emergency Support Plan.

Goals, Objectives, and Strategies

Goal: reduce losses of life and property, and minimize economic consequences of natural hazards.

Objective 1: Improve City's capacity to deal with hazards by investing in necessary equipment & training

	Strategy	Priority	Lead	Hazard
S1	Invest in supplies sufficient to stock existing shelter for a major mass care event	Medium	Emergency Management	Winter Storms

Objective 2: Improve infrastructure to minimize flooding impacts

	Strategy	Priority	Lead	Hazard
S1	Increase capacity of culverts where necessary; encourage private property owners to improve capacity of culverts on private land where necessary	High	Public Works	Flooding
S2	Improve city sewer system to prevent sewer backups during flood events	Medium	Public Works	Flooding
S3	Replace railroad bridge where Copper Mine Creek empties into the Pequabuck River (requires railroad cooperation)	Medium	Public Works	Flooding

Objective 3: Build upon existing preparedness education efforts

	Strategy	Priority	Lead	Hazard
S1	Encourage preparedness workshops in schools	High	Emergency Management	All
S2	Consider posting signs along evacuation routes to raise public awareness	High	Emergency Management	All

Objective 4: Continue participation in National Flood Insurance Program

	Strategy	Priority	Lead	Hazard
S1	Continue enforcement of floodplain management ordinances by regulating all new and substantially improved construction in flood zones	High	Inland Wetlands & Watercourses Commission	Flooding
S2	Work with FEMA to update FIRMs as necessary	High	Public Works, Inland Wetlands & Watercourses Commission	Flooding
S3	Continue to distribute information about the NFIP to homeowners	High	Inland Wetlands & Watercourses Commission	Flooding
S4	Continue to assist homeowners with amendments to NFIP maps as necessary	High	Inland Wetlands & Watercourses Commission	Flooding

Contributors

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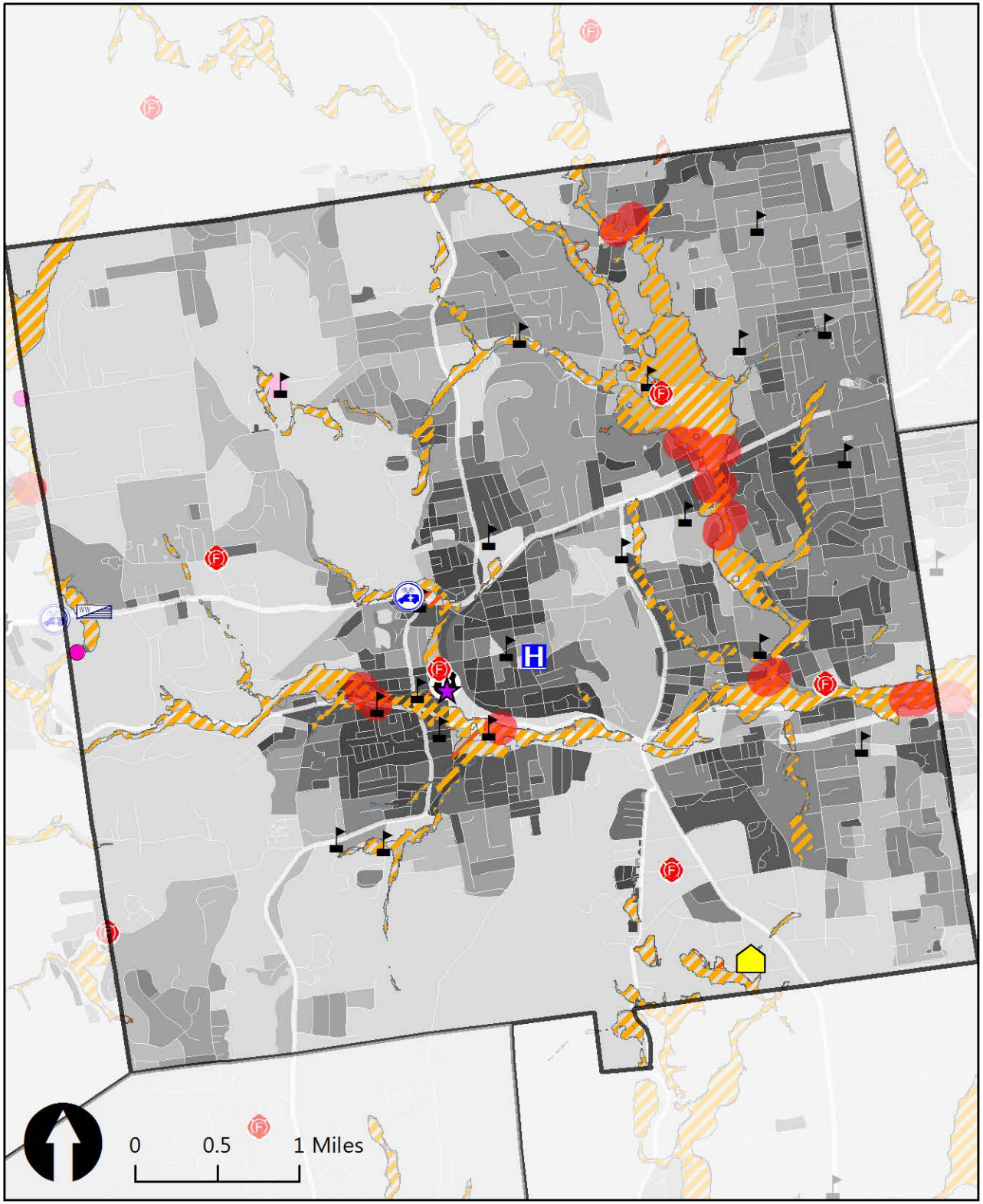
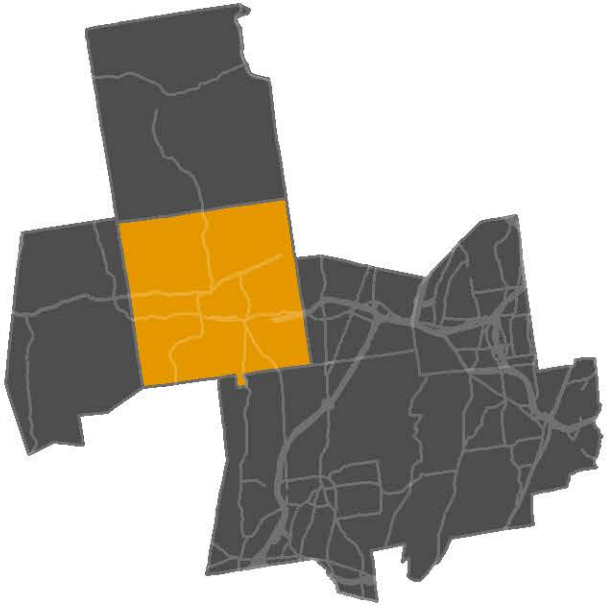
Flood Zones & Critical Facilities

Bristol





Critical Facilites

- Power_Plant
- Hospitals
- Ambulance
- Fire
- Police
- Waste Water
- Schools
- Primary Shelters
- RLP Zone
- Class C Dams
- Town Halls

Flood Zones

- 100 Year Flood
- 500 Year Flood

Pop/square mile

- 0 - 1,000
- 1,000 - 2,000
- 2,000 - 3,000
- 3,000 - 4,000
- 4,000 - 5,000
- 5,000 - 10,000
- 10,000+

Hazus-MH: Flood Event Report

Region Name: Bristol

Flood Scenario: Flood100

Print Date Wednesday, October 1, 2014

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

Section	Page #
General Description of the Region	3
Building Inventory	4
General Building Stock	
Essential Facilities Damage	
Flood Scenario Parameters	5
Building Damage	6
General Building Stock	
Essential Facilities Damage	
Induced Flood Damage	8
Debris Generation	
Social Impact	8
Shelter Requirements	
Economic Loss	9
Building-Related Losses	
Appendix A: Listing for the Region	10
Appendix B: Regional Population and Building Value Data	11

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 27 square miles and contains 733 census blocks. The region contains over 25 thousand households and has a total population of 60,314 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 21,216 buildings in the region with a total building replacement value (excluding contents) of 5,036 million dollars (2006 dollars). Approximately 91.75% of the buildings (and 73.62% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 21,216 buildings in the region which have an aggregate total replacement value of 5,036 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	3,707,732	73.6%
Commercial	808,785	16.1%
Industrial	366,201	7.3%
Agricultural	15,284	0.3%
Religion	60,473	1.2%
Government	22,525	0.4%
Education	55,403	1.1%
Total	**5,036,403**	**100.00%**

Table 2

Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,893,132	67.8%
Commercial	531,640	19.0%
Industrial	261,767	9.4%
Agricultural	7,530	0.3%
Religion	33,476	1.2%
Government	22,525	0.8%
Education	43,899	1.6%
Total	**2,793,969**	**100.00%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 128 beds.
There are 23 schools, 1 fire stations, 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:	CCRPA Disaster Resilience
Scenario Name:	Flood100
Return period Analyzed:	100
Analysis Option Analyzed:	No What-Ifs

General Building Stock Damage

Hazus estimates that about 108 buildings will be at least moderately damaged. This is over 15% of the total number of buildings in the scenario. There are an estimated 22 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5.3 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**	**(%)**
Agricultural	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	1	10.00	9	90.00	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	3	100.0	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	4	4.17	6	6.25	34	35.42	30	31.25	22	22.92
Total	**1**		**16**		**6**		**34**		**30**		**22**	

Table 4: Expected Building Damage by Building Type

Building	1-10		11-20		21-30		31-40		41-50		Substantially	
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	4	100.00
Masonry	0	0.00	1	33.33	1	33.33	1	33.33	0	0.00	0	0.00
Steel	1	12.50	7	87.50	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	4	4.44	5	5.56	33	36.67	30	33.33	18	20.00

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 128 hospital beds available for use. On the day of the scenario flood event, the model estimates that 128 hospital beds are available in the region.

Table 5: Expected Building Damage by Occupancy

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	1	0	0	0
Hospitals	1	0	0	0
Police Stations	3	0	0	0
Schools	23	3	0	3

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 5,500 tons of debris will be generated. Of the total amount, Finishes comprises 78% of the total, Structure comprises 12% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 220 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 1,504 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 3,487 people (out of a total population of 60,314) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 189.69 million dollars, which represents 6.79 % 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 188.48 million dollars. 1% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 23.44% 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	27.67	17.66	15.93	1.82	63.07
	Content	16.74	52.57	38.72	10.47	118.49
	Inventory	0.00	1.15	5.63	0.15	6.92
	Subtotal	**44.41**	**71.37**	**60.27**	**12.43**	**188.48**
Business Interruption						
	Income	0.03	0.06	0.02	0.02	0.12
	Relocation	0.00	0.27	0.03	0.04	0.33
	Rental Income	0.01	0.03	0.00	0.00	0.05
	Wage	0.01	0.29	0.02	0.40	0.71
	Subtotal	**0.05**	**0.65**	**0.06**	**0.45**	**1.21**
ALL	**Total**	**44.45**	**72.02**	**60.33**	**12.88**	**189.69**

Appendix A: County Listing for the Region

Connecticut

- Hartford

Appendix B: Regional Population and Building Value Data

		Building Value (thousand of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
Hartford	60,314	3,707,732	1,328,671	5,036,403
Total	60,314	3,707,732	1,328,671	5,036,403
Total Study Region	60,314	3,707,732	1,328,671	5,036,403